PREHISTORIC MAORI SUBSISTENCE: EVALUATING TWO REGIONS IN NORTH-EASTERN NEW ZEALAND

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ABSTRACT

Most existing models of settlement and subsistence in New Zealand archaeology were developed in conjunction with radiocarbon dates that no longer meet the current criteria for chronometric hygiene, and have generally been based on the restricted set of regions that have been the focus of much academic research, such Murihiku in the south of the South Island and the Auckland region in the northern North Island. This research evaluates these models by bringing together a corpus of data from two study areas on adjacent parts of the North Island east coast: the Coromandel Peninsula, which was the focus of some early research; and the Western Bay of Plenty, which while dense in archaeological sites, has had relatively little research into subsistence conducted at the regional level. Faunal assemblages with radiocarbon dates that meet strict chronometric hygiene criteria were selected and examined for patterns of spatial and temporal subsistence and variation in site types from which they derived. A case study from Whangamata, Coromandel Peninsula was used to provide fine-grained insight for patterns occurring at the regional level. Regional differences in subsistence and settlement patterns through time are identified. Early settlement in the Coromandel comprised both multi-function and specialised-function sites with generalised subsistence patterns. Settlement in the Western Bay of Plenty was sparse in early prehistory, with a sudden increase in site numbers in the middle period and a tendency towards specialised function sites and an overwhelming dominance of specialised subsistence assemblages. These results challenge the prevailing view of New Zealand prehistory that settlement was more transient in the early period and more settled in the late period. The data also emphasise the diverse patterns in regional prehistory, even when the study regions are directly adjacent to each other.

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1 INTRODUCTION

1.1 THESIS STATEMENT

The purpose of this thesis is to examine prehistoric Maori subsistence in two adjacent areas on the northeast coast of New Zealand, setting them within the context of the patterns of settlement that operated there. Models of prehistoric subsistence patterns in New Zealand are usually integrated with those for settlement patterns because it is generally hypothesised that prehistoric communities utilised a range of settlement localities to pursue the full range of subsistence activities on which they relied. It has frequently been proposed that there were changes in the nature of both subsistence and settlement patterns throughout the course of prehistoric occupation in New Zealand. Extinction or extirpation of some species thought to have been important sources of food during the early phase of occupation, and increasing reliance upon a narrower range of faunal taxa and on the products of horticulture, have been variously linked with either increasing or decreasing permanence of settlement. In recent years the chronological evidence underlying these models of change has been called into question through close scrutiny of the corpus of radiocarbon dates upon which they were based, raising the need for a thorough reassessment using reliably dated evidence.

The two areas used as case studies in this thesis are the Coromandel Peninsula and the Western Bay of Plenty on the north-eastern coast of North Island, New Zealand (Figure 1.1). The former was the focus of considerable research between the 1950s and 1970s and played an important role in developing the existing models of early prehistoric subsistence and settlement in northern New Zealand while its later prehistory was poorly known. The second study area is much less well-known in the published archaeological literature, but has generally been characterised as having few early sites and a high concentration of settlement in later prehistory. Both study areas have witnessed a surge in archaeological investigations during the past two decades, providing the data which is utilised here for the reconsideration of the nature and organisation of subsistence and settlement patterns in the two regions, documenting any changes through time in these, and the re-evaluation of the more general models of their operation.

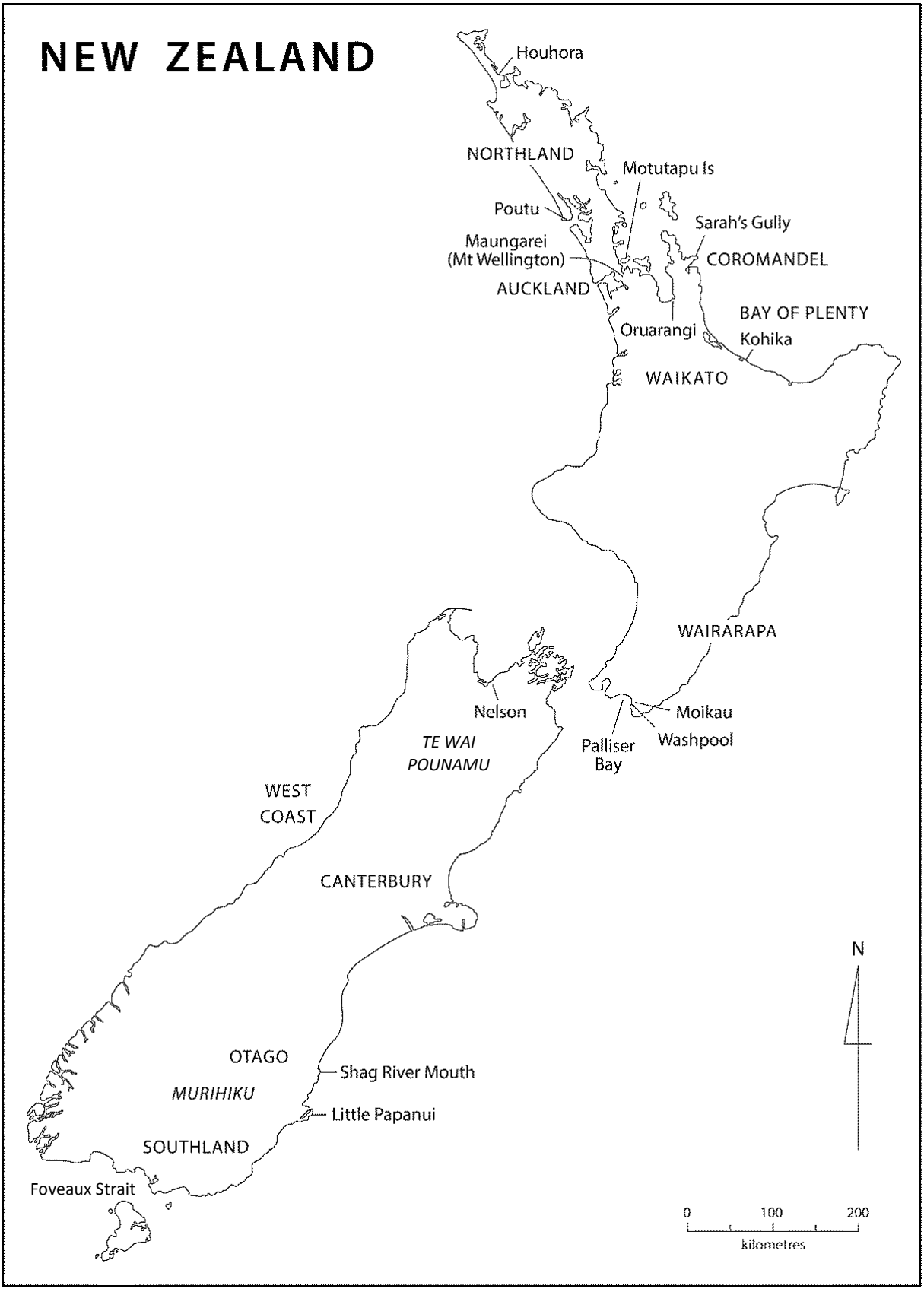

Figure 1.1 Map of New Zealand showing places mentioned in the text

1.2 AIM AND SCOPE

The primary aim of this research is to determine whether there were changes in patterns of subsistence in the Coromandel and Western Bay of Plenty areas during the prehistoric period. This will be achieved by compiling and examining robust data on faunal remains from reliably dated archaeological assemblages, and examining them using a standardized comparative framework. The comparative analysis will also consider whether there may have been changes in patterns of settlement during the prehistories of the study areas, but as the thesis depends primarily on data relating to subsistence activities, there will inevitably be less certainty about this aspect of the study.

In order to address these primary aims this research will consider a number of more specific questions:

- What was the range of subsistence activities undertaken at each study site, and where was each site located in relation to the environments from which those resources are most likely to have derived?
- Were there differences between the subsistence activities represented in contemporary sites in each of the study areas that might suggest that these sites were economically interrelated?
- Were there changes over times in either or both study areas in the range and relative importance of subsistence activities and/or the indications of interrelations between contemporary sites?
- What explanations can be hypothesised for any of the observed changes?

Before these questions are addressed in-depth, it is important to consider the theoretical underpinnings of the archaeological analysis of subsistence and settlement patterns of this kind. Attention will also be given to the development of explanations for change in New Zealand prehistory and, in particular, the way subsistence and settlement patterns have been previously modelled.

1.3 THEORY: SUBSISTENCE AND SETTLEMENT PATTERNS

Subsistence patterns are defined by Reitz and Wing (2008:251) as the "ways in which people obtain a variety of nutrients regularly, while ensuring that the costs required to find, catch, transport, process, distribute, and use them do not exceed the benefits they yield". They are influenced by both the availability of subsistence resources and choices made by the people exploiting them. The latter are, in turn, a product of the complex interplay of technology, culture history and social organization, and thus form part of the suite of learned, shared behaviours that are referred to as culture (Hardesty 1977 ; Ellen 1982). Differences in the ways in which groups of people exploited subsistence resources have played a significant part in the categorisations of cultures, such as the broad distinctions between hunter-gatherers, horticulturalists, agriculturalists and pastoralists, with associated differentiations in settlement patterns, technology and social institutions (Reitz & Wing 2008:252). Within each of those broad categories finer distinctions can be made, such as between opportunistic foraging and logistically planned collecting (Binford 1980), but as Kim and Grier (2006) note these kinds of labels do not fully capture the variety of ways in which people exploit subsistence resources.

One of the most useful approaches to analysing subsistence practices was developed by Jochim (1976; 1981), who proposed that cultural decisions about resource use attempt to balance security in meeting the demand for food and other resources against the costs in energy expenditure in procuring them (Jochim 1976:19-21). Variables on the demand side of this equation include the nutritional and energy yields of various subsistence resources, taste (measured largely by fat content), maintenance of variety in the diet, and acquisition of prestige (risky or expensive to acquire) foods. Costs include the time, effort and distance travelled to procure resources, the expense of technology used in their acquisition, personal risk to those involved, and the risk of failure. He argued that decision-making about subsistence involved the interaction of three variables: the *resource use schedule*, or preferred range of foods and other resources; *site placement*, or the locations of sites in relation to resources; and *demographic arrangements*, or the size and structure of the population utilizing the resources (Jochim 1976:11).

Although Jochim's approach was developed for the study of hunter-gatherer economies, it can be applied equally to those engaged in agriculture (Reitz & Wing 2008:254). Its importance for the present study is two-fold. Firstly, it explicitly linked subsistence practices and

settlement patterns, arguing that the size, location and spacing of settlements provided a key to controlling costs by minimizing distance (Jochim 1976:50). He proposed that settlements would normally be close to less mobile, densely concentrated resources which, although typically lower in yield and prestige value, were generally the most dependable (Jochim 1976:60). Secondly, Jochim emphasized the importance of evaluating subsistence practices in terms of the energy and nutritional yields of the exploited resources (1976:61).

The use of energy yields as a measure of the relative importance of subsistence resources had its origins in the work of Clark, G. (1954) who recognised that this provided a common measure across all classes of faunal remains. Denniston (1972) expanded this approach by incorporating yields of proteins, fats and carbohydrates in order to assess the nutritional adequacy of prehistoric diets. One limitation that these approaches face is the difficulty of documenting the role of plant foods in subsistence, due to the virtual absence of direct evidence of plants in the archaeological record. In recent years the development of stable isotope analysis of human remains has enabled direct assessment of the dietary role of plant foods (Katzenberg 2008). This is, however, confined to the situations in which human remains are available from archaeological contexts. In New Zealand, as in many other places, these are few in number and unevenly distributed throughout time and space. Some attempts have been made to incorporate isotope data from small numbers of samples with the more widely available faunal data to generate broad regional estimates of the relative importance of various plants (Leach, B.F., Quinn et al. 2000; Smith, I.W.G. 2011b). However, recent evaluation of broader data sets in animal populations suggests that such inferences are likely to be compromised by small sample sizes (Pearson & Grove 2013). For the present study analysis will be focused on those parts of the subsistence system that revolve around the use of animals, accepting that this is an incomplete picture, but nonetheless the part that is most amenable to broad regional analysis.

As already noted, there are linkages between subsistence patterns and the form, distribution and organization of human settlements. Although it had earlier origins (Parsons 1972), settlement pattern archaeology was first applied systematically by Willey (1953:1) who defined a settlement pattern as “the way in which man disposed himself over the landscape on which he lived”. Numerous subsequent studies have highlighted the relationship between settlement location and the distribution of subsistence resources (Roper 1979), and have shown that many settlement patterns incorporate functionally distinct sites that each exhibit

evidence for a concentration on a restricted range of subsistence activities, often linked by seasonal mobility (Kelly, R.L. 1992). However they also demonstrate clearly that there are many other factors that influence settlement patterns, including population size, trading networks, social and political organization (Kowalewski 2008). There are therefore limitations in the extent to which a study such as this, which relies predominantly on evidence of subsistence resource use, can fully explicate settlement patterns. Nonetheless an attempt will be made to assess the ways in which subsistence and settlement patterns were interrelated through time in the areas under study.

Originally developed in the context of behavioural ecology, foraging theory has been adapted by prehistoric subsistence specialists in order to predict and explain change in subsistence patterns through time (Anderson 1973; Bayham 1979; Anderson 1981; Nagaoka 2002b; Allen, M.S. 2012). A number of models are used to identify foraging efficiency, and they include several key assumptions: firstly, that foragers select prey to maximise their foraging efficiency; and secondly, that a measure of foraging efficiency is highly correlated with fitness (Stephens & Krebs 1986; Nagaoka 2002b). The prey choice model predicts which resource will be exploited or ignored upon encounter in a relatively homogenous environment (Stephens & Krebs 1986; Nagaoka 2001; 2002b). Resources are ranked according to their net energy returns. Foraging theory allows archaeologists to identify phenomena such as resource depression, diet breadth and richness and changes in foraging efficiency. Foraging efficiency is measured by combinations of evenness and abundance indices, richness values and changes in age and size distributions within species. The patch choice model applies prey-choice to habitats or areas, allowing resource depression, subsequent changes in the ranking of 'patches' and changes in mobility and resource use to be identified (Allen, M.S. 2012). The Marginal Value Theorem (MVT) was developed in response to resource depression and analyses how long a predator should stay within a patch (Nagaoka 2002b). Identified changes in skeletal element representation over time may correspond with declining foraging efficiency from resource depression, where the MVT is used to examine changes in transport over time. Central-place foraging models identify a home base which foragers return to in order to consume their prey, and predict that as distances and transport costs increase in order to reach prey, foragers become selective for larger, higher return items, in order to get the highest return for each trip.

The Ideal Free Distribution (IFD) model considers local and regional-scale interactions between mobility, agricultural developments and foraging efficiency (Fretwell & Lucas 1969; Sutherland 1996; Kennett, Anderson et al. 2006; Shennan 2007; Allen, M.S. 2012). The habitats of settlements are ranked by their suitability, however, the suitability is dependent on population density; as the human population grows the habitat becomes less suitable, due to competition and resource depression.

1.4 SEQUENCES, CHRONOMETRIC HYGIENE AND EVIDENTIAL UNEASE

1.4.1 SEQUENCE BUILDING

Sequence building has been a characteristic of New Zealand archaeology since its early development in the second half of the nineteenth century. The first two-phase culture history sequence for New Zealand prehistory was proposed by Julius von Haast, who used stratigraphic evidence and material culture to propose that Palaeolithic 'moa-hunters' were earlier and of different origins to the later Neolithic Maori 'shellfish eaters'. He proposed that moa-hunters drove the moa to extinction prior to the arrival of the ancestors of Maori (1872:28-9; Walter, R. 2004). By the 1890s the generally held opinion was that the 'moa-hunters' were the recent ancestors of modern Maori; as moa were hunted to extinction, the Maori adjusted their diet accordingly (Davidson 1984b). S. Percy Smith, an ethnologist and colonial surveyor (Clayworth 2001:155) contributed to the issue of the relationship between moa-hunters and modern Maori (Allen, H. 1987). He collected accounts of oral traditions and adapted them to form a settlement chronology (Whatahoro 1915; Smith, S.P. 1921) where the first settlers arrived between 950 A.D and 1350 A.D. (Simmons, D.R. 1976:107-8; Allen, H. 1987:6; Golson 1997:35). This adapted 'story' of the settlement of New Zealand persisted as the accepted chronology within New Zealand academia as late as 1950 (Golson 1997:35). Elsdon Best, a protégé and colleague of S. Percy Smith's, was also interested in recording an accurate history of pre-European Maori, and proposed that the 'Mouriuri' (Moriori) were the first settlers of Aotearoa (Best, E. 1974[1924]; Allen, H. 1987; Clayworth 2001). Best considered that the first settlers were at least partly Melanesian. He proposed that although Kupe (a voyager described in Maori oral traditions) discovered the unoccupied islands of New Zealand, they were later settled by people whose ancestors were a mix of Melanesian and West Polynesian. This was followed by the arrival of the settlers from an East Polynesian homeland. This last group either 'absorbed' or 'drove out' the people descended from the original

Melanesian/West Polynesian settlers; some of the surviving first settlers migrated to the Chatham Islands where they developed as the Mouriuri [Moriori] (Clayworth 2001:154, 210-19). From the mid-1910s the 'Moriori myth' was published in New Zealand's *The School Journal*. Von Haast's two-phase 'moa-hunter/shellfish-eater' sequence, S. Percy Smith's oral tradition settlement sequence and Best's 'Moriori Myth' have long since become outdated and discredited by subsequent research.

Along with S. Percy Smith and Elsdon Best, Henry Devenish Skinner, was one of the founding members of the Polynesian Society in 1892. An ethnologist and assistant curator at the Otago Museum (1918-1957), he opposed Smith's and Best's Mouriuri/Maruiwi origins of Maori and Moriori with his article *Culture areas in New Zealand* (Skinner 1921), his Cambridge BA monograph, *The Morioris of Chatham Islands* (Skinner 1923), and his article on Maori material culture (Skinner 1924). He proposed a model based on museum and ethnological studies of Maori material culture, which divided New Zealand into eight culture areas (Blake-Palmer 1958; Allen, H. 1987). These were grouped under the Northern Culture and the Southern Culture; the former encompassed the North Island and the latter the South Island and the Chatham Islands (Skinner 1921; 1923; 1924). To begin with, Skinner believed that the Northern Culture was more likely older than the Southern Culture, and more similar to the culture of the Western Pacific and, in particular, Melanesia (Skinner 1921:76). Later he discarded the theory that Melanesian art forms had influenced Maori decorative art, but retained the idea that Northern art was older than its Southern counterpart and that of the Cook Islands, as its characteristic curvi-linear depictions corresponded to an ancestral style of Polynesian art (Skinner 1924:241; Allen, H. 1987:6). Additionally, the Northern Culture included simple untanged adzes which were rare in the South Island; this provided further affirmation for the Northern Culture's earlier position in the model. This belief correlated well with a later hypothetical south-east Asian archaeological sequence, where round-sectioned adzes related to an early arrival of Melanesian groups were followed by the quadrangular-sectioned adzes of the Austronesians (Heine-Geldern 1932; Allen, H. 1987:7).

In the 1940s and 1950s, Roger Duff, an ethnologist at the Canterbury Museum (1938-1948) and later director (1948 – 1978), produced a theory of culture change using ethnographic and traditional evidence in addition to that of archaeology (Duff 1947; 1950; 1956). With his excavations of the significant and extensive Wairau Bar site in the northern South Island from 1942 onwards, Duff viewed Maori culture as the development, in isolation, of the culture of the first Polynesian immigrants. He also saw the 'Fleet' traditions of multiple arrivals as the

stimuli for the development of horticulture and warfare. Duff's work led to New Zealand archaeology's preoccupation with multiple origins for the ancestors of Maori (Davidson 1993). Although the standards of excavation utilised at Wairau Bar are poor by modern standards, Duff's work describing the material culture left by the early Polynesian settlers at Wairau Bar demonstraing the relationships with other Polynesian culture groups is still regarded as a 'landmark' in the the progress of understanding the prehistory of New Zealand (Davidson 2000)

In 1959, Jack Golson, a Cambridge-trained archaeologist lecturing at the University of Auckland, wrote his major paper on prehistoric culture change in New Zealand (1959a). By 1960, Golson had already investigated Stingray Point Pa, Headland Pa and Sarah's Gully Pa at Opito on the Coromandel Peninsula, and also Pakatore Pa at Paengaroa in the Western Bay of Plenty (Golson 1955; 1957; 1959b; 1959c). By this time Golson had come to share what he described as the 'orthodox view', that the origins of New Zealand Maori culture are wholly Polynesian, and that the later 'Classic Maori' developed within New Zealand, partly due to new climatic and geographic conditions. However, in his organisational framework he also provided for the possibility of significant cultural intrusion (Davidson 1993). Using chronological phases and regional aspects, he outlined a framework for New Zealand culture change, suggesting the term 'Archaic' for the earlier phase. Golson was primarily concerned with artefacts – he provided definitions of 'Archaic' and 'Classic' material culture (Anderson 1983) – but he did also acknowledge the possibility that warfare and horticulture occurred in the 'Archaic' phase. Golson's two phases were separated by a period of transition which he left undescribed (Golson 1986). Into the 1960s the two-phase model and its terminology were subject to on-going debate, with the point made that the two-phase model had an implicit assumption that cultural change in New Zealand prehistory took place in a brief transitional period between the 'Archaic' and 'Classic' phases (Green & Shawcross 1962). Furthermore, Davidson noted that since this debate began,

> Efforts… have shown that certain artefacts and the remains of extinct birds are almost the only traits distinctive of one or the other of the two poles of New Zealand prehistory over wide areas of New Zealand and that little or nothing is unique to a middle period. Other ways of organising the data are needed (1993:241).

Shortly after Golson's major paper, Roger Green, an American archaeologist, put forward a six-phase model on the prehistoric sequence of the Auckland province in his PhD dissertation, which included artefacts, settlement and economic criteria (Green & Shawcross 1962; Green 1963a). The six phases were termed 'Settlement', 'Developmental', 'Proto Maori', 'Classic Maori', and 'Early European Maori'; each phase was defined by interconnected changes in settlement, ecology and subsistence instead of artefact typology (Golson 1986). Green was arguing for culture change that mirrored trends overseas, with prehistoric Maori society moving from small-scale, mobile, hunter-gather bands to ranked, sedentary chiefdoms based on intensive horticulture (Walter, R., Smith et al. 2006). However, since the model was put forward, the seemingly diagnostic traits of the colonisation model have not held up (Davidson 1993).

Late in the 1960s, David Simmons also put forward a six-phase model, in which both artefactual and economic evidence was utilised (1969). This model proposed the initial arrival of East Polynesian culture in New Zealand from roughly 800 – 1000 A.D, with increasing regional variation in material culture up to ca. A.D. 1600, with the rapid spread of a more homogenous Classic Maori culture afterwards (Davidson 1993). Simmons explained this model by region, with the general hypothesis that "there were a number of changes in the basic economy of prehistoric New Zealand, and that these were determined by man's ability to adapt to or control his ecological situation" (1969:28). The succession of podocarp plant cover in both of the main islands had the effect of restricting avifauna, and gathering and shore fishing became the main focus of subsistence activities. Where kumara agriculture could be practiced, Simmons believed this 'reduced the long term effects' of this change (1969:29). Although Simmons' model is now outdated, his research is relevant in terms of the way subsistence was characterised for the present study area. Of much less relevance to the present study area, Simmons (1973) also proposed a four-phase model for the prehistory of the South Island, based on the analysis of artefacts. However, it did characterise subsistence for Canterbury and Murihiku (Otago and Southland).

Fieldwork which began in 1963 on Motutapu Island in the Hauraki Gulf (west and north-west of the present study areas), led to Janet Davidson's (1972) four-phase sequence for the island. The sequence included 'Settlement', 'Archaic', 'Auckland Maori' and 'Classic Maori' phases; however radiocarbon determinations in her 1978 summary indicated there was no chronological distinction between the 'Archaic' and 'Auckland Maori' phases (Davidson

1978). The Motutapu project involved intensive survey, and significantly commenced a move towards "models suited to the New Zealand evidence with the settlement approach" (Phillips, C.A. & Campbell 2004:90) and away from the widespread utilization of imported methodologies. Regional variation was interpreted based on underlying ecological conditions, where cool, southern soils were unable to be cultivated, combined with scattered resources which could only sustain small, mobile groups; and warmer, northern soils able to be cultivated, with large harbours, could carry sedentary, larger populations (Phillips, C.A. & Campbell 2004:90). However, Davidson pointed to kumara horticulture and interaction with the environment as the primary influences affecting the location of settlements. Horticulture often required the clearance of forest for establishing gardens, but this reduced the habitat of forest birds, and at times increased erosion at coastal settlements beside stream mouths; for example at Palliser Bay this led to increased amounts of sediment being carried down streams and rivers and being redeposited on beaches, where it impacted the survival of sandy shore filter-feeding shellfish leaving only rocky shore species (Davidson 1984a:40-1). The subsistence economy changed from early, broad spectrum hunting to being reliant on horticulture, shellfish and fish; this was typical of sequences for New Zealand prehistory. Davidson later modified this standpoint when she commented that variation was not due solely to ecology and noted that "we can expect more precise and meaningful definitions of prehistoric cultural regions to emerge" (Davidson 1984a:35). The project, with its basis in comprehensive site survey, was one of the earliest settlement pattern studies in New Zealand. Not only did it focus on highly visible *pa* (defended) sites but also open settlements and evidence of occupation across the wider landscape; this approach formed the basis for selection of sites to examine (Phillips, C.A. & Campbell 2004).

The work lead by Foss and Helen Leach during the 1970s on the Wairarapa Archaeological Research Programme (Leach, B.F. & Leach 1979c) did not produce evidence of marked change from 'Archaic' to 'Classic' cultures. Foss Leach (1981) proposed a model of seven cultural periods for the Wairarapa region, spanning A.D. 1100 to A.D. 1853: 'Period I Successful Colonization'; 'Period II Regional Consolidation'; 'Period III Economic and Environmental Decline'; 'Period IV Abandonment'; 'Period V New Colonisation'; 'Period VI Early Protohistoric' and 'Period VII Late Protohistoric'. These seven cultural periods were based on radiocarbon dates but also included a range of traits from material culture, economy, settlement pattern and environment change.

In his book on prehistoric southern Maori, Anderson (1983) used three periods to divide the southern (Murihiku) sequence over nine centuries. The 'Early Period' (A.D. 900 – 1350) and the 'Middle Period' (A.D. 1450 – 1550) were equated by Anderson to the Archaic Phase. The 'Late Period' (A.D. 1550 – 1800) was equivalent to the Classic Phase. The 'Early Period' was characterised by moa-butchery camps, coastal sites rich in artefacts, seal butchery sites and inland rock-shelter sites. The 'Middle Period' saw a recession in moa and seal resources and the extinction or near extinction of a number of birds. Anderson proposes that Maori cleared an amount of forest during the middle period. Late period sites were concentrated on the coast. Fishhooks tended to be two-piece, adze styles appear to have a restricted range compared to the early and middle periods; and weapons such as *patu* (a hand club) flourished, and greenstone pendants appeared.

Davidson's (1984b) *The Prehistory of New Zealand* emphasised geographic variation in New Zealand prehistory, and proposed a three-part scheme to combat what she regarded as the "polarisation between the extremes of Archaic and Classic, Moa-hunter and Maori" (Holdaway, S.J. 2004a:21). Her intention was to emphasise the continuity and change in a range of artefacts, as opposed to defining and describing two discrete assemblages (Davidson 1984b:61); in this way she overcame the "creation of an uncomfortable hiatus" between the 'Archaic' and 'Classic' phases. She specifically discussed subsistence in Chapter Six, again emphasising continuity in some regions and change in others, but relied on the Wairarapa research in her discussion of horticulture; variability was emphasised to the detriment of nation-wide evolutionary sequences (Holdaway, S.J. 2004a). Davidson's regionalism has been criticised; while it moved away from treating all examples of the archaeological record as equal, "it did not provide the theoretical rationale on how these differences were to be analysed" (Holdaway, S.J. 2004a:22). Site and artefact formation processes were not discussed; artefact form variability was treated as stylistic, and the constraints of tool manufacture were not considered in depth.

Since the introduction of radiocarbon dating in the late 1940s a general consensus had emerged that first settlement of New Zealand had taken place at around 900 AD (Davidson 1985). This 'orthodox chronology' was challenged by Sutton (1987) who proposed much earlier initial settlement. This sparked a period of intensive reassessment of the evidence that had underpinned the foregoing chronological models, and the development of protocols to ensure the reliability of chronological data in revised or new interpretations. This is discussed

in the following section, but it can be noted here that the sequence building continues to characterise the practice of archaeology in New Zealand. Regional models have been proposed for several areas including the northern South Island (Barber 1994; 1996; 2010; 2012a; 2012b; 2013), the Hauraki Plains (Phillips, C.A. 1994; 2000e), and the southern South Island (Jacomb, Walter et al. 2010), while several authors have reconsidered change through time in aspects of subsistence and settlement patterns (e.g. Anderson & Smith 1996a; Nagaoka 2000; 2001; 2002b; 2002a; Walter, R., Smith et al. 2006; Smith, I.W.G. 2013). Relevant aspects of these will be returned to in the following two sections.

1.4.2 Chronometric Hygiene in New Zealand

New Zealand's short prehistory has long provided archaeologists with unusual opportunities to study cultural, social and environmental change in relative isolation, but also the challenges of undertaking study effectively with the limitations of dating methods (Leach, B.F. 1969; Shawcross 1969; Smith, I.W.G. 2010:184). In this respect New Zealand is not unique, as there are many other islands and archipelagos with relatively short chronologies in East Polynesia, such as Hawaii and Easter Island. Radiocarbon dating is the main dating method used in New Zealand archaeology, but, as Holdaway (2004a:27) points out, its use lies in estimating occupation duration but not interpretation in terms of short-term behaviour. Radiocarbon ages provide probability curves indicating the years in which the dated remains were most likely deposited.

In recent decades, chronometric hygiene has had strong implications for New Zealand prehistory, reducing its span by 25% (Anderson 1991; McFadgen, Knox et al. 1994; Higham & Hogg 1997; Smith, I.W.G. 2008:368; Wilmshurst, Anderson et al. 2008). Chronometric hygiene involves applying critical rigour in accepting radiocarbon dates; protocols for the acceptance or rejection of radiocarbon dates are detailed in Anderson (1991) and Smith (2010) for New Zealand and Anderson and Spriggs (1993) for the rest of East Polynesia. For New Zealand, Anderson (1991) reviewed radiocarbon dates on different materials and compared them with the Shag River Mouth deposits. He noted issues with determinations from marine shell collagen - some samples were from environments with high levels of calcium carbonate of indefinite radiocarbon age and some sub-tidal rocky shore species samples were also from localities with limestone substrate and local upwelling which tend to give older dates. Moa (Dinornithiformes, ratites) bone collagen also had many associated issues - some samples had unexpectedly high or low $\delta^{13}C$ values for birds that must have

eaten an exclusively C3 plant diet, leading to a fractionation error range of approximately 150 radiocarbon years. At the time Anderson wrote, no tests of sample integrity were being used consistently by New Zealand laboratories, while levels of collagen concentration from moa bones were also found to be variable, increasing potential for error. Collagen extraction methods had varied over time while mineralization of collagen with younger carbon from the environment being taken up was also problematic. Anderson noted that charcoal samples also had significant issues, mostly associated with inbuilt age, such as 'old wood' generating earlier dates, species of short vs. long lifespans, accurate identification of 'twigs', 'branches' or 'small diameter' pieces of charcoal, the relative durability of timber being affected by the environment and the inherent nature of the species. From Anderson's extensive review of various radiocarbon age determinations, he observed that with regards to the marine shell and bone collagen chronologies "They are broadly similar to the charcoal chronology but disclose greater variability" (1991:782). Anderson provided a discard protocol for charcoal, which is summarised here:

1. Dates of 250 radiocarbon years BP. or younger are discarded on the basis of being indistinguishably modern;
2. Dates from a series of samples from a site which are greater than 1 SD or 300 radiocarbon years 'adrift' are discarded on the probability this is due to inbuilt age;
3. Single dates from a particular context, where no independent evidence of age is present to verify radiocarbon results, and where the sample species are not identified, are open to question because of inbuilt age;
4. Similarly, single dates from identified material with a highly likely inbuilt age are discarded; and
5. 'Sample-selection pairs' where two samples have been taken from the same area or feature within a cultural layer, especially where the charcoal material has not been identified are also discarded (Anderson 1991:782-3).

Higham and Hogg (1997) noted that the short duration of the New Zealand prehistoric period necessitates a cautious method for selecting samples and context, with a "rigorous approach to the analysis of the corpus of the available determinations" (Higham & Hogg 1997:152). Their discard protocol for the acceptance or rejection of radiocarbon dates was aimed specifically to "examine their accuracy in dating archaeological events, and to consider how the earliest

acceptable determinations challenge the various colonization hypotheses" (Higham & Hogg 1997:152). Additions to Anderson's protocols are summarised here:

1. Where the species of charcoal is unidentified and therefore may possess a high inbuilt age, the samples are rejected;
2. Samples from materials that have a tendency to provide inaccurate radiocarbon ages, e.g. riverine shells, are rejected;
3. Single dates that fail to relate the sample to an event, or possess error due to inbuilt age, such as "dispersed charcoal or sediments excavated from agricultural soils" are rejected (Higham & Hogg 1997:153);
4. Samples which appear to have been inadequately pre-treated, or may have been contaminated after initial deposition are rejected;
5. Samples from contexts which may have been subject to redeposition, or where the nature of the context is not unequivocally cultural, are rejected;
6. Samples of shell from marine and estuarine environments where there is a high likelihood of old carbon dissolution or oceanic upwelling, are rejected;
7. Where samples have been used for radiocarbon dates from mixtures of materials, such as different shellfish species, or charcoal and bone, are rejected; and
8. Samples of unidentified shellfish are rejected; as they may include unreliable species such as *Amphibola crenata* or *Hydrella menziesii* (Higham & Hogg 1997:152-4).

After rejecting 25 determinations from charcoal samples, 21 from marine, estuarine or freshwater shell samples, and four determinations from wood, eggshell or sediments samples, Higham and Hogg's (1997) protocols resulted in 221 acceptable radiocarbon determinations that did not extend beyond cal AD 1250. These were from 159 marine shellfish sample determinations, 50 charcoal sample determinations, and 12 samples including wood and moa eggshell.

Petchey (1999) focused on radiocarbon discard protocols for bone, evaluating determinations from human, dog, rat and moa bone samples. This was published at a time when debate on the accuracy of rat (*Rattus exulans*) bone gelatin determinations had been the topic of much debate (Anderson 1996b; Holdaway, R.N. 1996; Bevan & Sparks 1997; Ladefoged, Matisoo-

Smith et al. 1997; Anderson 1998; Smith, I.W.G. & Anderson 1998; Sparks 1998). Petchey aimed to provide

> "a culling protocol… to comprehensively appraise all bone determinations measured in New Zealand… to isolate bone determinations that are not obviously suspect, and consider whether there are sufficient grounds for rejecting radiocarbon results of bone in general" (1999:82).

A total of 46 sites with bone determinations were assessed; after the discard protocol was applied only 11 sites with bone and determinations from matching charcoal and/or marine shell samples remained. The discard protocol that Petchey devised is summarised here:

1. All determinations from carbonate are rejected, as bone carbonate can exchange with atmospheric CO_2 resulting in young or modern ranges;
2. All determinations from burnt bone samples are rejected on the basis of low bone protein content, increased porosity of the mineral phase and inconsistent isotope and radiocarbon results;
3. Determinations from marine mammal species which migrate into depleted Antarctic waters are rejected due to the "possibility of wide variation in reservoir correction" (Petchey 1999:97), as are mammal species which are deep ocean feeders, as samples may incorporate 'old carbon';
4. Fish species which range into depleted waters (below 200 metres) or outside of New Zealand waters may also incorporate 'old carbon'; therefore fish species which have not been found to be coastal are rejected;
5. Dog bone samples may produce erroneous determinations due to a marine component in the diet and are therefore rejected;
6. Determinations from human bone are rejected on the basis of erroneous results due to a varied diet (i.e. marine and terrestrial reservoir sources);
7. Similarly, determinations from *Rattus exulans* gelatin samples are likely to produce erroneous results from a varied diet; duplications of rat bone determinations from the same sample or individual appear to be unable to be duplicated, possibly due to inadequate pre-treatment of small AMS samples or laboratory-induced contamination. Therefore all rat bone determinations are rejected;

8. Determinations which are "removed by more than 2δ from results belonging to stratigraphically identical horizons" (Petchey 1999:100) are likely to be either from sub-fossil samples or subject to contamination, and are therefore rejected;
9. Where samples are from uncertain or displaced provenance, i.e. not in direct stratigraphic association with a specific archaeological event, the determinations are rejected; and
10. Single radiocarbon determinations are rejected where they cannot be validated with other stratigraphically associated, acceptable determinations; this is due to the uncertainties associated with all bone determinations.

Petchey concluded that the radiocarbon dating of bone samples in New Zealand was not inherently unreliable, but was affected by a number of factors including bone pre-treatment; species reliability; the influence of contamination had not been assessed; the effectiveness of various radiocarbon pre-treatments had not been well understood; submission of inadequate samples including burnt bone, sub-fossil bone and severely degraded bone, which had different chemistries; questionable provenance of samples (or associated samples) resulting in an inability to compare bone reliability; the limited and inaccurate publishing of determination results and procedures; and the lack of research into New Zealand bone radiocarbon measurement, largely due to existing but untested ideas on bone determination reliability (Petchey 1999:112-3).

Schmidt added to discard protocols in his investigation into the commencement of pa reconstruction in New Zealand (1996a) and his doctoral research on the radiocarbon dating of New Zealand prehistory using marine shell (1996b; 2000c) and his compilation of marine shell, charcoal and moa egg shell determinations from New Zealand moa-hunting archaeological sites (Schmidt 2000a). He noted that wood and charcoal samples from totara (*Podocarpus totara*) samples are one long-lived species at high risk of inbuilt age in radiocarbon date determinations, and it was commonly used in palisades and pit structures (Schmidt 1996a:444). The issue of whether species longevity is relevant in twig charcoal, where the sample represents only a few years of growth was addressed by discarding determinations from twig charcoal species known to have longer longevity (even when in some areas they had short lifespans) (Schmidt 2000a). His protocol rejected determinations from manufactured soils where "the constituents have not been identified and are seen as unreliable due to the risk of inbuilt age" (Schmidt 1996a:445). He noted that the large wedge

shell, *Macoma liliana*, had also been added to the shellfish species know to be unreliable (Hogg, Higham et al. 1998), along with mudsnail, *Amphibola crenata*, and freshwater shellfish (Schmidt 2000a). Schmidt also specified for the rejection of materials that had not been identified, and materials with unknown reliability for radiocarbon determinations, such as peat, kumara (*Ipomoea batatas*), soil, grease, and feathers (2000a).

Once protocols for sample selection and appropriate calibrations began to emerge, many New Zealand archaeologists commenced incorporating them into their research programmes. Barber's (1994; 1996; 2010; 2012a; 2012b; 2013) ongoing research on pre-European culture change in northern Te Wai Pounamu, or the northern South Island, employed calibrated radiocarbon dates and ecological events with known, established dates on which to base a chronological scheme of Early, Middle and Late periods. The samples submitted for radiocarbon dating were either marine bivalve species considered to be reliable (e.g. *Paphies spp*. and *Austrovenus stutchburyi*) or twig charcoal from short-lived flora from identified species with no potential for inbuilt age (e.g. Cyathaceae) (1996:871; 2010:78; 2012b:806; 2013:47). Although Barber calibrated two radiocarbon dates from Rotokura and Whangamoa from samples of terrestrial charcoal either from unidentified species or with potential inbuilt age, and pooled samples of terrestrial charcoal either from unidentified species or with potential inbuilt age from a further two sites (Tahunanui and Wairau Bar), he noted that,

> In light of ongoing research and debate on calibration scales and corrections for New Zealand (e.g. McFadgen, Knox et al. 1994) ranges should be treated as generally indicative of true chronology only. Unidentified charcoal dates with possible inbuilt age (McFadgen 1982a:384-87; for example see Wairau Bar marine and terrestrial ranges) signify maximum chronology only (1996:871).

The excavation of Shag River Mouth by Anderson, Allingham et al. (1996) yielded nine cultural deposits; samples of shell, bone, and charcoal produced 32 radiocarbon dates. These dates were originally published by Anderson, Smith & Higham (1996), who outlined a sampling strategy to collect as many materials as possible (e.g. charcoal, moa bone and egg shell, marine shell) from each excavated area and major stratigraphic deposit, particularly focusing on sequences of deposits in stratified areas. Charcoal samples were cleaned and identified to species, with twig and charcoal selected from small growing (i.e. limited diameter) species (1996:60). Charcoal samples were obtained from twig material from short-lived species. Moa bones with clear evidence of butchery were washed and identified to

species where possible (*Emeus, Euryapteryx*). Subtidal rocky shore and estuarine shellfish species (*Haliotis iris, Austrovenus stutchburyi, Amphibola crenata, Paphies australis* and *Mytilus edulis aoteanus*) were deliberately collected to check for the potential of error from contamination. Moa eggshell remains were cleaned and pretreated. Statistical tests demonstrated no significant differences in dates between pretreated and untreated samples; at the Shag River Mouth site it was concluded that there was little significant contamination of shell and charcoal material (1996:64-5). Groups of radiocarbon dates were evaluated by laboratory and material type to determine if statistically they could be combined for a pooled mean age, or treated as spate age determinations. *Amphibola crenata* dates varied from the mean charcoal and *Austrovenus stutchburyi* values, echoing Anderson's (1991) conclusion that this gastropod is unsuitable for dating, likely a result of their method of feeding on mud deposits on the highest tidal margins, as opposed to *A. stutchburyi* which is a filter feeding bivalve. The results of the ages grouped by laboratory were indistinguishable at the 1δ level. The dated moa egg shell ages were considered to be reliable, while the moa bone age series showed "variability inconsistent with other materials" (1996:66-7); this may be due to inbuilt age from the use of fossilised bone (considered unlikely) or variability in the rates of preservation or post-depositional contamination. The close range of the 32 dates covering the site (excluding the experimental samples) supported the interpretation that Shag River Mouth was "continuously occupied for a period of perhaps 20-50 years in the 14th century AD" (1996:67).

Caroline Phillips' (1994; 2000e) work on the prehistory and contact period of the Waihou River, west of the present study areas, utilised a set of calibrated radiocarbon dates from excavated sites (where available) to identify a chronology for settlement along the river. Samples were taken from shellfish and charcoal (including *Leptospermum scoparium*, *Olearia spp*., *Hebe spp*. and *Avicennia marina australasica* shrub species) (Best, S.J. 1980:73; Phillips, C.A. 2000e:109, 113, 114, 120, 123, 125, 129,134, 139, 142); the samples used for radiocarbon dating were not consistently described in detail in the published volume (2000e) which makes evaluation of hygiene protocols somewhat problematic. However, the results of the calibrated dates were combined with obsidian hydration dates (Doelman 1995) and the presence of contact period artefacts and faunal remains within and above deposits to provide a secure chronology for excavated sites along the Waihou River.

Sutton, Furey and Marshall's (2003) volume on Pouerua Pa, in the inland Bay of Islands, in northern New Zealand, employed sample selection criteria with 19 samples they submitted for radiocarbon age estimates, in order to anchor the stratigraphic sequence. The samples were taken from six of the seven excavation areas on the pa, with most samples comprising charcoal, although two samples of shell were also submitted. All of the charcoal samples were identified to genus, and species where possible; charcoal from young plants and short-lived species were selected. Samples were taken from sealed cultural contexts (e.g. firescoops), except for four samples from palaesols underlying cultural layers; the latter were intended to provide age estimates for the clearing of forest. The results of three of the samples were discarded, as they were considered unreliable: a) the $\delta^{13}C$ value suggesting post-depositional contamination of a cockle shell (*Austrovenus stutchburyi*) sample had occurred, in spite of the age estimate being consistent with the stratigraphic position it was taken from; b) a poorly preserved shell sample, originally assumed to be a marine species, was later identified as a freshwater species (freshwater mussel, *Hydriella menziesii*) which meant it could not be calibrated as no appropriate reservoir correction was known for the freshwater shell; and c) part of a charcoal sample from a firescoop was lost at the radiocarbon laboratory, resulting in the assumption of the $\delta^{13}C$ value; although it should be noted that the possible error from the assumed $\delta^{13}C$ was unlikely to exceed 20 years and the reported age was consistent with the other age estimates (Sutton, Furey et al. 2003:191-92). The authors chose not to include modern samples in the analysis, removing a further five sample results in addition to the three already considered unreliable, leaving a total of 11 reliable results to calibrate.

Jacomb, Walter and Jennings (2010) produced a review of the archaeology of Foveaux Strait, which included the results of radiocarbon dating samples taken during the Southland Coastal Heritage Inventory Project (SCHIP) along the southern coast. The review noted that all but two previously dated samples were of unidentified charcoal, which were unable to be assessed for inbuilt age. Small middens and larger sites were both targeted for radiocarbon dating samples during the SCHIP to develop a chronology. The former site type was targeted as they were under-represented in the existing dating record, and had potential to test "the possibility that later occupation of the southern coast only involved small groups who, who, by extension, left small sites" (Jacomb, Walter et al. 2010:38). The latter were targeted particularly when no other associated indicators of period such as 'Archaic' artefact types or pieces of industrial moa bone were present. The authors presented only the calibrated ages of dates on marine shell samples or charcoal from identified, short-lived plant species. This

reduced the number of calibrated radiocarbon dates to 30, from only 14 separate locations. The small body of dates for the Foveaux Strait region presented a bimodal distribution, with a marked decrease in population from the 16th century, which only begins to increase again near the end of prehistoric period (Jacomb, Walter et al. 2010:43). Although this could be argued as a skewed result due to the small sample size, the bimodal distribution is repeated at other dated sites along the southern coast.

1.4.3 Evidential Unease

Evaluating radiocarbon-dated samples for marine or terrestrial carbon reservoir origins, in-built age of wood samples, and the contexts from which samples were taken has led to the removal of inadmissible data, much of which has underpinned sequences and models of change. While the foregoing review demonstrates that there have been attempts to replace inadmissible data, this has been confined to a few regions of the country. This leaves the broader field of New Zealand archaeology in a state of unease with regards to the evidential bases of what was thought to be known about culture change in New Zealand (Smith, I.W.G. 2008:368). For example, of the sites that Golson (1959a) used to define the material-culture assemblage of the Archaic period, only four now have admissible radiocarbon dates, while his Classic phase was based on early European observations and stratigraphically insecure collections (Furey 2004a; Smith, I.W.G. 2008). Artefact sequences by Crosby (1966); Hjarno (1967); Simmons (1973) and Jacomb (1995) are also deficient in their chronological foundations. Proxy indicators of age, such as using evidence for moa-hunting, cannot surmount this issue; Schmidt's (2000b) review of previously accepted radiocarbon dates for 73 moa-hunting sites found only 15 which passed rigorous criteria for acceptability. This results in uncertainty for the span of moa-hunting, and limited the ability of archaeological evidence of moa-hunting to place otherwise undated deposits within a chronology (Smith, I.W.G. 2008:369). Also, further ramifications of the tightening timespan of New Zealand prehistory are highlighted with sites that are well-dated with relatively brief occupation durations and large artefact assemblages, which demonstrate that artefacts once thought to be chronologically distinctive are, in actual fact, contemporaneous (Anderson, Allingham et al. 1996; Furey 1996; 2002b). This results in an erosion of the view that Archaic and Classic assemblages are discrete or monolithic. In response to this, assemblages with radiocarbon dates that pass strict acceptance criteria need to have detailed analysis undertaken, in order to determine if and where prehistoric artefacts co-varied through time (Smith, I.W.G. 2008).

Chronometric hygiene however, has not impacted on the accepted timing of the emergence of *pa* at ca. AD 1500 (Schmidt 1996a), resulting in differing interpretations for what the emergence of *pa* at this time might indicate about changes in subsistence, settlement and social patterns (Phillips, C.A. & Campbell 2004). Just as analysis of reliably dated artefact assemblages is required to test earlier models of culture, faunal assemblages with robust radiocarbon ages need to be analysed for inter-site and inter-region variation, both in terms of contemporaneous and chronological data, to test previous understandings of subsistence (Smith, I.W.G. 2010). Smith stated "There is now more than ever a critical need to reassess the nature and timing of changes in material culture, subsistence patterns and environment" (2010:184).

1.5 Subsistence and Settlement Models in New Zealand Prehistory

The following literature review outlines the development of models of subsistence and settlement models for New Zealand prehistory; identifying and evaluating strengths and weakness in the models, and providing a clear indication of which directions researchers need to address.

Subsistence and settlement models describe how the range of subsistence practices of a prehistoric community were organised and how the various localities at which they took place were integrated into a functioning system. Much of the very early writing on New Zealand prehistory is not very clear about how subsistence practices were organised. From Haast onward there have been characterisations such as 'early' equates to moa hunting, and 'late' equates to shellfish gathering; or Duff's moa-hunters were nomadic hunter-gatherers and later Maori were settled horticulturalists; but for the most part these do not constitute explicit models. Since Davidson's (1972) work on Motutapu and Groube's (1964) MA thesis, New Zealand archaeology has had settlement pattern models that propose integration of multiple sites within the realm of community activities, but these early examples did not incorporate much in the way of subsistence.

Roger Green's (1963c) Auckland sequence did include aspects of subsistence, but it was based on "a survey of the existing literature, not something discovered simply by excavating sites" (Green 1963c:16; 1970). He defined his sequence "in terms of interlocking changes in ecology, subsistence and settlement" (Golson 1986:4). In the Auckland sequence, Maori

changed from hunting and gathering to horticulture, and shifted from temporary camps to *pa* and permanent villages; factors inducing these shifts comprised the development of advanced kumara cultivations and storage technologies, climate change and faunal extinction (Marshall 2004:60).

Groube's approach followed changes in the makeup of social groups. Groube's typology was important because it was foundational to the models that followed. His four archaeological units (Table 1.1) – ordinary sites, specialised activity sites, specialised living activity sites and diverse living activity sites; and four social units – domestic, communal, economic and political – were applied to archaeological evidence, to identify variation in time and space in different regions (Marshall 2004). While Groube was not explicit about subsistence, there was an implied connection – that single subsistence activities occurred at specialised sites, and a more diverse range of subsistence activities occurred at specialised living and diverse living sites. Groube envisaged change through time with a two-phase typology. In Groube's Archaic phase the economic unit consisted of the village and seasonal camps for fishing, moa hunting, etc., but in the Classic phase Groube considered the archaeological evidence to be much less clear about how site types were integrated into economic units.

Table 1.1 Comparison of economy-based site typologies, after Marshall (2004 Table 3.2)

Groube (1964:44-5)	Leach and Leach (1979c)	Anderson (1982:60-1)
Diverse living sites Settlements "with the remains of diverse ordinary living activities".	**Permanent winter villages** E.g. Moikau house site, Washpool midden site. Must include winter occupation.	**Multi-function sites** E.g. settlements/villages with a diverse range of artefacts, faunal remains and structures, including hearths, evidence for general domestic activities; and winter occupation.
Specialised living sites Settlements "where everyday living activities have taken place" alongside specialised activities; may include hearths.	**Seasonal villages** E.g. Cross site. May include hearths and houses	**Restricted function sites** "Places at which more than one activity was of significance, but which do not exhibit the wide range of fauna and artefacts or the size of the multi-function bases". May include hearths and houses but lack structured layout of space.
Specialised activity sites E.g. agricultural fields, quarries, forts, hunting camps etc., "where no actual living occurred".	**Resource camps** E.g. Black Rocks middens, garden sites. Restricted season of use.	**Single function sites** E.g. moa butcheries, quarries and tool production areas with no evidence of domestic activity; restricted season of use.
Ordinary sites Fortuitous survivals and chance finds		

Cassel's (1972a; 1972b) settlement approach applied the economic analyses of the 'Cambridge school' to an inland Waikato study area. The 'Cambridge school' in New Zealand refers to the Cambridge trained archaeologists Jack Golson, Peter Gathercole and Charles Higham, who arrived in New Zealand in 1954, 1958 and 1967 respectively (Allen, M.S. & Nagaoka 2004). Their economic approach derived from the research of two Cambridge archaeologists, Graham Clark (1939; 1954) and Eric Higgs (1972; 1975), and less influentially Leslie White (1943; 1959) and Julian Steward (1955), two American neo-evolutionists (Marshall 2004). The 'Cambridge school' approach inferred relationships between sites "on the premise that people need access to a suite of resources capable of sustaining them year-round" (Marshall 2004:63). In New Zealand, under this approach, a range of sites was excavated, and midden was analysed to identify the range of resources utilised and which seasons they were available (Marshall 2004). Cassels (1972a; 1972b) divided the study area into ecological zones, estimated the food value for each zone and then "attributed the prime resources exploited by each site according to zones within a two mile catchment" (Phillips, C.A. & Campbell 2004:92). He later used seasonality and the number of resources to estimate the permanence of sites. Although Cassel's work encouraged later study on environmental and economic factors (e.g. Anderson 1982), the focus remained generally on the social aspects of settlement pattern study stemming originally from Groube's work.

Sullivan (1972; 1974; 1975) instigated the mapping of complex stone structures in the Auckland area through aerial photographs, and utilised these with detailed analysis of stratigraphy and features to attempt to recreate original alignments prior to farming damage (Phillips, C.A. & Campbell 2004). Sullivan compared these structures to others found in the Pacific, particularly Hawai'i (1972), and later compared the gardened slopes of volcanic cones as an occupation phase when long radial boundary walls sectioned the slopes into territorial wedges (1975). While this settlement approach did include horticulture, there was no emphasis placed on other components of subsistence; however Sullivan did emphasise the integration of diverse site types into the settlement pattern of a community.

Irwin's (1985a) spatial analysis of *pa* (fortifications) at Poutu on the North Kaipara Head, Northland, analysed the dynamic nature of social interaction, using geographic locational theory (see Flannery 1976) especially rank size distributions, and integrated this with a programme of targeted excavation and dating data, and also social data. This produced a much more adequate result than Cassels' (1972a; 1972b) work. Irwin's results implied that at

Poutu, Maori society changed dramatically from one composed of independent small scale communities to a single integrated polity. Irwin's explanation for settlement change was largely social; the findings of the dating programme backed up the results of the independently determined spatial analysis (Phillips, C.A. & Campbell 2004). Subsistence again played little part in this settlement pattern analysis.

Leach and Leach (1979c) at Palliser Bay integrated subsistence into their model of community settlement patterns. With the Wairarapa Research Programme they followed a similar methodology to that used by Davidson at Motutapu, and sought to examine the regional culture history of the Palliser Bay area with a programme of survey and targeted excavation (Leach, B.F. & Leach 1979b:4-6). They utilised environmental, technological and subsistence data with settlement patterns at a macro scale and outlined the community at Palliser Bay (Leach, B.F. & Leach 1979a). Leach and Leach identified six inter-related communities who lived at Palliser Bay between ca. AD 1150 and 1500, who gardened extensively in a marginal environment and foraged marine and forest resources. Seasonal mobility was illustrated by economic and settlement patterns. Early on the settlement bases were congregated on the narrow coastal platform, with some birding and gardening camps located inland in bush clearings; later residences were built inland due to the exposed nature of the coastal platform from climatic and human induced environmental deterioration; gardening was constrained to high-quality coastal soils, with storage near settlements or concealed out of sight (Phillips, C.A. & Campbell 2004:92).

Anderson also integrated subsistence into his model of community settlement patterns for the southern South Island (Anderson 1982). He built on Cassel's economic focus but avoided the hazards of central place theories and the assumption that sites must be contemporary. Anderson focused on the general pattern of resource use and settlement mobility, rather than "the specific settlement pattern of a tightly defined area" (Phillips, C.A. & Campbell 2004:94). Anderson's approach resulted in an economic explanation which relies on settlement and environment seasonality; resource procurement strategies were adapted to declining moa numbers and increasing territoriality and population (Phillips, C.A. & Campbell 2004).

The large archaeological project at Shag River Mouth (Anderson, Allingham et al. 1996) provided an example of an extensive, permanent, early village in the southern South Island, and led Anderson and Smith (1996b) to propose the transient village model for southern New

Zealand. The radiocarbon dating of samples from the extensive archaeological deposits at Shag River Mouth indicated that the site was occupied continuously for approximately 50 years, with an economy based on hunting, fishing and gathering. In the early phase of Anderson and Smith's model, transient villages were positioned near rich resource clumps of seals and moa. As stocks of these high meat yielding resources depleted, the early phase transient village became impractical. By the late phase, new socio-political conditions helped to facilitate transient villages but with the movement to and transport of dispersed resources. Anderson and Smith suggested that villages were less apparent mid-sequence than early or late, and also that the underlying organisation of subsistence was different early and late in the occupation. Nagaoka's (2000; 2001; 2002b; 2002a) work on a set of faunal data from the Anderson, Allingham et al. (1996) Shag River Mouth excavations used foraging efficiency models to identify changes in patch use and mobility through time. However, she noted that "environmental variability produces different patterns of resource use (e.g. Cannon 2000). Thus, the patterns of subsistence change seen at Shag Mouth may not be representative of all sites in southern New Zealand" (Nagaoka 2002a:98).

Caroline Phillips' (1994; 2000e) work on the prehistory and contact period of the Waihou River, in the Hauraki Plains west of the present study areas, reviewed settlement along the river. Phillips identified five cycles or causes of mobility and settlement along the river. Long cycles of 50-100 years were caused by increases in population, economic development and environmental changes, and resulted in movement in to new areas and the development of new site types. 'Mid' cycles of 10-30 years were caused by the rise of the *mana* (status) of a new chief or new conquests, and resulted in people (and therefore sites) being grouped around the pa of the chief. Short cycles of 2-3 years were based on garden rotations, economic and environmental variables and keeping land for political purposes, resulting in new gardens and kainga (villages) being established. Annual cycles were based on the seasonal availability of resources, with people moving to gardens and areas for fishing, birding and plant gathering. The final, 'Other' cycles were temporary trips away, for social visits, trading or war parties (Phillips, C.A. 2000e:167-8). While Phillips'(1994; 2000e) doctoral research examined prehistoric and historic settlement, and used a combination of radiocarbon dates and historic sources to order the sequence of settlement, faunal analysis was not a key component in the research.

Barber's (1994; 1996; 2010; 2012a; 2012b; 2013) ongoing research on pre-European culture change in northern Te Wai Pounamu (NTWP), or the northern South Island, put forward an anthropological model of culture change based on diminishing faunal and lithic resources over time. During the 14-16th centuries, the Maori economy of NTWP experienced a resource crisis, which either began or catalysed a broader path of culture change. Barber suggested that as the diminishing faunal and lithic resources were perceived as linked by influential leaders during this Middle Period, distinctive ideologies, institutions and technologies were developed as a result. This model of culture could also be applied to other regions of New Zealand. The emergence of pa from the post-15th century has often been viewed as the result of population growth and the resulting need to protect resources under pressure; however pa vary in their form, function and size, and are not always located in a landscape of dense prehistoric population. Pa were monumental identifiers in the landscape, and

> …given a resource-crisis concern for territoriality, control and permanence, pa of the 15th and 16th centuries at least may represent a monumental reaffirmation of and appeal for the extension of a more beneficent and productive order into a now more permanently capricious island world (Barber 1996:876).

Irwin's (2004b) edited volume compiled the results and analysis of various field seasons at the inland Bay of Plenty swamp pa, Kohika, on the Rangitaiki Plains, providing insight into subsistence, settlement and environmental change at the site and the wider regional level. Irwin's (2004a) introduction chapter observed the distribution of recorded Maori archaeological sites showed broad trends, with Ohiwa Harbour, the ridges around the periphery of the Rangitaiki Plains and along the Whakatane River, as well as higher ground around the coast, being the predominant locations of pa sites. Kohika stood apart as the only recorded swamp pa in the area; other pa on the plains nearby date to the historic period (2004a). Terraces were the most common site type in the area; pits appear to be under-represented in parts of the inland area, but this may be as a result of covering by tephra from the 1886 Tarawera eruption (2004a). Compared to further west in the Bay of Plenty, rua (bell-shaped subterranean pits) were also relatively rare, although had been identified in excavations. Cultivation soils were also considered to be rare relative to further west in the Bay of Plenty. The scarcity of middens west of Matata was attributed to the high-energy beach environment being unsuitable for soft shore shellfish species typically found in middens. The paucity of midden sites continued along the coast of the Rangitaiki Plains,

despite the presence of estuaries and lower-energy sandy shore environments; this was interpreted as the result of under-recording. This may also be the reason why the Rangitaiki Plains in general had a lower recorded site density than surrounding areas; the Tarawera tephra cover may also have reduced the visibility of features and sites during surveys. Irwin concluded the site distribution discussion:

> In general, the site distribution shows the preference of Maori to live along the coast, especially near harbours. Away from the coast, sites are concentrated on soils attractive to Maori horticulturalists and areas enjoying both defensible uplands and access to rivers. Kohika is unusual in the context of the larger sample of sites, being a prehistoric lowland swamp pa in an area with a very low density of recorded sites (Irwin 2004a:6).

McGlone and Jones (2004) used pollen core analysis and the presence of three tephra layers – of the Tarawera, Kaharoa and Taupo eruptions, commonly found throughout the upper deposits in the Bay of Plenty – at three prehistoric archaeological sites to examine the impact of Polynesian settlement on the vegetation of the coastal Bay of Plenty. In terms of volcanic disturbance, the Taupo and Kaharoa eruptions, while causing widespread destruction of forests close to the eruptive centre of the North Island, had less direct impacts in the Bay of Plenty. The bay was beyond the spread of the ignimbrite flows, but extensive areas of tephra plains and forest devastation probably occurred as the result of flooding with tephric alluvium. Other areas closer to the coast, where coastal bush was the dominant vegetation, were more susceptible to the acidic ash-fall. The resulting die-back of the coastal bush led to lightning-strike fires, which allowed bracken (*Pteridium esculentum*) and grasses to establish. Prior to the Polynesian settlement of the Bay of Plenty, the coastal lowlands were blanketed by "tall, species-rich, conifer/broadleaved forests" while the large Rangitaiki Plains wetlands were densely vegetated in "complex mosaics of swamp forest, scrub and tall sedges, jointed sedges and flax" (McGlone & Jones 2004:40). The dense swamp vegetation was difficult to move through, and was not conducive to human settlement, in spite of the variety of plants and animals it supported. After the easily caught birds of the coastal forests were reduced in number, the primary forests were, in comparison, not rich in food resources. Subsequent burning of the swamp forests would have made the swamps and their resources easier to access; sources of starchy carbohydrate such as bracken, ti (*Cordyline*) and tutu (*Coriaria* sp.) would have spread, while eels, freshwater fish and birds would have become much easier to

access. Once the early Polynesians initiated burning, firing became a recurrent activity, demonstrated by the dominance of grass and bracken. Early in Maori settlement, a recurring pattern was set of "remnant forest patches surrounded by regenerating forest and scrub" (McGlone & Jones 2004:41). Regular burning was required in order to maintain the dense number of settlements with their need for accessible swamp, cultivable ground, fern and scrub and the plant and animal resources they supported. The faunal subsistence at Kohika included mammal (human, marine mammal and dog), birds, fish and shellfish (Irwin, Nichol et al. 2004). The results noted that for a late prehistoric Maori assemblage, it was not remarkable except for the large relative abundance of dogs, which had a raw MNI value of 16. The results indicated that as well as a source of food, the bones of mammals were used to make tools. The bird assemblage identified fowling was undertaken in forest, estuary, swamp and open coast environments; in addition to a source of food, it is likely that the bird bones, particularly those of albatross, were used for tool making, and potentially trade. Fish were mainly caught in the nearby estuary of the combined Rangitaiki and Tarawera Rivers with nets and bait hooks; some fish were also caught on the open coast. Eel remains were surprisingly absent. Bivalves and gastropods were gathered from mudflat, open coast, lake and sheltered soft-shore environments. The relative abundance of all classes of the assemblage was relatively stable spatially and temporally. Other evidence for diet was provided by Irwin, Horrocks et al. (2004) in their analysis of samples of more than 300 prehistoric dog coprolites excavated at Kohika. Dogs would have been fed scraps and food waste, meaning that their coprolites allowed some insight into the diet of humans at the site. Analysis of macrofossils and pollen present in the coprolite indicated that the regular diet contained fish and gathered plants including bracken fern (*Pteridium esculentum*), puha (*Sonchus*), raupo (*Typha orientalis*) and marsh cress (*Lipidium* sp.). Pollen, diatom and starch analysis indicated that by the time Kohika was occupied, the forest had been cleared and the lake and swamp were immediately adjacent. The coprolite analysis also indicated occupation during summer. Geomorphology and Bayesian analysis of eight radiocarbon dates were used to construct the site chronology at Kohika, giving an occupation during the late 17th century, for a duration of less than 160 years, but more likely less than 70-80 years (Irwin & Jones 2004). In contrast to the general preference of prehistoric Maori for living near the coast, particularly close to harbours, or else inland areas with good horticultural soils, defendable landforms and navigable rivers, the Kohika is rare as an inland swamp pa. Initially an unsuitable location, once regular burning was undertaken by the occupants it was able to support their presence with access to a wide range of resources.

Allen's (2006) work on three sites at Tauroa Point, northern North Island, places their subsistence and chronology in a regional context. She notes that at the earliest Tauroa occupation, while fishing was significant some seal was also exploited and whale also appears to have been scavenged. The earliest occupation appeared to be longer than all of the subsequent ones, and functionally more varied. Coastal sites in the region after this earliest occupation have been observed to be far less frequent. However, between AD 1400 and 1650, Tauroa Point was still being exploited for shell and finfish, although not intensively. Later occupations at Tauroa Point pointed to specialised, short-term occupations focused on shellfish with fish to a lesser degree. Although Allen's work did not actively propose a settlement and subsistence model, it reframed previous knowledge of settlement patterns in the northern North Island with tightly calibrated radiocarbon dates and information on subsistence.

The southern New Zealand transient village model was later developed and extended for the remainder of prehistoric New Zealand by Walter, Smith and Jacomb (2006). Their settlement model was based on sedentary but transient villages, fluctuating population structures and landscapes of community mobility. They outlined the concept of 'landscapes of community mobility' in the archaeological record of the islands that are believed to be Hawaiiki, or the homelands of the Polynesians who settled New Zealand, the southern Cook Islands. Here, the main residential site types were sedentary villages, with other specialist sites focused on fishing or forest bird hunting, and gardens located at least a kilometre from the villages. The villages probably shifted every couple decades, due to fluctuations in resource availability; this may have been within or between islands (Walter, R., Smith et al. 2006:276). Walter et al. noted that although the eastern Polynesians who first settled New Zealand moved from an agricultural to a predominantly hunting and gathering base, and then, after large-scale faunal depletions moved back to horticulture, the patterns of mobility, sedentism and socio-political organization remained relatively static throughout New Zealand prehistory (2006). They pointed to early northern examples such as Houhora (Furey 2002b) with its hunting and gathering based economy, Sarah's Gully (Davidson 1984b:166-7) and Washpool (Leach, B.F. & Leach 1979c) with both sites indicating horticulture was part of their economies. Later period sedentary settlements vary from small kainga (hamlets) to pa which acted as 'bases' from which occupants travelled to exploit resources further afield, for either seasonal or social reasons. Walter et al. gave examples of late sedentary villages including Oruarangi (Furey 1996) and Kohika (Irwin 2004b). Davidson (2011) also argued that Maungarei (Mt.

Wellington), a large Maori settlement on a volcanic cone in Auckland, was repeatedly occupied in a manner similar to that proposed for the transient village. Fishing, terrestrial foraging and horticulture formed the basis of the economies of these sites. Walter et al. argued that sedentism and mobility appeared regionally and chronologically consistent in New Zealand's archaeological record; and that the transient village model could also be applied to the horticultural zone. There were five key elements to their settlement model: 1) the basic unit of settlement throughout prehistory was sedentary villages or hamlets; 2) these villages were part of settlement-subsistence systems which included high rates of mobility in order to procure food; 3) village sites were relocated as major resource areas were depleted (or because of political contingencies); 4) village population structures fluctuated constantly (as a result of fission and fusion); and 5) although communities were generally economically and socially self-contained, they were also part of a landscape of high mobility (e.g. the long distance movement of raw materials).

Jacomb, Walter et al. (2010) produced a review of the archaeology of Foveaux Strait, in the southern South Island, which included the results of recent surveys and radiocarbon dating samples taken during the Southland Coastal Heritage Inventory Project (SCHIP) along the southern coast. Combined with analyses of artefact types and raw materials, the results of the SCHIP were used to develop three alternate models for the prehistory of Foveaux Strait. The *Economic Change Model* was characterised by ecological change and socio-economic response, both internal processes. The Foveaux Strait area was occupied soon after the first Polynesian settlers arrived on the islands of New Zealand. Occupation on the southern coastline was initially permanent, but as resource availability changed, the communities adapted their subsistence practices and became more mobile. In turn, the sizes of social groups reduced and populations dropped. With the arrival of European trade in the late 18th century, migration to Foveaux Strait increased; mobile seasonal patterns of resource procurement reduced as populations settled into permanent villages and undertook agriculture (Jacomb, Walter et al. 2010:49-50). In the *Meat and Potatoes Model*, the Foveaux Strait area was seen as only economically viable during the beginning and the end of the sequence; during the intervening period the inhabiting population was very sparse. Otherwise, the second model was similar to the first. In the late 18th and early 19th centuries, the opportunities for commerce and food from the sealing and flax industries and the production of the white potato drove the development of permanent villages (Jacomb, Walter et al. 2010:50). The *Resource Network Model* differed from the first two models in that the

prehistoric settlement of Foveaux Strait was interpreted as being affected by external resource networks, in terms of economy and population. Therefore, in early prehistory, although southern Maori were aware of the Foveaux Strait area and its resources, and visited it intermittently, the extreme conditions and low density of moa limited permanent settlement there. When moa populations declined in the early 15th century, southern Maori populations declined further, along with travellers to Foveaux Strait, which remained virtually uninhabited until the late 18th century with the appearance of sealers, whalers and flax traders. In response to European arrival and expansion, the population of southern Maori in the Foveaux Strait region increased, with the first appearance of permanent Maori settlement (Jacomb, Walter et al. 2010:51). While evidence for parts of all three models could be identified in the archaeological record of Foveaux Strait, it was the third model, the *Resource Network Model* which provided the best fit against the data (Jacomb, Walter et al. 2010:52).With the rapid exploration of the coastlines of New Zealand during the first century after Polynesian arrival, raw materials were identified for exchange or transfer; in Foveaux Strait this exploration took place almost immediately, at low levels. The archaeological record indicated that while low-level hunting of moa and seal occurred in the Foveaux Strait area, there was no evidence for sustained settlement or exploitation during the early phase. Three sites which could pose exceptions were interpreted as camps for birding and fishing, part of networks based further north. Early sites were generally small, focused on single activities, or represent irregular visits; they were concentrated in particular areas where key resources, such as argillite outcrops and sheltered estuaries for shellfish gathering and fishing, were located. Coastal sites of Otago indicate that industrial stone from Foveaux Strait linked the area to networks based in east Otago. The identified sites of Foveaux Strait date to the early period and the historic period, but sites dating to the 17th and 18th centuries are absent, supporting the *Resource Network Model's* premise that the southern coast was no longer part of resource networks focused further north. Evidence for this is supported by the abandonment by humans of part of the coast further north, and reduced populations elsewhere, after the decline in moa and sea mammal resources. Interestingly, the southern coast was one of the few areas of the country where sea mammal populations were not significantly reduced by early human predation. At the same time as parts of the coastline of the South Island became deserted or suffered reduced populations, the presence of southern argillite disappeared, suggesting the collapse of trade networks. Jacomb, Walter et al. (2010) indicated that the *Resource Network Model* may be relevant for other marginal areas in New Zealand, such as the west coast of the South Island and interiors of the North and South Islands. The development of models of change

would rely mainly on issues of resource depression, chronology and mobility, with material culture studies aiding in identifying finer details of change (Jacomb, Walter et al. 2010:52-4).

Many of the earlier models developed prior to 1990 are affected by the implications of chronometric hygiene, particularly those relating to the present study areas. Many explicitly used radiocarbon dates to support their models; but with recent, more stringent criteria for radiocarbon dates these models are sitting uneasily on dubious foundations. Later models have used more stringent protocols for selecting samples for radiocarbon dating calibration; but these have not reassessed the body of data that has amassed for the two study areas which are the focus of this research, the Western Bay of Plenty and the Coromandel Peninsula, both in terms of recent work and earlier interpretations. This thesis re-evaluates these models of subsistence and settlement, using reliably dated assemblages from specific study regions, the Coromandel Peninsula and the Western Bay of Plenty.

1.6 THESIS OVERVIEW

This thesis puts forward a new model of prehistoric subsistence and settlement for two adjacent regions in north-eastern New Zealand. It evaluates previous models of subsistence and settlement for New Zealand prehistory by gathering recent, reliably-dated subsistence data from the Coromandel Peninsula and Western Bay of Plenty areas. The analysis of the data explores and identifies any changes in prehistoric subsistence activities in time and space, and the possible reasons that caused these changes. The location of settlements in relation to subsistence resources are examined; the range of subsistence activities represented during any one time period are analysed to infer if there was some kind of dependent relationship between those sites. If a relationship is identified, how it might have worked is discussed, along with any changes over time.

Chapter Two describes the geography and reviews previous archaeological research undertaken in two study areas one the east coast of the North Island of New Zealand, the Coromandel Peninsula and the Western Bay of Plenty. Chapter Three describes the methods used, firstly for a case study on an assemblage from the Cabana Lodge site, Whangamata, Coromandel; secondly on the collection and analysis of faunal assemblage data from both study areas; and thirdly on the selection, hygiene and calibration of radiocarbon dates associated with assemblages used in this research. Chapter Four describes the results from the faunal analysis of the case study from Cabana Lodge, Whangamata, Coromandel

Peninsula. Chapter Five presents the results from the regional faunal analyses from the Coromandel Peninsula and the Western Bay of Plenty. The calibrated radiocarbon dates are also presented and used to place the assemblages within five time periods. Chapter Six discusses the results of chapter three and four, and uses the data to look for trends by region and over time. Chapter Seven reflects on the aims of the research, the contribution to the discipline and considers how useful the results have been. Implications for further research are highlighted.

2 THE STUDY AREAS

2.1 INTRODUCTION

The two study areas for this research encompass the Coromandel Peninsula and the Western Bay of Plenty (Figure 2.1), two adjacent regions on the east coast of New Zealand's North Island. This chapter describes their geography and reviews previous archaeological research undertaken there.

2.2 GEOGRAPHY – SIMILARITIES AND DIFFERENCES

The Coromandel Peninsula is located on the north-eastern coast of the North Island, east of Auckland city. The peninsula is large, extending roughly 85 km from the western end of the Bay of Plenty, and its broadest point is nearly 40 km wide. Its coasts are characteristically rocky on the west, with sandy beaches and harbour estuaries punctuated by rocky outcrops on the east. The west coast forms the east side of the Firth of Thames, which is also bordered by the northern extent of the Hauraki Plains and the Hunua Ranges. Further north from the Firth of Thames, the west and north coasts of the Coromandel Peninsula border the Hauraki Gulf, a much larger expanse of water encompassing many islands (such as Waiheke, Motutapu, and Rangitoto). The Coromandel Range forms the spine of the Peninsula, rising nearly 900 metres (Allo 1972; Law 1982). Its rugged nature means that even presently, much of the area is isolated and uninhabited. Much of the steep and hilly peninsula is to this day covered in subtropical rainforest, and a forest park covers a large proportion of the interior. Many islands and island groups lie offshore of the peninsula, including the large Great Barrier Island to the north. Tuhua (Mayor Island), lies east of the very south-eastern coastline of the study area, and was a major source of obsidian in prehistory.

The Western Bay of Plenty study area extends from Waihi Beach in the north-west, along the Bay of Plenty to Ohiwa Harbour in the south-east, and as far inland as Lake Rotorua.

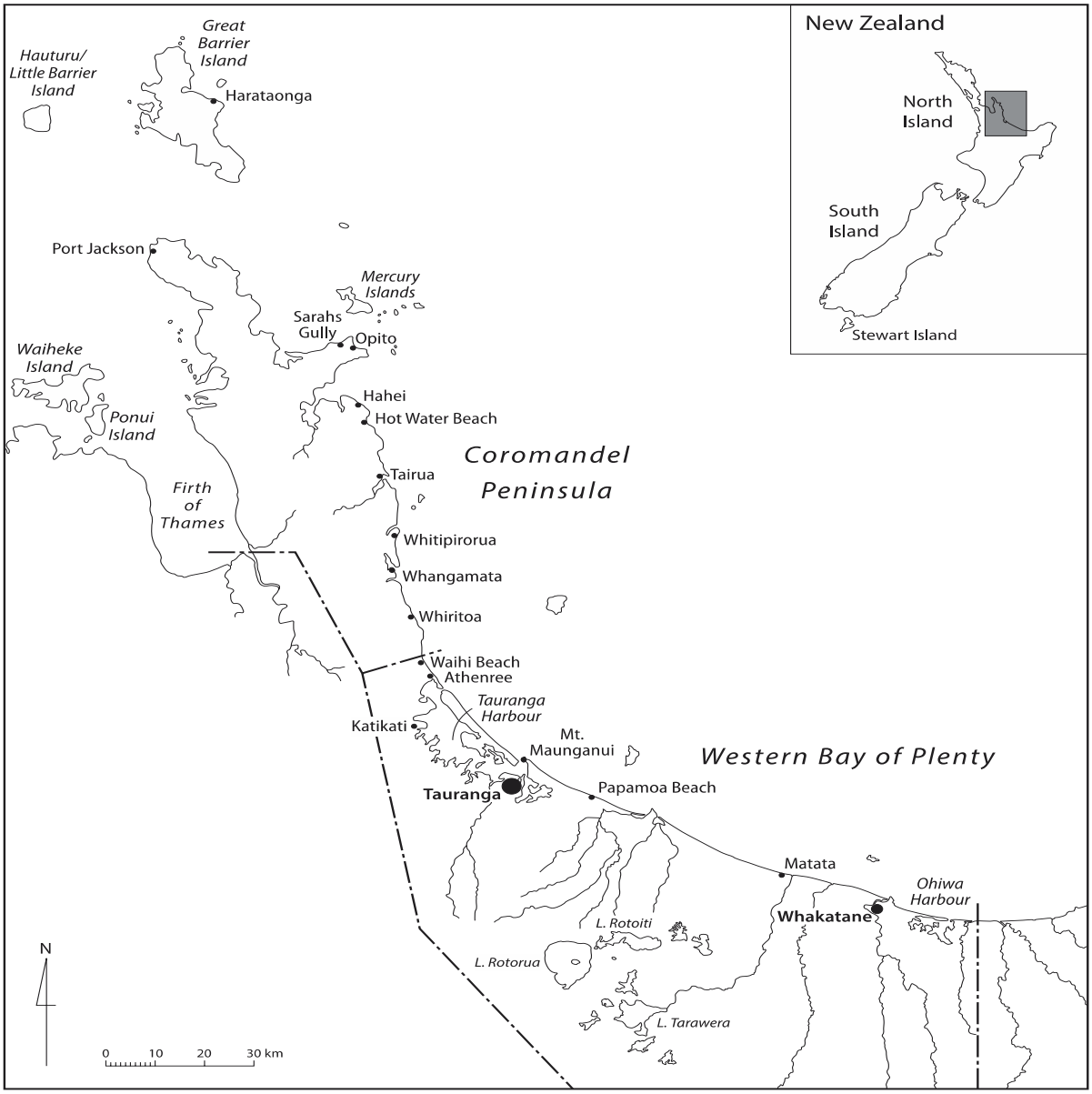

Figure 2.1 Map of the Coromandel Peninsula and Bay of Plenty, North Island, New Zealand

This corresponds with well with the Department of Conservation (DoC) boundaries as illustrated in Law (2008 Fig.1), and largely corresponds to the boundaries of the former Tauranga County used in O'Keeffe (1991), although the south-western boundary of the latter lies close to the Maketu headland and does not extend further along the bay to Ohiwa Harbour. The study area utilised here also overlaps the study area of Phillips' (1996b) MA thesis on Ohiwa Harbour in the eastern Bay of Plenty. The inland western boundary generally runs along the ridge of major catchments. Major landmarks in the region include Matakana Island (which lies across the mouth of Tauranga Harbour), and Whakaari (White Island), an

active volcano, as well as Mauao (Mt. Maunganui), Mt. Tarawera and Putauaki (Mt. Edgecombe). Tauranga and Ohiwa harbours are the only harbours in the western bay; there are also five major estuaries – Maketu, Little Waihi, Whakatane, Waiotahi and Wioeka/Otara. The Rotorua district has many lakes, including Rotorua, Rotoiti, Rotoehu, Rotoma and Tarawera. The eight major rivers in the Western Bay of Plenty catchment include Wairoa, Kaituna, Tarawera, Rangitikei and Whakatane (EBoP 2011).

Maori originally named the Bay of Plenty *Te Moana a Toi* (the sea of Toi); Captain James Cook later named the bay in his circumnavigation of New Zealand in 1769-70, alluding to the abundant resources there compared to another bay further south on the East Coast, Poverty Bay (McKinnon 2009). The bay has a temperate climate; based on data gathered by the National Institute of Water and Atmospheric Research (NIWA) in the period 1971-2000, Tauranga, the bay's largest town, had a mean annual rainfall of 1198 millimetres, mean annual sunshine of 2,260 hours and mean high temperatures in January of 19.2ºC and 9.7ºC in July (McKinnon 2010).

2.3 ARCHAEOLOGICAL LITERATURE OF THE STUDY AREAS

2.3.1 COROMANDEL PENINSULA

The published (Appendix Table A.7) and unpublished archaeological literature written pertaining to the Coromandel area began slowly in the 1930s, but did not really take off until the 1950s (**Error! Reference source not found.**). The rate of production continued to increase in the 1960s and reached a peak in the 1970s. In the 1980s and 1990s efforts dropped, with a sudden increase to another peak in the first decade of the twenty-first century. Published literature (often in the non-peer reviewed *New Zealand Archaeological Association Newsletter,* later *Archaeology in New Zealand*) was the only source of documents in the 1950s and 1960s. While publications were still the dominant source of archaeological documents in the 1970s, unpublished surveys and unpublished excavation reports started appearing, along with post-graduate theses and unpublished archaeological assessments. During the 1980s large numbers of surveys were conducted, but from the 1990s the rates of surveys continued to drop, as did publications. No specific, damage assessment-only reports were prepared for the Coromandel Peninsula. Unpublished post-harvest reports and monitoring reports made small contributions in the last two decades.

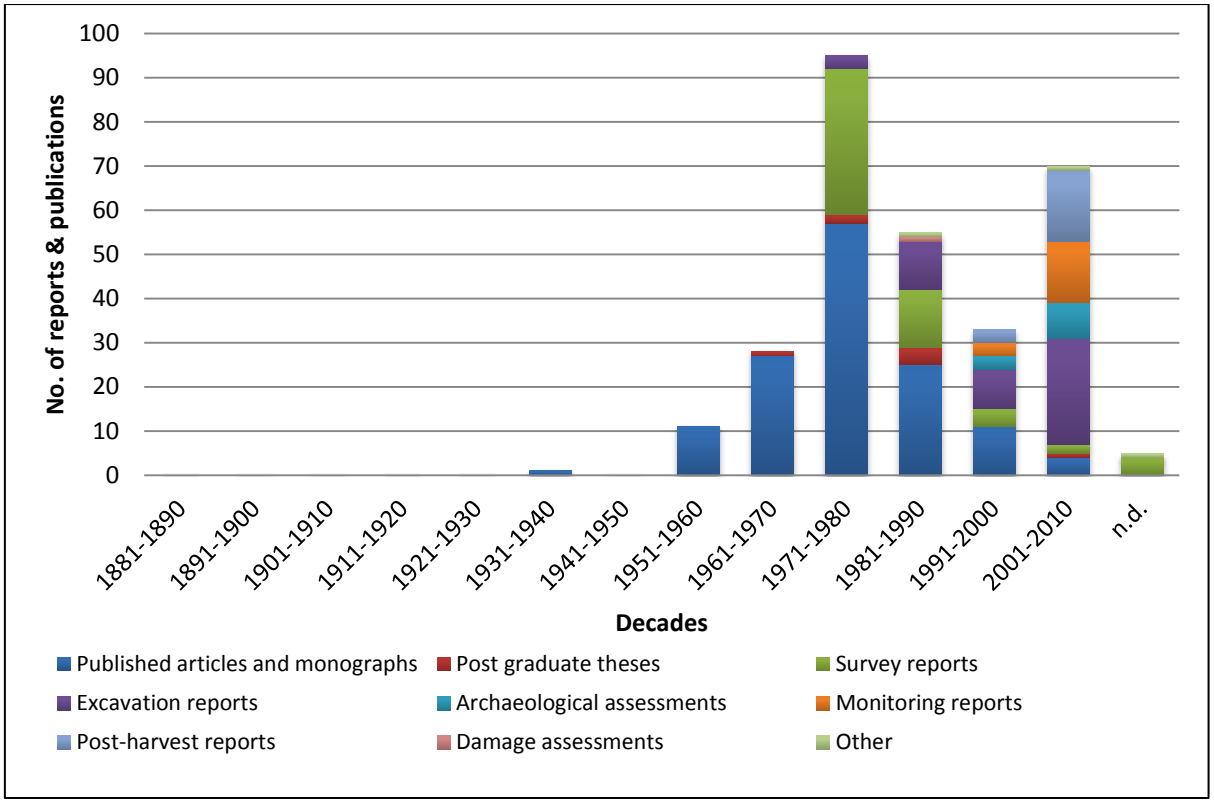

Figure 2.2 Number of documents on Coromandel Peninsula archaeology by decade and document type

The 1970s saw a peak in the numbers of post-graduate theses on the Coromandel Peninsula, and combined with unpublished excavation and survey reports, theses totalled more documents than publications. In the 1980s the number of published articles and books began to drop, while post-graduate research project numbers increased and unpublished survey reports remained relatively constant. Unpublished excavation reports increased slightly. The 1990s saw further reductions in the numbers of articles or books published, while unpublished excavation reports remained relatively stable; the number of unpublished survey reports decreased slightly; a small number of unpublished archaeological assessments were written but no post-graduate research projects for the Coromandel were produced. The first decade of the twenty-first century saw a complete dominance in the archaeological literature by unpublished excavation reports, followed by unpublished archaeological assessments and very low numbers of publications, unpublished survey reports and post-graduate research projects. It should be noted that the authority conditions for most excavations in New Zealand require interim and final reports, which can go some way to explaining the high proportion of excavation reports to archaeological assessments.

2.3.2 WESTERN BAY OF PLENTY

The first archaeological report about sites in the Western Bay of Plenty was written in 1880s (**Error! Reference source not found.**). Occasional papers or reports on sites or areas in the Western Bay of Plenty trickled through until the 1950s, when numbers started to increase. A small peak in report and paper numbers occurred in the 1960s, but these dropped again in 1970s. The 1980s saw some increase in numbers, increasing again in the 1990s. It was the first decade of the twenty-first century, however, that saw a dramatic increase in the number of archaeological reports and articles on the Western Bay of Plenty region. Between 1884 and 1960, all of the archaeological literature for this area was published. It was not until the 1970s that post-graduate research contributed to archaeological knowledge of the Western Bay of Plenty. Although published sources were still dominant in the archaeological literature, unpublished survey, excavation and archaeological assessment reports for the Western Bay of Plenty started appearing in the 1980s. For the first time, in the 1990s, published archaeological literature was no longer the dominant source; unpublished excavation reports were now the largest source of archaeological information, followed by unpublished archaeological assessments. Post-graduate research projects also reached their peak numbers in this decade. By the first decade of the twenty-first century, published articles or books on the Western Bay of Plenty had reached their lowest numbers since the 1950s, and unpublished excavation reports were clearly the largest source of literature on archaeological sites in the Western Bay of Plenty. The number of archaeological assessments was also at their highest in this decade.

In the twenty years since 1990, continuing pressure on land development in both the Coromandel and Western Bay of Plenty areas has resulted in a surge of archaeological fieldwork, with most data remaining unpublished in the 'grey literature' of consultants' reports (for example Furey 1987b; Sewell 1990; 2000a; 2000b; 2001; Furey 2002a; Gumbley 2003c; 2005a). Until 2008, this data had not been assessed or reviewed since the early 1980s (Law 1982; 2008). This is despite the fact that the Bay of Plenty region has the third highest number of recorded archaeological sites in the country. Law noted that the recent development of archaeology in the Bay of Plenty generally has been hampered by "the lack of resident archaeologists with an academic base to undertake research not driven by development or site development needs" (2008:7). A number of theses and post-graduate research essays have been written about the area (Edson 1973; Boileau 1978; Lawlor 1979;

Williams 1980; Kahotea 1983; Spring-Rice, W. 1983; Seelenfreund-Hirsch 1985; O'Keeffe 1991; Holroyd 1993; Petchey 1993a; Palmer 1994).

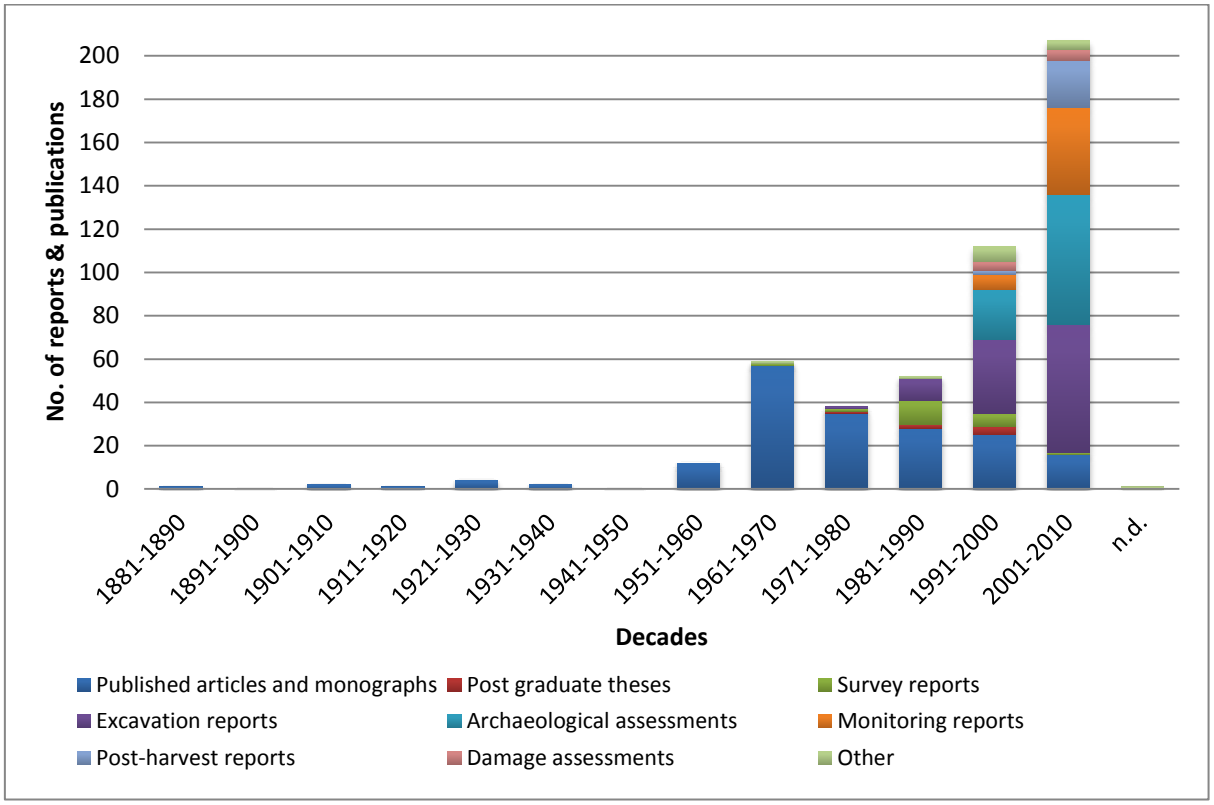

Figure 2.3 Number of documents on the Western Bay of Plenty archaeology by decade and type

2.4 ARCHAEOLOGY OF THE STUDY AREAS

2.4.1 COROMANDEL PENINSULA ARCHAEOLOGY

The first recorded archaeological find in the Coromandel was by Cormack, at a midden at Opito, Kuaotunu Peninsula (east coast, north of Whitianga) in 1850. This was also the first report of moa bones associated with other food remains in a midden (Duff 1956:250; Davidson 1979).

2.4.1.1 *EXCAVATIONS*

Archaeological research proper in the region did not progress until much later. In 1956, Roger Duff reviewed the then called 'moa-hunter' culture and described the Coromandel region as a "virtual 'island' of discovered artefacts of the Moa-hunter type" (Duff 1956:250). In 1959 Jack Golson also drew on material from two Coromandel sites, Sarah's Gully and Opito, when he defined the North Island 'Archaic'. Duff suggested that the first settlers did not have

horticulture, but Golson's finds of drains at Sarah's Gully (Golson 1959c) evidenced the contemporaneity of horticulture and early middens in the Coromandel.

By the mid-1960s, a substantial number of archaeological investigations had been carried out in the Coromandel area, including important sites such as Sarah's Gully, Opito, Tairua, and Whiritoa amongst others (Appendix Table A.1). While many sites were excavated, many more were surveyed, either briefly or thoroughly; and some had surface artefacts collected (i.e. were fossicked), leaving no reliable, detailed or datable information on the stratigraphic context (Appendix Table A.2).

This formative period of archaeological investigation established many of the primary characteristics of Coromandel prehistory. It showed that occupation began early in the New Zealand sequence, with adzes, fish hooks and ornaments in forms assigned to the Archaic period present at many sites along the east coast of the peninsula including Sarah's Gully, Opito Beach Midden, Hot Water Beach and Tairua (Smart & Green 1962; Green 1963a; Davidson 1964a; Leahy 1971; 1974). Moa bones occurred in these and other sites, along with evidence for a broad range of subsistence pursuits including marine mammal hunting, fishing, fowling and shellfish collecting. Early sites included both large and small beach middens, and sites with storage pits, such as at Skipper's Ridge I (Davidson 1964a; 1974; 1975; Davidson & Green 1975). Where excavations were sufficiently extensive, as for example at Sarah's Gully, it appeared that beach middens, storage pits and housing areas were likely to be contemporaneous components of hamlets or small villages (Davidson 1984b). Fewer sites excavated at this time derived from later prehistory, but the upper layer at Tairua pointed to a shift towards shellfish in the focus of subsistence activities (Smart & Green 1962), and Sarah's Gully Pa indicated that at least some settlement was in defensible locations.

In the 1970s the focus on excavations slowed. A few sites were still excavated, and some sites excavated in the previous decade were finally published in the 1970s (i.e. Law 1972; Leahy 1974; Davidson 1975). Analysis of assemblages from earlier excavations were also published, such as the article by Boileau (1980) on the Opito Beach midden site; as were analyses of previously excavated middens, such as Tairua, by Rowland (1977a). Unfortunately 'selective surface sampling' – or fossicking – still took place at some sites during this time, leaving us with data and interpretations that are not considered as reliable for present research, i.e. Whitipirorua (Jolly 1978a) and others were salvage excavations after site damage, and as such are not complete or reliable, such as Hahei (Edson & Brown 1976; 1977; Edson 1979;

Harsant 1979; 1983), Parker's Midden/Pohutukawa Flaking Floor (Jolly & Murdock 1973), Opito, (Calder & Calder 1977) and Cabana Lodge (Shawcross 1964b).

Excavation work slowed during the 1970s. Moore (1977c) excavated one test pit at Poikeke Pa, on Poikeke Island north of Hahei Beach for a dating sample; while Rowland excavated a series of test pits at the sites at Home Bay and South Bay on Slipper Island, which he discussed in his MA thesis (1978).

The rate of excavations increased during the 1980s, and sites within forestry plantations began to be excavated – such as a pa site in Tairua State Forest was investigated by Jones (1981c), the Brier Block sites in the Whangapoua Forest investigated by Furey (Furey 1982c; 1982a; 1983a), the open settlement terrace and midden site in the Tairua Forest by Furey (1987a), the three midden, and terrace sites of the Whangapoua Forest excavated by Crosby, A., Sewell et al. (1987), and an open settlement site in the Tairua Forest investigated by Short (1988). Excavations were also used for post-graduate theses, such as the Port Jackson undefended settlement site. Initially a surface collection was conducted by Davidson (1979) in 1971, but the site was then excavated by Foley and Bulmer in 1981 and written up by Foster (1983a; 1983b) who used the site as the focus of his MA thesis (Foster 1983a). The Cross Creek site was excavated by Sewell (1983) who prepared an MA thesis on this site (Sewell 1984a). The Hahei midden site was sampled and reported on by Nichol (1986), and one other excavation, an early beach midden site Whitipirorua at Onemana, north of Whangamata, was excavated by Furey in 1986 and 1988, to give an archaeological context to the artefacts collected by Jolly (Furey 1988; 1990; 1991).

A limited number of excavations were conducted during the 1990s, although sites on the west coast of the Coromandel Peninsula were excavated for the first time (Gumbley 1997b; 1998a). Additionally, excavations relating to land development for subdivisions, individual residential lots, etc. began to be a new driver for excavations - a midden site and a midden and hangi pit site at Whangamata were both excavated by C.A. Phillips (1996a; 1997); a pit and midden site at Totara, near Thames, was excavated by Gumbley (1997b) later also by Phillips, C.A. (2000b); a midden site at Matarangi Sandspit was excavated by Furey (1998; 1999); a terrace and midden site at Te Mata was excavated first by Twohill (1996; 1998) and then by Gumbley (1998a); and part of the Kopu Pa Complex on the west coast south of Thames was also excavated (Phillips, C.A. 2000f; 2000d).

It was not until the turn of the century that an increase in coastal development saw the rate of excavations rise again. The majority of excavations continued to be concentrated on the east coast, with a few west coast exceptions.

Two excavations identified midden and oven sites at Tararu, on the west coast north of Thames (Sewell 2001; Phillips, C.A. 2004a). Another excavation was conducted at a pa in Kopu, identifying late prehistoric occupation (Phillips, C.A. 2005d).

Further investigations at Matarangi identified large middens dominated by softshore shellfish (Sewell 2003b). A number of excavations were conducted at Whitianga, identifying a series of middens and ovens (Furey 2002a; 2003a; Campbell & Gumbley 2004a)

Excavations in the Whangapoua Forest, west of Whitianga identified a complex of middens and pits (Felgate 2005b) and an occupation site with midden, postholes, an oven, a hearth, associated with gardening and part of a wider complex of occupation sites on the hills above the Whitianga Harbour estuary (Gumbley 2007a).

Investigations at Whangamata identified midden and rectangular and rua pits (Gumbley 2005a). Further investigations identified sites in the Tairua Forest including ovens and midden/terraces site (Gumbley 2002a; 2002e; 2004e). At Pauanui, Tairua Harbour, a kainga (undefended settlement) site was excavated, the first of its type in the harbour area (Gumbley 2003c)

2.4.1.2 *MONITORING AND POST-HARVEST REPORTS*

Two non-traditional report formats started appearing from the 1990s for the Coromandel Peninsula - monitoring reports and post-harvest reports. The former (Appendix Table A.5) were often included as one of the conditions of Archaeological Authorities granted under the HPA 1993, often in situations where there was a reasonable likelihood to expect archaeological evidence to be encountered during development earthworks, but where no archaeological sites had previously been recorded.

An undated terrace and midden site was exposed during monitoring at Te Mata, on the west coast (Phillips, C.A. 2000a). Monitoring of flood protection works at Tararu identified a midden (undated) (Phillips, C.A. 2006a). Part of the Aputa pa site (undated) was monitored during postholes being dug, at Te Puru, on the west coast between Te Mata and Thames (Gumbley 2007c). During monitoring at the Okiwi Airfield on Great Barrier Island, garden

soils, middens and hearths (undated) were identified (Prince & Clough 2001). Various midden sites (undated) as well as a ca. 16th century a midden site were exposed during monitoring at Whangapoua (Sewell 2000b; 2002a; 2005). A ca. 16th century midden site was exposed during monitoring at Whitianga (Furey 2003b). An undated midden site and part of a 15th to 17th century midden, working floor, firescoop and pit site were exposed during monitoring at Cooks Beach, east of Whitianga (Sewell 2002b; Simmons, A. 2002b; Sewell 2003a). Large soft-shore middens (ca. 16th century) were exposed during monitoring at Matarangi on the Omara Spit (Sewell 2000a; 2003b). Monitoring at Tairua affected a previously disturbed part of a midden (undated) (Gumbley 2004a); the significant Tairua stratified dune midden site T11/62 (early–mid 15th century) was monitored during posthole digging and encountered the shell layer but not the early occupation layer (Furey 2009b). Monitoring which did not identify archaeological evidence was undertaken at Thames (Phillips, C.A. 2001a; 2005c), Tararu (Phillips, C.A. 2005a) and Whitianga (Mallows 2007a).

Post-harvest reports, which describe inspections of archaeological sites located in forestry plantations after harvests have taken place, began to be produced during the 1990s (Appendix Table A.6). Providing updates on the conditions of archaeological sites, these reports present similar information to survey reports. Examples include Tairua Forest (Hooker, R.H. 1994a; Barr 1996; Gumbley 2006c) and Whangapoua Forest (Gumbley 2002d; 2004c; 2005c).

2.4.1.3 *SURVEYS*

A large number of surveys were undertaken during the 1970s and 1980s in the Coromandel many of which were carried out by or on behalf of the New Zealand Historic Places Trust (NZHPT) (Appendix Table A.3). The bulk of the survey reports were produced between 1975 and 1981; many were of blocks in State Forests. This resulted in the Coromandel being one of the most well-recorded areas in the country at that time (Law 1982). By the 1990s, the number of surveys occurring on the Coromandel Peninsula had reduced even more significantly than those of excavations. Traditional large scale surveys were still undertaken, but the first narrow-focused, small scale surveys, in the form of archaeological assessments began to appear during the 1990s, with the introduction of the *Historic Places Act* 1993 (HPA 1993). The HPA 1993 aimed to protect archaeological sites, both prehistoric and historic, from damage, destruction and modification, by requiring the prior authority of the NZHPT. An application for an authority requires, amongst other information, "an assessment of the archaeological values of the site and the effect of the work on those values" (New Zealand

Historic Places Trust Pouhere Taonga n.d.). These assessments address the condition and significance of archaeological sites present within a given parcel or property proposed for development, such as residential subdivisions, or sometimes in road reserves for utilities installation or maintenance. Surprisingly, in the Coromandel Peninsula the number of these archaeological assessment surveys did not dramatically increase after the year 2000, relative to the number of excavations. Archaeological assessments tended to be for coastal locations on both east and west coasts, often for proposed residential subdivisions (Clough & Sheppard 1993; Furey 1997; Gumbley 1997a; Gumbley, Campbell et al. 2001; Gumbley 2002b; Phillips, C.A. 2002a; Simmons, A. 2002a; Campbell 2004e; Pishief 2004; Campbell 2005c; Gumbley & Hoffmann 2007b).

2.4.1.4 *POST-GRADUATE THESES*

A number of post-graduate theses on topics relating to the Coromandel Peninsula have been written (Appendix Table A.4). Davidson's MA (1964a) thesis included the significant site of Tairua. Excavations at the site yielded faunal analysis results which showed a marked shift in shellfish species composition from large rocky shore species to dense, soft shore species. Davidsons' thesis however focused on the use of bulk samples, the impact on results of using different screen sizes, and compared different methods of quantifying shellfish.

Edson's MA thesis (1973) examined human ecology and prehistoric settlement on offshore islands between the East Cape and Cape Reinga of the North Island, including the Alderman Islands, Cuvier Island, Tuhua (Mayor Island), Slipper Island, Whakahau, Ahuahu and Great Mercury Island (within the present Coromandel Peninsula study area). Edson concluded that the settlement patterns identified did not match predicted ones. He identified an island's potential for horticulture as the most important factor for deciding settlement location, duration and intensity of settlement.

Rowland's (1975) MA thesis examined Tairua and nearby offshore islands, including Slipper Island. Rowland concluded that the Tairua site was a seasonal 'Archaic' period camp, occupied for short durations during autumn and winter. During the early settlement phase of prehistory, an 'island-mainland' model was proposed for the study-area, with agricultural 'home bases' located on the islands and seasonal sites on the mainland; offshore islands may have possessed that greatest potential for the survival of introduced tropical crops for Polynesian settlers.

Furey's (1981b) MA research examined the methodology of site surveying and data analysis from field survey recording on the Coromandel Peninsula. Site type frequencies from over 20 intensive surveys were compared; data from seven surveys were examined for patterns in site types and environmental factors. It was concluded that the frequencies of site types on the east coast of the Coromandel Peninsula differed to that of the west coast; features within sites and the size of sites were variable across different areas of the Peninsula.

Foster's (1983a) MA research reported the results of the excavation at Port Jackson (N35/38); an 'Archaic' period, winter-spring occupation was identified with clear specialisation in land-based hunting, particularly of kaka. This result did not follow the established general pattern of 'Archaic' occupations in the Coromandel.

Sewell's (1984a) MA thesis examined spatial patterns and continuity over time at the Cross Creek site (T10/399). The research aimed to test the theory that discrete activity areas were present in 'Archaic' period sites. Four layers of cultural occupation were identified; shellfish, fish, dog, and rat were exploited throughout all of the occupation layers. Fishhooks demonstrated cultural change through form, size and material used, as did the presence and utilisation of moa and the exploitation of sea mammals.

Smith's (1985) PhD thesis was a pioneering study on prehistoric Maori sea mammal exploitation, in which he developed a suite of methods for determining the age at and season of death, sex and butchery patterns of sea mammal remains from archaeological sites. His analysis included assemblages from the Coromandel Peninsula - Tairua, Hot Water Beach, Parker's Midden, Opito Beach Midden and Sarah's Gully.

The first post-graduate research relating to the Coromandel Peninsula in 25 years, Mann's (2009) MA research analysed fish remains from the permanent settlement site of Arthur Black's Midden (T10/164) at Opito Bay, Kuaotunu Peninsula. Leatherjacket (*Parika scaber)* was the most abundant fish taxa, and catching methods employed would have been netting or trapping.

2.4.1.5 *OVERVIEWS*

A number of overviews of aspects of Coromandel archaeology have been produced. In 1979, Janet Davidson presented a review of Archaic midden sites of the Coromandel Peninsula (1979), including Tairua, Hot Water Beach, Whangamata Wharf/Cabana Lodge, Skipper's

Midden, Port Jackson, Sarah's Gully, Harataonga and Opito. Davidson raised concerns that the "interpretation of Archaic middens in relation to the wider subsistence base… has never been adequately considered" (1979:187), and that many site investigations lacked detailed information on food remains. As is often the case with most sites in New Zealand, avifaunal assemblages from early sites investigated by this time included only small MNI totals from each species. However, a considerable variety of now extinct species, such as various moa, Eyle's harrier, extinct coot, and New Zealand raven were present. Davidson noted a pattern of generalised bird hunting without marked concentration on particular species. Interpretations were restricted as MNI values were only available from four sites. *Arctocephalus forsteri* (seals) and mammals were reported from all sites. *Sphenodon punctatus* (tuatara), a now rare, medium-sized reptile, the only extant member of the Order Sphenodontia which was well-represented with many species approximately 200 million years ago (Department of Conservation 2014), was found at some sites. The early sites at Coromandel exhibited the importance of fishing through fishing material culture and substantial fish faunal remains, with *Pagrus auratus* (snapper) apparently the most commonly caught species, and *Arripis trutta* (kahawai) occasionally appearing in noticeable numbers. Trolling gear was represented in small amounts at most sites. Both the unbarbed, one-piece bone hook and the Polynesian trolling lure were sufficiently appropriate to Coromandel conditions to continue in use until the end of the 'Archaic' period. There was no sign of the barracouta point or the barbed point, both well-established elsewhere during the 'Archaic'. Stone sinkers were rare. With regards to shellfish gathering, Davidson observed that local conditions are an important consideration in evaluating exploitation, i.e. whether the immediate coastline was rocky or soft shore. She also observed that by 1979 little or nothing was known about the relative contribution of different foods to the diet, season of occupation, or whether the sites reflect preservation of food to be eaten elsewhere. General trends such as the decline and extinction of moa and an increase in the exploitation of estuarine shellfish were still evident. Most sites reflected generalised exploitation of a range of food resources, but with a strong marine emphasis; specialisation was the exception rather than the rule. For example Parker's Midden focused on shearwaters, kaka were important at Port Jackson, and at Whangamata Wharf the midden was notable for the numbers of dogs and also contained 'economic' evidence of moa in small quantities. A full range of 'Archaic' ornaments were in use in the Coromandel Peninsula, however tattooing chisels, bird spear points and awls were not common. The typology of adzes from the Coromandel Peninsula was closely related to the use of the Tahanga quarry; distinctive types found in these Coromandel sites included Duff's 1A, 2A, 3 and 5. Greenstone was

notably lacking. Other stone tools present in some of the sites included drill points, files, grindstones, hammers, saws, used pumice, used flakes and waste flakes. The early Coromandel midden sites demonstrated extensive and generalised hunting and collecting, with relatively little specialisation, but successful local adaptation and displayed recognisable 'Archaic' material culture. The sites were interpreted as either seasonal camps or specialised activity areas within larger settlements. Sarah's Gully is the best example of a complex of site components including midden, a working area, burials, cultivation and storage components, which appear to be contemporary.

Furey (1980d) prepared an annotated bibliography of the survey reports of the Coromandel Peninsula produced up to the time of writing. The surveys extended north from Whangamata on the east coast, and the Kaueranga Valley (just south of Thames) on the west coast. Furey also published an overview on excavation literature of the Coromandel Peninsula (1982b). Radiocarbon dates indicated a general pattern of 'Archaic' period occupation, with exceptions at N30/3, N30/4 and N40/73. It was noted that in some undated deposits ages were "inferred by association with Loisels pumice or the presence of moa bone" (Furey 1982b:33). With regards to economy, Furey observed that the early sites differed from the later sites with less shell and more bone; the shell species of later sites usually contained larger proportions of soft shore species whereas early sites tended to focus on rocky shore species. Seal was present in all middens reported, and moa and other extinct forest bird species were represented also; the importance of fishing was indicated by the evidence of the production of fishhooks at all sites. Resources were exploited at close and long distances from the sites (Furey 1982b:35). It was observed that the range of artefacts present in 'Archaic' sites provided evidence for the manufacture of personal ornaments, fishhooks and associated items, and the manufacture and maintenance of adzes. Most of the 'Archaic' sites had basalt from the Tahanga site (N40/8); Tuhua (Mayor Island) obsidian was the most prevalent obsidian source, in spite of there being closer local sources for some sites. In later sites, this pattern changed, with local obsidian sources more common, including Great Barrier Island, Whitianga and Whangamata (Furey 1982b:35-7). Late period sites had noticeably much fewer artefacts than the 'Archaic' period sites (Furey 1982b:40). The 'Archaic' sites of the Coromandel were generally small, but collectively they exhibited the range of artefacts and activities considered typical of the early period. Settlement pattern analysis of the Coromandel sites indicated that 'Archaic' middens were associated with "open settlement pit complexes", and therefore gardening and storage taking place as early as the 13th century (Furey 1982b:37-8). 'Archaic' sites generally

appeared to have habitation and storage in separate areas from cooking activities; middens also exhibited spatial separation of activities with features such as ovens, flaking areas and postholes (e.g. Tairua) (Furey 1982b:40). Furey noted that the excavated site literature for the Coromandel to this point was biased towards early sites, and none of these exhibited the characteristics of a permanent village (Furey 1982b:40-1).

In 1982 a major regional synthesis on New Zealand archaeology was published, *The First Thousand Years* (Prickett 1982), in which a chapter by Law (1982) summarised the state of archaeological knowledge up to that time for the Coromandel Peninsula, from Tauranga Harbour in the south to Great Barrier Island in the north. He noted the importance of the Coromandel in development of archaeology in New Zealand, and the intense period of excavation activity from the mid-1950s to approximately 1970. Because of the subsequent reduced rate of investigation, research interests of the 1970s, including horticulture and quantitative analyses of fish and bird remains, were poorly represented in reports and publications on the Coromandel. Law noted that 'Archaic' sites were typically quite small and unspecialised; they had a wide range of evidence of preparation and consumption of a wide variety of sea foods and birds, together with evidence of production and maintenance of tools.

2.4.1.6 *SUMMARY*

The archaeology of the Coromandel Peninsula played an early role in the development of the understanding of New Zealand prehistory, with focus on significant early period settlement sites in the vicinity of Opito Bay, on the Kuaotunu Peninsula, on the Coromandel's northeast coasts. A significant number of surveys, especially during the 1970s and 1980s proved that sites were not just focused on the coasts, but inland as well. All though the rate of large scale surveys slowed after this period, forestry post-harvest reports have continued to increase the number of pa, pit, terrace and undefended occupation sites identified and recorded in the hinterland. As sites were uncovered by excavation and also during monitoring from the 1990s, reliable samples were increasingly frequently submitted for radiocarbon dating, building a picture of occupation throughout the prehistoric period, particularly at the time of the colonisation by the first settlers. Understanding of the complexity of the relationship between horticulture, temporary and permanent occupation sites has increased in recent decades, with the increase in pit sites and garden soil sites being identified. Coastal development on the west coast has been driven by mitigation monitoring and excavation investigations, and is beginning to redress the imbalance of knowledge skewed towards the

east coast, though there are still large gaps. The Coromandel Peninsula is a significant archaeological landscape in terms of the density of early period sites and the changes in subsistence evident in stratified sites.

2.4.2 WESTERN BAY OF PLENTY ARCHAEOLOGY

In contrast to regions such as Northland, coastal Otago and the Coromandel Peninsula, the Western Bay of Plenty is generally lacking in known sites relating to early period occupation (O'Keeffe 1991; Law 2008). The overwhelming majority of recorded sites in the region are termed late or "Classic" prehistoric Maori, or historic (i.e. since A.D. 1769). Although the Western Bay of Plenty received ashfall from the Kaharoa eruption (ca. AD 1305 ± 12) (Law 2008:29), acting as a precise temporal marker in the stratigraphy of archaeological sites, there is no archaeological evidence underlying this deposit, and few archaeological sites dating directly after it in the region. The Tarawera eruption of 1886 produced a lapilli deposit which, when it caps archaeological sites can prove useful in determining disturbance (Law 2008:29). Loisels Pumice is present in some coastal sites but it was deposited by sea action rather than falling, and may have been the result of multiple eruptions; its use is therefore limited as a temporal marker (Law 2008:29).

Two middens near Kauri Point, were recorded as an 'Archaic' site (U13/1) in 1977, based on artefacts typical of the period (Law 2008:40). The Bowentown site U13/149 is thought to have dated to the early period, as is the U14/363 site at Pilot Bay, Mt Maunganui, which may now have been completely eroded by storm events (Mallows 2007b; Law 2008:40; Phillips, K.J.S. 2009; Hooker, R.H. 2010e). Other sites at Whakatane (W15/105), Ohope Spit (W15/82) and Tokitoki at Ohiwa Harbour (W15/582) are also thought to be from the early period, although they are yet to be dated. No inland sites have of yet reported early dates (Law 2008:41). These early sites are located in typical environments of 'Archaic' sites, inside the mouths of river estuaries and harbours on sheltered beach-fronts. More recently, an early site near the mouth of the Maketu estuary was uncovered during monitoring by Moore (2008c; 2009). Similar to other early sites with its position just inside a harbour or estuary, and close to the shoreline, V14/187 provides the first definite evidence for early occupation in the vicinity of Maketu, and is notable for the presence of moa and sea mammal remains, which are uncommon in Western Bay of Plenty middens. As Law notes, Tuhua (Mayor Island) obsidian has been identified in early sites around New Zealand, and indicates that the Western Bay of Plenty was visited from the beginning of the early period even if it was not extensively settled at this time. McFadgen (2007:173) proposed that the limited number of sites dating to the early period is the result of significant and catastrophic events which struck the Bay of Plenty coast; tsunami and the deposition of the Kaharoa ash. He points to the ash fall creating conditions well-suited for later horticultural activities by prehistoric Maori; this is plausible in

light of the increased population apparent by the density of sites during mid and late New Zealand prehistory in the Bay of Plenty.

The recorded prehistoric sites for the Bay of Plenty form a general pattern of coastal sites near harbours or estuaries or lake side location in the Rotorua area. Walton (2006) noted that the Western Bay of Plenty is notable for its high proportion of pa sites measuring over 5000 m².

Knowledge of the archaeological sites within the Western Bay of Plenty was not reported on as early as for the Coromandel Peninsula; however pa on Tuhua (Mayor Island) were described during the late 19th century by Gold-Smith (1884), then followed by Mair's (1902) published report on an early occupation site at Katikati in 1902, and a number of published descriptions of artefacts, petroglyphs, rock shelters, rock art, *whare* and *pataka* from various locations - Rotorua, Mt Maunganui, Matata, Kaingaroa, Tauranga, Maungatawa, Waihi Beach to Bowentown, Whakatane, Lake Rotoiti, Tuhua (Mayor Island) Lake Tarawera (Semadeni 1912; Fulton 1921; Hamilton 1925; Anon. 1928; 1931; 1939; Phillips, W.J. 1952; Gregg 1956; Davis, F.W. 1958b; 1958a).

2.4.2.1 *EXCAVATIONS*

Archaeological excavations in the Western Bay of Plenty began with the excavation of Pakotore Pa/Matapara Pa in Paengaroa (south-east of Te Puke) by Golson (Golson 1959b; 1960), Kauri Point Pa near Katikati (Golson 1961b; 1961c; 1961a; Melvin 1961a), Thornton (Pullar 1961a), Karearea Pa (Kingsley-Smith, Pullar et al. 1961; Mabon 1961) and Ana-O-Muriwai (Pullar 1961b; Stafford 1962) in Whakatane. Areas which received significant focus include Athenree and Katikati, Matakana Island, Ruahihi, Papamoa and Kohika.

In the Athenree and Katikati area at the north-western end of the Tauranga Harbour, one of the most significant sites to be excavated was located in a small valley adjacent to the Kauri Point Pa (original name Owaru Pa). Recorded as part of the pa site (U13/4), Kauri Point Swamp revealed up to 200 wooden combs and an estimated 13,000 obsidian flakes (Shawcross 1962; 1963; 1964c; 1964b). Other features included silt and organic material floors, horizontal timbers and upright stakes, and further artefacts comprised wooden bowls, figures, weeding tools, *ko* (digging sticks), adze handles, wooden spear tips, fibre and broken musical instruments. The number of wooden combs was disproportionate to other organic items excavated, while the obsidian flakes were indicative of a simple, unsophisticated stone-working industry (Law 2008:60). Shawcross (1977:297-300) later examined ethnographic

evidence and argued the Kauri Point Swamp site functioned as the disposal place of *tapu* (sacred) material associated with the head, such as wooden combs, obsidian for hair cutting, ochre used for hair or head decoration and musical instruments played with the lips. By 2010, Kauri Point Swamp appears to be unique in New Zealand as a prehistoric wooden comb depository site. The associated Kauri Point Pa, a ring-ditch pa located on a cliff edge, was also excavated in the 1960s (Golson 1961b; 1961c; 1961a; Ambrose 1962; 1967), but investigations yielded a much smaller assemblage in comparison to the adjacent swamp part of the site. The interior revealed terraces with pits, ovens and midden, capped by horticultural soil, followed by fortifications. Original radiocarbon dates of the site suggested earliest occupation in the late 17th century, with later occupation occurring in the 18th century (Green 1978); this dating sequence needs to be reassessed in line with modern radiocarbon protocols. The Kauri Point undefended site (U13/45), approximately 600 m to the north of the Kauri Point Pa, was also investigated in the 1960s (Green 1963b; 1964). The site comprised a small midden and a variety of pits; unidentified charcoal yielded a radiocarbon date range around the 15th century but should be treated with caution because of potential inbuilt age issues.

Approximately 2 km to the north of the Kauri Point Pa, the Ongare Point Pa site (U13/8), also located on the edge of a cliff, was a further significant site excavated in the 1960s (Schofield 1964; Shawcross 1964a; 1966). Features included an extensive shell midden and three ditch and bank units, with excavations of the interior uncovering evidence of intensive building of pits, which often inter-cut; cultivation and oven building were the earliest features. The structures and evidence of gardening soil were able to be put into seven phases, the second latest of which comprised the interring of burials, followed with a reoccupation phase of shellfish processing and defensive earthworks. The site was undated.

Anatere Pa (U13/46), also located by a coastal cliff, at Athenree, has been excavated a number of times (McFadgen 1982b; Phillips, C.A. & Allen 1996b; 1996a). Investigations identified the initial occupation with gardens, storage pits, ovens and midden was an undefended phase during the early 16th century; the subsequent seven major low internal terraces and ditch-and-bank fortifications were dated to the late 16th and early 17th centuries. The terraces fulfilled different functions, such as pit storage, or domestic cooking and house areas. The investigations recovered a large amount of obsidian, the majority sourced from Waihi and Tuhua (Mayor Island).

Matakana Island, the only sand island within New Zealand (Law 2008:20), can be divided into two zones. The side closest to Tauranga Harbour comprises consolidated Pleistocene sand dunes, where many pa sites have been recorded (McFadgen & Walton 1981). The second zone, on the seaward side, comprised accumulated sand and is more recent in age. The island was subject to a research project in the early 1990s, which included investigation of sites in the seaward accumulated sand zone (Anon. 1993; Marshall, Paama et al. 1993a; 1993b; McFadgen & Shepherd 1993; Marshall, Paama et al. 1994a; 1994b; Shepherd, McFadgen et al. 1997). These revealed cultivated soils overlain with midden, with some sites indicating gardening continued after the middens were deposited. Midden was, in some places, deposited directly on top of the Kaharoa tephra, but was never identified below it. In the harbour-side consolidated sand dune zone, middens were more varied, and larger, than those of the seaward zone. The middens are thought to date from the late 17th to the early 19th centuries, although these dates may need to be reassessed. On the inland side of the island, Ureturituri Pa (U14/187) was a ditch-an-bank cliff-edge pa, similar to the Kauri Point, Ongare Point and Anatere pa sites. Investigations identified two or three phases of occupation, dating to between the mid-16th and early 19th centuries (Petchey 1993b; Marshall, Paama et al. 1994a). Internal features included rectangular pits, rua, a fire scoop and postholes and potential house sites. Midden samples were analysed from the inland zone of the island, with results indicating a variety of ocean beach and harbour species in the same samples; no patterns or changes were identified over time (Pepa 1993). In spite of its relatively recent deposition, the seaward zone of Matakana Island was extensively used during prehistory, for not only shellfish gathering and consumption but also for gardening and storage of crops. The excavated pa sites indicate they were used contemporaneously with the seaward sites, in a similar fashion to the pa at Katikati and Athenree. The residents of Matakana lacked easy access to the resources of the forests of the Kaimai Ranges, and would have had to bring in these resources, including ovenstones. It was concluded that the combination of the Kaharoa tephra and the forest soils resulted in favourable conditions for prehistoric Maori horticulture, which appears to have been prevalent over a large part of the island.

The impressive Papamoa archaeological landscape has attracted attention since the 1940s (Blake-Palmer 1947:237), with pa sites on the steep Papamoa Hills overlooking the coastal plains, which comprise unconsolidated coastal dunes (deposited after the Taupo eruption , ca. 200 AD) extending 400 m inland, and a zone of older, regular, smooth dunes with wetter swales. The plains extend east to the channels of the Kaituna River. The unconsolidated

coastal zone appears to have relatively fewer middens that the older inland zone, which has a comparatively greater concentration of sites, including three swamp pa. Pa are also recorded in the vicinity of the Kaituna River and channels. Most sites have been recorded as middens, and often include hangi and scoop hearths, or moderately-sized storage pits; postholes and living floors are also encountered. The coastal plain sites are noticeably lacking in the remains of fish, although middens contain ocean and harbour shellfish species; they also have low numbers of artefacts. Much of what is known of the inland zone is the result of monitoring and excavations driven by the development of residential subdivisions. The large number of shell radiocarbon dates indicates occupation from the early 15th to the 17th centuries. The Tamapahore Pa site (U14/209), a hill pa with scarp defences, was subject to mitigation investigations after a damage assessment (Phillips, C.A. 1999a; Phillips, C.A. 1999b). These investigations confirmed the presence of large storage pits on the upper levels, and the use of a lower terrace for storage and cooking. As found in the Papamoa coastal dune middens, the midden at Tamapahore Pa included coastal and harbour shellfish species. A second unnamed pa site (U14/243) on the Papamoa Hills was also excavated (Anon. 1985; O'Keeffe 1991). The ridge pa, consisting of a southern terrace, a central platform and a northern section, was investigated at the terrace; midden, evidence of cooking, post holes, storage pits, rua and an infilled defensive ditch were identified. Vague dates for the fill of the defensive ditch and from a rua indicated occupation between the 16th and 19th centuries. The investigation of an undefended site on the Papamoa Hills (U14/1675) identified a platform and lower terrace with rectangular pits, burnt areas, hearths, midden and postholes (Bowers, L.C. & Phillips 1998d). The site was not dated but may be contemporaneous with the nearby pa site U14/166, which was dated to between the mid-17th and late 18th centuries (Law 2008:70). Subject to further investigations and reliable radiocarbon dates, it presently appears that the Papamoa Hills pa and associated undefended sites began to be occupied a century later than the coastal plains, and with the hills still being occupied into the 18th century, when the plains seem to have stopped being used for settlement in favour of processing shellfish.

The inland Ruahihi Pa site, on the Lower Kaimai Ranges and adjacent to the Wairoa River, was excavated in the early 1980s prior to destruction for a hydroelectric dam (McFadgen & Sheppard 1984). The pa was never intensively used but had a long sequence of occupation beginning in the late 16th century. Investigations identified features including rua and rectangular pits, houses, garden soil, cooking areas, shell middens and house floors. Initial occupation was dated to the late 16th century, and continued periodically into the post-contact

period. The extent of the good preservation at Ruahihi Pa included evidence of plant use, particularly repeated use of the area immediately outside the pa for gardening, storage and occupation. Pits seem to have been absent during the middle period. The pa was within navigable access to the Tauranga Harbour along the Wairoa River, providing access to marine resources. The significance of the Ruahihi Pa site lies in the range of preserved evidence, particularly the plants used, as well as demonstrating long-term reuse of the area while still maintaining access to marine resources.

Excavations at the swamp pa site Kohika, close to the Tarawera River and south-west of Matata on the Rangitikei Planes, in inland Bay of Plenty, began in 1974 (Irwin 1975; Lawlor 1975; Moore, K.W. 1975a; London 1976; McGlone & Pullar 1976; Moore, K.W. 1976a; Lawlor 1980; Nichol 1988; Wallace & Irwin 1999; Irwin 2000; Horrocks, Irwin et al. 2003); resulting in an edited monograph which took an in-depth examination of the late 17th century site (Irwin 2004b), and also a number of MA theses (Boileau 1978; Lawlor 1979; Williams 1980). Situated on the edge of a shallow lake, the defended settlement was occupied for approximately 40-80 years. The interior contained differentiated areas for domestic use (food preparation and houses) and storage of crops. The economy of the Kohika site is notable for the large number of dogs present. Due to the preservation conditions of the site, a comprehensive range of artefacts was recovered, including numerous wooden items, woven fabrics and nets.

2.4.2.2 *SURVEYS*

Compared to the total number of excavations undertaken in the Western Bay of Plenty, the number of surveys conducted up to the year 2010 is much larger at a total of 103, although eighty-two of these are archaeological assessments, produced in the 1990s and early 2000s (Appendix, Table A.9). Many surveys were undertaken in the early 1980s (Appendix, Table A.9) in Tauranga, Te Puke and Whakatane, funded by the New Zealand Historic Places Trust. Observations that the Western Bay of Plenty was seeing a large increase in horticultural development (McFadgen 1981) and that areas of hill country were not controlled by the New Zealand Forest Service were undergoing private afforestation; as well as New Zealand Forest Service becoming aware of the need to survey areas about to be harvested (Law 2008:124)

One particularly well-surveyed example is Matakana Island, described previously, which stretches across the mouth of the Tauranga Harbour, and is composed of consolidated

Pleistocene sand dunes and has many pa sites (McFadgen & Walton 1981:65; Law 2008). A project in the 1990s investigated the island with particular focus on the more recent, seaward part, which has high numbers of midden sites (Marshall, Paama et al. 1993a; 1993b; 1994a; 1994b). The surveys and investigations revealed an unexpected archaeological landscape; the forest soils and fallen Kaharoa ash led to a favourable environment for prehistoric horticulture (Law 2008).

Another important, well-surveyed area is the Papamoa archaeological complex (Fredericksen, Kahotea et al. 1996; Bowers, L.C. & Phillips 1998a; 1998b; Gumbley & Phillips 2000; Kahotea 2002; Bader & Hawkins 2004; Bader, Hawkins et al. 2004; Campbell & Gumbley 2004b; Phillips, K.J.S. 2004d; 2005e; Gumbley n.d.), described previously.

Large areas of the Western Bay of Plenty are relatively well-surveyed, although some areas still require further work, particularly west of the Kaimai Ranges, south of the Rotorua Lakes area and the Rangitaiki Plain (Law 2008:125).

2.4.2.3 *POST-GRADUATE THESES*

A number of post-graduate theses have been written on or including areas within the Western Bay of Plenty (Appendix Table A.10). Edson's (1973) MA thesis examined human ecology and prehistoric settlement on selected offshore islands from the East Cape to Cape Reinga of the North Island, and included Tuhua (Mayor Island) and Motiti Island from the Western Bay of Plenty. His research concluded that "the density of occupation on the northern offshore islands seems to be correlated with the suitability of these islands for gardening" (Davidson 1990:151).

Lawlor's (1979) MA thesis examined the paleoenvironment of the Kohika Swamp Pa (N68/140). He analysed seeds and pollen studies; these showed that a low swamp forest was present around the Kohika Swamp Pa, including sedges and herbs. He reported that before the Kaharoa Eruption (ca. 1314), the area of the Kohika Swamp was characterised by changing river systems and associated lagoons, and old dunes. A low degree of flooding was indicated by the lack of significant alluvial deposits below the Kaharoa Ash; this also indicated the swamp vegetation was relatively stable. Lawlor stated that his results indicated that Maori may have been present in the area before the Kaharoa Eruption. After the Kaharoa Eruption, the swamp was affected by the accumulation of air-fall ash and alluvium, with a major

reduction in the previous forest plants and increases in grasses and bracken. He concluded that the Kohika swamp pa was occupied after the Kaharoa Eruption.

Williams' (1980) MA thesis examined coprolites from the Kohika Swamp pa site. She conducted microfossil analysis of parasite eggs and analysis of pollen. The waterlogged site yield large numbers of coprolites. Based on the evidence of consumption of food scraps from the ground and the distribution of the coprolites on the site, these were attributed to dogs rather than humans.

Although not a strictly archaeological project, Kahotea's 1983 MA thesis examined the interaction of Tauranga hapu with the landscape. Nichol's (1988) PhD thesis considered sources of prehistoric subsistence in the north of North Island with emphasis on evidence obtainable from food wastes. His faunal analyses included the inland Kohika Swamp Pa site; he concluded that the occupants were fishing in winter and probably throughout the year. The presence of *Pagrus auratus* (snapper) indicated that the occupants were exploiting the open sea, but otherwise fish were taken in estuary of two rivers, probably taken by nets. Seelenfreund-Hirsch (1985) wrote her PhD thesis on the exploitation of Tuhua (Mayor Island) obsidian in prehistoric New Zealand.

O'Keeffe's M.Litt. thesis (1991) examined prehistoric settlement in the Western Bay of Plenty, from just north of Athenree in the north-east, inland to the Kaimai Ranges, and south-west to Otamarakau. She used data from a programme of three seasons of field surveying instigated by the New Zealand Historic Places Trust between 1981 and 1984. This work was in response to increasing horticultural development in the area, with the contouring of land for kiwifruit and other orchard crops posing a great loss in previously unrecorded archaeological sites. O'Keeffe analysed the environments in the study area, and defined ten zones on the basis of climate, aspect, soils, geology and resources. Combining the site data (from nearly 5000 recorded sites) with the environmental analysis, she examined the relationships between archaeological components, and between sites and the environment. O'Keeffe identified a positive relationship between site location and environment; topography, slope and resource availability are the main factors influencing site location. Also noted was a disparity in the types of preferred site location and economic dependence between the eastern and western parts of the study area. Western areas were dependent on marine resources, while eastern areas were dependent on inland horticultural resources. O'Keefe also examined excavated sites and radiocarbon dates from within the study area, and concluded that settlement began in

the 14th century onwards, with *pa* constructed soon afterwards; reuse of sites was common, and many undefended sites later had defences added.

Holroyd (1993) MA thesis examined sources and characteristics of obsidian from the north island. Locations of obsidian sources from the Western Bay of Plenty included Waihi, Maketu, Lake Rotoiti, Lake Rotokawau, Ngongotaha, Whakarewarewa and Lake Tarawera. Petchey's (1993a) MA thesis examined lithic artefacts found on Matakana Island and focused on their sources. Palmer's (1994) MA thesis compared the obsidian artefact assemblages from Kauri Point pa and Kauri Point swamp sites.

Phillips' MA thesis (1996b) on the prehistory of the eastern Bay of Plenty used available archaeological data from recorded sites, amateur excavations, artefact assemblages and a salvage excavation, along with radiocarbon dates for pa to provide a broad analysis of the area surrounding the Ohiwa Harbour, between Ohope and Opotiki. Phillips concluded from these sources that they provided evidence for an early and widespread settlement of the Ohiwa Harbour in the 13th century, with artefacts from excavated early sites matching those usually found in 'Archaic' sites in other regions of the country. Pa radiocarbon dates also suggest an intense phase of pa building in the 16th and 17th centuries. The pa in the Ohiwa Harbour area included larger and possibly dominant pa which protected horticultural harvests, and the pa economic focus also included food resources from the harbour. Phillips also constructed a tentative prehistoric sequence for the Ohiwa Harbour, proposing first settlement just prior to the Kaharoa ash fall, located at river and stream mouths and entrances of estuaries and the Ohiwa Harbour, with a focus on both forest and marine resources (however, more recent research (e.g. Higham & Hogg 1997; Newnham, Lowe et al. 1998; Hogg, Higham et al. 2003) no longer supports settlement prior to the Kaharoa ash fall in New Zealand, although see Sutton *et al.* (2008)) for the argument supporting the 'long chronology'). An increasing population extended 30 kilometres inland up the main river systems, and with increasing population came increasing pressure on resources and conflict, resulting in the construction of pa on available headlands around the harbour, many with extensive numbers of storage pits and ring ditches.

2.4.2.4 *Monitoring, Post-harvest and Damage Assessment reports*

As in the Coromandel Peninsula, the 1990s saw the appearance of monitoring reports (Appendix Table A.11), post-harvest reports (Table A.13) and also damage assessments

(Appendix Table A.12) under the HPA 1993, in the Western Bay of Plenty. The former were produced in large numbers, with a total of 47 monitoring reports having been prepared from the Western Bay of Plenty area by 2010, in comparison with 17 in the Coromandel Peninsula. Examples include Birch Avenue, Judea (Kahotea 1994b), Waihi Beach North (Moore, P.R. & Phillips 2002), Harbour View Road, Omokoroa (Hooker, R.H. 2007b) and Matapihi Road, Matapihi Peninsula (Mallows 2009a). Twenty-four post-harvest reports had been prepared for Western Bay of Plenty forests by 2010 (only five more than the Coromandel Peninsula), including Rotoehu Forest (Hooker, R.H. 1999b), Sun Valley Forest (Hooker, R.H. 2004f) and Tuhoe Forest (Hooker, R.H. 2010g). There are nine damage assessment reports from the Western Bay of Plenty (there was only one from the Coromandel Peninsula, but this also included an excavation and restoration and was thus classified under excavation reports) and included Tamapahore Pa, Papamoa (Phillips, C.A. 1999b) and Thornton Ridge, Tauranga (Phillips, K.J.S. 2004b).

2.4.2.5 *OVERVIEWS*

A major review of the archaeology of the Bay of Plenty was not undertaken until relatively recently, on behalf of the Department of Conservation (Law 2008). Law noted that although no known early sites have been reported from the inland areas of the Bay of Plenty conservancy, their presence at Tokoroa and Taupo indicates that absence of evidence is not necessarily evidence of absence; isolated finds of early style artefacts (adzes and ornaments) inland from the coast also support the supposition that there are unrecorded early sites in the inland Bay of Plenty (2008:41). The inland areas have not been actively investigated, and the paucity of early recorded sites is likely to change upon further investigative field survey. Law noted the lack of published material also made summarising the archaeology of the region difficult. The Western Bay of Plenty early sites are typical of other sites of their period from around the country – sheltered beach-front occupations just inside the mouths of harbours and river estuaries. Recovered artefacts are indicative of typical 'Archaic' forms of adzes, fishhooks and ornaments, but are not sufficient in number to draw conclusions about a regional style in manufacture. Little is known of early economy. Law discussed two sites with moa associations, noting there was debate about whether these were part of the diet or were sub-fossil remains collected for industrial use. At the time Law's review was published, the early site at Maketu, V14/187, was just being investigated, and so was not included in his discussion. He stated that the form of early settlements in the Bay is completely unknown. Law (2008:53) observed that the distribution of middens in the late period of New Zealand

prehistory are mostly coastal, although they extend well inland in some areas, in particular south of Tauranga and Maketu. However, the density of middens declines notably between Pukehina and Te Teko (a relatively hilly area, to the south-east of Maketu, but also including a flat plain bisected by the Rangitaiki River), where estuaries are absent and the presence of steep, high-wave-energy beaches where shellfish are less abundant. The Tauranga area is rich in middens, which are frequently exposed during even minor earthworks. Storage pits are often encountered with these middens. Law (2008:53-4) described the scarcity of fish and mammal remains in the middens from the late period as "startling". While there is little in the way of archaeological fishing gear recovered from late period sites, the fish identified in analysis represent the species that would be present in the nearby marine or freshwater habitats. Eels, however, are not amongst these species, even when they should be preserved by the alkaline conditions of shell middens; we would expect to find the fine bones of eel remains more commonly in inland middens, which are scarce in some areas but not in others. If eel remains had been discarded without shellfish they are unlikely to have survived due to acidic soil conditions. Middens in the Rotorua Lakes area include kakahi (*Hyridella menziesii*, freshwater mussel).

Law's relatively recent (2008) overview of the Bay of Plenty covered sites not only on Department of Conservation land, but also all other recorded sites on public and private land within the conservancy boundaries. The volume used the problematic term 'Archaic' for describing early sites, while avoiding the term 'Classic' for late sites. Unlike the Coromandel Peninsula, no earlier syntheses provide a model or sequence of settlement in the Bay of Plenty; recent and early models of subsistence and settlement for this area are generally lacking. The present research will address the data from the recent surge in archaeological excavation and monitoring reports with reliable radiocarbon dates, and evaluate these with respect to models put forward for the nearby Coromandel to the north.

2.4.2.6 *SUMMARY*

The archaeological landscape of the Western Bay of Plenty, as it is recorded presently, is notable for the small number of sites from the earliest period of settlement by prehistoric Maori, the high number of pa sites relative to other areas of New Zealand, and the high proportion of large pa sites (i.e. >5000 m²). It contains significant areas such as the Papamoa archaeological landscape and Matakana Island, rich in archaeological sites, as well as unique sites such as the inland swamp pa of Kohika and the wooden comb cache of the Kauri Point

swamp. While early settlement appears to have been limited, the Tuhua source of obsidian appears in early sites around New Zealand and indicates the Western Bay of Plenty was involved in trade from the earliest period of occupation by the Polynesian settlers. Occupation intensified during the middle of New Zealand prehistory, evidenced by high numbers of midden, pit and terrace sites and the appearance of pa during this time.

3 METHODS

3.1 INTRODUCTION

The methods employed in this research fall into two main parts. The first involves the fine-grained analysis of fauna from a case-study site; the second is a comparative analysis of data from a regional sample of sites. Archaeozoological methods are discussed first, to evaluate which are most appropriate for each of these studies. Next the case-study site is introduced and the methods used with it described; then the procedures used in selecting, organising and analysing the comparative datasets are outlined.

3.2 FAUNAL QUANTIFICATION METHODS

The quantification measures used in this research serve two purposes; first, they are used to indicate importance of individual species and within faunal classes. Secondly, the quantification measures are used in the comparative analysis to indicate the importance of each faunal class across the assemblages, identifying spatial and temporal patterns. There are a range of measures available for quantifying faunal remains; each has different strengths and flaws which have been and continue to be extensively debated and discussed (1977; Grayson 1979; Watson 1979; Gilbert, Singer et al. 1981; Lyman 1982; Grayson 1984; Horton 1984; Lyman 1984; Reitz & Scarry 1985; Lyman 1994a; Landon 1996; Lyman 2008; Reitz & Wing 2008). The application of different methods is considered here to determine which are most appropriate for the present study.

3.2.1 PRESENCE/ABSENCE (UBIQUITY)

The presence/absence or ubiquity method allows different samples to be easily compared and is implicit in all analyses of faunal assemblages. A taxa is recorded as either 'present' or 'absent', the former being used regardless of whether one or fifty elements (or individuals) of the taxa are present in the assemblage. An advantage of this method is that the possibility of error of interpretation is lessened with differential preservation, such as that between mammal and bird remains. Additionally, the presence/absence method does not increase the number of sample divisions; as the sample size is increased or divided into smaller groups taxa that

occur more frequently will appear more important, while taxa that appear less often will be present in fewer samples and considered less significant (Sobolik 2003:93).

As the aim of the both fine-grained and comparative analysis is to examine the importance of species and faunal classes, and not to identify the range of species present, ubiquity was not used as a measure of abundance in this research.

3.2.2 Number of Identified Specimens (NISP)

The Number of Identified Specimens (NISP) can be defined as the number of identified specimens (fragmented or whole) for a given taxon (Lyman 1994b; Landon 1996:140; Baker, B.W., Shaffer et al. 1997; Sobolik 2003; Lyman 2008). NISP is an observational unit, where the taxon can be from a range of taxonomic categories, such as sub-species, species, genus or family (Baker, B.W., Shaffer et al. 1997). 'Specimen' should be understood to mean a tooth, bone or fragment of tooth or bone, as opposed to 'element', which is a single complete bone or tooth (Lyman 1994a:34). This unit is often used as a way to measure abundances of taxa in faunal assemblages (Grayson 1979:201). There are two main advantages in using NISP for quantification. First, NISP is an observed measure; it is a direct tally which can be calculated while bone identifications are carried out, without the need for later numerical calculations (Lyman 2008:28). Secondly, NISP values are additive, which means species abundance can be updated after consecutive field seasons, purely by adding new NISP values to the old NISP values (Klein & Cruz-Uribe 1984; Baker, B.W., Shaffer et al. 1997; Sobolik 2003; Lyman 2008). NISP does not suffer from issues that affect Minimum Numbers of Individuals (MNI; see below) such as those associated with the siding of elements or describing fragments (Baker, B.W., Shaffer et al. 1997).

However, using NISP to quantify faunal assemblages can be problematic. One of the most overlooked issues (which also affects MNI) is that different faunal analysts may identify different species in a given assemblage or unit (Lyman 2008:28). This is virtually impossible to control for in inter-site comparisons, unless the same specialist(s) works on all of the assemblages. NISP can be affected by the total number of bones in a skeleton (Sobolik 2003; Lyman 2008), which vary from species to species. However, Lyman (2008:44) suggested this is easily overcome by either normalizing "all NISP by dividing those values by a value that accounts for variation in identifiable elements per skeleton, or delete from tallies those taxonomically unique elements". Human butchering patterns affect how many fragments each

bone is broken into, thereby inflating NISP values (Klein & Cruz-Uribe 1984; Lyman 2008). Use of NISP assumes that "all specimens are equally affected by chance or deliberate breakage" (Grayson 1979:201), but denser or larger bones are less prone to breakage and more likely to be affected by butchering. Weathering processes may affect specimens differently within and between assemblages (Lyman 1994b; O'Connor 2000; Lyman 2008). The method employed for the collection of specimens, (i.e. mesh size of excavation sieves) affects NISP totals (Lyman 2008). The way specialists define 'specimen' and how they calculate NISP can be variable (O'Connor 2000). The presence of a complete skeleton in the assemblage will skew NISP abundance values compared to those of skeletons which are only partially represented due to off-site butchering. NISP is vulnerable to the interdependence of elements – that several or more specimens are from one bone – which invalidates further use in statistical analysis (Reitz & Scarry 1985:16-17; Lyman 2008:30). These weaknesses render any inter-site comparisons useless (Grayson 1984; Baker, B.W., Shaffer et al. 1997; Fagan & Decorse 2009). The problem of interdependence in NISP data is yet to be resolved, and Grayson (1979:202) states that "the use of this measure must be *demonstrated* to be appropriate for the problem and fauna at hand" (emphasis in original).

While NISP is not the primary measure used in this research, it is still recorded and taken into account in the case study. NISP is not used in the comparative analysis.

3.2.3 Minimum Number of Elements (MNE)

Compared with other units of quantification, there is relatively little literature discussing Minimum Number of Elements (MNE). The earliest definition of MNE simply states "minimum number of elements" (Bunn 1982:35; Lyman 1994b). It does not clearly define whether these elements are complete or partial skeletal portions (Lyman 1994b). MNE is vulnerable to implementation variability, such as analysts deciding whether to take into account age, sex, or size differences between specimens. Therefore, MNE is also an analytical unit (Lyman 1994b). MNE is used as a way of analysing how much of complete skeletal remains are represented in an assemblage (Fagan & Decorse 2009). The way an analyst deals with fragmentary bones can affect MNE and MNI values. Options include 1) ignoring fragments; 2) treating fragments as complete bones; or 3) recording bone fragments as fractions of complete bones (Klein & Cruz-Uribe 1984). In the first alternative, ignoring fragmentary bone will artificially decrease MNE and MNI values, while treating them as whole bones will increase them. This creates a dependency between the MNE (and therefore

MNI) values and the degree of fragmentation, which obviously cannot be expected to be consistent between all sites. Therefore, recording fractions of complete bones present is a more useful method for inter-site comparison. It is acknowledged that estimating fractions could vary between analysts, but as long as definitions and diagrams of fractions are detailed, this error potential should be minimalized (Klein and Cruz-Uribe 1984).

In one detailed article by Marean *et al.* (2001), the traditional methods employed in calculating MNE are reviewed and an additional approach is put forward. The first traditional approach to calculating MNE, the 'Fraction Summation Approach', is a system that relies upon defining diagnostic zones on bones. The goal of this approach is to avoid counting the same bone twice, either by using larger zones to count specimens, but only where more than half a zone is present; or by using very small zones, such as nutrient foramina, that would be usually found complete. Problems with this approach include bones which regularly split through nutrient foramina, and the counting of only fragments with more than half a zone preserved which may reject a substantial portion of the assemblage. Both of these issues could result in an assemblage with a large NISP total having low MNE counts. Klein and Cruz-Uribe's (1984; 1986) solution to this issue was to describe in detail both their procedures for converting fragments in to MNI and a computer code for analysts to follow. The program calculated MNE and used these results to calculate MNI. Klein and Cruz-Uribe also used zones, but these were either whole epiphyses or unfused metaphyses. Small bones such as carpals and tarsals were recorded as fractions. Marean *et al.* suggested the strengths of this approach are that firstly, there is "little systematic inter-analyst variation" (2001:335) in the estimation, and secondly the summing of fractions to calculate MNE totals is simple and easily built into databases or spreadsheets. However, this approach also has some weaknesses. First, if one area of a zone preserves better than another on a regular basis, then MNE estimates will be biased. Secondly, the MNE estimates of whole bones are affected by the zones chosen by the analyst to quantify. Thirdly, a fragment is only described by the information contained within the defined zone and other detail is lost. Related to this issue is that some fragments do not retain the zones or features chosen by the analyst. The fraction summation approach is also difficult to use in conjunction with studies of surface modification, such as cut marks.

The second of three approaches reviewed by Marean et al. is 'The Overlap Approach', with slightly differing approaches by Morlan (1994) and Bunn (1986; Bunn, Kroll et al. 1986).

Morlan's approach calculates MNE with 'hands-on' matching of fragments, i.e. manually counting overlapping features or zones. Bunn *et al.*'s approach was similar, but it involved "detailed specimen-by-specimen comparisons among all specimens in each limb and animal size category" (1986:435), with attention specially paid to areas of overlap of homologous parts. Bunn et al.'s approach is differentiated by Marean et al. as 'The *Manual* Overlap Approach' (Marean, Abe et al. 2001:338; emphasis in original). One strength of this approach is that it is probably the best fit for the analyst's goal of calculating the best estimate of bones present in the excavated assemblage. Another strength of the manual overlap approach is that all fragments are identified, not just those that include defined zones or features. However, one serious issue with the manual overlap approach is it is confusing to count and calculate; a problem that becomes worse with larger assemblages or samples. This problem is made worse by the issue of inter-analyst variation, because judging overlap is subjective. Different analysts could calculate widely varying MNE totals on the same assemblage. Münzel (1988) and Marean and Spencer (1991) independently came up with a solution, whereby each bone is divided into segments by use of a three-dimensional grid. The advantage of this approach lies in that MNE calculations do not become difficult and unwieldy with larger samples. It also reduces inter-analyst variation in calculation, as the analyst does not need to make a subjective decision on what is and is not an 'overlap'. One problem with this approach is that coding the fragment is time-consuming. A photo is usually taken of a model bone, which is used to compare the fragment in conjunction with the grid; then the bone identification, order of quadrants and segments need to be correctly recorded. Also, as quadrants and segments may be large, fragments that project into one may be counted as overlapping when in fact they do not. This therefore requires a preference for smaller segments/quadrants, which in turn creates more cumbersome recording of segments/quadrants.

The problem that the analyst is left with is one of accuracy versus efficacy. Marean et al. (2001) propose a 'New Image-Analysis GIS Approach'. This grew out of an approach where a fragment was recorded on tracing paper overlying a bone template. MNE was calculated by lying all of the appropriate tracings for the element over the template and manually counting the overlaps. The major weakness with this approach was that as the sample increased it became more difficult to see through the increasing layers of tracing paper. Marean et al. (2001) developed a computer-based approach which counted overlapping fragments. They used ArcView® GIS (Geographic Information Systems) software version 3.1 and the ArcView Spatial Analyst extension version 3.0. The GIS software was chosen because it used

spatial co-ordinates and has the ability to convert between feature and grid themes. Marean et al. (2001) listed four steps in their MNE analysis:

> 1) Preparing a digital template, or an original digital drawing with co-ordinates, of each skeletal element in different views, left and right sides if needed; 2) drawing in the outline of each fragment over the template; 3) converting these polygon feature data into grid data; and 4) adding together these newly created grids, in order to obtain an MNE count (Marean, Abe et al. 2001:341).

The advantages of this approach were that this method of recording and storing data on bone fragments generated a complete and flexible record of the fragment, which meant that GIS data can be recoded, allowing it to be matched to the coding conventions of any approach. This would allow different analysts to analyse the same dataset. The GIS images could also be used in the analysis of surface marks such as burning coverage and cut-mark placement. Another advantage of this GIS method was that it allowed the entire bone surface to be taken into consideration, not just areas in certain zones or features.

MNE values are recorded for both the Cabana Lodge case study and where available for comparative analysis, which becomes important for energy calculations for mammals (dog, fur seal, etc.) which may have certain elements/body parts present in the assemblage, due to butchering elsewhere.

3.2.4 Minimum Numbers of Individuals (MNI)

As the term implies, Minimum Number of Individuals (MNI) is the quantification unit that calculates the minimum number of individuals necessary to account for one taxon in a faunal assemblage (Landon 1996:140; Baker, B.W., Shaffer et al. 1997; Sobolik 2003; Fagan & Decorse 2009). MNI may be calculated by the siding of paired elements to lefts and rights; the greater number is used as the total MNI for that species (Sobolik 2003; Lyman 2008:38-9). In some respects, the strengths of MNI compensate for the weaknesses of NISP (Watson 1979; Klein & Cruz-Uribe 1984; Landon 1996). While NISP assumes that each bone in an assemblage comes from a different animal, MNI assumes that if it is possible that two bones came from the same animal, then this is the case. The problem that neither assumption is correct lies at the heart of the debate on which method is appropriate to use in quantifying relative taxonomic abundance (Landon 1996:140). One advantage of MNI over NISP is that

the MNI value for one species cannot be larger than another species simply because it may have more elements present in its skeleton (Sobolik 2003; Lyman 2008:44). On top of this, MNI appears to be relatively insensitive to differentiation in bone fragmentation, in comparison with NISP (Klein & Cruz-Uribe 1984; Sobolik 2003).

The MNI abundance results can be affected by the sampling selection procedures employed in the field; for example, inconsistent application of faunal collection procedures, the size of sieve mesh used and variations in experience within the field excavation team. MNI calculations with large amounts of data can be tedious, leading to higher chances of calculation error. MNI calculations are based on MNE calculations and the principle of paired elements; different analysts can make varying decision with their methods due to the lack of consensus amongst archaeozoologists (Klein & Cruz-Uribe 1984; Reitz & Scarry 1985; Baker, B.W., Shaffer et al. 1997; Sobolik 2003). Some analysts sort sides of elements and take the highest value, whether it be left or right; some try to match different elements from the same individual, while others use presence or absence of epiphyseal fusion in mammals to match for the age criterion (Klein & Cruz-Uribe 1984; Baker, B.W., Shaffer et al. 1997; O'Connor 2000). Sorting sides and matching techniques are more likely to affect MNI values in small samples than larger ones (Klein & Cruz-Uribe 1984).

An underlying assumption of MNI is that the complete skeleton of an animal was consumed on site, when in reality parts of the animal may be widely dispersed at the kill and/or butchery site(s), as well as the consumption site (Klein & Cruz-Uribe 1984; Reitz & Scarry 1985:17; Sobolik 2003). Therefore, MNI does not "accurately approximate the number of individuals contributing to an assemblage and must be viewed strictly as an estimate for providing a relative view of taxonomic abundance"(Landon 1996:141).

MNI values are not additive in the same way NISP values are. This can be described as aggregation: when samples are added together, the sum of the initial MNI values is not the same as the final MNI value of the combined sample (Klein & Cruz-Uribe 1984; Reitz & Scarry 1985; Plug & Plug 1990; O'Connor 2000; Sobolik 2003). The effects of aggregation on MNI values undermine them in such a way that the absolute abundances and taxonomic abundance ratios become almost meaningless (Grayson 1979). Grayson (1979:214) stated that to show that MNI is valid as a form of ordinal data, it is necessary to "show the conditions under which rank orders of taxonomic abundance are not affected by aggregation methods", and suggested examining the taxonomic abundance distribution within an assemblage.

Grayson (1984:66) went on to argue that in order to be sure that MNI values were not interdependent, one must be sure that the "aggregates from which they are defined are totally interdependent of each other", which in some cases could mean treating an entire site as a single faunal aggregate. With inter-site comparisons of assemblages, different methods in combining assemblages from excavation units can affect the MNI values, with either maximum or minimum values being used. The former method calculates the MNI for each excavation unit, level and feature, and added together; the latter method calculates all data for the whole assemblage as one unit. Neither of these are likely to provide meaningful results, as they disregard archaeological information about function and context within the site (Reitz & Scarry 1985). When function and context of the site are taken into consideration in MNI calculations, the problem of interdependence is reduced (Landon 1996:140). The problem of inter-dependence can be further reduced by incorporating criteria such as age, sex and size during MNE and MNI calculations (Watson 1979:128; Landon 1996:140-1). However, analysts may or may not choose to take into account individual variation such as age, sex, or size, making MNI a derived unit (Lyman 1994b).

A weakness that MNI shares with NISP is that neither takes into consideration the specific numbers of skeletal parts that make up the assemblage – strong patterns of element representation are not visible in these values (Klein & Cruz-Uribe 1984). Also, MNI values over-emphasize the importance of 'rare' species – they may only contribute a few bones to the assemblage, but can have the same MNI as a species that contributes many bones (Klein & Cruz-Uribe 1984; Plug & Plug 1990; Sobolik 2003). MNI does not indicate how much a taxon contributes to the diet of a family or community at a specific site, e.g. one bivalve provides far less energy than one cow, though they both have an MNI of one, and therefore have equal values of relative abundance. In this way MNI overemphasizes the importance of small animals (Odum 1971:82; Reitz & Scarry 1985:17).

Observations have been made that it is the norm to find that in most assemblages, the majority of taxa are represented by only a few individuals, while a minority are represented by large numbers (Grayson 1979). A related issue is that MNI values are affected by sample size; the smaller the sample the less likely it is to accurately reflect the abundance of the taxa in the deposit (Uerpmann 1973; Grayson 1978; 1979; Lyman 1979; Grayson 1981; 1984; Baker, B.W., Shaffer et al. 1997; Lyman 2008). Plug and Plug (1990) argued that numerical analyses based on MNI estimates were to be avoided, as MNI values were only minimum estimates,

not finite values. This included the converting of MNI estimates of a given sample to relative percentage data; mathematically it is illogical to sum a series of minima. O'Connor (2000) observed that despite twenty years of criticism and refutation of the use of MNI estimates, they were still being used. This resulted from the reality that no better method had been put forward in place of estimating minimum numbers of individuals – archaeozoologists fell back on this method while acknowledging its many flaws. Hence, percentage MNI values are often used as a proxy for relative abundance in lieu of absolute (i.e. not 'minimum') values. Percentage MNI values are usually utilised in comparison with other MNI values – they are not seen as meaningful, absolute values (Grayson 1979). Plug and Plug (1990) stated that their examples of repeatedly sampled MNI count produced ratios demonstrated MNI counts that were biased and potentially highly erroneous. They proposed that the MNI counts were affected by taxon sample sizes and the number of identifiable bones in the skeleton. Domínguez-Rodrigo (2012), in his critical review of MNI, used an experimentally controlled study to test assumptions and critiques of this method of quantification. In regards to the sample size biases outlined by Plug and Plug (1990), Domínguez-Rodrigo demonstrated that repeated sampling of any bone assemblage is not possible, as "each sample under study is considered an independent non-divisible sample" (2012:56). In addition, Domínguez-Rodrigo pointed out that as MNI values are of a "scientific approximating nature" (i.e. *all* scientific interpretations of reality are never 100 percent certain), and epistemically they cannot be assumed to produce values that are 'known' to the user (2012:56). Therefore, when elaborating MNI values, sample size is not a variable affecting results. He also noted that the mathematical modelling of MNI by Plug and Plug (1990) did not take into account differential preservation of certain skeletal elements and element portions – archaeozoologists do not compare "the proportion of bones per taxon according to the number of bones in a complete skeleton [*n(i)/k(i)*]" when they estimate MNI, but instead "the highest number of discrete (high-surviving) elements in each skeleton" (2012:56). Inherently, bone assemblages are the result of a range of taphonomic processes (e.g. transport, butchery, attrition, etc.), and archaeozoologists therefore base their MNI calculations on elements which tend to survive well. Furthermore, Domínguez-Rodrigo noted that while Plug and Plug conceived of a faunal population in terms of "all the identifiable parts of the complete but disarticulated skeletons (or partial skeletons) of the animal population" (1990:54), when a more realistic conception of faunal population actually referred to the number of complete individuals. Accurate MNI estimates do not require complete faunal populations; "the number of surviving elements per skeleton is *irrelevant* [emphasis in original] to reconstructing the number of animals

represented" (Domínguez-Rodrigo 2012:57). Based on these arguments, it was concluded that MNI calculations were not biased by sample size. Previous arguments that MNI results in biased accounts of animals in small samples in relation to marginally represented individuals (Uerpmann 1973; Grayson 1978; 1984; Lyman 2008) have never been supported scientifically, because the datasets have always been archaeological in nature and the original numbers of individuals were therefore impossible to determine.

MNI data were used for both the present case study and the comparative analysis, in order to calculate meatweight values. They are the most common data values presented in the grey literature consultants' reports, many of which do not provide NISP or MNE values.

3.2.5 Bone Weight

Absolute weight of faunal remains can be used to quantify contents of bulk samples by classes of shell, bone, ceramic, metal, lithics, wood, charcoal, etc. At a finer-detailed level, within faunal assemblages, absolute weight can be used as a proxy for meat weight. If meatweight and nutritional data are available for the species identified in the assemblage, estimates of useable meatweight and total energy can be calculated. These values can then be used to rank the taxa in terms of importance in the diet of the people who originally deposited the assemblage. However, the attraction in the use of weighing is the assumption that the relationship between the weight of the skeleton and the weight of the whole animal is generally the same across species (see below for discussion of meatweight) (O'Connor 2000). However, weight as a method of relative abundance can be problematic. Post-depositional processes such as weathering, drying, mineralization, preservation, etc. will cause fluctuations in moisture content, and therefore bone weight (Lyman 1979; Reitz & Scarry 1985:17; O'Connor 2000). Even factors such as how clean the specimens are (particularly fragments and cancellous bone) can affect weight (O'Connor 2000). Even the basic premise that the larger, denser bones of larger species are more likely to preserve well than smaller species means that larger species will usually be over-represented when quantified by weight (O'Connor 2000). Other variations, such as the denser bones of flightless birds compared to their flying counter-parts, could have similar effects on preservation rates. Bone weights have been used in allometric equations which estimate the amount of consumed biomass (Reitz & Scarry 1985:17).

Bone weight was not used to quantify species abundance in either the case study or the comparative analysis.

3.2.6 MEATWEIGHT

In the early 1950s an approach was put forward for calculating meat yields for exploited species, multiplying minimum number of individual values for each taxon by an average weight of useable meat (White, T.E. 1953). In the New Zealand archaeological context, influenced by Graham Clark's (1954) use of faunal remains to reconstruct diet at Starr Carr, Wilfred Shawcross used five steps to reconstruct meatweight, diet and occupation duration at Galatea Bay site on Ponui Island (Shawcross 1967a; 1967c) and later at Houhora (Mt Camel) in Northland (1972). Issues which Shawcross himself identified with the reconstructions included assumptions of human population estimation, differential skeletal element survival and sampling and variations in meat:bone ratios (Shawcross 1967c:108; 1972:596-7).

The use of the 'meatweight' approach is supposed to overcome the weakness of MNI, where the significance of a large species may be understated by a small MNI value (Klein & Cruz-Uribe 1984). In other words, while MNI addresses how many animals are represented at the site, meatweight addresses the amount of food provided by those animals. In meatweight calculations, 'live weight' is defined as the weight of an animal while alive; 'available meat' is live meat minus hide and bone weight (Lyman 1979; 1994b). 'Consumable meat' is defined as the proportions of available meat of a species that were consumed by the people under study, exclusive of bone and hide. Analysts should define the consumable meat that their study group would have consumed, since this can vary between time, place and cultural group (Lyman 1979; 1994b). Examples of available meat that may or may not be included in consumed meat include hooves, fat, eyes, brains, etc. In a modification of the MNI approach, 'meatweight' (MTWT) has been defined as 'useable meat', and was put into equation form by White, T.E. (1953); (Lyman 1979:397; 1994b):

MNI (% live weight represented) (average live weight per individual) = MTWT

This equation was supposed to demonstrate the importance of a large species in a diet, which is not obvious in MNI or NISP counts (Klein & Cruz-Uribe 1984). White's application of the above equation relied on percentage figures from modern American concepts of consumable meat and butchering practices – an assumption that prehistoric concepts of available meat and butchery techniques are the same as modern ones. This is a flawed assumption (Lyman 1979).

Other problems with this equation included the underlying assumption that all members of a species have the same meatweight percentage, regardless of sex, age, season at death or geographical region (Lyman 1979). Also, this meatweight calculation is flawed when it assumes that each individual represents consumption of a complete carcass at a site, disregarding whether butchering was on– or off–site (Lyman 1979; Klein & Cruz-Uribe 1984; Landon 1996). Importantly, the meatweight calculation assumes that the MNI of a faunal assemblage accurately represents the preceding death assemblage, which is unlikely. Bones may be present in the assemblage because they were being used for tool manufacture, not as part of food discard (Klein and Cruz-Uribe 1984). It is important to note that any biases inherent in MNI calculations (Section 3.2.4) are inevitably carried through in the calculation of meatweight, i.e. sample selection.

An alternative way of calculating meatweight is called 'weigemethode', or 'weight method', which depends on the bone weight of the different taxa in a faunal assemblage (see earlier discussion) – the bone weight is multiplied by a factor that is supposed to represent the ratio between bone weight and meatweight in live animals of that taxon, such as 7% (Lyman 1979; Klein & Cruz-Uribe 1984). The flaws inherent in the bone weight method are transferred, where bones are affected by differential taphonomic processes such as weathering, mineralization, etc. (Lyman 1982; Reitz & Scarry 1985; Landon 1996). Other flaws lie in the assumption that bone weight to meat weight ratios are consistent across individuals within a species – there is allometric scaling as bigger animals require proportionally bigger bones to support their weight (Reitz & Scarry 1985:18). For example, the bones of a young lamb compose 6% of its body weight, while those of an adult cow account for 10% (O'Connor 2000). The same value and equation cannot be used for each element due to variations in bone:meat weight ratios; and there is a tendency to under-represent species which do not preserve well in the archaeological record (Lyman 1979; Klein & Cruz-Uribe 1984). This led Klein and Cruz-Uribe to conclude that "the bone weight index is a poor measure of species abundance" (1984:35). Lyman (1979) pointed out that one or two elements or portions of elements do not necessarily indicate a complete animal in terms of live weight. There have been, however, successful applications of quantifying by weight using allometric scaling for fish (Casteel 1974; O'Connor 2000).

The more precise approach for estimation of meat yields from archaeofauna uses calculations directly from the dimension of shells, teeth or bones from archaeological assemblages, and

then applies dimension-to-weight relationships previously calculated from thorough analysis of large samples from modern populations of the relevant species (Reitz & Wing 2008). For New Zealand fauna, dimension-to-weight algorithms are available for several fish and shellfish species (e.g. Leach, B.F., Davidson et al. 1997; Leach, B.F. & Davidson 2001; Leach, B.F. 2006). Smith noted that "the measurements necessary to apply them have been taken from only a small number of archaeological assemblages, limiting the extent to which they can be used in comparative studies" (2011a:1). Until data are available across all New Zealand archaeofaunal species, the default position is to use a refined version of White's less precise approach. This has been further developed and described by Smith (1985; 2004; 2011a).

Meatweight calculations based on MNI values in both the case study and the comparative analysis were used to calculate energy values, which act as a proxy indicator for importance in the diet.

3.2.7 Energy Yields and Nutritional Analyses

The method put forward by White (1953) for calculating meat yields was extended by Clark (1954), who converted these values for useable meat for each taxon into energy yields. Later, nutritional values for protein, carbohydrate and fat yielded by the meat were determined by Denniston (1972). The approach has seen further refinements with body part analysis to identify butchery units that were consumed and their corresponding meat yields, and increasingly precise nutrient and energy yield data (Smith, B.D. 1975; Stewart & Stahl 1977; Grayson 1979; Lyman 1979). As mentioned previously, Shawcross investigated nutritional components of prehistoric diet from two sites in the northern North Island (1967c; 1970; 1972); amongst many aspects of these sites, his work used the calorie yield of the faunal assemblages to estimate the size of the human populations and the duration of their occupations at the sites. Shawcross' work mobilised further research in more precise calculations for determining meatweights for the archaeological remains of various classes of fauna in New Zealand (Nichol 1978; Smith, I.W.G. 1985; Nichol 1988; Leach, B.F., Davidson et al. 1996; Leach, B.F., Davidson et al. 2001; Smith, I.W.G. 2004; 2011a). The method of calculating assemblage energy yields to evaluate the relative dietary importance of various taxa and classes of taxa has been developed and described by Smith (1985; 2004; 2011a). First, data sets for analysis are selected carefully; the assemblage must contain all faunal remains for a discrete period of activity, and be aggregated into the largest meaningful

assemblage for the research question. Secondly, while archaeofaunal remains are usually identified to species level, on occasion coarser identification is only possible to the genus or family level, or to even more generic categories such as 'seal or dog' or 'fish sp.'; if these are not subsumed by specific species during MNI calculations, it is necessary to define appropriate values for meatweight, nutritional and energy yields for these less precise taxonomic categories. While these values are calculated by species, they are described in seven broad faunal categories; the same basic analytical procedures apply to each of the categories, and some share key data inputs. Third, MNI is used to measure abundance, with the underlying assumption all animals in the assemblage were complete when they were arrived at the site prior to deposition, meaning that all useable meat would have been available for consumption. This assumption is reasonable for the shellfish, fish and small-to-medium bird species, but is uncertain for dogs, and not applicable to larger species such as seals, cetaceans and moa. The latter group is often represented in assemblages as incomplete skeletons, which have been butchered off-site. In these cases, Minimum Numbers of Butchery Units (MNBU) are calculated instead of MNI, i.e. "the smallest number of butchery units necessary to account for all of the remains of a taxon in an archaeological assemblage" (Smith, I.W.G. 2011a:3). For the larger mammals, differences in size relating to age and sex are also taken into consideration. The next step in the process relies upon mean weights of useable meatweight for each taxonomic group or species; conservative estimates for mean useable meatweights in the New Zealand context are used and listed in Smith (2011a). Values for finfish and a small number of shellfish were sourced from detailed proximate composition analyses (Vlieg 1988); the values for remaining taxa were derived from comparable species or best available sources (White, T.E. 1953; Altman & Ditmar 1968; Denniston 1972; Stewart & Stahl 1977; Alexander, Maloiy et al. 1979; Smith, I.W.G. 1985; Paul 2000; Worthy & Holdaway 2002; Bunce, Worthy et al. 2003; Worthy, Bunce et al. 2005; Leach, B.F. 2006; 2010; Maxwell 2010; Raven & Bracegirdle 2010). As with meatweight, it is important to note that any biases inherent in MNI calculations (Section 3.2.4) are inevitably carried through in the calculation of meat weight, i.e. sample selection.

3.2.8 FORAGING THEORY

Foraging theory covers a suite of optimal-foraging models where the aim is usually to maximise foraging efficiency (Krebs & Davies 1981; Stephens & Krebs 1986; Marean & Cleghorn 2003). Foraging theory models were originally developed in an ecological

framework for analysis of periods of relatively short duration, but have been utilised within archaeology for decades (Nagaoka 2002b). Within archaeozoology, foraging theory has generally been used in skeletal element abundance and species abundance analysis (Grayson 1991; Broughton & Grayson 1993; Broughton 1994b; 1994a; 1997; Grayson & Delpech 1998; Stiner, Munro et al. 1999; Stiner, Munro et al. 2000; Grayson 2001; Grayson, Delpech et al. 2001). Several assumptions are implicit in foraging theory; 1) foragers select prey to maximise their foraging efficiency; 2) a measure of foraging efficiency (such as calories captured per unit of foraging time) is highly correlated with fitness (Stephens & Krebs 1986; Nagaoka 2002b).

The prey-choice model allows archaeologists to examine how foragers selected the resources they exploited (Nagaoka 2000; 2001; 2002b). The model predicts which resource will be exploited or ignored upon encounter in a relatively homogenous environment (Stephens & Krebs 1986; Nagaoka 2001; 2002b). Prey are ranked by their net energy return (given the costs of pursuing, capturing and processing); where net energy values for taxa are unknown, body size is sometimes used as a proxy. The prey-choice model proposes that the most efficient strategy for a predator is to take the highest-ranked prey when they are met by chance; the rate at which lower-ranked prey are taken is correlated with the frequency of the encounter of higher-ranked resources. Encounter rates are therefore dependent on prey densities – as high-ranked prey decrease in abundance, low-ranked prey are more frequently taken. Other factors taken into consideration in the prey-choice model are limited prey mobility and predator population increases, both of which are likely to cause resource depression of high-ranked prey. Resource depression is "the decline in encounter rates of prey due to the foraging behaviour of predators" (Nagaoka 2002a:86). This is documented by measuring changes in diet breadth, or the number of resources utilised, and changes in foraging efficiency, or the net return per unit of time (Broughton 1999; Grayson & Cannon 1999). The basic premise of the prey-choice model is that high-ranked resources are taken first as they yield the highest returns in energy. The prey-choice model therefore predicts that high-ranked taxa are vulnerable to resource depression, as they are always selected upon encounter (Bayham 1979; Broughton 1994b; 1994a; 1997; 1999). Lower ranked resources are selected when higher ranked ones decline in abundance. Diet breadth is defined as the number of resources included in a diet (Nagaoka 2001). Diet breadth expands as higher-ranked species are encountered less-frequently (Butler 2001:89; Nagaoka 2001:102-3). Richness measures the number of species in a population (Nagaoka 2001), while evenness measures the

abundances of species within a population – where abundances of different species are different, the population is uneven. Differences in evenness over time can reflect changes in the relative importance of high and low-ranked resources in the diet of the predator, especially where the high-ranked resources were originally abundant. An increase in the evenness index should indicate a decrease in foraging efficiency. One issue with evenness is that it does not recognise the rank position of prey in a set of ranked resources, with the result that the evenness index remains static in spite of changes in resource exploitation. Therefore, the proportion of individual prey types must be examined in order to determine if the diet is changing when evenness is static (Nagaoka 2001). Richness can be used to quantify the number of prey types in the diet; an increase in richness indicates an increase in diet breadth due to lower-ranked prey being added to the menu. Diet breadth has often been analysed in archaeological contexts in terms of the number of taxa (NTAXA) in a faunal sample (Broughton & Grayson 1993; Grayson & Delpech 1998), however Nagaoka noted that while it estimates diet breadth, it may be more suitable for distinguishing differences between samples than similarities. Although Grayson (1984) stated that sample size can affect both evenness and richness measures and Nagaoka (2001:104) concluded that "the role of sample size in structuring the data must be assessed", Domínguez-Rodrigo (2012) recently demonstrated that MNI (and therefore measures derived from MNI) are not affected by sample size.

In order to meet the prey-choice model assumption that prey are encountered in homogenous environments, taxa from an assemblage are assigned to defined patches of environment type (Nagaoka 2002b; 2002a). This ensures that the data meet the criteria for randomly occurring, as opposed to "clumped" prey encounters. This ensures the probability of any one prey type being encountered is equal across space (Stephens & Krebs 1986; Nagaoka 2001). The prey-choice model is applied to each patch separately, allowing differences (or similarities) in exploitation patterns in each patch over time to become obvious. While patches are employed to overcome the prey choice model's assumption that prey are distributed evenly across space, for butchery and transport, the patch is scaled down to individual prey items which have already been gathered or hunted. In this context, the patch choice model "examines how much time a forager spends extracting resources from a large prey item before moving to the next one" (Nagaoka 2002a:93). The implicit assumption is that the prey caught must be of sufficient size that it needs to be butchered in order to transport it.

The Marginal Value Theorem (MVT) was developed in response to resource depression (Charnov 1976; Charnov, Orians et al. 1976); it analyses how long a predator should stay within a patch (Nagaoka 2002b). Assuming that transport costs do not change over time, MVT predicts for large, high-ranked animals that "as encounter rates of prey and overall foraging efficiency decline, the amount of time a forager spends extracting resources from a carcass should increase" (Nagaoka 2002a:93). Therefore, the proportion of each prey individual should increase, beginning with high return portions and adding increasing numbers of low return portions. Identified changes in skeletal element representation over time may correspond with declining foraging efficiency from resource depression, where the MVT is used to examine changes in transport over time. The MVT assumes that transport costs are not a factor, as prey are being consumed at the point of capture. When resource abundances near home have declined to the level where foragers are forced to travel further for their prey, transport costs are accrued and increase with distance. In these situations, central-place foraging models, where foragers return to a home base with their prey for consumption, predict that as distances and transport costs increase in order to reach prey, foragers become selective for larger, higher return items, in order to get the highest return for each trip. It follows that as distance to prey within a patch increases, the proportion of prey retuned to home base will decrease, with a preference for high-return portions. Mean utility then measures the "average returns or utility per element for each stratigraphic layer or temporal unit" (Nagaoka 2002a:93). The larger the mean utility value, the higher the proportion of high return elements being transported. Nagaoka observed that other studies (e.g. Cannon 2000) had demonstrated that variability within the environment produces different patterns of resource use.

The Ideal Free Distribution model (IFD) was developed within population ecology (Sutherland 1996) and within archaeology is used to provide a "useful framework for considering the changing set of ecological circumstances within which individual decision making takes place" (Kennett, Anderson et al. 2006). The habitats or locations of settlements are ranked by their suitability; this measure is associated with the net productivity of the resource habitat and also the fitness of the original occupants (Winterhalder & Smith 1992; Shennan 2007). The suitability of a habitat is dependent on population density; as the predator population increases, the habitat suitability decreases as a result of exploitation. A key prediction of the IFD is that a colonising human population will select the best habitats available for initial location. As the population of the colonising humans increases, the

suitability of the chosen habitat declines, as a result of either interference from competition or density dependent resource depletion. When the suitability of the first-ranked habitat drops to the same level of the second-ranked resource habitat or patch, the successive population growth will be divided between both patches. Individuals relocate to their own best advantage; at the population level this results in an equilibrium distribution over marginal habitats with equal suitability (Kennett, Winterhalder et al. 2009). Allen, M.S. (2012) used the IFD to consider interactions between foraging efficiency, competition and agricultural developments at the regional scale and its associated effects on mobility in far northern New Zealand, in relation to molluscan foraging efficiency.

3.3 Observing and Recording the Condition of Faunal Remains

This section looks at general issues to do with taphonomic analysis – age, butchery marks, burning, weathering, and animal attrition. Taphonomy is defined by Lyman as "the science of the laws of embedding or burial… it is the study of the transition in all details, of organics from the biosphere into the lithosphere or geological record" (1994a:1). The study of taphonomy - in this context the study of modified archaeozoological specimens - is often perceived as important because it implies that "the zooarchaeological and ethnobotanical records are biased if some non-human related processes have affected the conditions or frequencies of biological remains" (Lyman 1994a:1). However this is not always accurate. Taphonomy is significant because it is part of the deposition of often large parts of the archaeological record; taphonomic studies on archaeozoological and archaeobotanical remains of the archaeological record involves "the study of those processes of preservation and how they affect information" (Behrensmeyer & Kidwell 1985:105, quoted in Lyman 1994b).

Of interest in archaeofaunal assemblages is the process of bone formation and growth in vertebrates, as the cartilaginous model of a bone is gradually ossified (Lyman 1994a). Age at death can sometimes be determined in vertebrate species by examining epiphyseal fusion of long bones. Silver (1969) is generally referred to as a guide to age at epiphyseal fusion in distal and proximal ends of long bones of various domestic mammals, including dog, cow, pig and sheep. Reference collections with a range of specimens of different known ages can also be used to identify age-at-death. However, it should be noted that the fusion of epiphyses can vary between populations, sex, individuals, and also be influenced by environmental

conditions (Davis, S. 1987; Tucker 1999). Another potential issue is that the bones of sub-adults are less likely to survive in the archaeological record than those of their adult counterparts, which can lead to misrepresentation of the age–at–death of the death assemblage (Lyman 1994a).

Lyman (1987:252) defined butchering as "the human reduction and modification of an animal carcass into consumable parts", where "consumable" is "broadly constructed to mean all forms of use of carcass products, including but not restricted to consumption of products as food" (Lyman 1987:252). Primary butchering refers to dismembering a carcass, while secondary butchering is the further subdivision of the dismembered carcass into smaller units of meat (Reitz and Wing 1999:128). Tertiary butchering generally refers to cut marks made during the meal preparation and cooking process, as well as during consumption. Butchery marks can inform archaeologists about the types of tools used in the butchering process, for example surface cut marks are generally assumed to be made with a knife during tertiary butchering, and element reduction is usually associated with part of a bone being removed through chopping with a cleaver or sawing, during secondary and primary butchering. There are said to be five distinctive butchering and skinning marks made by humans that can be identified: cut marks, scrape marks, chop or hack marks, blows and saw marks. However, sometimes these butchery processes do not leave behind any marks on a bone; even though they are not present, it does not mean that butchering has not occurred.

Burning can be defined as resulting from excessive heat, which modifies or damages the heated object (Lyman 1994a). An important distinction needs to be made between naturally burnt bone, and bone that has been burnt by humans (Lyman 1994a). Burning of bones widely and consistently across a site may be evidence of a fire event; in order to confirm this there would need to analyses of charcoal from microfossil floral remains in soil samples from the site. Roasting generally chars bones, while disposal in a fire would show much more intense levels of burning (Reitz & Wing 1999; Orton 2010). It is unlikely that considerably burnt bone would be direct evidence of cooking – the aim of cooking meat does not usually include burning it. The frequency of burnt bone in an assemblage can be used as an indicator of assemblage survival. Burning under different temperatures results in a range of bone colours: from black at low heat levels, to white or blue at very high heat levels (Lyman 1994a). As well as temperature, colour of burning varies with duration and type of heating, and also condition before heating, and the depositional environment afterwards (Orton 2010). Burning

causes bone to shrink by up to five per cent, especially under very hot conditions. Lyman notes that some analysts present NISP counts or proportions for the amount of specimens in each assemblage that exhibit evidence of burning; these are little more than descriptive, especially if bones burned intentionally by humans have not been divided from those burned accidentally or by non-human events (1994a). Determining the proportion of particular element portions that exhibit evidence of burning may indicate whether they had been de-fleshed before they were heated, and therefore be interpreted as evidence of cooking and perhaps method of preparation (Lyman 1994a; Orton 2010).

Behrensmeyer (1978:153) defined the weathering of bone as "the process by which the original microscopic organic and inorganic components of bone are separated from each other and destroyed by physical and chemical agents operating on the bone in situ, either on the surface or within the soil zone". Weathering is a natural process of nutrient recycling, and is influenced by a range of factors including the severity of the weathering conditions, the length of exposure, and the size and density of the element (Reitz and Wing 1999:137). The most damaging weathering processes are alternating hot and cold, and wet and dry conditions. Water from streams, rivers, water tables and tidal flow can also act as weathering agents (Reitz and Wing 1999:138). Weathering can be measured on scales which have been established through experiments in laboratory conditions (Behrensmeyer 1978; Johnson, E. 1985; Reitz & Wing 1999). Soil pH level, skeletal element, taxon, depositional microenvironment, vegetational habitat, microenvironment of a spatial point, years since death and exposure duration are all variables that affect rates of weathering (Lyman 1994a).

Dogs and rats are common causes of gnaw marks, and may indicate scavenging by these species, or in the case of dogs, deliberate feeding of scraps by the humans that they were associated with. Rabbits, hares, mice, cats and even reptiles also gnaw on bone (Reitz and Wing 1999:134). Gnawing implies that faunal remains were exposed for a period before burial; additionally the severity and frequency of marks can be used in conjunction with element frequencies to indicate major agents of destruction (Orton 2010). Gnaw-marks are described as leaving 'irregular broad-grooves and pit-like features' made by the carnassials, canines and incisors of carnivores (Reitz and Wing 1999:134). Gnawing increases the intake of calcium which can be scarce in some diets (Reitz and Wing 1999:133). Carnivores often gnaw the cancellous ends of long bones first, which leaves the shaft with ragged ends, also referred to as *crenulated edges* or *ragged-edge chewing* (Lyman 1994a; Reitz & Wing 1999).

Shallow pitting or *pitting* is usually restricted in distribution to parts of bone that are strong enough to withstand the pressure of teeth without being punctured (Lyman 1994a). *Punctures*, *puncture depressions* and *perforations* all refer to the roughly oval depressions caused when bone collapses under the pressures of teeth, probably canine teeth, at right angles to the bone surface (Lyman 1994a). The dragging of teeth across a bone surface results in *striations*, *gouge marks* and *scoring*, which are generally short, parallel straight marks that are roughly transverse to the long axis of the bone. *Furrows* are irregular and randomly-oriented grooves often found on the ends of long bones, where the bone is cancellous (i.e. porous and much less dense). Extreme furrowing is called *scooping out* or *hollowing out*, and involves the extraction of the cancellous bone from the epiphyseal ends of long bones; it results in large, irregular holes (Lyman 1994a). Animal attrition gives us information about whether humans were the primary agent responsible for the assemblage; gnaw marks are also indicators of scavengers or predators who may have introduced the remains or moved them on the site; inference that gnawed bones were not disposed of by burying is also possible (Reitz & Wing 1999). Methods for recording gnawing vary from simplistic scales to complex systems that record type, degree and extent of damage (Orton 2010). Weisler and Gargett noted that "rats prefer to gnaw on bone that is no longer greasy… gnawing on archaeological bird bone does not necessarily indicate rodent predation" (1993:88).

3.4 CASE STUDY: SITE INVESTIGATION AND ANALYTICAL METHOD

3.4.1 INVESTIGATION

The site referred to as Cabana Lodge is located adjacent to the Whangamata Wharf, Whangamata, on the east coast of the Coromandel Peninsula (Figure 3.1). It is recorded in the New Zealand Archaeological Association Site Recording Scheme as T12/3. While Gumbley's (2003b) assessment of the Cabana Lodge (T12/3) site acknowledged that neither it nor the nearby deposits of the Whangamata Wharf (T12/2) site had been radiocarbon dated, it noted that Jolly's (1978b) report clearly interpreted the 'Archaic' phase deposit of the Whangamata Wharf as part of the same site as Cabana Lodge. Gumbley concurred with Jolly's (1978b) report, assessing the two record sites as "contemporary in archaeological terms and to consider them separately would be artificial" (2003b:7). The Whangamata Wharf (T12/2) site is recorded approximately 130 metres to the east of the Cabana Lodge site; subsequent excavations in 2007 (Gumbley & Hoffmann 2008) substantiated this interpretation (James-Lee & Gumbley 2012). It is recognised that some archaeologists may disagree with the interpretation that the two recorded sites of Cabana Lodge and Whangamata Wharf are parts of one larger site. However, as this still remains a moot point, the proximity of the deposits of the latter site to the former make it directly relevant to the interpretation of Cabana Lodge. On this basis, both sites are described below.

3.4.1.1 *RECORDS IN THE NZAA SITE RECORDING SCHEME*

T12/2 was originally recorded on the New Zealand Archaeological Site Recording Scheme as Whangamata Wharf N49/2 by Roger Green (date of recording not stated). He described the location of the midden site as "On south bank of Whangamata Harbour by the wharf, where the bar narrows to river proportions. Site is in part covered by road" (NZAA site record T12/2). The site was in poor condition due to road works, beach development and wharf improvements. Green noted that one hour was spent by himself and Robert Jolly sketching a map and tape plan; they also collected obsidian and bone samples. The midden contained pipi and other shellfish species, fish and mammal bone, chert and chalcedony flakes, obsidian and charcoal. The latter may have been indication of hangi. Green described the size of the site: "Area extensive, under road and in road cut and under path to wharf – extends east along beach – more than 100 yards of the beach involved and 20 yards back from the present edge

of the bank in places". A sketch of the stratigraphy indicated 1 foot of topsoil overlying 1.5-2.0 feet of midden deposit on a base of beach sand. Most, if not all of the site was on active dunes stabilised by grass coverage. The undated addition of the reference to Allo's (1972) investigation of the site, and also of 'working floor' to the midden site type, were added to Green's original site record entry for T12/2, but Allo did not update to the record herself.



Figure 3.1 Map showing location of the Cabana Lodge site (T12/3), Coromandel Peninsula

In 1980, Furey inspected the site to determine its condition and provide management recommendations to the Thames-Coromandel District Council (TCDC). The visible extent of

the historic midden layer had increased between April and July 1980, and the 'Archaic' midden face had been exposed by 0.5 m in the same period. Sand trap mesh fences were recommended to stabilise the dunes and raise the beach level, which then would be planted. Furey noted the wall TCDC were intending to build an erosion prevention wall in front of N49/3 (T12/3) to the west of the wharf.

In 1982, Easdale and Jacomb inspected the site as part of the Hauraki Catchment Board Coromandel Coastal Survey (1982). They also noted that much of the site had been destroyed or covered by the road, car park and toilet block. Small eroding sections were intermittently visible south of the wharf; these contained cockle, pipi and charcoal.

The last update to the site record was made in June 2012, based on an inspection in April that year, for a proposed extension of the Whangamata Ocean Sports Club, and referenced a report by Phillips, C.A. (2012) and a Section 18 authority (2012/676) issued by the Historic Places Trust. The update noted three "overlapping layers of midden", and speculated the upper layer was of a similar period to that identified by Allo, ca. 1870 AD; the middle layer dated to 1534-1645 and suggested the lower layer had a similar date to that identified by Allo and at T12/3, of 1350-1400 AD. The proposed extension of the sports club would affect part of the site.

T12/3 (Cabana Lodge) was recorded on the New Zealand Archaeological Site Recording Scheme in April 1962 by R.G. Jolly as N49/3, a beach midden located "Between road and beach along the 'port' area of Whangamata Harbour, just across from the area called Cabana Flats. The area here between road and beach is very narrow…". The site was observed to be a midden deposit "of more than a foot in depth" (i.e. < 0.30 m); as with T12/2, repairs to the road, building construction and erosion were observed to be damaging the site. Janet Davidson inspected the site and recorded an update to the site record in 1969 subsequent to the Shawcross and Jolly excavation and surface collection of 1962. She recorded the extent as

> …partly located on the land occupied by the Cabana Flats or Cabana Lodge, Beach Road, Whangamata, principally in the front garden and formerly extended across the road to the foreshore opposite the lodge. It also extends minimally into the piece of Crown Land on the corner of Port and Beach Roads (T12/3 [N49/3] Site Record).

Davidson described the midden as containing ‘Archaic’ artefacts including trolling and bait fishhooks, an imitation whale-tooth pendant, adze making debris and roughouts and a greenstone chisel. The presence of a post-contact deposit above the ‘Archaic’ layer was noted and thought to be possibly contemporary with the upper layer of N49/2 (T12/2). The ‘Archaic’ layer of N49/3 (T12/3) was also thought to be possibly contemporaneous with N49/2 (T12/2) and possibly part of the same site.

Easdale and Jacomb updated the site record for T12/3 (N49/3) in 1981 during an inspection of the site as part of the Hauraki Catchment Board Coromandel Coastal Survey (1982), and included a site plan (Figure 3.2) of the midden “extending onto the reserve section on the corner of Port Rd and Beach Rd and along the frontage of Port Rd for the whole of the block” (Gumbley 2003b:3). Although much of the site had been destroyed, midden was “observed in several places nearby” (NZAA site record T12/3), including on the corner of Port Road and Beach Road in the “soil along the edge of the building section” (NZAA site record T12/3), where pipi and cockle shells and basalt and obsidian flakes were identified. Between Port and Rutherford Roads, the bank of the beach was in places observed to be eroding deposits containing basalt, obsidian, pipi and cockles, notably at 80 and 100 metres upstream from the wharf. Otherwise the bank of beach (and therefore the midden deposit) were stabilised beneath grass; the midden was thought to be “present for most of the extent of the estuary bank, right up to N49/269”.

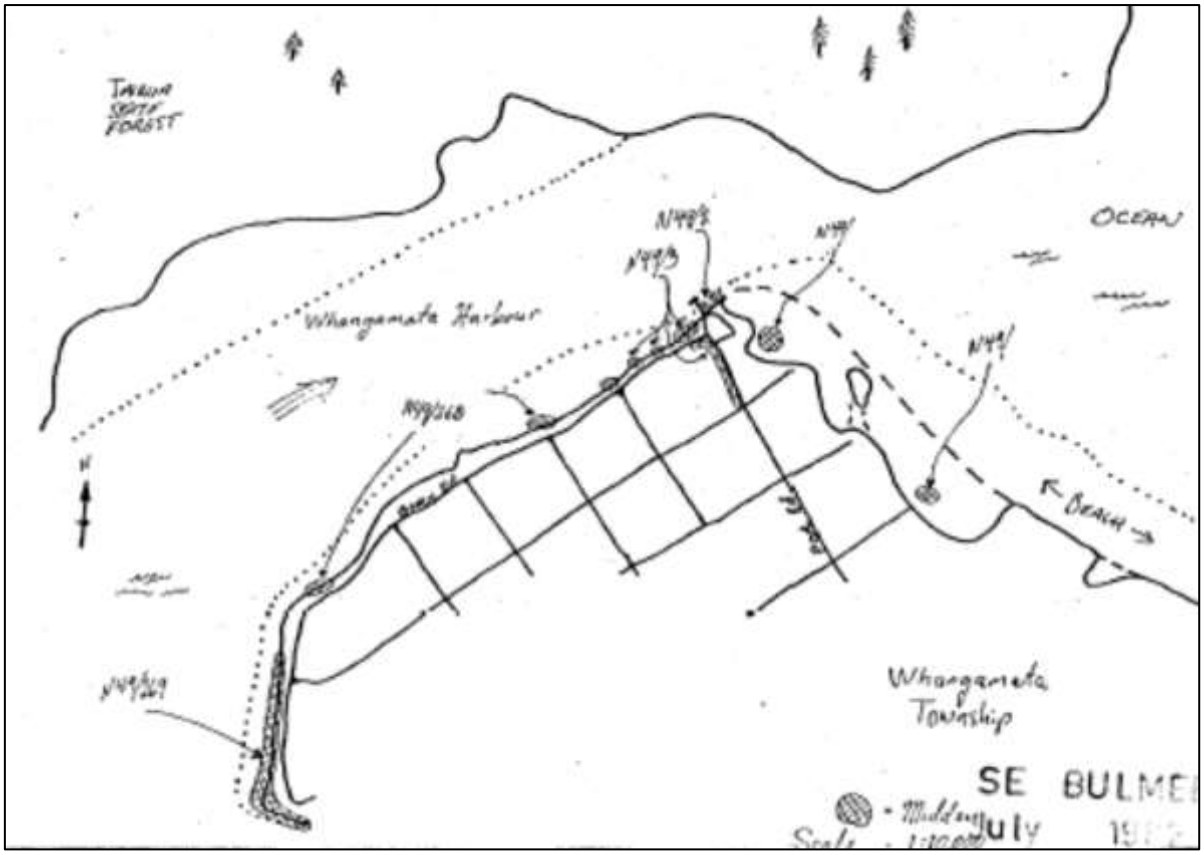

Figure 3.2 Site plan of T12/3 (N49/3) by Easdale and Jacomb (1981) from NZAA Site Record T12/3

The T12/3 site record from was not updated until July 1997, when Warren Gumbley briefly inspected the site and noted that it was difficult to estimate the inland extent of it; erosion debris from the midden deposit was visible on the tidal flats up to 35 m from the shoreline. The last update to the site record for T12/3 was submitted in 2010, as part of the NZHPT Coromandel Coastal project which visited the site in August 2006. The description noted the bank stabilisation works in front of Cabana Lodge (with rocks at ground level) had deposited sand, flakes and shell behind the rocks. Obsidian and basalt flakes were observed in the intertidal area approximately 25 m from the bank of the foreshore, with the area in front of Cabana Lodge showing the greatest density of artefacts.

3.4.1.2 *Reporting in Published and Grey Literature*

In the New Zealand Archaeological Association Newsletter (NZAAN), Jolly and Green mentioned a formerly extensive beach midden site near the wharf at Whangamata Harbour, which had been largely destroyed by "roading and parking improvements coupled with holiday activities" (1962:43). They noted that the faunal material and artefacts, although smaller in amount, was similar to that recovered at Whiritoa. It is not clear if this midden was part of T12/3 (west of the wharf) or T12/2 (east of the wharf).

Shawcross, in his analysis of three archaeological lithic assemblages, presented data from an assemblage at Whangamata "gathered as a weekend's visit which turned into a small controlled excavation" (1964b:17) in 1962 (Gumbley 2003b:2). Allo later identified this location as "on the bank immediately above the beach a little to the west of the wharf site, and just across the road from the Cabana flats", indicating that he was referring to T12/3 (N49/3) (1972:61). Shawcross noted only a drill point and a pounamu chisel in terms of formal tool types (although numerous flakes of obsidian and basalt were also present), but did not specifically state an interpretation of which cultural or temporal period the assemblage was indicative of (1964b:23). Allo later indicated that the assemblage's basalt flakes were of the 'Classic' period, and implied that this deposit was a separate site from the 'Archaic' period site of which she had excavated parts of (1972:61).

The Cabana Lodge site T12/3 (N49/3) was excavated by the owner of the Cabana Lodge flats, Mr East, and R.G.W. Jolly in April 1968, but was not reported on until ten years later (Jolly 1978b:135). Jolly indicated that the site was extensive (but did not provide a map plan of the site), spanning Beach Road, along the harbour margin and under the Cabana Lodge Motel (which is still present at the time of writing). The excavations on the Cabana Lodge property took place after a hole was dug to establish a garden; Jolly identified four layers: "Layer 1 was sand darkened by ash and by gardening. Layers 2, 3 and 4 were grey rather than black and were well preserved" (1978b:135). Jolly reported three bone lure shanks from Layer 1; he suggested that the deposits at Cabana Lodge (T12/3) and Whangamata Wharf (T12/2) were contemporary and likely to be parts of the same site, probably covering an area of 500 metres by 100 metres (Jolly 1978b:136; Gumbley 2003b:2). Much of the archaeological material recovered from Cabana Lodge (from both the Jolly investigation and surface collections) has been stored at the Auckland Museum – mostly stone including basalt waste flakes from adze manufacture, obsidian flakes, calcareous stone (chert or chalcedony) flakes, but also worked

bone remains of moa and sea mammal fashioned into fish hooks and shanks; an imitation whale tooth pendant reported by Jolly (1978b) is missing from the collection. Also the collection includes a sizeable amount of fishbone (particularly snapper *Pagrus auratus*), cockles (*Austrovenus stutchburyi*), Cooks turban (*Cookia sulcata*), ostrich foot (*Struthiolaria papulosa*), and whelks (*Thais orbita*). In 1981 the site was visited by Easdale and Jacomb, who drew a sketch plan showing the midden deposit of T12/3 extending onto the reserve section on the corner of Port and Beach Roads and along the frontage of Port Road for the whole of the block (Easdale & Jacomb 1982).

In 1969, the archaeological deposits east of the Whangamata Wharf, recorded as site T12/2 (N49/2), were investigated and later reported on by Allo (1972). In a limited excavation of 28 m², from a site extent she estimated at "two or three acres" (0.809 - 1.214 ha; Allo 1972:61), she recorded two layers, the upper containing nineteenth century remains, and the lower containing a modest artefact assemblage, including a one-piece fishhook, pieces of two adzes, obsidian flakes and cores; and a faunal assemblage containing the remains of fur seals, dogs, birds, fish and shellfish (Allo 1972:64-6, 69-76). Fragments of burnt human bone were also present; although no mention of butchery marks was made, Allo speculated the fragmented remains were indicative of cannibalism (1972:76). Interestingly, Allo's analysis concluded that seals and dogs provided most of the edible meat respectively, but shellfish made up relatively little of the diet of the prehistoric occupants at Whangamata Wharf (1972:78). The bias away from shellfish reinforced her interpretation of 'Midden B' as an 'Archaic' cultural deposit. Allo, probably due to the limited proportion of the site excavated, made no attempt to categorise the function of the site.

As part of an archaeological assessment, Gumbley (2003b) assessed the property at Cabana Lodge Motels and two neighbouring lots on Bond Road to determine the extent of the archaeological deposits. Gumbley excavated nineteen test-pits, with eight located in the lodge property, nine on lots 12A and 13 fronting Bond Road to the north-west, and two in the reserve adjacent to the lodge at the corner of Beach and Port Roads (Figure 3.3), reporting:

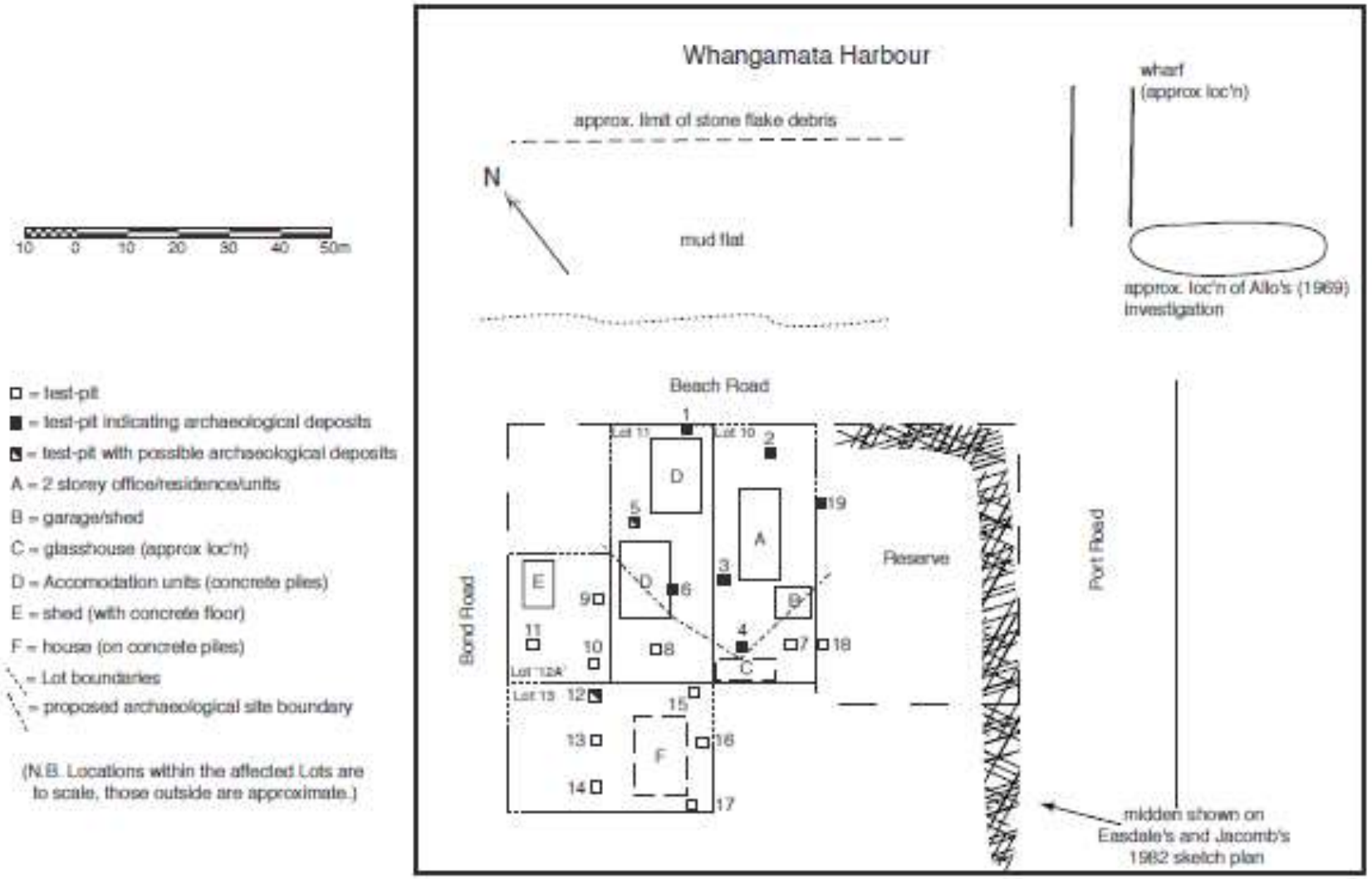

Figure 3.3 Plan of Cabana Lodge Motel and test pit locations (Gumbley 2003b:11)

> Six of the test-pits show clear evidence for the presence of archaeological deposits formed by cultural activities represented in one to four layers. The soils are heavily blackened by the addition of large quantities of charcoal and each test-pit contained midden (shellfish valves, charcoal, fish and bird bones, heat fractured 'hangi' stones, stone flakes (obsidian, and basalt)). A seventh test-pit (4) had a similarly blackened soil to the others but no midden was present (Gumbley 2003b:4).

In June 2007 Gumbley started investigations at Cabana Lodge under the conditions of an authority (No. 2007/108) granted by the New Zealand Historic Places Trust. Six areas were excavated, labelled A, B, C, D, E and F (Figure 3.4), the extent of which was restricted by the existing motel buildings and boundaries of the property. Areas A, B, C, D and E together covered ca. 56 m², while Area F was approximately 42 m². The latter area was divided into roughly equal halves and labelled Areas Fz and Fy (Gumbley & Hoffmann 2008).

The following is quoted directly from Gumbley and Hoffman (2008:1-2) as a description of the excavation methodology:

> *Stripping and cleaning*
>
> A 1-tonne hydraulic digger was used to strip the driveway concrete and turf from the investigated areas. Due to the small working space available across Areas A-E, Areas A, C and E were stripped first, and their spoil was placed across Areas B and D. In turn, the Area A, C and E spoil was replaced and Areas B and D were stripped and investigated. Area Fy and Fz were similarly stripped of turf and concrete.
>
> *Surveying*
>
> A Total Station Theodolite, with a level of accuracy to within 1cm, was used to plot the relative position of each designated investigation area, test trenches, positions of drawn section profile, and the archaeological features present within them. Disturbance areas, such as that caused by service trenches etc. were also located on the survey plan. A separate paper record of the dimensions and attributes of each feature was also kept.

Test-trenches, excavation, section profiles and sampling

Views of the site stratigraphy and nature of the archaeological deposit were gained by the hand-excavation of test-trenches within Areas A, C, E and F. No test-trenches were excavated with-in Areas B and D. Results of these tests allowed appropriate strategies for the further excavation and sampling of each Area.

Area A was excavated with two 1 m-wide test trenches along the northern boundary (parallel to the road and footpath) and the western boundary of the area. Subsequent to the excavation of both trenches, the remainder of the area was excavated by spits to the underlying non-cultural layer.

No test-pitting of Area B was undertaken as the southern baulks of Area A and Area C indicated that deposits in Area B would be of similar depths to that of Area C. The deposit was excavated in two spits; upper and lower.

In Area C four test squares (1 m^2) and one 2 x 1 m test trench were excavated in 10 cm spits. The first spit showed evidence of disturbance. The remainder of Area C was excavated with only one upper spit of 10 cm and the remainder of the deposit as the second spit.

As indicated by deposits in Areas C and E, the Area D deposit increased in thickness in an easterly direction. It was excavated in 10 cm spits.

In Area E, a single 1 m-wide trench was placed along the extent of the eastern boundary of the area, and excavated in 10 cm spits. The remainder of Area E had been previously disturbed by the laying of service trenches, and was therefore not excavated.

Area F is composed of two sub-areas referred to as Fy and Fz (Figure 3.4). Three test-trenches were dug across the whole area. Trench one was approximately 1 m wide, dug by a hydraulic excavator halfway across the area. Subsequently, the eastern edge of this trench became a baulk extending north-south, marking the dividing line between sub-areas Fy and Fz. A large midden deposit was encountered during the excavation of Trench 1, but was left intact to be later excavated by hand. Trench 2 was dug by hand, spanning the northern boundary of both sub-areas, and was approximately 0.5 m wide. Test Trench 3 was also dug by hand, approximately 0.5 m wide, and was extended in line with and approximately parallel and

adjacent to the eastern property boundary and ca. 2 m east of Area F. The soil in both trench two and three was quickly identified as disturbed, so they were not excavated in spits or sieved. As well as the north-south baulk described above, another baulk was retained, on an east-west baulk; intersecting with the former baulk at approximately the centre of Area F.

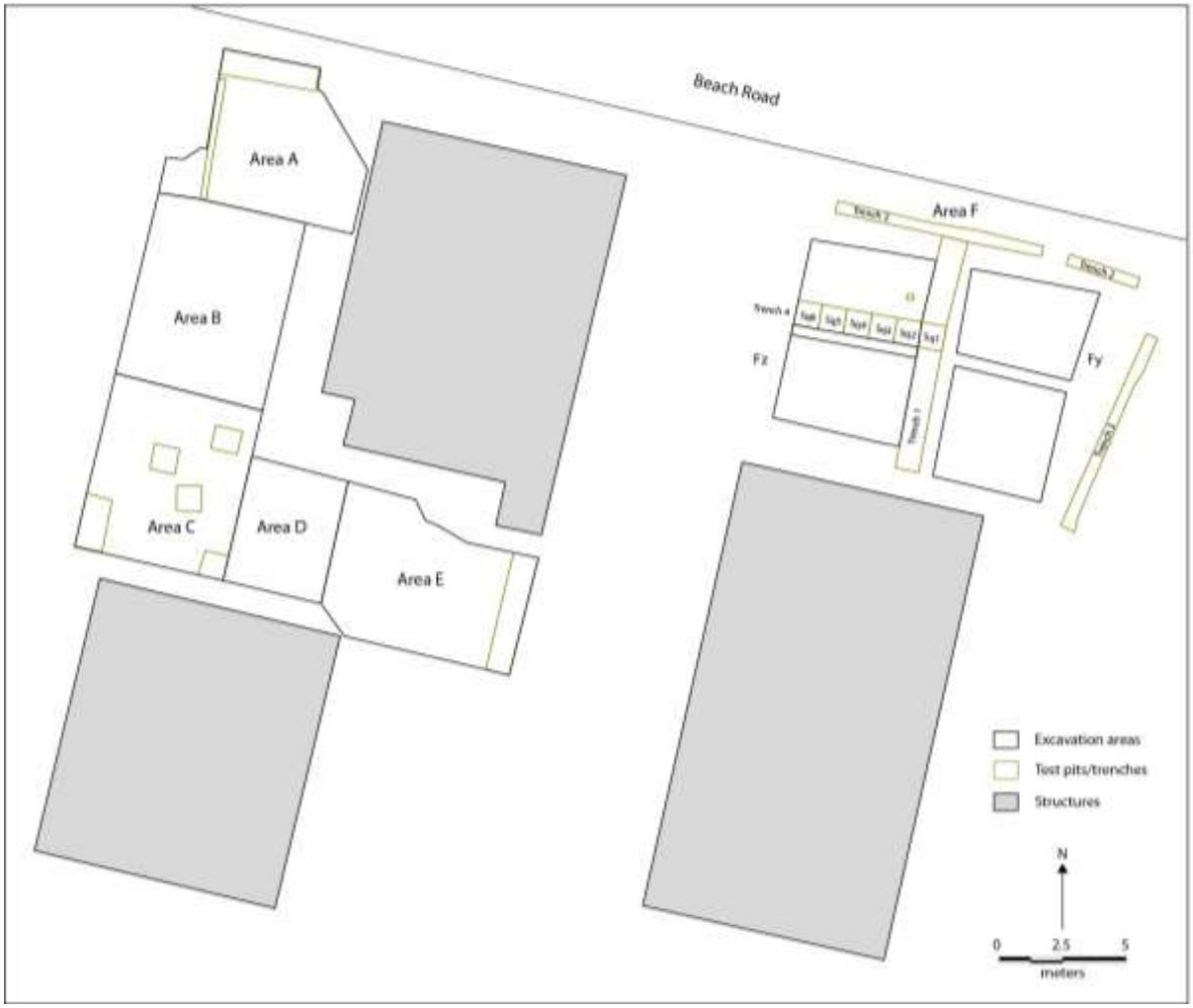

Figure 3.4 Excavation plan of Cabana Lodge (T12/3), Whangamata, Coromandel Peninsula

Adjacent to the northern side of the east-west baulk, in sub-area Fz, a 1 m-wide trench, test trench four, was established in the core area of the midden deposit. The trench was divided into six 1 m² squares, which were further divided into quadrants (NW, NE, SW, SE). The midden within each layer was completely sampled, and any artefacts identified were collected and catalogued separately. This midden was referred two as Layer 2. The cultural layer underlying the midden was not included in these samples and was excavated separately. The remainder of Area F was excavated following stratigraphic layers, leaving features intact until their attributes were recorded and added to the survey plan. The baulks remaining after both

sub-areas had been excavated were subsequently excavated by layer; the material was sieved but only artefacts were retained (Gumbley & Hoffmann 2008:2-3).

Figure 3.6 is a plan profile of the western wall of a trench marked in Figure 3.5 with the circled letters ‘A’ and ‘B’. The profile indicates deposition layers with circled numbers ‘1’, ‘2’ and ‘3’, as well as disturbances in the layers and distinct features.

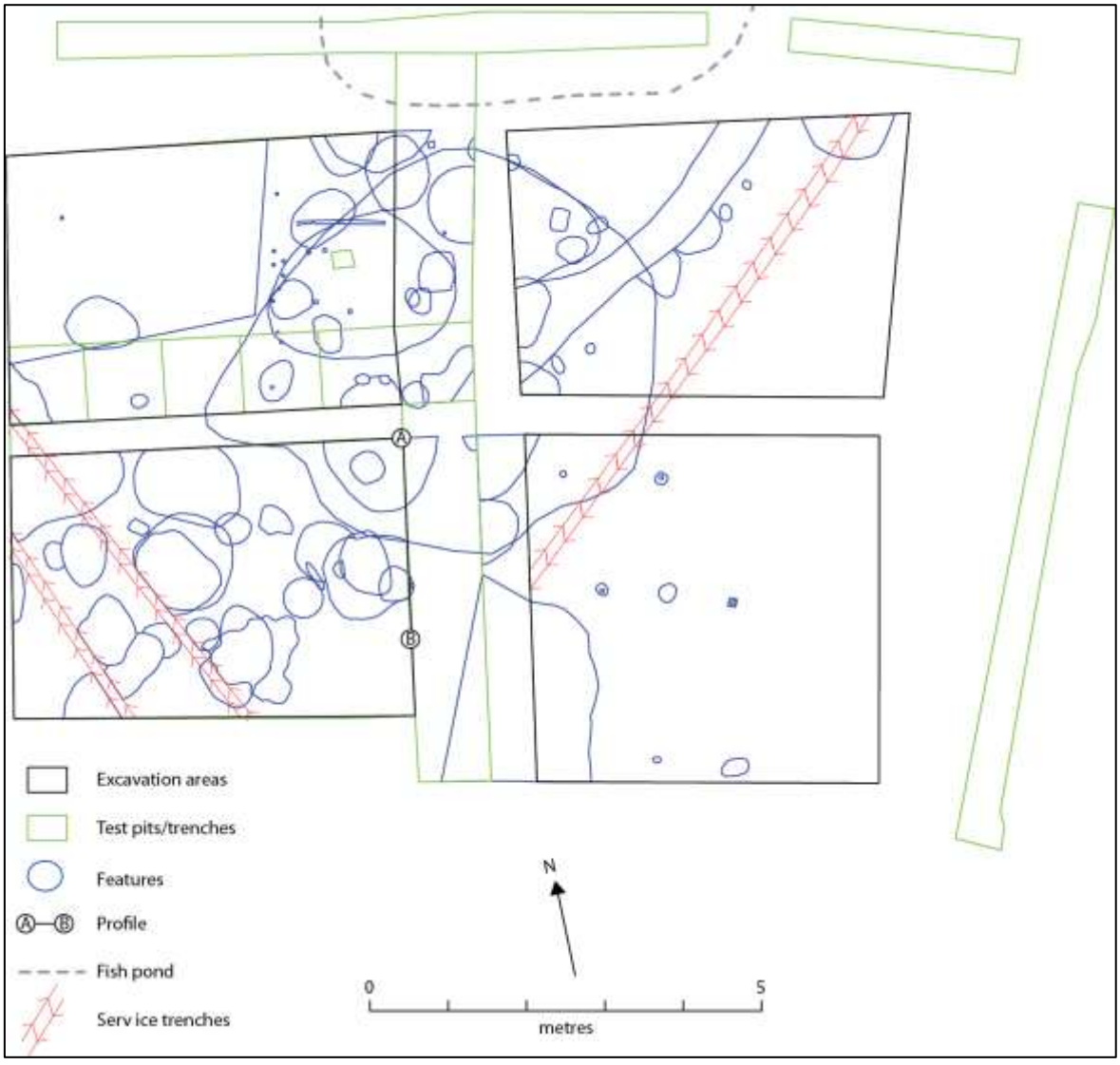

Figure 3.5 Excavation plan of Area F, Cabana Lodge (T12/3), Whangamata, Coromandel Peninsula

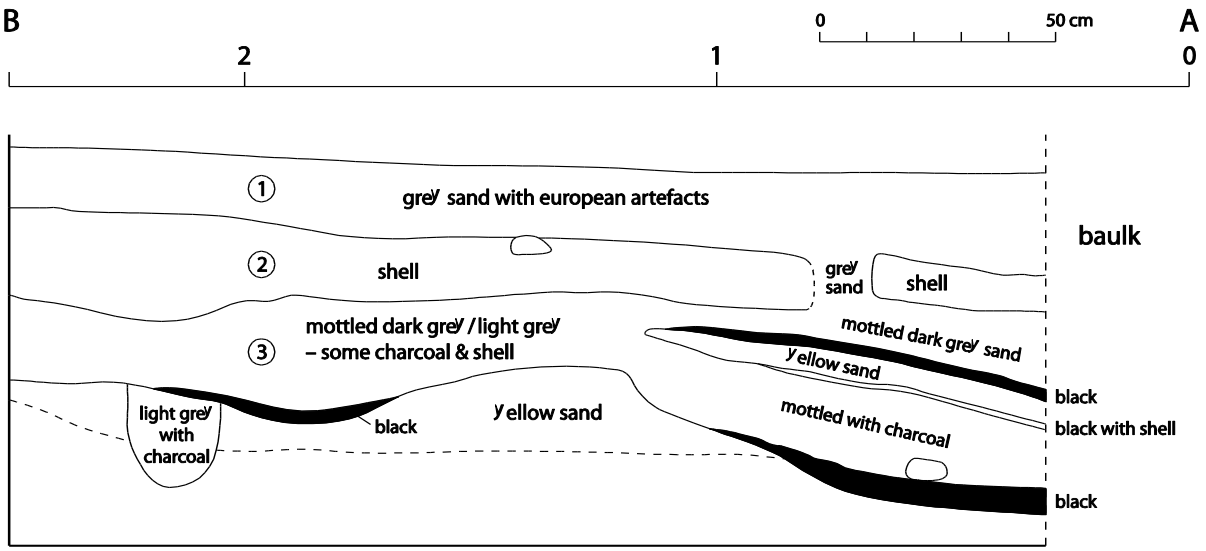

Figure 3.6 Profile plan of Trench 1 Area F, T12/3 Cabana Lodge

3.4.2 CABANA LODGE FAUNAL ANALYSIS METHODS

In April 2008 faunal remains from the 2007 excavations were delivered to the Otago Archaeology Laboratories (OAL) at the University of Otago. After the assemblage arrived, all provenance information from each individual bag was entered into an Excel spreadsheet (Appendix A2). Some of the faunal assemblage was washed to facilitate more accurate identification. Time constraints on the availability of the steam-cleaning laboratory meant that it was not possible to wash or clean all of the assemblage; however if it was found during analysis that material was too dirty to identify, it was set aside for washing. After careful cleaning, the materials were arranged on trays with their original bags, so as to not lose vital provenance information, and left in the Anthropology Department drying room for at least one day. Materials were then carefully re–bagged.

Faunal material was sorted into shell and bone classes. The bone was sorted into fish, bird, mammal and 'unidentifiable' classes. Then the mammal class was further divided into sub-classes of 'small mammal' (e.g. rat), 'medium mammal' (e.g. dog) and 'large mammal' (e.g. fur seal). These classes were based on size and density of bone, and were only a rough guide – they were devised purely to facilitate the identification process. All elements of bone and shell were identified using the Reference Collection at OAL, University of Otago; shell identification was aided using Crowe's (1999) shellfish identification guide; fish identification with Leach's (1997) publication. All bones were first identified to element and then species. Data appropriate to the class of faunal remains was entered into spreadsheets; differences in types of data recorded are noted below. Site, bag ID, element, taxon, side, age/sex, portion,

NISP and ‘notes’ were entered where identified. Where possible, age was recorded in order to aid in MNE and MNI calculation later in the analyses. NISP and MNE were recorded to generate MNI figures; weight was not recorded for the general assemblage. In this analysis, the fraction approach was used in calculating MNE. While this approach has its weaknesses, it is deemed appropriate when dealing with a large assemblage, particularly when much of the bone is from the fish class, while the mammal class is much smaller. Shellfish gastropod MNE were calculated by counting non-repeating elements portions such as the apex of the shell or the operculum. For bivalves, complete hinges were counted, and this number was divided by two to calculate MNI. As the assemblage is in poor condition, a fair number of broken ‘half-hinges’ were present; these were counted and the total divided by two to calculate the MNE; this was then divided by two again to derive the MNI. All paired fish bones that could be identified using the University of Otago New Zealand fish reference collection were identified to element and family, if not species. Fish elements were generally described as ‘C’ for complete, >1/2 for portions that were near-complete, and otherwise divided into three zones – ‘ant’ for anterior, ‘mid’ for middle and ‘post’ for posterior.

For the bird class, no age–at–death or sex data was recorded, as Silver (1969) points out that the short growth period of birds means that it is unpractical to identify age beyond juvenile and adult level. Many of the bird remains were weathered; proximal and distal ends were often missing. The fish bone assemblage was identified to element using the standard ‘five paired’ cranial bones and ‘special’ bones, such as inferior pharyngeal clusters commonly used in New Zealand (Leach, B.F. 1997), and as many other paired and unpaired cranial bones (i.e. vomer, hyomandibular, parasphenoid, epihyal-ceratohyal, scapula, cleithrum, post-temporal, peropercular, opercular, palatine, and pharyngeal plate) as possible, and then identified to species. Age-at-death, sex, cut-marks, and gnawing were not recorded for fish elements, as it is unusual to find indications of these in archaeological fish assemblages.

Occasionally, particularly in the bird and fish assemblages, an element would be similar to a particular species or family in the reference collection, but differ in a small but significant ‘landmark’. Sometimes weathering or breakage would compound identification issues; the species ID would be identified to family level, i.e. ‘Carangidae sp.’ Occasionally, in the shellfish or fish assemblages, taxa could only be identified to family level, again because of the level of weathering.

For bird and mammal, each ‘long bone’ element was described by the portion present; whether complete with fused epiphyses, complete but with unfused epiphyses, proximal end, proximal shaft, midshaft, distal shaft, distal end, or a combination of these. Other elements, such as vertebrae, pelves, scapulae, cranial portions, etc. are not able to be described in this manner; instead, they were described in terms of ‘landmarks’ or particular anatomical parts of an element; e.g. acetabulum, ischium, ilium and pubis - the main parts of a pelvis bone. Ribs are problematic, as they have few landmarks, and their long slender form makes them prone to breaking into small fragments that can usually only be described as ‘shaft’. This means that ribs are likely to be under-represented in MNE totals, as it is very difficult to tell how many rib fragments account for one complete rib.

Due to the high numbers of shells contained in most of the bags in the shell assemblage, data was recorded by hand on specially designed record sheets as identification proceeded, and later transferred to the Excel spreadsheet after identification was completed. Siding was not recorded for the bivalve species, as with such a large assemblage this does not provide significantly greater accuracy than taking the MNI total for bivalves and dividing by two (Klein & Cruz-Uribe 1984). No evidence of burning, butchery or gnawing was observed in the shellfish assemblages, and therefore this information was not entered in the spreadsheet.

The assemblage was examined for evidence of burning, weathering, animal attrition and cut marks. Burning was recorded by colouration of the bone when present; weathering was not noted, as most of the specimens identified were incomplete – giving a fair idea that specimens are not in pristine condition. Recording of weathering in a large assemblage such as this was not viewed as generating valuable information for the time taken to record it. Animal attrition was noted as ‘dog’ or ‘rat’ when teeth gnaw marks pertaining to those species were visible. The portions where these taphonomic processes were visible were not recorded.

A decision was made to undertake fine-grained analysis of a particular unit, FzT4S1NE, from within Trench 4 of Area Fz. This gave an indication of the fragmentation, and therefore condition, of the assemblage. In this unit, all shell fragments were counted, along with half and complete hinges of bivalves, and the apexes and opercula of gastropods in order to generate a shellfish NISP count. Similarly, all fragments of bone identifiable as fish were counted, including broken ribs, scales and teeth. All fragments of bird and mammal bone were counted. In units not analysed in this fine-grained manner, only specimens with diagnostic landmarks were identified and counted, such as half and complete bivalve hinges, gastropod

apex and opercula for shellfish; specimens of ribs with articulating facets, shafts and epiphyses of long bones, and incomplete or complete elements that could still be identified to element level for fish, bird and mammal remains were counted. Non-diagnostic shell and bone fragments were retained, re-bagged and labelled as residue.

In order to assess the relative contributions of each species to human diet, the approach developed by Smith (2004) has been followed. The MNI for each species was converted into estimates of the weight of usable meat that they represent, using standardised meat yield values for each taxon (Smith, I.W.G. 2011a). To avoid over-estimating the importance of species with large body sizes (marine mammals, moa) minimum numbers of butchery units were used as the starting point. Meat yields for each taxon were then converted to energy yields (kcal) using taxa-specific kcal per kg values (Smith, I.W.G. 2011a)(Appendix 3). To facilitate inter-site comparisons species were grouped into seven faunal classes (fish, shellfish, marine birds, marine mammals, terrestrial mammals, moa and smaller terrestrial birds) and the proportion of total energy harvest from each of these was calculated, in order to determine the relative importance of each faunal class in the diet. These relative proportions were used to look for patterns in faunal research use across space and time in the study areas.

3.5 COMPARATIVE ANALYSIS

The purpose of the comparative analysis is to identify spatial or temporal trends in faunal assemblages with reliable radiocarbon dates from the Coromandel Peninsula and the Western Bay of Plenty. This involves identifying and selecting assemblages with suitable radiocarbon dates, organising the chronological data, and comparative analysis of the faunal relative abundance by space and time.

3.5.1 ASSEMBLAGE SELECTION

Literature from published articles (i.e. *New Zealand Journal of Archaeology*, *Journal of the Polynesian Society*, *Archaeology in New Zealand/New Zealand Archaeological Association Newsletter*), published books, published reports (i.e. by the Department of Conservation) and unpublished consultants' reports were collected, read and entered into an Excel spreadsheet and also into EndNote referencing software. As well as bibliographic details, the type of report (excavation, survey, archaeological assessment, forestry post-harvest monitoring, damage), the main results, inclusion of faunal analysis and radiocarbon dates were entered.

The report by Smith, I.W.G. and James-Lee (2010), which presented primary archaeological data utilised in the National Institute of Water and Atmospheric Research (NIWA) project *Taking Stock*, is used as a data source. This report compiled data from two study areas, *Otago-Catlins* in the South Island, and the *Greater Hauraki Gulf*, spanning from south of Whananaki to Waihi Beach, encompassing one of the study areas of the present project. Sites were selected on the basis of the availability of faunal data suitable for the *Taking Stock* methodology, and reliable chronological information. The faunal data were collected from unpublished (such as consultants' reports) and published sources, with revisions of data being incorporated after subsequent re-examinations (e.g. Smith, I.W.G. 1985; Leach, B.F. & Boocock 1993). Due to the older publication dates of many of the sources, taxonomic nomenclature was checked for revisions and updated as necessary. The data was compiled and summarised under four broad classes of fauna, and following taxonomic terminology from Spencer, Willan et al. (2009), Froese and Pauly (2010); Ornithological Society of New Zealand (2010), King (2005) and Baker, C.S., Chilvers et al. (2010). While the *Taking Stock* data included the simplest level of recording, i.e. the presence/absence of a species, most of the assemblage data extracted was frequency-based in the form of MNI for each taxon. The assemblages also had to meet the radiocarbon discard protocols listed by Anderson (1991), Petchey (1999) and Schmidt (2000c), as previously outlined in Chapter 1. Taking Stock assemblages with raw MNI data have been utilised in the present research.

From the spreadsheet of compiled sources, reports with both faunal analysis and radiocarbon dates were preliminarily selected; these were then checked for full faunal analysis (i.e. not just one or two classes, as occasionally is the case) with raw MNI values. These were then checked for matching radiocarbon dates relating to the same feature or layer. Finally, the radiocarbon samples were compared against criteria for accepted modern chronometric hygiene, as described below. The assemblages with acceptable radiocarbon dates are listed in Tables 3.1 and 3.2. The site and or deposit which each assemblage came from were also assigned to a site type – restricted function or multi-function. These are based on the types defined by Anderson (1982:60-1) as outlined in Chapter 1. As can be seen in Tables 3.1 and 3.2, the Coromandel Peninsula study area has a mixture of assemblages from restricted function and multifunction sites, while the Western Bay of Plenty study area has assemblages from exclusively restricted-function sites. This may influence the faunal record in terms of the breadth of faunal classes and number of taxonomic species present in assemblages between

the two study areas, or be a result of different occupation periods or differing resource exploitation zones within the study areas.

Table 3.1 Archaeozoological assemblage codes, names, site numbers and sources; Coromandel Peninsula

Assemblage Code	Assemblage Name and Site Number	Source
AHU-944	Ahuahu #3 (T10/944)	(Furey 2009a)
CCK-399-L3	Cross Creek Midden Layer 3 (T10/399)	(Smith, I.W.G. & James-Lee 2010)
CCK-399-L5	Cross Creek Midden Layer 5 (T10/399)	(Smith, I.W.G. & James-Lee 2010)
CCK-399-L7	Cross Creek Midden Layer 7 (T10/399)	(Smith, I.W.G. & James-Lee 2010)
CCK-399-L9	Cross Creek Midden Layer 9 (T10/399)	(Smith, I.W.G. & James-Lee 2010)
CL-3	Cabana Lodge, Whangamata (T12/3)	*this manuscript*
HHB-242-Lower	Hahei Beach lower (T11/242)	(Smith, I.W.G. & James-Lee 2010)
HHB-242-Middle	Hahei Beach middle (T11/242)	(Smith, I.W.G. & James-Lee 2010)
HHB-242-Upper	Hahei Beach upper (T11/242)	(Smith, I.W.G. & James-Lee 2010)
HWB-115-Llower	Hot Water Beach lower (T11/115)	(Smith, I.W.G. & James-Lee 2010)
HWB-115-Middle	Hot Water Beach middle (T11/115)	(Smith, I.W.G. & James-Lee 2010)
MTR-990	Matarangi Beach (T10/990)	(Smith, I.W.G. & James-Lee 2010)
MTR-993	Matarangi Beach (T10/993)	(Smith, I.W.G. & James-Lee 2010)
NH-173	Ngarimu Heights, Thames Coast (T12/173)	(Hoffmann 2008)
PAU-1028	Pauanui (T10/1028)	(Smith, I.W.G. & James-Lee 2010)
PJK-53	Port Jackson (S09/53)	(Smith, I.W.G. & James-Lee 2010)
TRN-62-Lower	Tairua Lower Layer 2 (T11/62)	(Smith, I.W.G. & James-Lee 2010)
TRN-62-Upper	Tairua Upper Layer 6 (T11/62)	(Smith, I.W.G. & James-Lee 2010)
WHA-1035	Beach Road, Whangamata (T12/1035)	(Hoffmann 2009c)
WHA-106	Whangamata Rising Main (T12/106)	(Mallows 2009c)
WHA-240	Whangamata (T12/240)	(Hoffmann 2009d)
WHA-959	Moana Park ,Whangamata (T12/959)	(Smith, I.W.G. & James-Lee 2010)
WHI-624	Whitianga Waterways 624 (T11/624)	(Smith, I.W.G. & James-Lee 2010)
WHI-858	Whitianga Waterways 858 (T11/858)	(Smith, I.W.G. & James-Lee 2010)
WHI-926	Whitianga Waterways 926 (T11/926)	(Smith, I.W.G. & James-Lee 2010)
WHI-927-A	Whitianga Club Marina Apartments Area A (T11/927)	(Smith, I.W.G. & James-Lee 2010)
WHI-927-B	Whitianga Club Marina Apartments Area B (T11/927)	(Smith, I.W.G. & James-Lee 2010)
WHP-751	Whangapoua(T10/751)	(Gumbley 2008)
WHT-16	Whitipirorua (T12/16)	(Smith, I.W.G. & James-Lee 2010)

Table 3.2 Archaeozoological assemblage codes, names, site numbers, and sources; Western Bay of Plenty

Assemblage Code	Assemblage Name and Site Number	Source
ANA-46-Lower	Anatere Pa Lower, Athenree (U13/46)	(Smith, I.W.G. & James-Lee 2010)
ANA-46-Upper	Anatere Pa Upper, Athenree (U13/46)	(Smith, I.W.G. & James-Lee 2010)
ASH-2912	Asher Block, Omanu-Papamoa (U14/2912)	(Gumbley 2010)
BAP-3269-F6	Balintoy Park, Welcome Bay, Tauranga (U14/3269)	(Harris & Campbell 2009)
BAP-3269-T1	Balintoy Park, Welcome Bay, Tauranga (U14/3269)	(Harris & Campbell 2009)
BWT-874	Bowentown (U13/874)	(Smith, I.W.G. & James-Lee 2010)
BWT-875	Bowentown (U13/875)	(Smith, I.W.G. & James-Lee 2010)
BWT-876	Bowentown (U13/876)	(Smith, I.W.G. & James-Lee 2010)
CHE-1920	Cheyne Rd, Oropi, Tauranga (U14/1920)	(Furey 2004b)
CHE-3193	Cheyne Rd, Oropi, Tauranga (U14/3193)	(Furey 2004b)
EVA-3256	Evans Road, Papamoa U14/3256	(Felgate 2006a)
FPC-3305	Fergusson Park, Matua, Tauranga (U14/3305)	(Mintmier 2008)
FTP-1465	Florence Lane, Te Puna (U14/1465B)	(Furey 2008b)
GSP-3113	Golden Sands, Papamoa (U14/3113)	(Gumbley & Phillips 2004)
GSP-3116	Golden Sands, Papamoa (U14/3116)	(Gumbley & Phillips 2004)
HAM-9	Hamurana Road, Rotorua (U15/9)	(Campbell & Phillips 2005)
KAI	Kaitemako Substation, Welcome Bay, Tauranga (U14/-)	(Campbell & Farley 2008)
KTR-78	Koutunui Road, Athenree (U13/78)	(Smith, I.W.G. & James-Lee 2010)
MAN-188	Maketu North, Maketu (V14/188)	(Moore, P.R., Taylor et al. 2009)
MAS-187	Maketu South, Maketu (V14/187)	(Moore, P.R., Taylor et al. 2009)
MAT-2351-F11	Mataraua, Tauriko (U14/2351)	(Campbell & Hudson 2009)
MAT-2351-F248	Mataraua, Tauriko (U14/2351)	(Campbell & Hudson 2009)
ORO-1941	Oropi Downs, Tauranga (U14/1941)	(Campbell & Hudson 2008)
ORO-1945	Oropi Downs, Tauranga (U14/1945)	(Campbell 2003b) (Campbell & Piahana 2003)
ORO-3056	Oropi Downs, Tauranga (U14/3056)	(Campbell & Hudson 2008)
ORO-3197	Oropi Downs, Tauranga (U14/3197)	(Campbell 2004b)
ORO-3216	Oropi Downs, Tauranga (U14/3216)	(Campbell & Hudson 2008)
ROW-1972	Rowesdale, Oropi, Tauranga (U14/1972)	(Campbell 2005a)
ROW-3218	Rowesdale, Oropi, Tauranga (U14/3218)	(Campbell 2005a)
STR-780	The Strand, Whakatane (W15/780)	(Cable 2007a)
SUP-2888	BOP Supacenta Development, Papamoa (U14/2888)	(Felgate 2005a)
SUP-2889	BOP Supacenta Development, Papamoa (U14/2889)	(Felgate 2005a)
SUP-2891	BOP Supacenta Development , Papamoa (U14/2891)	(Felgate 2005a)
TAR-3230 G	Tara Road, Papamoa (U14/3020 G)	(Campbell, Gumbley et al. 2009)
TAR-3230 H	Tara Road, Papamoa (U14/3020 H)	(Campbell, Gumbley et al. 2009)
TAR-3231	Tara Road, Papamoa (U14/3231)	(Campbell, Gumbley et al. 2009)
TAU-2402	Tauriko (U14/2402)	(Harris 2009)
TEH-584	Te Horo Drive, Ohope Beach (W15/584)	(Bowers, L.C. & Phillips 1997c)
TEP-3221	Wairoa Rd, Te Puna (U14/3221)	(Campbell 2008)
TUI-2897-1	Tuihana Subdivision, Papamoa (U14/2897)	(Felgate 2006b)
TUI-2897-2	Tuihana Subdivision, Papamoa (U14/2897)	(Felgate 2006b)
TUI-2897-3	Tuihana Subdivision, Papamoa (U14/2897)	(Felgate 2006b)
WHA-1229	Whakamarama Road, Western Bay of Plenty (U14/1229)	(Cable 2008b)
WHB-1246	The Crescent, Waihi Beach (U13/1246)	(Smith, I.W.G. & James-Lee 2010)
WHB-1275	Waihi Beach U13/1275	(Moore, P.R. 2007)

3.5.2 ORGANISATION OF CHRONOLOGICAL DATA

Protocols outlined in Smith (2010) have been utilised here in radiocarbon date and faunal assemblage selection. Faunal assemblages were selected for use in this analysis based on the criteria that they could be dated directly with at least one secure radiocarbon date, or indirectly through inference based on other stratigraphic radiocarbon dates from the same site. The lab number, Conventional Radiocarbon Age, error, sample material and provenance were all noted and checked against the New Zealand Radiocarbon Database (www.waikato.ac.nz//waikato/nzcd) where possible. Sample suitability criteria as outlined in Anderson (1991), Petchey (1999) and Schmidt (2000c) have been followed, where materials regarded as unreliable have been excluded, i.e. freshwater shell, re-crystallized shell, fish, seal bone, human bone, bone carbonate, whole bone, soil, peat, unidentified species charcoal, 'old wood' (with inbuilt age) (Anderson 1991), burnt bone, rat bone (Petchey 1999) and mudsnail (*Austrovenus stutchburyi*) (Schmidt 2000c). After passing the criteria for suitable dating material, all radiocarbon determinations have been calibrated using Calib601 calibration software and the SH04 calibration curve (McCormac, Hogg et al. 2004) for terrestrial samples; the Marine 04 calibration curve (Hughen, Baillie et al. 2004) was used for marine samples with delta R set at -7±45 (as specified in Smith 2010).

As well as the conventional radiocarbon age (CRA) and standard deviations (SD), inputs for marine dates included Delta R values (in years), Delta R standard deviations (also in years) and the proportion of marine carbon present in the radiocarbon reservoir. The appropriate calibration curve is indicated by number; '3' indicates the 2004 marine calibration curve (Hughen, Baillie et al. 2004) used for shellfish; while '5' indicates the southern hemisphere 2004 calibration curve (McCormac, Hogg et al. 2004) used for terrestrial reservoir sources (i.e. charcoal). When an assemblage had multiple determinations on the same material type, these were tested for statistical significance at the 95% level. If the determinations were indistinguishable at the 95% level, a pooled mean radiocarbon age was calculated (Ward & Wilson 1978) and this was used in place of the multiple determinations. The associated test statistic (T), the Xi^2 (0.05) value and the degree of freedom associated with these calculations is also presented with the MPRA. As per Smith (2010), when multiple determinations used different materials, a best estimate of their age was based on the overlap of their calibrated age ranges. The calibrated ranges were recorded at both the 1σ and 2σ levels; both were taken into consideration for assigning into three prehistoric designations: 'early' (ca. AD 1250-1450), 'middle' (AD 1450-1650) and 'late' (AD 1650-1800). When both sigma ranges for a

determination fall entirely within a single period, or when the 2σ range extends over a boundary by less than 50 years, the assemblage is assigned to that period. Where both the 1σ and 2σ calibration ranges overlap a period boundary, or the 2σ range crosses one boundary by more than 50 years, the assemblage is assigned to an 'overlap' period such as 'early-middle' or 'middle-late'. However, some 'late' period assemblages have calibrated ranges that extend into the historic period, some as far as AD 1949; the absence of historic artefacts is used to place these securely in the prehistoric 'late' period designation. It should be noted that the periods used in this research are 'time slices' and not cultural periods.

3.5.3 Site Type Analysis

In order to analyse settlement patterns, each site (or site layer or area) is given a site *type* description (see site descriptions in Appendix 4) and also placed into a site type *category*. Due to factors such as site sampling, intra-site spatial function variability, erosion and variability in interpretation and reporting, a decision was made *not* to attempt to interpret and classify the scale of the sites for each site type. As noted in Chapter 1 there is broad agreement between Groube (1964), Leach and Leach (1979c) and Anderson (1982) that prehistoric sites in New Zealand fall into three broad descriptive categories (Table 3.1), and Anderson's terms for these are used here. In terms of site type categories, *multi-function sites* are defined as settlements or villages with a diverse range of structures, activities and artefacts in evidence, such as houses, pits, terraces, gardens, tool making features, butchering features and cooking features. *Restricted function sites* exhibit a much narrower range of activities, usually associated with subsistence, and include middens, pits, postholes and houses; but they do not exhibit an otherwise structured use of space. *Single function sites* are specialised activity areas, which have only one function such as quarrying, tool manufacturing, moa butchering or shellfishing. They were almost certainly used only for short durations and are likely to have been seasonal. It is important to note that because the primary criterion for inclusion of samples within the present study was the presence of quantified faunal remains, several kinds of single function sites were automatically excluded, such as quarries or flaking floors. Thus, what is able to be reconstructed here is an incomplete picture of settlement patterns in the Coromandel Peninsula and the Western Bay of Plenty. Nonetheless, these patterns are likely to be a broadly indicative representation of the overall patterns within each of those areas.

Total MNI values for each assemblage can be used as proxy gauges for sample representativeness, although larger assemblage MNI totals do not necessarily equate to

thorough sampling throughout a site, and may still only relate to one spatial or temporal unit when a site may contain many of these units. As outlined in Section 3.2.4, Domínguez-Rodrigo (2012) demonstrated that sample size does not a affect results; rather sampling *strategy* does. With a large data set gathered from unpublished, published and peer-reviewed sources, it is inevitable that different sampling strategies were implemented. While this inconsistency is acknowledged, it is deemed that the results are unlikely to dramatically skew identified trends through time and space. MNI values for the Coromandel Peninsula and Western Bay of Plenty have been listed in Tables 3.3 and 3.4 respectively.

There are twenty-nine assemblages from the Coromandel study area (Table 3.3). Three of the assemblages from Whangamata, Cross Creek and Whitianga stand out as the largest assemblages, with MNI totals over 7000. Five assemblage MNI totals fall in the 2000-2999 range and a further four assemblages fall in the 1000-1999 MNI range. Eleven assemblages have MNI totals that fall between 500 and 999. Three assemblage MNI totals fall in the 100-499 range; and only three assemblages have MNI totals of less than 100.

The most common site type of the twenty-nine assemblages is temporary camp, at 58.6%. The next most common site type, undefended settlement, accounts for 37.9% of assemblages. Undefended pit complex makes up 3.4% of Coromandel assemblages.

In the Coromandel study area, 31.0% of the assemblages are from multi-function sites. All but one of these multifunction sites are undefended settlements (88.9%), with the remaining site a temporary camp (11.1%). Restricted function sites make up 48.3% of assemblages, and the most common site types in this group are temporary camps (71.4%), followed undefended settlements (21.4%) and undefended pit complex (7.2%). Single function sites account for 20.7% of Coromandel assemblages, and all are temporary camps.

There is no strong relationship between site category/type and assemblage MNI totals; the latter appears to be more influenced by the sampling strategy or size of the investigation rather than the size or function of the site itself.

There are forty-four assemblages from the Western Bay of Plenty study area (Table 3.4). The largest assemblage, from Omanu-Papamoa, has an MNI total over 7000. There are two assemblages which have MNI totals between 3000 and 6999, and two assemblages fall in the 2000-2999 MNI range. Eight assemblages have MNI totals of between 1000 and 1999; in the

500-999 MNI range there are six assemblages. Nine assemblages have MNI totals of 100-499; and four assemblages have MNI totals of fewer than 99.

The Western Bay of Plenty assemblages cover five different site types. Temporary camps account for 57.8% of assemblages, followed by pit complex-temporary camps at 18.2%, defended settlements at 6.8%, and both undefended settlements and temporary camp-horticultural soils 4.5% of assemblages.

The categorisation of sites in the Western Bay of Plenty follows a much different pattern to that of the Coromandel. Out of forty-four assemblages, only 4.5% sites are multi-function, a large defended settlement in Oropi, Tauranga, and a medium undefended settlement in Bowentown. Restricted function sites make up 77.2% of Western Bay of Plenty assemblages, with the most common site types being temporary camps (50.50 of restricted function sites) and pit complex-temporary camps (23.4%). The remainder comprise are a mixture of undefended settlements (11.4%), defended settlements (8.8%), temporary camp-horticultural soils (5.9%) and a pit complex (2.9%). Single function sites account for 18.3% of Western Bay of Plenty assemblages, which are all temporary camps. As with Coromandel assemblages, there does not appear to be an obvious relationship between site category/type and assemblage MNI totals.

Table 3.3 Coromandel assemblage site category, site type and MNI totals

Assemblage Code	Site Category	Site Type	MNI Total
TRN-62-Lower	multi-function	temporary camp	616
CCK-399-L3	multi-function	undefended settlement	8929
CCK-399-L7	multi- function	undefended settlement	999
CCK-399-L5	multi-function	undefended settlement	427
CL-3	multi-function	undefended settlement	9587
WHT-16	multi-function	undefended settlement	420
HWB-115-Lower	multi-function	undefended settlement	2269
HWB-115-Middle	multi-function	undefended settlement	976
NH-173	multi-function	undefended settlement	1801
TRN-62-Upper	restricted function	temporary camp	1132
WHP-751	restricted function	undefended pit complex	2558
PAU-1028	restricted function	undefended settlement	44
PJK-53	restricted function	undefended settlement	2934
AHU-944	restricted function	temporary camp	973
HHB-242-Lower	restricted function	temporary camp	614
HHB-242-Middle	restricted function	temporary camp	819
HHB-242-Upper	restricted function	temporary camp	1227
WHA-1035	restricted function	temporary camp	842
WHA-106	restricted function	temporary camp	980
WHA-240	restricted function	temporary camp	1409
WHI-624	restricted function	temporary camp	1102
CCK-399-L9	restricted function	temporary camp	38
WHA-959	restricted function	undefended settlement	649
MTR-990	single function	temporary camp	206
MTR-993	single function	temporary camp	2463
WHI-858	single function	temporary camp	2191
WHI-926	single function	temporary camp	733
WHI-927- B	single function	temporary camp	7376
WHI-927-A	single function	temporary camp	648

Table 3.4 Western Bay of Plenty assemblage site category, site type and MNI totals

Assemblage Code	Site Category	Site Type	MNI Total
ROW-3218	multi-function	defended settlement	715
BWT-875	multi-function	undefended settlement	67
MAT-2351	restricted function	defended settlement	2928
ANA-46-Upper	restricted function	defended settlement	576
ASH-2912	restricted function	pit complex-temporary camp	9602
HAM-9	restricted function	temporary camp	668
TEH-584	restricted function	temporary camp	1071
STR-780	restricted function	undefended settlement	353
WHB-1246	restricted function	undefended settlement	285
CHE-3193	restricted function	pit complex-temporary camp	1919
BWT-876	restricted function	pit complex	215
MAN-188	restricted function	temporary camp	1364
EVA-3256	restricted function	temporary camp	1150
TAR-3230-G	restricted function	temporary camp	247
TAU-2402	restricted function	temporary camp	1827
TUI-2897-1	restricted function	temporary camp	102
TUI-2897-2	restricted function	temporary camp	334
TUI-2897-3	restricted function	temporary camp	245
BAP-3269-F6	restricted function	pit complex-temporary camp	43
BAP-3269-T1	restricted function	pit complex-temporary camp	1919
CHE-1920	restricted function	pit complex-temporary camp	472
FTP-1465	restricted function	pit complex-temporary camp	4584
ORO-1941	restricted function	pit complex-temporary camp	929
ORO-3216	restricted function	pit complex-temporary camp	715
FPC-3305	restricted function	temporary camp	380
ORO-1945	restricted function	temporary camp	1529
ORO-3056	restricted function	temporary camp	893
SUP-2888	restricted function	temporary camp	21
SUP-2891	restricted function	temporary camp	501
TAR-3230-H	restricted function	temporary camp	6651
WHA-1229	restricted function	temporary camp	176
MAS-187	restricted function	temporary camp	10
GSP-3116	restricted function	temporary camp-horticultural soils	980
GSP-3113	restricted function	temporary camp-horticultural soils	510
SUP-2889	restricted function	undefended settlement	341
ANA-46-Lower	restricted function	undefended settlement	149
TEP-3221	single function	temporary camp	4800
KAI	single function	temporary camp	1755
ORO-3197	single function	temporary camp	2029
ROW-1972	single function	temporary camp	640
KTR-78	single function	temporary camp	504
TAR-3231	single function	temporary camp	277
BWT-874	single function	temporary camp	225
WHB-1275	single function	temporary camp	202

3.5.4 Comparative Analysis Methods

After faunal assemblages with suitable radiocarbon dates from the Coromandel Peninsula and Western Bay of Plenty were identified, each assemblage was entered into spreadsheet templates with lists of all shellfish, fish, marine and terrestrial bird, moa and marine and terrestrial mammal species available in the North Island during the prehistoric period. These were used to calculate MNI and relative (percentage) MNI values, which in turn were used to identify the most common species within each faunal class in each period. Because such the

large amount of data was unwieldy, the assemblages were grouped by area and period. The raw MNI data spreadsheets were manipulated with live meatweight and edible meatweight calculations using values from Smith (2011a) to provide total meatweights per species and faunal class; these meatweights were used to generate energy (kcal) values, which were then converted into percentage energy yields (%kcal). This last set of data allowed identification of the importance of species and faunal class in the assemblage. The percentage energy yields by faunal class for all assemblages were analysed using statistical software SPSS that performed cluster analysis; this identified four main groups of faunal assemblage by patterns in the proportions of each faunal class.

4 CASE STUDY RESULTS

4.1 INTRODUCTION

This chapter presents results on fine-grained and general analysis samples of the case study assemblage from Cabana Lodge (New Zealand Archaeological Association site record number T12/3), Whangamata, Coromandel Peninsula. Section 4.2 covers the composition of fine-grained analysis samples; section 4.3 examines the composition of general samples; section 4.4 looks at the relative abundance of the assemblage. Section 4.5 looks at the relative abundance by faunal class; section 4.6 presents the energy contributions by faunal class; while section 4.7 examines the protein, carbohydrate and fat proportions in the assemblage.

4.2 FINE-GRAINED ANALYSIS

In order to quantify the degree of fragmentation of the assemblage, one unit, FzT4S1NW, was analysed in much greater detail than the remainder of the fauna from the 2006 excavations. This sample was treated as a 'bulk sample' – it was not washed in order to retain as many small specimens as possible, such as otoliths, small fish bones and rat bones. Although fine sieves were available, the condition of the sample appeared variable and it was concluded that smaller and more delicate specimens might degrade further during the washing process. First the sample was sorted into various faunal and material classes, and weighed (Table 4.1).

Table 4.1 Sample FzT4S1NW material class by weight

Material	Weight (kg)	% Weight
shellfish	10.732	70.35
fish bone	0.151	0.99
bird bone	0.001	0.00
mammal bone	0.019	0.13
lithics	0.250	1.64
metal	0.016	0.10
glass	0.001	0.01
wood	0.004	0.03
charcoal	0.027	0.18
other	0.004	0.03
residue	4.04900	26.54
TOTALS	**15.25358**	**100.00**

Shell dominated the assemblage, making up 70.35% by weight, with the next heaviest class, residue (soil and remains that were too small/fragile to pick up with tweezers), only making up less than 1% of the weight. Other classes, including bird bone, mammal bone, metal, glass, wood, charcoal and 'other' all made up less than 0.20% each of the sample by weight. After weighing, all fragments of shellfish and bone were counted and identified where possible. The summary of the species abundances calculated for Number of Identified Specimens (NISP), Minimum Numbers of Elements (MNE), Minimum Numbers of Individuals (MNI) and % MNI for sample FzT4S1NW are presented in Table 4.2. Shellfish is the largest faunal class by relative abundance, making up 98.73% of MNI. The most common species are *Paphies australis* (pipi) followed by *Austrovenus stutchburyi* (cockle). The fish class contributes 0.93% of MNI, with *Pagrus auratus* (snapper) the most common species, followed by *Latridopsis ciliaris* (blue moki). While bird and moa are represented by one specimen each, they are not identifiable to species. No marine mammal remains are present, and terrestrial mammal remains account for only 0.17% of MNI. The NISP:MNE ratios for the various faunal classes give an idea of their susceptibility to fragmentation. Dividing the shellfish NISP total of 29,981 by the shellfish MNE total of 2314 gives a ratio of 12.96:1. The corresponding calculation for the fish class (13,682÷220) gives a ratio of 62.19:1. The bird and moa classes both have a 1:1 ratio due to the paucity of their remains. The terrestrial mammal class has a ratio of 4:1. The overall fragmentation ratio for the assemblage is 17.22:1. The ratios are variable; this could be because of the limited number of elements present in shellfish (usually 1 or 2 per individual) and their dominance of the assemblage. However the ratios for both shellfish and fish demonstrate that a large amount of fragmented, non-diagnostic (to species) specimens are present.

Table 4.2 Sample FzT4S1NW summary of NISP, MNE, MNI & %MNI calculations

Species	Common name	NISP	MNE	MNI	%MNI
Shellfish					
Paphies australis	pipi	1328	1328	664	56.22
Austrovenus stutchburyi	cockle	862	486	243	20.58
Paphies sp.	Paphies sp.	646	379	190	16.09
bivalve sp.	bivalve sp.	3119	52	26	2.20
Lunella smaragdus	cats eye	29	29	22	1.86
whelk sp.	whelk sp.	15	14	14	1.19
Paphies subtriangulata	tuatua	10	10	5	0.42
chiton sp.	chiton sp.	14	14	1	0.08
Pratulum pulchellum	heart cockle	2	2	1	0.08
shellfish sp.	shellfish sp.	23794	0	0	0.00
gastropod sp.	gastropod sp.	162	0	0	0.00
Shellfish totals		**29981**	**2314**	**1166**	**98.73**
Fish					
Pagrus auratus	snapper	19	19	4	0.34
Latridopsis ciliaris	blue moki	8	8	3	0.25
Arripis trutta	kahawai	3	3	1	0.08
Chelidonichthys kumu	red gurnard	2	1	1	0.08
Genyagnus monopterygius	spotted stargazer	1	1	1	0.08
Nemadactylus macropterus	tarakihi	1	1	1	0.08
fish sp.	fish sp.	13648	187	0	0.00
Fish totals		**13682**	**220**	**11**	**0.93**
Bird					
bird sp.	bird sp.	1	0	1	0.08
Bird totals		**1**	**0**	**1**	**0.08**
Moa					
moa sp.	moa sp.	1	0	1	0.08
Moa totals		**1**	**0**	**1**	**0.08**
Terrestrial mammal					
Canis familiaris	dog	2	1	1	0.08
Rattus sp.	rat sp.	1	1	1	0.08
medium mammal sp.	medium mammal sp.	1	0	0	0.00
mammal sp.	mammal sp.	4	0	0	0.00
Terrestrial mammal totals		**8**	**2**	**2**	**0.17**
Marine mammal - none					
ASSEMBLAGE TOTALS		**43673**	**2536**	**1181**	**100.00**

4.3 ANALYSIS BY SITE AREA

NISP, MNE and MNI values for the Cabana Lodge assemblages are shown in Tables 3 - 8. Faunal remains from within the site are divided into the following units:

Area A	Area B
Area C	Area E
Area F Layer 1	Area F Layer 2 & 3

These units are not necessarily representative of all the faunal remains across the extent of the T12/3 and T12/2 site(s); these units were dictated by the proposed development at the Cabana Lodge property. To overcome the limitations of the selective sampling, the present results are discussed and interpreted with results from previous faunal analyses relating to T12/3 and T12/2 in Section 6.2.2.

The assemblage from Area A (Table 4.3) has a total NISP of 163, and a total MNI of seven. The fish class makes up 71.43% of MNI, followed by terrestrial bird and terrestrial mammal, both at 14.29% of MNI. No marine and wetland bird or marine mammal species are present, and while moa bone is present it is not identifiable to element or species.

Table 4.3 Area A faunal assemblage summary for NISP, MNE, MNI & %MNI

Taxon	Common Name	NISP	MNE	MNI	%MNI
Shellfish - none					
Fish					
Pagrus auratus	snapper	11	10	3	42.86
Latridopsis ciliaris	blue moki	6	6	1	14.29
Nemadactylus macropterus	tarakihi	1	1	1	14.29
fish sp.	fish sp.	134	23	-	-
Fish totals		**152**	**40**	**5**	71.43
Terrestrial bird					
Hemiphaga novaeseelandiae	kereru (NZ wood pigeon)	1	1	1	14.29
bird sp.	bird sp.	2	-	-	-
Terrestrial bird totals		**3**	**1**	**1**	14.29
Marine & wetland bird - none					
Terrestrial mammal					
Canis familiaris	dog	1	1	1	14.29
medium mammal sp.	medium mammal sp.	1	-	-	-
mammal sp.	mammal sp.	5	-	-	-
Terrestrial mammal totals		**7**	**1**	**1**	14.29
Marine mammal - none					
Moa					
moa sp.	moa sp.	1	-	-	-
Moa totals		**1**	**-**	**-**	**-**
ASSEMBLAGE TOTALS		**163**	**42**	**7**	**100.00**

The dominant fish species is *Pagrus auratus* (snapper) contributing three individuals, supplemented by one each of *Latridopsis ciliaris* and *Nemadactylus macropterus* (tarakihi). The only bird present is a forest-dwelling species, *Hemiphaga novaeseelandiae* (kereru, New Zealand wood pigeon). One dog of unknown age is also present.

Table 4.4 presents the summary results of NISP, MNE, MNI and %MNI for Area B. The assemblage is extremely small with a total NISP of three and total MNI of one, contributed solely by fish remains. These are not identifiable to the level of species.

Area C NISP, MNE, MNI and %MNI summary data are presented in Table 4.5. The assemblage has a total NISP of 53 and a total MNI of three. No shellfish, fish, terrestrial bird, marine mammal or moa remains are present. Two waterfowl species are represented by one individual each - *Anas platyrnchos* (mallard) *and Anas superciliosa* (grey duck). One unidentified medium-sized mammal is also present.

Table 4.4 Area B faunal assemblage summary for NISP, MNE, MNI & %MNI

Taxon	Common Name	NISP	MNE	MNI	%MNI
Shellfish - none					
Fish					
fish sp.	fish sp.	3	2	1	100.00
Fish totals		**3**	**2**	**1**	100.00
Terrestrial bird - none					
Marine & wetland bird - none					
Terrestrial mammal - none					
Marine mammal - none					
Moa - none					
ASSEMBLAGE TOTALS		**3**	**2**	**1**	100.00

Table 4.5 Area C faunal assemblage summary for NISP, MNE, MNI & %MNI

Taxon	Common Name	NISP	MNE	MNI	%MNI
Shellfish - none					
Fish - none					
Terrestrial bird - none					
Marine & wetland bird					
Anas platyrnchos	mallard	14	12	1	33.33
Anas superciliosa	grey duck	2	2	1	33.33
bird sp.	bird sp.	35	14	-	-
Marine & wetland bird totals		**51**	**28**	**2**	**66.67**
Terrestrial Mammal					
medium mammal sp.	medium mammal sp.	2	-	1	33.33
Terrestrial mammal totals		**2**	**-**	**1**	**33.33**
Marine mammal - none					
Moa - none					
Assemblage Totals		**53**	**28**	**3**	**100.00**

In Table 4.6 the summary results for the Area E excavation unit are presented. The total NISP and MNI is only one, a seabird, *Puffinus griseus* (sooty shearwater). No shellfish, fish, terrestrial bird, terrestrial mammal, marine mammal or moa remains are present.

Table 4.7 presents the summary results for the faunal assemblage from Area F layer 1. The assemblage has a total NISP of 18 and a total MNI of six. No shellfish, terrestrial bird, marine mammal or moa remains are present. The terrestrial mammal class includes one each of *Ovis aries* (sheep), *Canis familiaris* (kuri, dog) and a large unidentified mammal species. Two individuals of *Pagrus auratus* (snapper) make up the total fish MNI. One individual of *Gallus gallus* (chicken) makes up the remainder of the MNI total.

Table 4.6 Area E faunal assemblage summary for NISP, MNE, MNI and %MNI

Taxon	Common name	NISP	MNE	MNI	%MNI
Shellfish - none					
Fish - none					
Terrestrial bird - none					
Marine & wetland bird					
Puffinus griseus	sooty shearwater	1	1	1	100.00
Marine & wetland bird totals		**1**	**1**	**1**	**100.00**
Terrestrial mammal - none					
Marine mammal - none					
Moa - none					
ASSEMBLAGE TOTALS		**1**	**1**	**1**	**100.00**

Table 4.7 Area F layer 1 faunal assemblage summary for NISP, MNE, MNI and %MNI

Taxon	Common Name	NISP	MNE	MNI	Assemblage %MNI
Shellfish - none					
Fish					
Pagrus auratus	snapper	8	7	2	33.33
fish sp.	fish sp.	7	0	0	0.00
Fish totals		**15**	**7**	**2**	**33.33**
Terrestrial bird - none					
Marine & wetland bird					
Gallus gallus	chicken	1	1	1	16.67
bird sp.	bird sp.	3	1	0	0.00
Marine & wetland bird totals		**4**	**2**	**1**	**16.67**
Terrestrial mammal					
Ovis aries	sheep	1	1	1	16.67
Canis familiaris	dog	1	1	1	16.67
large mammal sp.	large mammal sp.	1	0	1	16.67
mammal sp.	mammal sp.	2	0	0	0.00
medium mammal sp.	medium mammal sp.	4	1	0	0.00
Terrestrial mammal totals		**9**	**3**	**3**	**50.00**
Marine mammal - none					
Moa - none					
ASSEMBLAGE TOTALS		**28**	**12**	**6**	**100.00**

The assemblage from Area F layers 2 & 3 makes up the largest of all the faunal units, with a total NISP of 68,533 and a total MNI of 9,595 (Table 4.8). It should be noted that this dataset incorporates the fine-grained sample examined in Section 4.2. Shellfish made up 98% of all identified individuals, with half of these being *Austrovenus stutchburyi*, and about one third *Paphies australis*, both of which are soft-shore species. The large NISP value for shellfish sp. represents fragments that are almost certainly from species already represented in the MNE and MNI counts. Fish were the best represented class of vertebrates, and 69% of these were *Pagrus auratus*, with *Latridopsis ciliaris* and *Nemadactylus macropterus* the only other species to make more than minor contributions. It should be noted that this taxa has been specifically referred to as *Notolabrus celidotus* on the basis of diagnostic special bones from Leach's (1997) guide to New Zealand fish bone identification. There are two other labrid species in inshore New Zealand waters, *Pseudolabrus miles* (scarlet wrasse) and *Notolabrus fucicola* (banded wrasse). Leach notes that the bones of these three fish are similar and "it is unlikely that we will ever be able to identify species reliably from all five paired cranial bones which we routinely analyse from archaeological sites" (Leach, B.F. 2006:84). However, as the individuals identified as *N. celidotus* in the Cabana Lodge main assemblage were not identified using the five-paired cranial bones, we can be confident in the specific identification here.

The high NISP and MNE counts for "fish sp." are mostly vertebrae, spines, scales and rays almost certainly from the species positively identified. A large proportion of these were broken, therefore increasing the NISP:MNE ratio. The marine and wetland bird class is small, with *Eudyptula minor* (little blue penguin) accounting for two out of four individuals, and possibly for most of the remaining unidentifiable bird bones. Only one individual of *Arctocephalus forsteri* (New Zealand fur seal) is present in the marine mammal class, with all the bones derived from the upper forelimb butchery unit. The terrestrial mammal class is represented by two individuals of *Canis familiaris* and two individuals of unidentified *Rattus sp.*, with the unidentifiable medium mammal bone fragments likely to be from the former, and the unidentifiable small mammal bone fragments probably from the latter. It should be noted that as yet, no known reliable morphological differentiation between *Rattus exulans* (kiore, Polynesian rat) and the two European-introduced rats, *Rattus norvegicus* (Norway or brown rat) and *Rattus rattus* (ship or common rat). *R. norvegicus* is the largest of the three, but size is not a reliable method for species identification. Terrestrial birds included two indigenous species, *Halcyon sancta vagans* (New Zealand kingfisher*)* and the *Egretta novaehollandiae*

(white-faced heron), along with bones from two *Gallus gallus*. The latter are interpreted as intrusions from the historic layer, as chickens were not present in prehistoric New Zealand, and were excluded from meatweight and energy yield calculations. *E. novaehollandiae* was self-introduced from Australia and has been sporadically observed in New Zealand since about 1865 (Ornithological Society of New Zealand 2010:160-1); it is not listed in the Ornithological Society of New Zealand (2010) checklist as confirmed present prior to European arrival. On this basis, *E. novaehollandiae* is also excluded from meatweight and energy yield calculations as a historic intrusion. Although moa bone fragments were present in the assemblage, they were so small as to indicate they were probably debris from tool manufacture, so were also excluded from further analysis.

Table 4.8 Cabana Lodge prehistoric Area F Layer 2 & 3 faunal assemblage summary for NISP, MNE, MNI & %MNI

Taxon	Common Name	NISP	MNE	MNI	MNI %
Shellfish					
Austrovenus stutchburyi	cockle	9930	9554	4777	50.82%
Paphies australis	pipi	6455	6455	3228	34.34%
Turbo smaragdus	cat's eye	661	661	507	5.39%
Paphies sp.	Paphies sp.	938	938	469	4.99%
Paphies subtriangulata	tuatua	269	269	135	1.44%
bivalve sp.	bivalve sp.	3203	136	84	0.89%
gastropod sp.	gastropod sp.	242	66	66	0.70%
Nerita melanotragus	black nerita	29	29	29	0.31%
whelk sp.	whelk sp.	25	25	25	0.27%
Struthiolaria sp.	ostrich foot sp.	19	18	18	0.19%
Amalda australis	southern olive shell	12	12	12	0.13%
Penion sulcatus	siphon whelk	9	9	9	0.10%
limpet sp.	limpet sp.	8	8	8	0.09%
mussel sp.	mussel sp.	15	15	8	0.09%
Crepidula costata	ribbed slipper shell	6	6	6	0.06%
Cominella adspersa	speckled whelk	6	6	6	0.06%
Amphibola crenata	mudsnail	4	4	4	0.04%
Cookia sulcata	cook's turban	3	3	2	0.02%
Austrofusus glans	knobbed whelk shell	2	2	2	0.02%
Sigapatella novaezelandiae	circular slipper shell	1	1	1	0.01%
Zeacumantus lutulentus?	horn shell?	1	1	1	0.01%
Struthiolaria vermis	small ostrich foot	1	1	1	0.01%
Pratulum pulchellum	strawberry cockle	2	2	1	0.01%
shellfish sp.	shellfish sp.	20,836	0	0	-
Chiton sp.	chiton sp.	25	25	p	-
Shellfish totals		**42702**	**18246**	**9399**	**100.00%**
Fish					
Pagrus auratus	snapper	1124	864	125	70.22%
Latridopsis ciliaris	blue moki	113	113	24	13.48%
Nemadactylus macropterus	tarakihi	74	72	13	7.30%
Meuschenia scaber	leatherjacket	5	4	4	2.25%
Arripis trutta	kahawai	20	20	3	1.69%
Notolabrus celidotus	spotty	3	3	3	1.69%
Chelidonichthys kumu	red gurnard	19	6	1	0.56%

Table 4.8 Cabana Lodge prehistoric Area F Layer 2 & 3 faunal assemblage summary for NISP, MNE, MNI & %MNI, *continued*

Taxon	Common Name	NISP	MNE	MNI	MNI %
Genyagnus monopterygius	spotted stargazer	2	2	1	0.56%
Gempylidae sp.	snake mackerel sp.	1	1	1	0.56%
Helicolenus percoides	sea perch	1	1	1	0.56%
Carangidae *sp.*	mackerel sp.	1	1	1	0.56%
Zeus faber	john dory	1	1	1	0.56%
Notolabrus celidotus?	spotty?	1	1	0	0.00%
Pagrus auratus?	snapper?	1	1	0	0.00%
fish sp.	fish sp.	23385	2629	0	0.00%
Fish totals		**24751**	**3719**	**178**	**100%**
Terrestrial bird					
Gallus gallus	chicken	9	8	(2)	40.00%
Anas superciliosa	grey duck	1	1	1	20.00%
Halcyon sancta vagans	New Zealand kingfisher	1	1	1	20.00%
Egretta novaehollandiae	white-faced heron	2	2	(1)	20.00%
Terrestrial bird totals		**13**	**12**	**5**	**100.00%**
Marine & wetland bird					
Eudyptula minor	little blue penguin	14	12	2	50.00%
Larus novaehollandiae scopulinus	red-billed gull	2	2	1	25.00%
Puffinus griseus	sooty shearwater	1	1	1	25.00%
bird sp.	bird sp.	171	27	-	-
Eudyptula minor?	little blue penguin?	1	1	-	-
Marine & wetland bird totals		**189**	**43**	**4**	**100.00%**
Terrestrial mammal					
Canis familiaris	dog	106	66	2	50.00%
Rattus sp.	rat	10	10	2	50.00%
mammal sp.	mammal sp.	536	-	-	-
medium mammal sp.	medium mammal sp.	150	4	-	-
Rattus sp.?	rat?	4	4	-	-
small mammal sp.	small mammal sp.	11	5	-	-
Terrestrial mammal totals		**817**	**89**	**4**	**100.00%**
Marine mammal					
Arctocephalus forsteri	fur seal	22	21	5	100.00%
Marine mammal totals		**22**	**21**	**5**	**100.00%**
Moa					
moa sp.	moa sp.	39	-	-	-
Moa totals		**39**	**-**	**-**	-
ASSEMBLAGE TOTALS		**68533**	**22130**	**9595**	-

4.4 Energy Contributions by Faunal Class

The data set used for the energy calculations is from Area F, layers 2 and 3. Gumbley (pers. comm.) observed that layer 2 and layer 3 appear to have been deposited with the same occupation event and can therefore be treated as one temporal unit. This data set has been chosen because it is the largest and therefore assumed to be the most representative of all the data sets. The meat weights, energy yields and percentage energy yields calculated for each species are shown in Table 4.9. For these calculations, species that were determined to be

historic species deposited through disturbance have been removed – i.e. chicken and white-faced heron. Despite their numerical dominance in the assemblage MNI total, shellfish contributed only 3.33% of edible meat and about 0.96% of the energy harvested. Fish provided the overwhelming majority of the assemblage meat weight yield at 54.37%, but only 37.80% of the total energy yield. Marine mammal, i.e. *Arctocephalus forsteri* was the other significant resource, providing 38.04% of total meatweight and 57.63% of the energy yield. Terrestrial mammal provided only 3.40% of the assemblage meatweight yield, and only 2.45% of energy yields. Marine and terrestrial birds were no more than marginal energy sources (yielding less than 1% each), and as noted above, moa did not contribute to the energy harvest.

Table 4.9 Cabana Lodge prehistoric faunal assemblage MNI, meatweight, meat yield & energy yield calculations

Taxon	Common Name	MNI	MTWT kg	MTWT Yield kg	Energy kcal/kg	Energy Yield kcal	Energy Yield %kcal
Shellfish							
Aethocola glans	knobbed whelk	2	0.002	0.004	797	3.188	0.000
Amalda australis	southern olive shell	12	0.001	0.012	797	9.564	0.001
Amphibola crenata	mudsnail	4	0.001	0.004	797	3.188	0.000
Austrovenus stutchburyi	cockle	4777	0.002	9.554	430	4108.220	0.493
Buccinulum ?sp.	whelk Buccinulum ?sp.	25	0.001	0.025	797	19.925	0.002
Cominella adspersa	speckled whelk	6	0.002	0.012	797	9.564	0.001
Cookia sulcata	cooks turban	2	0.015	0.030	797	23.910	0.003
gastropod ?sp.	gastropod ?sp.	66	0.001	0.066	797	52.602	0.006
limpet ?sp.	limpet ?sp.	8	0.001	0.008	797	6.376	0.001
Lunella smaragdus	cats eye	507	0.004	2.028	797	1616.316	0.194
Maoricrypta costata	ribbed slipper shell	6	0.002	0.012	797	9.564	0.001
Mollusca sp.	shellfish sp.	84	0.001	0.084	797	66.948	0.008
Mytilidae sp.	mussel sp.	8	0.001	0.008	797	6.376	0.001
Nerita atramentosa	black nerita	29	0.001	0.029	797	23.113	0.003
Paphies australis	pipi	3228	0.001	3.228	410	1323.480	0.159
Paphies subtriangulata	tuatua	135	0.002	0.270	1100	297.000	0.036
Paphies sp.	Paphies sp.	469	0.001	0.469	797	373.793	0.045
Penion sulcatus	siphon whelk	9	0.003	0.027	797	21.519	0.003
Pratulum pulchellum	heart cockle	1	0.001	0.001	797	0.797	0.000
Sigapatella novaezelandiae	circular slipper shell	1	0.002	0.002	797	1.594	0.000
Struthiolaria sp.	ostrich foot sp.	19	0.002	0.038	797	30.286	0.004
Zeacumantus sp.	horn shell sp.	1	0.001	0.001	797	0.797	0.000
Shellfish totals		**9399**		**15.912**		**8008.120**	**0.961**
Fish							
Arripis trutta	kahawai	3	1.260	3.780	1828	6909.840	0.829
Carangidae sp.	Carangidae ?sp.	1	0.770	0.770	1185	912.450	0.110
Chelidonichthys kumu	red gurnard	1	0.490	0.490	1013	496.370	0.060
Gempylidae sp.	snake mackerel sp.	1	1.860	1.860	1225	2278.500	0.273
Latridopsis ciliaris	blue moki	24	1.890	45.360	1297	58831.920	7.061
Meuschenia scaber	leatherjacket	4	0.560	2.240	849	1901.760	0.228
Genyagnus monopterygius	spotted stargazer	1	0.350	0.350	923	323.050	0.039
Nemadactylus macropterus	tarakihi	13	0.560	7.280	1736	12638.080	1.517
Notolabrus celidotus	spotty	3	1.050	3.150	1000	3150.000	0.378

Table 4.9 Cabana Lodge prehistoric faunal assemblage MNI, meatweight, meat yield & energy yield calculations, *continued*

Taxon	Common Name	MNI	MTWT kg	MTWT Yield kg	Energy kcal/kg	Energy Yield kcal	Energy Yield %kcal
Pagrus auratus	snapper	125	1.540	192.500	1174	225995.000	27.126
Helicolenus percoides	sea perch	1	0.700	0.700	695	486.500	0.058
Zeus faber	john dory	1	0.980	0.980	1020	999.600	0.120
Fish totals		**178**		**259.460**		**314923.070**	**37.800**
Marine & wetland bird							
Eudyptula minor	Little penguin	2	0.770	1.540	3210	4943.400	0.593
Larus novaehollandiae	Red-billed gull	1	0.182	0.180	3210	584.220	0.070
Puffinus griseus	Sooty shearwater	1	0.560	0.560	3210	1797.600	0.216
Marine & wetland bird total		**4**		**2.280**		**7325.220**	**0.879**
Terrestrial bird							
Anas superciliosa	grey duck	1	1.000	0.7000	3210	2247.000	0.270
Halcyon sancta vagans	NZ kingfisher	1	0.046	0.0455	1760	80.080	0.010
Terrestrial bird total		**2**		**0.0455**		**80.080**	**0.279**
Terrestrial mammal							
Canis familiaris	dog – sub adult	1	6.00	6.000	1260	7560.000	0.907
	dog - adult	1	10.00	10.000	1260	12600.000	1.512
Rattus exulans	rat	2	0.10	0.200	1260	252.000	0.030
Terrestrial mammal totals		**4**		**16.200**		**20412.000**	**2.450**
Marine mammal							
Arctocephalus forsteri	fur seal - juvenile	2	14.38	28.760	2620	75351.200	9.044
Arctocephalus forsteri	fur seal - adult female	2	30.00	60.000	2620	157200.000	18.868
Arctocephalus forsteri	fur seal - adult male	1	94.50	94.500	2620	247590.000	29.718
Marine mammal totals		**5**		**183.260**		**480141.200**	**57.631**
Moa							
No subsistence moa remains		-		-		-	-
ASSEMBLAGE TOTALS		**9588**		**477.160**		**833136.690**	**100.000**

4.5 PROTEIN, CARBOHYDRATE AND FAT CONTRIBUTION

The values used to calculate protein, fat and carbohydrate yields are presented in Table 4.10. The summary of these results is presented by faunal class in Table 4.11. The fish class provides 19.17% of the protein yield, and a similar proportion of fat (24.72%) but much less carbohydrate (11.96%). Marine mammal contributes an even lower proportion of protein (10.42%), but the highest proportions of fat (72.27%) and carbohydrate (84.45% of assemblage yield). Shellfish contributes only 3.59% of total carbohydrate yield, 0.60% of protein yield, and 0.29% of fat yield. Terrestrial mammal makes the highest contribution to protein yield (69.61%), but minor contributions to fat yield (1.17%) and no contribution to carbohydrate yield. Terrestrial and marine and wetland birds make marginal contributions to all yields.

It seems likely that the percentage yields of these mammal classes will be fairly dependent on the MNI values for those classes, rather than the species within them. However, considering

the low MNI for the marine mammal class *(Arctocephalus forsteri*), it is apparent that it contributed the second highest meatweight yield and was the overwhelmingly dominant supply of fat and carbohydrates. Fish has a considerably higher MNI count than the marine mammal class, and contributes over half the meatweight, but is the second highest supplier of protein, fat and carbohydrates. The terrestrial mammal class also has a low MNI count, but is the highest contributor of protein in spite of its relatively low meatweight yield. At the other end of the spectrum, the extremely high MNI count of shellfish provides only a similar meatweight to that of the terrestrial mammal class, a small proportion of the carbohydrate yield, and insignificant contributions to protein and fat. In conclusion, the analysis of the Area F Layers 2 and 3 assemblage indicates that the marine mammal class, consisting of only one species, *Arctocephalus forsteri*, was important as a source high in fat and carbohydrate, while terrestrial mammal (*Canis familiaris* and *Rattus sp.*) was important as a source of protein. These were supplemented by fish which contributed significant amounts of protein, fat and carbohydrate. Shellfish, terrestrial bird, and marine mammal only made small supplementary contributions to these yields; moa made no contribution.

Table 4.10 Cabana Lodge prehistoric faunal assemblage MNI, protein yield, fat yield and carb yield calculations

Taxon	Common name	MNI	Protein g/kg	Protein Yield g	Fat g/kg	Fat Yield g	Carb g/kg	Carb Yield g
Shellfish								
Aethocola glans	knobbed whelk	2	136	0.544	17	0.068	23	0.092
Amalda australis	southern olive shell	12	136	1.632	17	0.204	23	0.276
Amphibola crenata	mudsnail	4	136	0.544	17	0.068	23	0.092
Austrovenus stutchburyi	cockle	4777	82	783.428	9	85.986	6	57.324
Buccinulum sp.	whelk Buccinulum sp.	25	136	3.400	17	0.425	23	0.575
Cominella adspersa	speckled whelk	6	136	1.632	17	0.204	23	0.276
Cookia sulcata	cooks turban	2	136	4.080	17	0.510	23	0.690
gastropod sp.	gastropod sp.	66	136	8.976	17	1.122	23	1.518
limpet sp.	limpet sp.	8	136	1.088	17	0.136	23	0.184
Lunella smaragdus	cats eye	507	136	275.808	17	34.476	23	46.644
Maoricrypta costata	ribbed slipper shell	6	136	1.632	17	0.204	23	0.276
Mollusca sp.	shellfish sp.	84	136	11.424	17	1.428	23	1.932
Mytilidae sp.	mussel sp.	8	136	1.088	17	0.136	23	0.184
Nerita atramentosa	black nerita	29	136	3.944	17	0.493	23	0.667
Paphies australis	pipi	3228	82	264.696	7	22.596	5	16.140
Paphies subtriangulata	tuatua	135	167	45.090	22	5.940	62	16.740
Paphies sp.	Paphies sp.	469	136	63.784	17	7.973	23	10.787
Penion sulcatus	siphon whelk	9	136	3.672	17	0.459	23	0.621
Pratulum pulchellum	heart cockle	1	136	0.136	17	0.017	23	0.023
Sigapatella novaezelandiae	circular slipper shell	1	136	0.272	17	0.034	23	0.046
Struthiolaria sp.	ostrich foot sp.	19	136	5.168	17	0.646	23	0.874
Zeacumantus sp.	horn shell sp.	1	136	0.136	17	0.017	23	0.023
Shellfish totals		**9399**		**1482.174**		**163.142**		**155.984**

Table 4.10 Cabana Lodge prehistoric faunal assemblage MNI, protein yield, fat yield & carb yield calculations, *continued*

Taxon	Common name	MNI	Protein g/kg	Protein Yield g	Fat g/kg	Fat Yield g	Carb g/kg	Carb Yield g
Fish								
Arripis trutta	kahawai	3	194	733.000	116	438.480	2	8.000
Carangidae sp.	Carangid sp.	1	196	151.000	44	33.880	2	2.000
Chelidonichthys kumu	red gurnard	1	186	91.000	29	14.210	2	1.000
Gempylidae sp.	snake mackerel sp.	1	182	339.000	55	102.300	2	4.000
Latridopsis ciliaris	blue moki	24	194	8800.000	57	2585.520	2	91.000
Meuschenia scaber	leatherjacket	4	172	385.000	17	38.080	2	4.000
Genyagnus monopterygius	spotted stargazer	1	159	56.000	31	10.850	2	1.000
Nemadactylus macropterus	tarakihi	13	189	1376.000	108	786.240	2	15.000
Notolabrus celidotus	spotty	3	167	526.000	36	113.400	2	6.000
Pagrus auratus	snapper	125	179	34458.000	50	9625.000	2	385.000
Helicolenus percoides	sea perch	1	138	97.000	15	10.500	2	1.000
Zeus faber	john dory	1	181	177.000	32	31.360	2	2.000
Fish totals		**178**		**47188.120**		**13789.820**		**518.920**
Marine & wetland bird								
Eudyptula minor	Little penguin	2	160	246.400	290	446.600	0	0.000
Larus novaehollandiae	Red-billed gull	1	160	29.120	290	52.780	0	0.000
Puffinus griseus	Sooty shearwater	1	160	89.600	290	162.400	0	0.000
Marine & wetland bird totals		**4**		**365.120**		**661.780**		**0.000**
Terrestrial bird								
Anas superciliosa	grey duck	1	160	112.00	290	203.000	0	-
Halcyon sancta vagans	NZ kingfisher	1	280	12.740	60	2.730	0	-
Terrestrial bird totals		**2**		**124.740**		**205.730**		**-**
Terrestrial mammal								
Canis familiaris	dog – sub adult	1	210	45360.000	40	240.000	0	-
	dog - adult	1	210	126000.000	40	400.000	0	-
Rattus exulans	rat	2	210	42.000	40	8.000	0	-
Terrestrial mammal totals		**4**		**171402**.000		**648.000**		**-**
Marine mammal								
Arctocephalus forsteri	fur seal - juvenile	2	140	4026.400	220	6327.200	20	575.200
Arctocephalus forsteri	fur seal - adult female	2	140	8400.000	220	13200.000	20	1200.000
Arctocephalus forsteri	fur seal - adult male	1	140	13230.000	220	20790.000	20	1890.000
Marine mammal totals		**5**		**25656.400**		**40317.200**		**3665.200**
ASSEMBLAGE TOTALS		**9592**		**246218.554**		**55785.672**		**4340.104**

Table 4.11 Summary of Cabana Lodge prehistoric faunal assemblage %meatweight, %protein, %fat & %carbohydrate yields by faunal class

Class	% MNI	% MTWT Yield	% Protein Yield	% Fat Yield	% Carb Yield
Shellfish	97.99	3.33	0.60	0.29	3.59
Fish	1.86	54.30	19.17	24.72	11.96
Terrestrial bird	0.02	0.16	0.05	0.37	0.00
Moa	0.00	0.00	0.00	0.00	0.00
Terrestrial mammal	0.04	3.39	69.61	1.16	0.00
Marine and wetland bird	0.04	0.48	0.15	1.19	0.00
Marine mammal	0.05	38.35	10.42	72.27	84.45
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

5 COMPARATIVE ANALYSIS RESULTS

5.1 INTRODUCTION

This chapter presents the results of the inter-assemblage analysis from within the Coromandel Peninsula and Western Bay of Plenty. First the assemblages are listed with a brief description of the site excavation and results. Then the calibrated radiocarbon dates for these assemblages are presented. These are used to put the assemblages into five time periods – early, early-middle, middle, middle-late and late. The assemblage MNI data will be presented with summaries of energy yields for each assemblage. This data will then be analysed for trends in faunal resources.

5.2 ASSEMBLAGES

Twenty-nine faunal assemblages from the Coromandel Peninsula and forty-four assemblages from the Western Bay of Plenty have been used in this analysis. Procedures used in the selection of these and for extracting and compiling the data were outlined in Chapter Three. As noted there, data for the majority (twenty-two) of the Coromandel assemblages and a smaller number (seven) of those from the Western Bay of Plenty, was compiled as part of the interdisciplinary *Taking Stock* project. The data repository for that project (Smith, I.W.G. & James-Lee 2010) has been used as the data source for these assemblages in the present analysis, as it provides a careful analysis of which components of the material reported from each site can be combined into reliably dated assemblages, and also incorporates revisions of taxonomy, where these are relevant. Data sources for the six additional Coromandel assemblages and 35 from Western Bay of Plenty are listed in Tables 5.1 and 5.5. The assemblages, sites types and calibrated radiocarbon results for the Coromandel assemblages are presented below, followed by those for the Western Bay of Plenty.

5.2.1 COROMANDEL PENINSULA

In Table 5.1, the twenty-nine Coromandel Peninsula faunal assemblages have been listed by their assigned code names, with their location, site number and source of data listed. Appendix A lists summaries of the site contexts and the samples used in the assemblages, along with associated radiocarbon dates.

Table 5.1 Archaeozoological assemblages & sources from the Coromandel Peninsula

Assemblage Code	Assemblage Name and Site Number	Source
NH-173	Ngarimu Heights, Thames Coast (T12/173)	(Hoffmann 2008)
PJK-53	Port Jackson (S09/53)	(Smith, I.W.G. & James-Lee 2010)
AHU-944	Ahuahu #3 (T10/944)	(Furey 2009a)
WHP-751	Whangapoua (T10/751)	(Gumbley 2008)
MTR-993	Matarangi Beach (T10/993)	(Smith, I.W.G. & James-Lee 2010)
MTR-990	Matarangi Beach (T10/990)	(Smith, I.W.G. & James-Lee 2010)
CCK-399-L9	Cross Creek Midden Layer 9 (T10/399)	(Smith, I.W.G. & James-Lee 2010)
CCK-399-L7	Cross Creek Midden Layer 7 (T10/399)	(Smith, I.W.G. & James-Lee 2010)
CCK-399-L5	Cross Creek Midden Layer 5 (T10/399)	(Smith, I.W.G. & James-Lee 2010)
CCK-399-L3	Cross Creek Midden Layer 3 (T10/399)	(Smith, I.W.G. & James-Lee 2010)
WHI-858	Whitianga Waterways 858 (T11/858)	(Smith, I.W.G. & James-Lee 2010)
WHI-624	Whitianga Waterways 624 (T11/624)	(Smith, I.W.G. & James-Lee 2010)
WHI-927-A	Whitianga Club Marina Apartments Area A (T11/927)	(Smith, I.W.G. & James-Lee 2010)
WHI-927-B	Whitianga Club Marina Apartments Area B (T11/927)	(Smith, I.W.G. & James-Lee 2010)
WHI-926	Whitianga Waterways (T11/926)	(Smith, I.W.G. & James-Lee 2010)
HHB-242-Upper	Hahei Beach upper (T11/242)	(Smith, I.W.G. & James-Lee 2010)
HHB-242-Middle	Hahei Beach middle (T11/242)	(Smith, I.W.G. & James-Lee 2010)
HHB-242-Lower	Hahei Beach lower (T11/242)	(Smith, I.W.G. & James-Lee 2010)
HWB-115-Llower	Hot Water Beach lower (T11/115)	(Smith, I.W.G. & James-Lee 2010)
HWB-115-Middle	Hot Water Beach middle (T11/115)	(Smith, I.W.G. & James-Lee 2010)
TRN-62-Lower	Tairua Lower Layer 2 (T11/62)	(Smith, I.W.G. & James-Lee 2010)
TRN-62-Upper	Tairua Upper Layer 6 (T11/62)	(Smith, I.W.G. & James-Lee 2010)
PAU-1028	Pauanui (T10/1028)	(Smith, I.W.G. & James-Lee 2010)
WHT-16	Whitipirorua (T12/16)	(Smith, I.W.G. & James-Lee 2010)
CL-3	Cabana Lodge, Whangamata (T12/3)	*this manuscript*
WHA-959	Moana Park, Whangamata (T12/959)	(Smith, I.W.G. & James-Lee 2010)
WHA-240	Whangamata (T12/240)	(Hoffmann 2009d)
WHA-1035	Beach Road, Whangamata (T12/1035)	(Hoffmann 2009c)
WHA-106	Whangamata Rising Main (T12/106)	(Mallows 2009c)

In Table 5.2 the Coromandel assemblages are ranked in order of assemblage MNI totals. Three assemblages from Whangamata, the Kuaotunu Peninsula and Whitianga stand out as the largest assemblages with MNI totals over 7000. Five assemblage MNI totals fall in the 2000-2999 bracket, and a further five assemblages fall in the 1000-1999 MNI bracket. Eleven assemblages have MNI totals that fall between 500 and 999. Three assemblage MNI totals fall in the 100-499 bracket; only two assemblages have MNI totals of less than 100.

Table 5.2 Coromandel assemblage MNI totals in rank order with site type

Assemblage Code	MNI total	Site type
CL-3	9592	undefended settlement
CCK-399-L3	8929	undefended settlement
WHI-927-B	7376	temporary camp
PJK-53	2934	undefended settlement
WHP-751	2558	undefended pit complex
MTR-993	2463	temporary camp
HWB-115-Lower	2269	undefended settlement
WHI-858	2191	temporary camp
NH-173	1801	undefended settlement
WHA-240	1409	temporary camp
HHB-242-Upper	1227	temporary camp
TRN-62-Upper	1132	temporary camp
WHI-624	1102	temporary camp
CCK-399-L9	999	undefended settlement
WHA-106	980	temporary camp
HWB-115-Middle	976	undefended settlement
AHU-944	973	temporary camp
WHA-1035	842	temporary camp
HHB-242-Middle	819	temporary camp
WHI-926	733	temporary camp
WHA-959	649	undefended settlement
WHI-927-A	648	temporary camp
TRN-62-Lower	616	temporary camp
HHB-242-Lower	614	temporary camp
CCK-399-L5	427	undefended settlement
WHT-16	420	undefended settlement
MTR-990	206	temporary camp
PAU-1028	44	undefended settlement
CCK-399-L7	38	undefended settlement

The most common site type of the 29 assemblages is temporary camp, at 55.2%. The next most common site type, undefended settlement, accounts for 41.3% of assemblages. Undefended pit complex makes up the remaining 3.4% of Coromandel assemblages.

Figure 5.1 shows locations of the Coromandel sites beginning with Ngarimu Heights on the east coast, following the coastline in a clockwise direction up to Port Jackson and then south along the east coast, finishing at Whangamata. It should be noted that the geographic distribution of sites illustrated here is not a representative sample of all prehistoric site types in the area, or even of excavated midden sites.

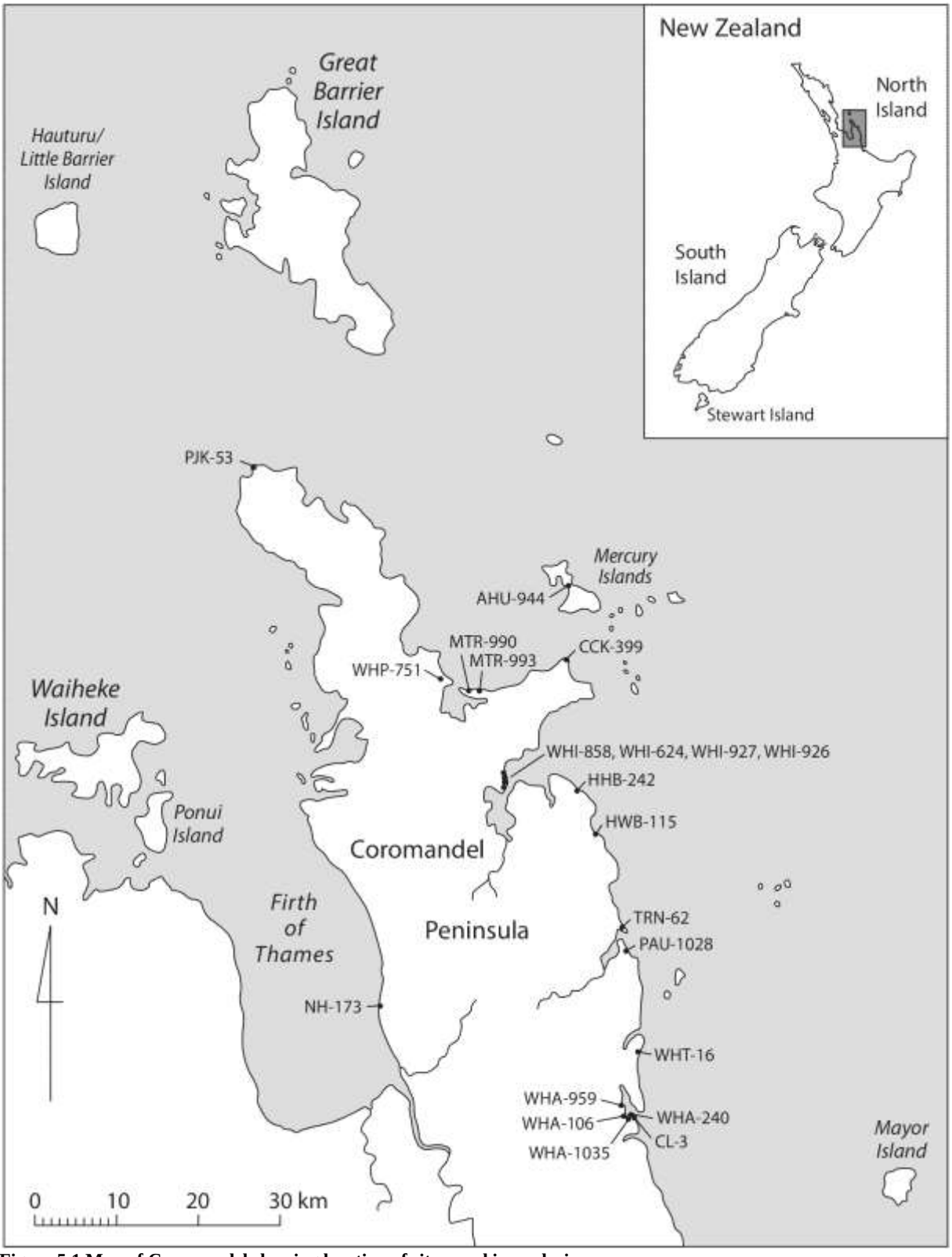

Figure 5.1 Map of Coromandel showing location of sites used in analysis

The included assemblages are constrained by meeting the strict chronometric hygiene criteria and the full faunal analysis and reporting of relative abundance (MNI) data. Nevertheless, there is an obvious discrepancy in site density between the west and east coasts of the Coromandel Peninsula, with the east being heavily favoured over the west. Sites in the east

tend to cluster near harbours and estuaries, e.g. Whitianga and Whangamata Harbours; and sandy beaches and bays, e.g. Cross Creek, Hahei and Hot Water Beach.

Table 5.3 presents the calibrated radiocarbon dates for the Coromandel assemblages. These are listed in order from earliest calibrated radiocarbon dates (i.e. TRN L2) to latest (i.e.WHI-927-A). Where radiocarbon dates have been tested for similarity at the 95% level, the results are presented for the Mean Pooled Radiocarbon Age (MPRA), along with Mean Pooled Radiocarbon 14C, Standard Deviation (MPR 14C SD), Test Statistic T, Xi^2 (0.05) value, and Degrees of Freedom. Where radiocarbon dates are tested and proved not to be similar at the 95% level, this is specified ("statistically different at 95% level") along with the values specified for MPRA.

Table 5.3 Calibrated radiocarbon dates for Coromandel assemblages

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 -0.05	Degrees of Freedom
Wk5444	TRN Lower L2	1313	1413	1	1267	1458	1					
Wk5445	TRN Lower L2	1226	1349	1	1172	1417	1					
MPRA	**TRN Lower L2**	**1286**	**1393**	**1**	**1227**	**1437**	**1**	**1045**	**47.56574**	**0.890276**	**3.84**	**1**
Wk21355	CCK L9	1236	1334	1	1190	1403	1					
Wk21363	CCK L9	1314	1404	1	1279	1444	1					
MPRA	**CCK L9**	**1285**	**1388**	**1**	**1231**	**1428**	**1**	**1049.5**	**39.88107**	**1.135649**	**3.84**	**1**
NZA0576	CCK L9	1235	1242	0.058677	1221	1330	0.684406					
		1265	1317	0.6301	1332	1391	0.315594					
		1353	1383	0.311223								
Wk21642	CCK L9	1275	1305	0.719696	1233	1245	0.018745					
		1362	1378	0.280304	1264	1322	0.666873					
					1348	1387	0.314382					
MPRA	**CCK L9**	**1276**	**1302**	**0.797656**	**1266**	**1319**	**0.722075**	**745.7119**	**28.6241**	**0.011004**	**3.84**	**1**
		1364	**1376**	**0.202344**	**1351**	**1385**	**0.277925**					
NZ6800	**CCK L7**	**1298**	**1388**	**1**	**1260**	**1430**	**1**					
NZ6642	**HHB upper**	**1339**	**1457**	**1**	**1289**	**1524**	**1**					
Wk21693	CL T12/3 Area F L2 Nth Baulk	1303	1395	1	1265	1437	1					
Wk21694	CL T12/3 Area F L2 F22	1353	1373	0.166214	1315	1483	1					
		1381	1453	0.833786								
MPRA	**T12/3 L2**	**1328**	**1421**	**1**	**1291**	**1458**	**1**	**977.5043**	**39.25021**	**1.433717**	**3.84**	**1**
inclusion	HHB middle											
NZ6646	**HHB lower**	**1337**	**1441**	**1**	**1293**	**1485**	**1**					
NZ4883	**PJK**	**1319**	**1351**	**0.414967**	**1300**	**1369**	**0.450564**					
		1385	**1426**	**0.585033**	**1370**	**1442**	**0.549436**					
Wk1169	WHT upper	1407	1507	1	1327	1527	1					
Wk1515	WHT earliest occ	1318	1418	1	1274	1462	1					
MPRA	**WHT-16**	**1352**	**1457**	**1**	**1306**	**1500**	**1**	**926.6764**	**46.22956**	**1.6793**	**3.84**	**1**
NZ6825	**CCK L5**	**1395**	**1505**	**1**	**1317**	**1566**	**1**					
NZ6798	**CCK L3**	**1427**	**1510**	**1**	**1352**	**1375**	**0.017072**					
					1380	**1588**	**0.982928**					

Table 5.3 Calibrated radiocarbon dates for Coromandel assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 -0.05	Degrees of Freedom
inclusion	HWB lower											
NZ1297	**HWB middle M11/12 baulk L4**	**1430**	**1533**	**1**	**1395**	**1640**	**1**					
Wk8065	**MTR-990**	**1454**	**1583**	**1**	**1427**	**1656**	**1**					
Wk25355	**AHU-944 M3**	**1448**	**1544**	**1**	**1428**	**1633**	**1**					
Wk14234	**WHI-927 B F44**	**1484**	**1595**	**0.952026**	**1458**	**1653**	**1**					
		1608	**1615**	**0.047974**								
Wk12109	PAU swe	1517	1640	1	1467	1677	1					
Wk12110	PAU lot 3	1511	1636	1	1464	1674	1					
MPRA	**PAU MPRA**	**1514**	**1639**	**1**	**1464**	**1677**	**1**					
Wk25357	WHA-1035 M3	1436	1516	1	1399	1598	0.992355					
					1606	1616	0.007645					
Wk25356	WHA-1035 M2	1636	1765	0.908537	1539	1843	1					
		1785	1804	0.091463								
MPRA	**WHA 1035**	**1518**	**1638**	**1**	**1469**	**1674**	**1**	**729.1279**	**37.85044**	**9.136063**	**3.84**	**1**
Wk13352	**WHI-624**	**1518**	**1636**	**1**	**1471**	**1672**	**1**					
Wk14472	**WHA-1044 upper AC F9**	**1545**	**1658**	**1**	**1490**	**1693**	**1**					
Wk15677	WHP-751 Area D/E Midden	1569	1718	1	1529	1820	1					
Wk15678	WHP-751 Area A Midden 1a	1532	1648	1	1479	1684	1					
Wk15679	WHP-751 Area C Midden over pit3/F23	1566	1692	1	1510	1772	0.9777432					
					1784	1805	0.022568					
MPRA	**WHP-751**	**1562**	**1683**	**1**	**1495**	**1727**	**0.9779**	**663.7497**	**32.56121**	**1.111056**	**5.99**	**2**
					1728	**1757**	**0.012582**					
					1788	**1802**	**0.009518**					
Wk6377	MTR-993 25cm bs	1553	1679	1	1486	1728	0.975026					
					1737	1758	0.01405					
					1788	1802	0.010924					
Wk6378	MTR-993 35cm bs	1540	1664	1	1473	1729	0.973637					
					1736	1759	0.015447					
					1787	1803	0.010916					
Wk6379	MTR-993 F4	1656	1821	1	1572	1903	0.974015					
					1925	1949	0.025985					
MPRA	**MTR-993**	**1564**	**1700**	**1**	**1518**	**1810**	**1**	**645.3715**	**37.32354**	**1.376735**	**5.99**	**2**

Table 5.3 Calibrated radiocarbon dates for Coromandel assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 -0.05	Degrees of Freedom
Wk5650	WHA-959 AF SA hangi scoop	1633	1806	1	1531	1872	1					
Wk5651	WHA-959 AF SA hangi scoop	1630	1806	1	1529	1870	1					
MPRA	**WHA-959**	**1632**	**1806**	**1**	**1530**	**1871**	**1**	**611**	**45**	**0.004938**	**3.84**	**1**
Wk24975	WHA-106 WRM A3	1627	1765	0.914536	1533	1844	1					
		1785	1804	0.085464								
Wk24976	WHA-106 WRM B1	1556	1676	1	1486	1724	0.988755					
					1743	1752	0.004628					
					1790	1801	0.006618					
Wk24977	WHA-106 WRM C6	1674	1814	1	1631	1905	0.973211					
					1920	1949	0.026789					
MPRA	WHA-106	**1619**	**1761**	**0.929844**	**1532**	**1832**	**1**	**618**	**32.91403**	**1.608**	**5.99**	**2**
		1787	**1803**	**0.070156**								
Wk21803	NH-173 Area A Pit 9	**1672**	**1813**	**1**	**1624**	**1905**	**0.975221**					
					1921	**1949**	**0.024779**					
Wk21804	NH-173 Area B Sq1	1669	1814	1	1618	1907	0.973213					
					1918	1949	0.026787					
Wk21805	NH-173 Area D midden	1661	1806	1	1566	1889	0.997827					
					1947	1949	0.002173					
MPRA	**NH-173 Average**	**1669**	**1808**	**1**	**1594**	**1608**	**0.008672**	**578.4265**	**33.26591**	**0.052756**	**5.99**	**2**
					1614	**1899**	**0.978211**					
					1933	**1949**	**0.013118**					
Wk5446	**TRN Upper L6**	**1670**	**1818**	**1**	**1627**	**1910**	**0.966637**					
Wk11074	WHI-858 FA	1658	1818	1	1572	1901	0.978551					
					1928	1949	0.021449					
Wk11075	WHI-858 FC	1646	1813	1	1542	1891	0.995865					
					1945	1949	0.004135					
Wk11076	WHI-858 FD	1709	1878	1	1689	1949	1					
MPRA	**WHI-858 Average**	**1675**	**1820**	**1**	**1642**	**1908**	**0.963688**	**562.0852**	**37.70588**	**0.990933**	**5.99**	**2**
					1918	**1949**	**0.036312**					
					1915	**1950**	**0.033363**					

Table 5.3 Calibrated radiocarbon dates for Coromandel assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 -0.05	Degrees of Freedom
Wk26143	WHA 240 Area A F3	1721	1885	1	1702	1949	1					
Wk26144	WHA 240 Area B F6	1650	1775	0.872798	1549	1872	1					
		1782	1805	0.127202								
MPRA	**WHA 240**	**1681**	**1832**	**1**	**1657**	**1909**	**0.948559**	**549**	**40.31129**	**1.538462**	**3.84**	**1**
					1916	**1949**	**0.051441**					
Wk13650	**WHI-926**	**1516**	**1637**	**1**	**1468**	**1674**	**1**					
Wk14233	**WHI-927 A F8**	**1686**	**1831**	**1**	**1663**	**1905**	**0.954128**					
					1920	**1950**	**0.045872**					

Table 5.4 presents the Coromandel Peninsula assemblages assigned to time period (see Section 3.5.2). All time periods are represented, with 27.6% of assemblages in the early period, 13.8% in the early-middle period, 24.1% of assemblages in the middle period, 13.8% in the middle-late period, and 20.7% falling in the late period. Figure 5.2 illustrates the 1σ and 2σ ranges of the calibrated dates for 27 of the 29 Coromandel assemblages, in ascending order. Two assemblages without calibrated dates (HHB-242-Middle and HWB-115-Lower) have had dates inferred from stratigraphically adjacent assemblages from their sites.

Table 5.4 Coromandel Peninsula assemblages assigned to time period

Assemblage Code	Assemblage Name and Site Number	Period
CCK-399-L9	Cross Creek Midden Layer 9 (T10/399)	E
TRN-62-Lower	Tairua Lower Layer 2 (T11/62)	E
CCK-399- L7	Cross Creek Midden Layer 7 (T10/399)	E
PJK-53	Port Jackson (S09/53)	E
CL-3	Cabana Lodge (T12/3)	E
HHB-242-lower	Hahei Beach Lower (T11/242)	E
HHB-242-middle	Hahei Beach Middle (T11/242)	E
HHB-242-Upper	Hahei Beach Upper (T11/242)	EM
WHT-16	Whitipirorua (T12/16)	EM
CCK-399-L5	Cross Creek Midden Layer 5 (T10/399)	EM
CCK-399-L3	Cross Creek Midden Layer 3 (T10/399)	EM
HWB-242-Lower	Hot Water Beach Lower (T11/115)	EM
HWB-242-Middle	Hot Water Beach Middle (T11/115)	EM
AHU-944	Ahuahu #3 (T10/944)	EM
MTR-990	Matarangi Beach (T10/990)	M
WHI-927-B	Whitianga Club Marina Apartments Area B (T11/926)	M
PAU-1028	Pauanui (T10/1028)	M
WHI-926	Whitianga Waterways (T11/926)	M
WHA-1035	Beach Road, Whangamata (T12/1035)	M
WHI-624	Whitianga Waterways (T11/624)	M
WHP-751	Whitipirorua (T10/751)	ML
MTR-993	Matarangi Beach (T10/993)	ML
WHA-106	Whangamata Rising Main (T12/106)	ML
WHA-959	Moana Park Whangamata (T12/959)	ML
NH-173	Ngarimu Heights, Thames Coast (T12/173)	ML
TRN-62-Upper	Tairua Upper Layer 6 (T11/62)	L
WHI-858	Whitianga Waterways (T11/858)	L
WHA-240	Whangamata (T12/240)	L
WHI-927-A	Whitianga Club Marina Apartments Area A (T11/927)	L

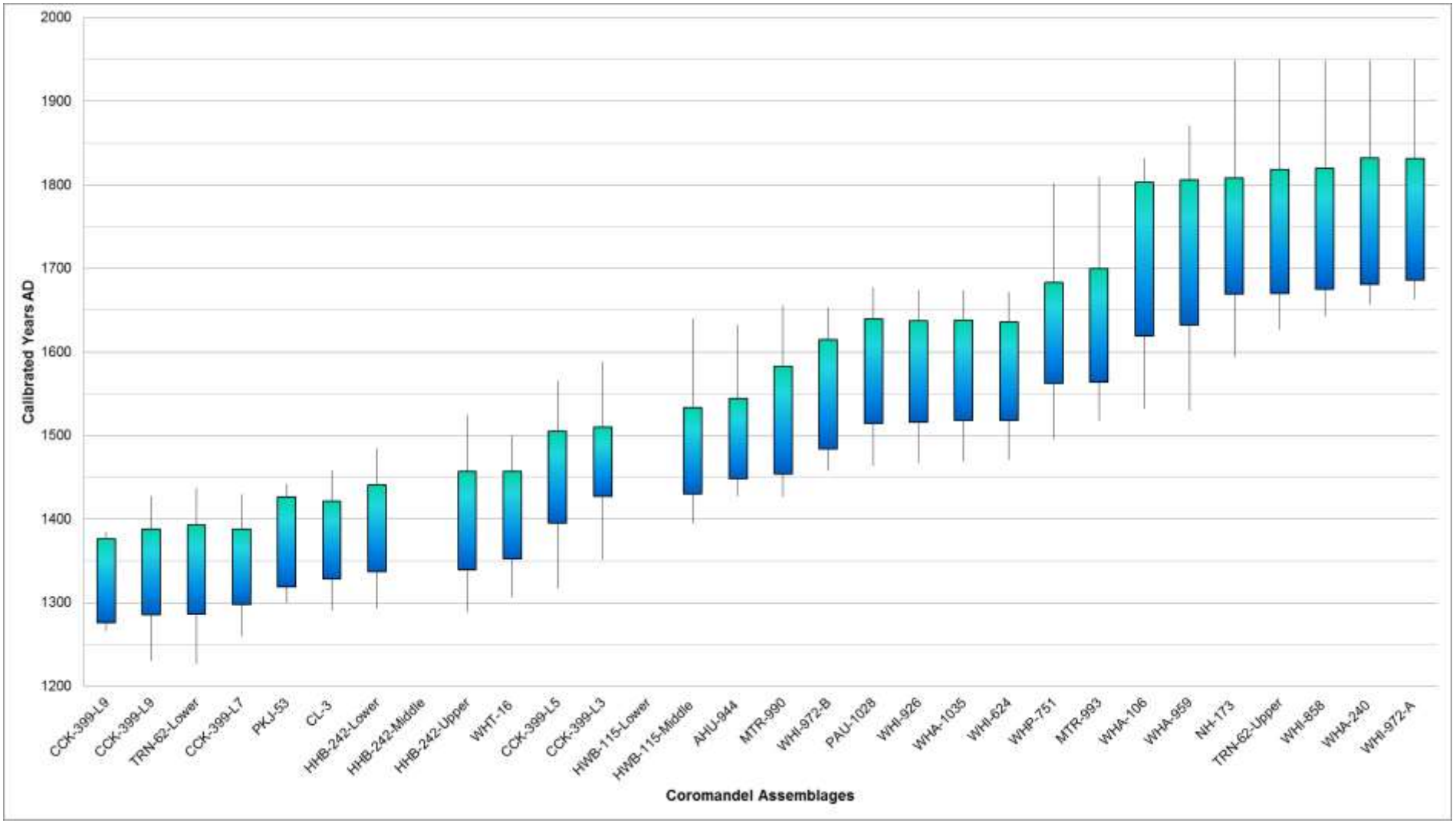

Figure 5.2 Calibrated date ranges showing 1 δ and 2 δ ranges, Coromandel Peninsula assemblages

5.2.2 WESTERN BAY OF PLENTY

In Table 5.5 the 44 Western Bay of Plenty faunal assemblages have been listed by their assigned code names, with their location, site number and source of data listed. Appendix A lists summaries of the site contexts and the samples used in the assemblages, along with associated radiocarbon dates. The northern section of the present Western Bay of Plenty study area was included in the *Taking Stock* study, thus assemblage data for Waihi Beach, Bowentown and Athenree assemblages used in this research were sourced from Smith, I.W.G. and James-Lee (2010). However, this thesis presents the first cohesive overview of faunal data from the Western Bay of Plenty area.

Figure 5.3 indicates the locations of sites listed from the Western Bay of Plenty. The sites are ordered by their approximate geographical location, beginning in the north-east at Waihi Beach, following the coast in a south-west direction and finishing at Ohope Beach. It should be noted that the Western Bay of Plenty has a high density of sites, particularly midden sites, and the assemblages included in this analysis represent only a small fraction of these. Thus, the geographic distribution of the assemblages presented in Figure 5.3 is directly influenced by assemblages that not only have radiocarbon dates which meet the chronometric hygiene criteria but also have full MNI data available for all faunal classes in their assemblages.

Table 5.6 presents the Western Bay of Plenty assemblages in rank order of MNI totals and also lists the site type each assemblage is provenance from. Only one assemblage, ASH-2912, has an MNI total over 7000 (2.3% of Western Bay of Plenty assemblages). Three assemblages (6.8%) have MNI totals between 4000 and 6999, and two assemblages (4.5%) fall in the 2000-3999 MNI bracket. Eight assemblages (18.2%) have MNI totals of between 1000 and 1999; in the 500-999 MNI bracket there are eleven assemblages (25.0%). Fifteen assemblages (34.1%) have MNI totals of 100-499; and four assemblages (9.1%) have MNI totals of fewer than 99.

The forty-four Western Bay of Plenty assemblages cover a range of 6 different site classes, including temporary camps (54.4%), pit complex-temporary camps (18.2%), undefended settlements (13.6%) defended settlements (4.5%), temporary camps-horticultural soils (4.5 %) and pit complex (2.3%); one site could not be determined (2.3%).

Table 5.5 Archaeozoological assemblages & sources, Western Bay of Plenty

Assemblage Code	Assemblage Name and Site Number	Source
ANA-46-Lower	Anatere Pa Lower, Athenree (U13/46)	(Smith, I.W.G. & James-Lee 2010)
ANA-46-Upper	Anatere Pa Upper, Athenree (U13/46)	(Smith, I.W.G. & James-Lee 2010)
ASH-2912	Asher Block, Omanu-Papamoa (U14/2912)	(Gumbley 2010)
BAP-3269-F6	Balintoy Park, Welcome Bay, Tauranga (U14/3269)	(Harris & Campbell 2009)
BAP-3269-T1	Balintoy Park, Welcome Bay, Tauranga (U14/3269)	(Harris & Campbell 2009)
BWT-874	Bowentown (U13/874)	(Smith, I.W.G. & James-Lee 2010)
BWT-875	Bowentown (U13/875)	(Smith, I.W.G. & James-Lee 2010)
BWT-876	Bowentown (U13/876)	(Smith, I.W.G. & James-Lee 2010)
CHE-1920	Cheyne Rd, Oropi, Tauranga (U14/1920)	(Furey 2004b)
CHE-3193	Cheyne Rd, Oropi, Tauranga (U14/3193)	(Furey 2004b)
EVA-3256	Evans Road, Papamoa (U14/3256)	(Felgate 2006a)
FPC-3305	Fergusson Park, Matua, Tauranga (U14/3305)	(Mintmier 2008)
FTP-1465	Florence Lane, Te Puna (U14/1465B)	(Furey 2008b)
GSP-3113	Golden Sands, Papamoa (U14/3113)	(Gumbley & Phillips 2004)
GSP-3116	Golden Sands, Papamoa (U14/3116)	(Gumbley & Phillips 2004)
HAM-9	Hamurana Road, Rotorua (U15/9)	(Campbell & Phillips 2005)
KAI	Kaitemako Substation, Welcome Bay, Tauranga (U14/?)	(Campbell & Farley 2008)
KTR-78	Koutunui Road, Athenree (U13/78)	(Smith, I.W.G. & James-Lee 2010)
MAN-188	Maketu North V14/188	(Moore, P.R., Taylor et al. 2009)
MAS-187	Maketu South V14/187	(Moore, P.R., Taylor et al. 2009)
MAT-2351	Mataraua, Tauriko (U14/2351)	(Campbell & Hudson 2009)
ORO-1941	Oropi Downs, Tauranga (U14/1941)	(Campbell & Hudson 2008)
ORO-1945	Oropi Downs, Tauranga (U14/1945)	(Campbell 2003b; Campbell & Piahana 2003)
ORO-3056	Oropi Downs, Tauranga (U14/3056)	(Campbell & Hudson 2008)
ORO-3197	Oropi Downs, Tauranga (U14/3197)	(Campbell 2004b)
ORO-3216	Oropi Downs, Tauranga (U14/3216)	(Campbell & Hudson 2008)
ROW-1972	Rowesdale, Oropi, Tauranga (U14/1972)	(Campbell 2005a)
ROW-3218	Rowesdale, Oropi, Tauranga (U14/3218)	(Campbell 2005a)
STR-780	The Strand, Whakatane (W15/780)	(Cable 2007a)
SUP-2888	BOP Supacenta Development, Papamoa (U14/2888)	(Felgate 2005a)
SUP-2889	BOP Supacenta Development, Papamoa (U14/2889)	(Felgate 2005a)
SUP-2891	BOP Supacenta Development , Papamoa (U14/2891)	(Felgate 2005a)
TAR-3230 G	Tara Road, Papamoa (U14/3230 G)	(Campbell, Gumbley et al. 2009)
TAR-3230 H	Tara Road, Papamoa (U14/3230 H)	Campbell, 2009 #1012}
TAR-3231	Tara Road, Papamoa (U14/3231)	Campbell, 2009 #1012}
TAU-2402	Tauriko (U14/2402)	(Harris 2009)
TEH-584	Te Horo Drive, Ohope Beach (W15/584)	(Bowers, L.C. & Phillips 1997c)
TEP-3221	Wairoa Rd, Te Puna (U14/3221)	(Campbell 2008)
TUI-2897-1	Tuihana Subdivision, Papamoa (U14/2897)	(Felgate 2006b)
TUI-2897-2	Tuihana Subdivision, Papamoa (U14/2897)	(Felgate 2006b)
TUI-2897-3	Tuihana Subdivision, Papamoa (U14/2897)	(Felgate 2006b)
WHA-1229	Whakamarama Road, Western Bay of Plenty (U14/1229)	(Cable 2008b)
WHB-1246	The Crescent, Waihi Beach (U13/1246)	(Smith, I.W.G. & James-Lee 2010)
WHB-1275	Waihi Beach U13/1275	(Moore, P.R. 2007)

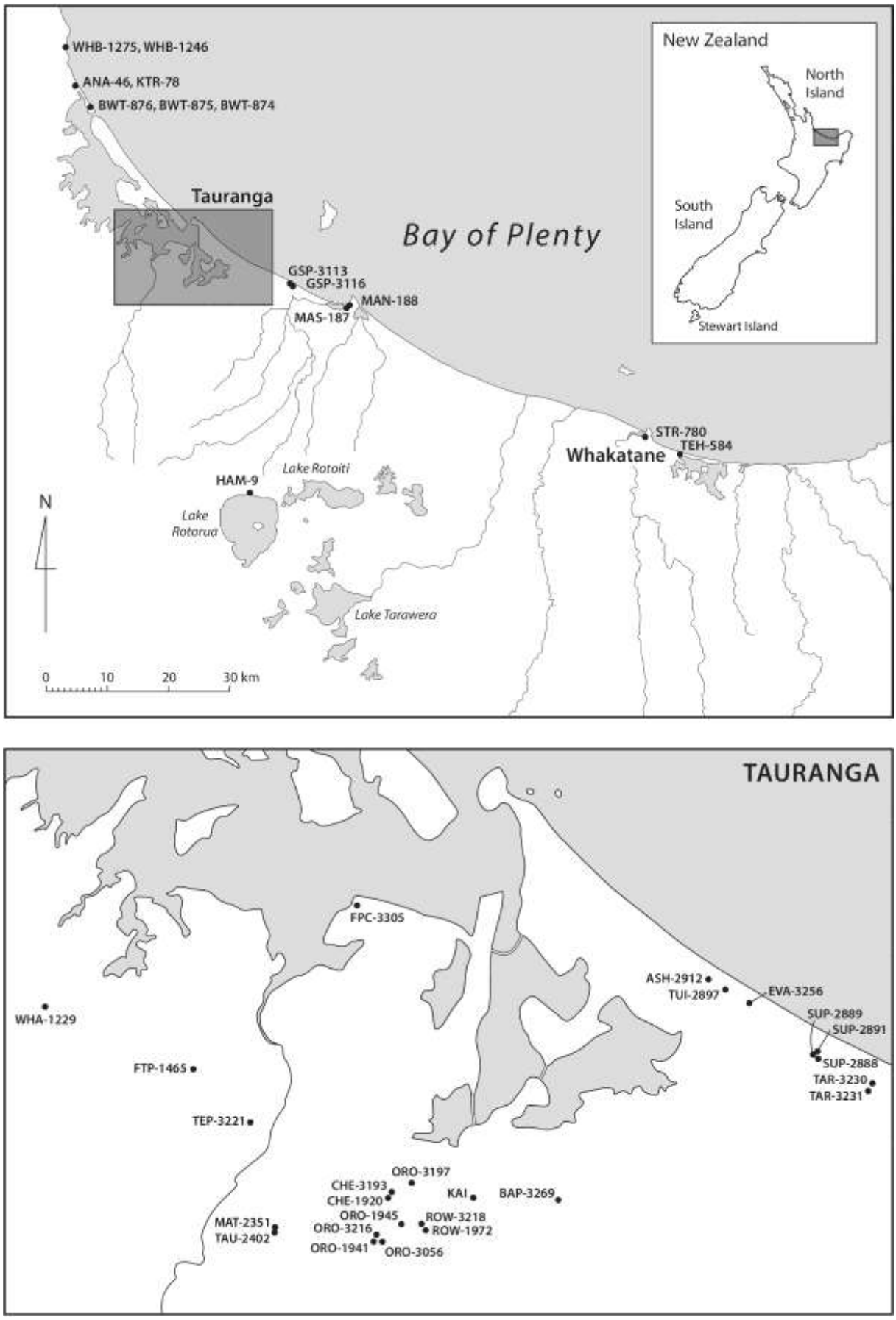

Figure 5.3 Map of Western Bay of Plenty showing location of sites used in analysis

Table 5.6 Western Bay of Plenty assemblage MNI totals in rank order with site type

Assemblage Code	MNI Total	Site Type
ASH-2912	9602	pit complex-temporary camp
TAR-3230-H	6651	temporary camp
TEH-584	4800	temporary camp
FTP-1465	4584	pit complex-temporary camp
MAT-2351	2928	defended settlement
ORO-3197	2029	temporary camp
CHE-3193	1919	pit complex-temporary camp
BAP-3269-T1	1919	pit complex-temporary camp
TAU-2402	1827	temporary camp
KAI	1755	temporary camp
ORO-1945	1529	temporary camp
MAN-188	1364	temporary camp
EVA-3256	1150	temporary camp
TEP-3221	1071	temporary camp
GSP-3116	980	camp-horticultural soils
ORO-1941	929	pit complex-temporary camp
ORO-3056	893	temporary camp
ROW-3218	715	defended settlement
ORO-3216	715	pit complex-temporary camp
HAM-9	668	temporary camp
ROW-1972	640	temporary camp
ANA-46-Upper	576	undefended settlement
GSP-3113	510	temporary camp-horticultural soils
KTR-78	504	temporary camp
SUP-2891	501	temporary camp
CHE-1920	472	pit complex-temporary camp
FPC-3305	380	temporary camp
STR-780	353	undefended settlement
SUP-2889	341	undefended settlement
TUI-2897-2	334	temporary camp
WHB-1246	285	undefended settlement
TAR-3231	277	temporary camp
TAR-3230 G	247	temporary camp
TUI-2897-3	245	temporary camp
BWT-874	225	temporary camp
BWT-876	215	pit complex
WHB-1275	202	temporary camp
WHA-1229	176	temporary camp
ANA-46-Lower	149	undefended settlement
TUI-2897-1	102	temporary camp
BWT-875	67	undefended settlement
BAP-3269-F6	43	pit complex-temporary camp
SUP-2888	21	undetermined
MAS-187	10	temporary camp

Table 5.7 presents the calibrated radiocarbon dates for the Western Bay of Plenty assemblages. As for the Coromandel assemblages, these are listed in order from earliest calibrated radiocarbon dates (i.e. KTR-78) to latest (i.e.SUP-2889). Where radiocarbon dates have been tested for similarity at the 95% level, the results are presented for the Mean Pooled Radiocarbon Age (MPRA), along with Mean Pooled Radiocarbon 14C, Standard Deviation

(MPR 14C SD), Test Statistic T, Xi^2 (0.05) value, and Degrees of Freedom. Where radiocarbon dates are tested and proved not to be similar at the 95% level, this is specified ("statistically different at 95% level") along with the values specified for MPRA.

Table 5.8 lists the Western Bay of Plenty assemblages by time period. The calibrated ranges of these assemblages are not evenly spread through the time periods as with the dates for the Coromandel assemblages. The early period assemblage accounts for 2.3% of the Western Bay of Plenty assemblages, the early-middle period 13.6%, the middle period 43.2% the middle-late period 25.0% and the late period 15.9% of assemblages. Figure 5.4 illustrates the 1σ and 2σ ranges of the calibrated dates for each assemblage, in ascending order.

Table 5.7 Calibrated radiocarbon dates for Western Bay of Plenty assemblages

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 - 0.05	Degrees of Freedom
Wk23623	**MAS-187 M22**	1325	1342	0.238	1316	1356	0.382					
		1390	1412	0.444	1381	1430	0.572					
Wk14285	**KTR-78 MM1**	**1391**	**1484**	**1**	**1325**	**1518**	**1**	-	-	-	-	-
Wk14413	**BWT-875 base of occupation**	**1401**	**1490**	**1**	**1329**	**1530**	**1**	-	-	-	-	-
Wk14113	CHE 1920 Pit 3	1416	1501	1	1336	1558	1	-	-	-	-	-
Wk14114	CHE 1920 Trench 4	1443	1530	1	1415	1624	1	-	-	-	-	-
MPRA	**CHE 1920**	**1428**	**1521**	**1**	**1385**	**1630**	**1**	**842.8947**	**39.23613**	**0.285668**	**3.84**	**1**
Wk5480	TEH 584 Sample 4	1449	1652	1	1428	1645	1					
Wk5481	TEH 584 Sample 19	1410	1502	1	1330	1559	1	-	-	-	-	-
MPRA	**TEH 584**	**1430**	**1520**	**1**	**1393**	**1637**	**1**	**835**	**42.57347**	**0.675862**	**3.84**	**1**
Wk16946	**ROW 1972**	**1444**	**1534**	**1**	**1418**	**1628**	**1**	**-**	**-**	**-**	**-**	**-**
Wk17613	TUI 2897-1	1699	1722	0.175111	1676	1736	0.241221	-	-	-	-	-
		1809	1820	0.080314	1799	1953	0.759779	-	-	-	-	-
		1821	1838	0.124293			-	- - -	-			
		1844	1868	0.166678				-	-	-	-	-
		1877	1932	0.392457				-	-	-	-	-
		1938	1945	0.055134				-	-	-	-	-
		1951	1951	0.006013				-	-	-	-	-
Wk17614	TUI 2897-2	1450	1557	1	1431	1641	1	-	-	-	-	-
Wk17615	TUI 2897-3	1685	1830	1	1662	1905	0.95319	-	-	-	-	-
					1920	1949	0.04681	-	-	-	-	-
DIFFERENT								**397.1903**	**27.95608**	**100.9611**	**5.99**	**2**
Wk18306	**ORO 3216 F17**	**1452**	**1556**	**1**	**1434**	**1640**	**1**	**-**	**-**	**-**	**-**	**-**
Wk16952	**ROW 3218 F32**	**1446**	**1494**	**1**	**1432**	**1509**	**0.839606**	**-**	**-**	**-**	**-**	**-**
Wk14115	CHE 3193 trench 1 Pit 4	1448	1544	1	1428	1633	1	-	-	-	-	-
Wk14116	CHE 3193 Trench 2, midden scoop	1491	1598	0.921341	1461	1655	1	-	-	-	-	-
		1606	1616	0.078659								
MPRA	**CHE 3193**	**1463**	**1583**	**1**	**1443**	**1651**	**1**	**780.2171**	**37.66248**	**0.047614**	**3.84**	**1**

Table 5.7 Calibrated radiocarbon dates for Western Bay of Plenty assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 - 0.05	Degrees of Freedom
Wk13116	ORO 1945 S3	1464	1581	1	1445	1649	1	-	-	-	-	-
Wk13117	ORO 1945 S4	1505	1589	0.860361	1480	1644	1	-	-	-	-	-
		1616	1630	0.139639				-	-	-	-	-
DIFFERENT								**471.3408**	**29.82725**	**40.36313**	**3.84**	**1**
Wk16947	ROW 3218 F21	1461	1574	1	1445	1646	1	-	-	-	-	-
Wk16948	ROW 3218 F25	1450	1551	1	1431	1637	1	-	-	-	-	-
Wk16949	ROW 3218 F38 sp 2	1480	1594	0.966526	1455	1654	1	-	-	-	-	-
		1608	1614	0.033474								
Wk16950	ROW 3218 F1	1451	1554	1	1434	1638	1	-	-	-	-	-
MPRA	**ROW 3218**	**1459**	**1567**	**1**	**1444**	**1642**	**1**	**786.6708**	**27.39299**	**0.321339**	**7.81**	**3**
Wk18304	**ORO 3056**	**1465**	**1584**	**1**	**1446**	**1650**	**1**	**-**	**-**	**-**	**-**	**-**
Wk4660	ANA Lower A4a L12 firescoop	1461	1591	0.994346	1434	1661	1	-	-	-	-	-
		1609	1611	0.005654								
Wk4662	ANA Lower Trench 4 L22	1526	1655	1	1462	1699	1	-	-	-	-	-
NZ5184	ANA Lower scarp of terrace 7	1425	1551	1	1385	1653	1	-	-	-	-	-
MPRA	**ANA Lower**	**1499**	**1628**	**1**	**1455**	**1673**	**1**	**745**	**47.56,74**	**0.541437**	**3.84**	**1**
Wk24223	MAT 2351 F11	1482	1595	0.946529	1454	1657	1	-	-	-	-	-
		1607	1615	0.053471								
Wk24224	MAT 2351 F248	1329	1419	1	1293	1455	1	-	-	-	-	-
MPRA	**MAT-2351**	**1463**	**1586**	**1**	**1441**	**1653**	**1**	**779.5**	**40.31129**	**0.188462**	**3.84**	**1**
Wk23624	MAN-188 N17	1438	1532	1	1409	1629	1					
Wk23625	MAN-188 N26	1516	1636	1	1470	1672	1					
MPRA	**MAN-188**	**1464**	**1586**	**1**	**1442**	**1654**	**1**	**778.5**	**40.31129**	**1.388462**	**3.84**	**1**
Wk24220	BAP 3269 T1	1472	1591	0.987684	1450	1653	1	-	-	-	-	-
		1609	1611	0.012316								
Wk24221	BAP 3269 F6	1499	1525	0.023761	1464	1470	0.017148		-	-	-	-
		1535	1598	0.611202	1476	1637	0.982852					
		1610	1626	0.151188								
DIFFERENT								**478.0447**	**29.82725**	**36.11263**	**3.84**	**1**
Wk20104	**TEP 3221**	**1474**	**1592**	**0.987208**	**1451**	**1654**	**1**	**-**	**-**	**-**	**-**	**-**
		1609	**1612**	**0.012792**								

Table 5.7 Calibrated radiocarbon dates for Western Bay of Plenty assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 - 0.05	Degrees of Freedom
Wk24203	FPC 3305 D3-1	1529	1646	1	1477	1681	1	-	-	-	-	-
Wk24204	FPC 3305 D3-2	1442	1538	1	1417	1633	1	-	-	-	-	-
MPRA	**FPC 3305**	**1476**	**1594**	**0.967525**	**1449**	**1658**	**1**	**766.5**	**40.31129**	**1.569385**	**3.84**	**1**
		1608	**1614**	**0.032475**								
Wk21753	**WHB 1275**	**1500**	**1621**	**1**	**1463**	**1663**	**1**	**-**	**-**	**-**	**-**	**-**
Wk17609	**SUP-2888**	**1831**	**1949**	**1**	**1722**	**1794**	**0.167256**	**-**	**-**	**-**	**-**	**-**
					1798	**1949**	**0.832744**					
Wk22574	**ORO 1941**	**1507**	**1625**	**1**	**1468**	**1664**	**1**	**-**	**-**	**-**	**-**	**-**
Wk15814	**ORO 3197**	**1512**	**1631**	**1**	**1469**	**1668**	**1**	**-**	**-**	**-**	**-**	**-**
Wk13790	GSP 3113 Sample B Area C1	1491	1600	0.92086	1458	1659	1	-	-	-	-	-
		1605	1617	0.07914								
Wk13791	GSP 3113 F1b	1535	1652	1	1479	1690	1	-	-	-	-	-
MPRA	**GSP 3113**	**1515**	**1638**	**1**	**1466**	**1675**	**1**	**730.8099**	**40.52191**	**0.380228**	**3.84**	**1**
Wk21373	TAR 3230 H #191 F359 LA	1465	1580	1	1447	1648	1	-	-	-	-	-
Wk21374	TAR 3230 H #192 F359 LB	1535	1648	1	1484	1683	1	-	-	-	-	-
Wk21375	TAR 3230 H #193 F359 LB1	1530	1648	1	1478	1683	1	-	-	-	-	-
MPRA	**TAR 3230 H**	**1515**	**1632**	**1**	**1471**	**1669**	**1**	**734.0655**	**32.20805**	**1.006349**	**5.99**	**2**
Wk22622	ASH 2912a	1558	1672	1	1488	1714	1	-	-	-	-	-
Wk23092	ASH 2912 F19	1531	1647	1	1480	1681	1	-	-	-	-	-
Wk23093	ASH 2912 F96 S#266	1553	1671	1	1482	1716	1	-	-	-	-	-
Wk23094	ASH 2912 F108	1507	1627	1	1466	1667	1	-	-	-	-	-
Wk23095	ASH 2912 F140	1507	1627	1	1466	1667	1	-	-	-	-	-
MPRA	**ASH 2912**	**1537**	**1647**	**1**	**1488**	**1680**	**1**	**708.6301**	**24.9524**	**1.306451**	**9.49**	**4**
Wk20987	FTP 1465A F13	1526	1650	1	1469	1689	1	-	-	-	-	-
Wk20988	FTP 1465B F74	1549	1675	1	1479	1725	0.983684	-	-	-	-	-
					1740	1755	0.008609					
					1789	1801	0.007707					
MPRA	**FTP 1465**	**1538**	**1662**	**1**	**1470**	**1709**	**1**	**693.8514**	**43.75648**	**0.198327**	**3.84**	**1**
Wk23492	**WHA 1229**	**1538**	**1653**	**1**	**1484**	**1689**	**1**	**-**	**-**	**-**	**-**	**-**

Table 5.7 Calibrated radiocarbon dates for Western Bay of Plenty assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 - 0.05	Degrees of Freedom
Wk17618	EVA 3256 1	1512	1631	1	1468	1669	1	-	-	-	-	-
Wk17619	EVA 3256 2	1566	1689	1	1505	1764	0.982684	-	-	-	-	-
					1785	1804	0.017316					
MPRA	**EVA 3256**	**1539**	**1659**	**1**	**1477**	**1700**	**1**	**695.5743**	**39.66827**	**1.01668**	**3.84**	**1**
Wk11407	ANA Upper outer ditch	1519	1649	1	1460	1692	1	-	-	-	-	-
Wk4659	ANA Upper T4 L9	1544	1682	1	1484	1771	0.981089	-	-	-	-	-
					1784	1804	0.018911	-	-	-	-	-
Wk4661	ANA Upper A4a L7	1531	1661	1	1460	1712	1	-	-	-	-	-
Wk3751	ANA Upper palisade posthole	1546	1691	1	1493	1809	1	-	-	-	-	-
Wk3755	ANA Upper palisade posthole	1519	1649	1	1461	1691	1	-	-	-	-	-
MPRA	**ANA Upper**	**1545**	**1658**	**1**	**1490**	**1693**	**1**	**694.0352**	**30.21545**	**0.680662**	**9.49**	**4**
Wk22575	**KAI**	**1541**	**1651**	**1**	**1491**	**1684**	**1**	**-**	**-**	**-**	**-**	**-**
Wk21013	STR 780 WHK001	1566	1699	1	1520	1807	1	-	-	-	-	-
Wk21014	STR 780 WHK002	1561	1684	1	1495	1730	0.969632	-	-	-	-	-
					1735	1760	0.018345					
					1787	1803	0.012023					
MPRA	**STR 780**	**1559**	**1692**	**1**	**1506**	**1777**	**0.972156**	**654.5**	**40.31129**	**0.044462**	**3.84**	**1**
					1781	**1805**	**0.027844**					
Wk24224	**TAU 2402**	**1563**	**1690**	**1**	**1504**	**1765**	**0.980824**	-	-	-	-	-
					1785	**1804**	**0.019176**					
Wk14412	**BWT-876 fill of pit 3**	**1565**	**1718**	**1**	**1525**	**1822**	**1**	-	-	-	-	-
Wk14414	**BWT-874 base of M2**	**1623**	**1764**	**1**	**1532**	**1839**	**1**	-	-	-	-	-

Table 5.7 Calibrated radiocarbon dates for Western Bay of Plenty assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 - 0.05	Degrees of Freedom
Wk17606	SUP 2891	1511	1550	0.452657	1498	1601	0.591575	-	-	-	-	-
		1558	1572	0.124985	1607	1669	0.398006					
		1622	1651	0.422358	1786	1793	0.01042	-	-	-	-	-
Wk17610	SUP 2891	1651	1681	0.269502	1639	1711	0.300091	-	-	-	-	-
		1731	1802	0.730498	1718	1813	0.576048	-	-	-	-	-
					1836	1885	0.074644					
					1888	1890	0.002886					
					1923	1951	0.046331					
MPRA	**SUP 2891**	**1635**	**1669**	**0.889204**	**1516**	**1540**	**0.041899**	**276.9274**	**25.90594**	**2.683599**	**3.84**	**1**
		1785	**1794**	**0.110796**	**1625**	**1675**	**0.686473**					
					1738	**1798**	**0.271627**					
Wk19035	**WHB-1246 F5**	**1647**	**1776**	**0.878014**	**1544**	**1869**	**1**	-	-	-	-	-
		1782	**1805**	**0.121986**								
Wk22576	**TAR 3231**	**1650**	**1772**	**0.885855**	**1554**	**1865**	**1**	**-**	**-**	**-**	**-**	**-**
		1784	**1805**	**0.114145**								
Wk13792	GSP 3116 B1 fill	1651	1776	0.866607	1550	1875	1	-	-	-	-	-
		1782	1805	0.133393								
Wk13793	GSP 3116 B18/B firescoop	1674	1814	1	1631	1905	0.973211	-	-	-	-	-
					1920	1949	0.026789					
MPRA	**GSP 3116**	**1662**	**1811**	**1**	**1572**	**1897**	**0.988865**	**583.3433**	**40.52849**	**0.127987**	**3.84**	**1**
					1936	**1949**	**0.011135**					

Table 5.7 Calibrated radiocarbon dates for Western Bay of Plenty assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 - 0.05	Degrees of Freedom
Wk16046	HAM 9 Trench 1 Sample 1	1680	1731	0.308205	1671	1747	0.292538					
		1802	1816	0.091081	1753	1781	0.056463					
		1828	1893	0.400159	1796	1952	0.650999					
		1919	1951	0.200555								
Wk16047	HAM 9 Trench 1 Sample 2	1627	1679	0.458833	1502	1593	0.161016					
		1732	1801	0.541167	1614	1707	0.385171					
					1721	1810	0.413527					
					1837	1847	0.007137					
					1857	1862	0.003052					
					1866	1879	0.010826					
					1925	1951	0.01927					
Wk16048	HAM 9 Area A F5	1656	1677	0.2266	1640	1707	0.300176					
		1735	1799	0.7734	1721	1810	0.631493					
					1837	1847	0.012891					
					1857	1863	0.00556					
					1866	1879	0.018238					
					1924	1951	0.031641					
Wk16049	HAM 9 Area D F4	1651	1673	0.307129	1632	1698	0.351887					
		1742	1773	0.409299	1723	1808	0.633099					
		1777	1797	0.283572	1839	1843	0.003488					
					1868	1877	0.006086					
					1933	1936	0.00181					
					1946	1950	0.00363					
MPRA	**HAM 9**	**1667**	**1673**	**0.100173**	**1652**	**1680**	**0.215598**	**226.3666**	**19.72398**	**2.949363**	**7.81**	**3**
		1741	**1789**	**0.794091**	**1731**	**1801**	**0.784402**					
		1791	**1797**	**0.105736**								

Table 5.7 Calibrated radiocarbon dates for Western Bay of Plenty assemblages, continued

Lab code	Description	1 δ Start	1 δ Finish	Relative Area	2 δ Start	2 δ Finish	Relative Area	MPR 14C BP Age	MPR 14C SD	Test Statistic T	Xi2 - 0.05	Degrees of Freedom
Wk21371	TAR 3230 G #113 F240 upper	1691	1839	1	1671	1906	0.94517	-	-	-	-	-
					1919	1949	0.05483					
Wk21372	TAR 3230 G #166 F187	1665	1807	1	1580	1894	0.993998	-	-	-	-	-
					1941	1949	0.006002					
Wk21376	TAR 3230 G #110 F240 Sp4	1650	1773	0.881413	1553	1866	1	-	-	-	-	-
		1784	1805	0.118587								
MPRA	**TAR 3230 G**	**1685**	**1765**	**0.822336**	**1662**	**1837**	**1**	**573.0309**	**31.98892**	**14.30412**	**11.1**	**2**
		1785	**1804**	**0.177664**								
Wk17605	**SUP 2889 Area H F1006 Sp 6**	**1512**	**1548**	**0.404057**	**1501**	**1595**	**0.509639**	**-**	**-**	**-**	**-**	**-**
		1563	**1570**	**0.05482**				**-**	**-**	**-**	**-**	**-**
		1622	**1655**	**0.541124**								
Wk17607	SUP 2889 Area H F1006 (pit) Sp 5	1666	1688	0.206902	1649	1711	0.259789	-	-	-	-	-
		1728	1804	0.793098	1719	1812	0.605982	-	-	-	-	-
					1836	1849	0.025442					
					1852	1881	0.054801					
					1923	1951	0.053986					
Wk17608	SUP 2889 Area H F1006 (pit) Sp 1	1664	1697	0.253802	1650	1713	0.25083	-	-	-	-	-
		1724	1808	0.692563	1717	1814	0.526499					
		1839	1842	0.009572	1831	1891	0.143901					
		1869	1876	0.029614	1921	1951	0.078771					
		1947	1950	0.014448								
								-	-	-	-	-
MPRA	**SUP 2889 Area H F1006 (pit) Sp1&5**	**1669**	**1683**	**0.17031**	**1652**	**1700**	**0.240948**	**207.3623**	**23.20623**	**0.016468**	**3.84**	**1**
		1730	**1784**	**0.714313**	**1722**	**1809**	**0.69555**					
		1794	**1803**	**0.115377**	**1838**	**1846**	**0.012106**					
					1867	**1878**	**0.019204**					
					1926	**1951**	**0.032193**					

Table 5.8 Western Bay of Plenty assemblages assigned to time period

Assemblage Code	Assemblage Name and Site Number	Period
MAS-187	Maketu South V14/187	E
KTR-78	Koutunui Road, Athenree U13/78	EM
BWT-875	Bowentown(U13/875	EM
CHE-1920	Cheyne Rd, Tauranga U14/1920	EM
TEH-584	Te Horo Drive, Ohope Beach W15/584	EM
ROW-1972	Rowesdale, Tauranga U14/1972	EM
TUI-2897-2	Tuihana Subdivision, Papamoa U14/2897	EM
ORO-3216	Oropi Downs, Tauranga U14/3216	M
ROW-3218	Rowesdale, Tauranga U14/3218	M
CHE-3193	Cheyne Rd, Tauranga U14/3193	M
ORO-1945	Oropi Downs, Tauranga U14/1945	M
ORO-3056	Oropi Downs, Tauranga U14/3056	M
ANA-46-Lower	Anatere Pa Lower, Athenree U13/46	M
MAT-2351	Mataraua, Tauriko U14/2351	M
MAN-188	Maketu North (V14/188)	M
BAP-3269-T1	Balintoy Park, Welcome Bay U14/3269	M
TEP-3221	Wairoa Rd, Te Puna U14/3221	M
FPC-3305	Fergusson Park car park U15/3305	M
WHB-1275	Waihi Beach U13/1275	M
BAP-3269-F6	Balintoy Park, Welcome Bay U14/3269	M
SUP-2888	BOP Supacenta Development U14/2886	M
ORO-1941	Oropi Downs, Tauranga U14/1941	M
ORO-3197	Oropi Downs, Tauranga U14/3197	M
GSP-3113	Golden Sands, Papamoa U14/3113	M
TAR-3230-H	Tara Road, Papamoa U14/3230 H	M
ASH-2912	Asher Block, Omanu-Papamoa U14/2912	M
FTP-1465	Florence Lane, Te Puna U14/1465B	ML
WHA-1229	Whakamarama Road, Western Bay of Plenty U14/1229	ML
EVA-3256	Evans Road, Papamoa U14/3256	ML
ANA-46-Upper	Anatere Pa Upper, Athenree U13/46	ML
KAI	Kaitemako Substation, Welcome Bay, Tauranga	ML
STR-780	The Strand, Whakatane W15/780	ML
TAU-2402	Tauriko, U14/2402	ML
BWT-874	Bowentown U13/874	ML
BWT-876	Bowentown U13/876	ML
SUP-2891	BOP Supacenta Development U14/2891	ML
WHB-1246	The Crescent, Waihi Beach U13/1246	ML
TAR-3231	Tara Rd, Papamoa U14/3231	L
GSP-3116	Golden Sands, Papamoa U14/3116	L
HAM-9	Hamurana Road, Rotorua U15/9	L
TAR-3230-G	Tara Road, Papamoa U14/3230 G	L
TUI-2897-3	Tuihana Subdivision, Papamoa U14/2897	L
TUI-2897-1	Tuihana Subdivision, Papamoa U14/2897	L
SUP-2889	BOP Supacenta Development U14/2889	L

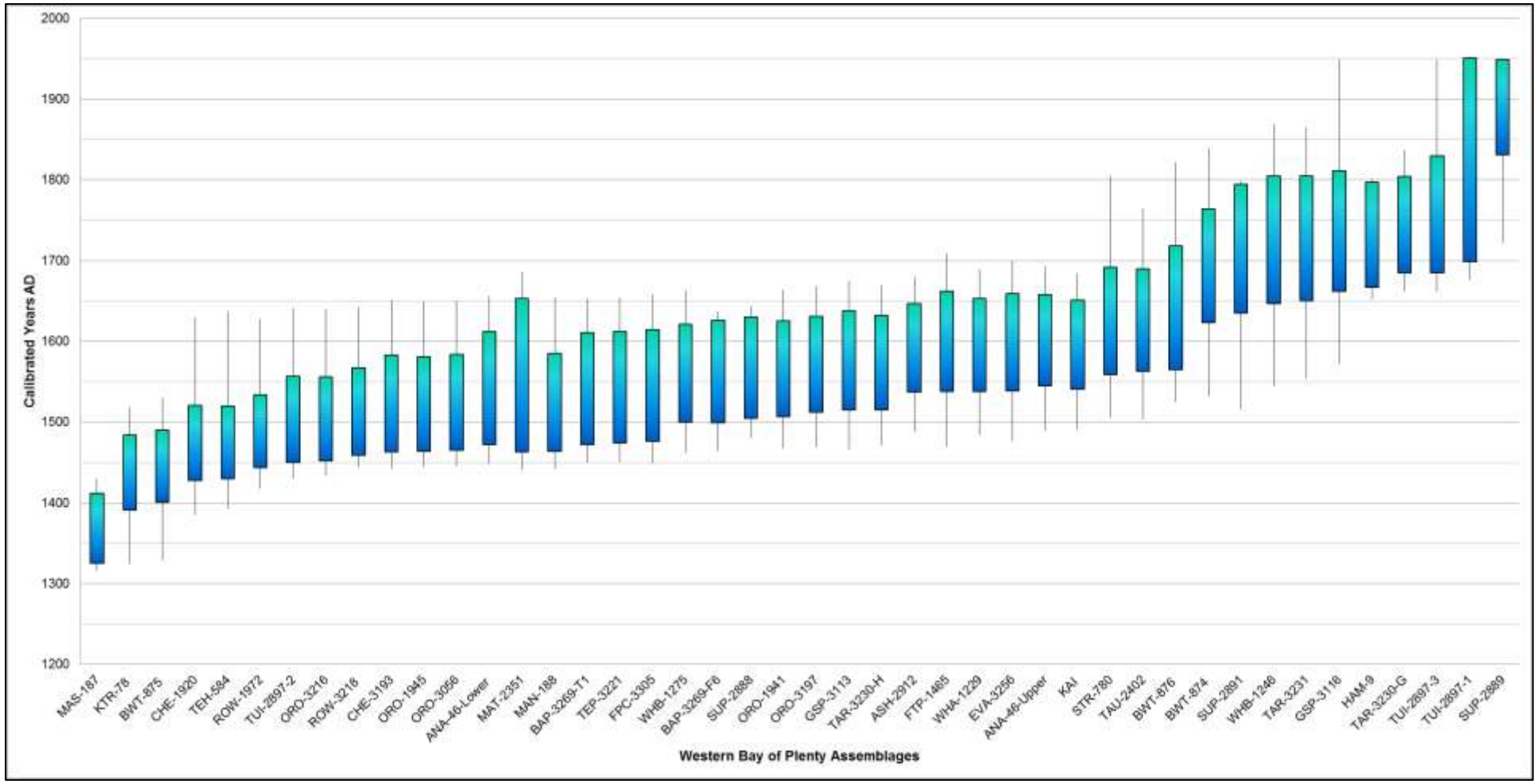

Figure 5.4 Calibrated dates showing 1 δ and 2 δ ranges for Western Bay of Plenty assemblages

5.3 ASSEMBLAGE FAUNAL DATA

This section presents the raw MNI data from Coromandel Peninsula and Western Bay of Plenty assemblages, grouped by time period. To make the data easier to manage, assemblages have been broken down into six classes – shellfish, fish, marine and wetland bird, terrestrial bird, moa, terrestrial mammal and marine mammal.

5.3.1 COROMANDEL PENINSULA

5.3.1.1 *EARLY COROMANDEL ASSEMBLAGES*

Seven assemblages from the Coromandel have calibrated radiocarbon date ranges that fall within the 'early' period: CCK-399-L9, TRN-62-Lower, CCK-399-L7, PJK-53, CL-3, HHB-242 Lower and HHB-242 Middle.

In the shell class (Table 5.9), *Lunella smaragdus* (cats eye) was the only species to be present in all assemblages; *Paphies subtriangulata* (tuatua), *Austrovenus stutchburyi* (cockle), *Paphies australis* (pipi), *Perna canaliculus* (green-lipped mussel) and *Cellana radians* (radiate limpet) were present in most assemblages and usually in higher frequencies. Other species of shellfish were also represented, but only sporadically, in low frequencies, and are considered to be 'non-economic' species, as they were likely to have been accidentally collected, i.e. not deliberately as a food resource.

The fish class (Table 5.10) is dominated by *Pagrus auratus* (snapper), *Labridae sp.* (wrasses), *Arripis trutta* (kahawai) and *Meuschenia scaber* (leatherjacket), although *P. auratus* is the only species present in all assemblages. Some assemblages have species which although not the most frequent, make an atypical contribution to the assemblage, such as *Chelidonichthys kumu* (red gurnard) in TRN-62-Lower or *Nemadactylus macropterus* (tarakihi) in CL-3. A number of other fish species are present in 1-3 assemblages in low frequencies.

Across the marine and wetland bird class, *Eudyptula minor* (little blue penguin) appears in six of the seven assemblages, while *Anas superciliosa* (grey duck) appears in four and *Stictocarbo punctatus* (spotted shag) in three (Table 5.11). The frequencies of these three species are low (MNI of 1 or 2); *Larus dominicanus* (southern black-backed gull) is the only

species to have an MNI of 4 (but is only represented in two assemblages). All other marine bird species are represented in only one or two assemblages and with MNI totals of 1.

The species abundance for terrestrial birds is even more erratic than marine birds (Table 5.12). Although the numbers are skewed by the PJK-53 assemblage, *Nestor meridionalis* (kaka) is the most abundant species and present in four of the assemblages. Two other species include *Prosthemadra novaeseelandiae* (tui) and *Hemiphaga novaeseelandiae* (kereru, NZ wood pigeon) which are present in three and two assemblages respectively, in slightly higher frequencies than other species.

In the moa class, moa species are rare (Table 5.13), and only two individuals in total are present, *Dinornis novaeseelandiae* (North Island giant moa) and *Pachyornis geranoides* (Mantell's moa) in one assemblage, TRN-62-Lower.

Sea mammals are present in five of the assemblages (Table 5.14); the most common is *Arctocephalus forsteri* (fur seal) followed by *Phocarctos hookeri* (sea lion).

Rattus exulans (kiore, Polynesian rat) is present in all of the assemblages and is also the most abundant species of the terrestrial mammal class (Table 5.15), followed by *Canis familiaris* (kuri, Polynesian dog).

Table 5.9 Shell raw MNI data from early period Coromandel assemblages

Taxon	Common Name	CCK-399-L9	TRN-62 Lower	CCK-399-L7	PJK-53	CL-3	HHB-242-Lower	HHB-242-Middle
Austrovenus stutchburyi	cockle		40	1		4777	2	2
Paphies australis	pipi		14	1		3228	10	76
Paphies subtriangulata	tuatua	1		4	1844	135	10	38
Lunella smaragdus	cats eye	1	307	184	276	507	159	184
Perna canaliculus	green-lipped mussel	4		272	46		34	50
Paphies sp.	Paphies sp.					469		
Cellana radians	radiate limpet	1		98	150		100	61
Cellana denticulata	denticulate/Cook Strait limpet	9	131	199	3		9	2
Nerita atramentosa	black nerita			30	145	29	11	20
Diloma aethiops	spotted top shell			25	188			
Maoricrypta costata	ribbed slipper shell					6	58	98
Protothaca crassicostata	ribbed venus				92			
Mollusca sp.	shellfish sp.					84		
Cominella maculosa	spotted whelk						39	38
gastropod sp.	gastropod sp.					66		2
Dosinia anus	ringed venus shell				54		1	1
Amphibola crenata	mudsnail					4	3	29
Haustrum haustorium	dark rock shell	1		22			11	14
Maoricolpus roseus	turret shell				13		32	3
Amalda australis	southern olive shell					12	27	7
Dosinia sp.	venus shell	1		32				
Haliotis iris	paua	1		20			5	5
Buccinulum sp.	whelk Buccinulum sp.					25		
Sigapatella novaezelandiae	circular slipper shell					1	5	19
Patelloida corticata	encrusted limpet						13	9
Aethocola glans	knobbed whelk					2	12	6
Struthiolaria ?sp.	ostrich foot ?sp.					19		
Dicathais orbita	white rock shell	1		9	5			
Anomia trigonopsis	golden oyster						2	9
Xymene traversi	trophon X. traversi						3	8
Cookia sulcata	cooks turban			3	3	2	1	1
Penion sulcatus	siphon whelk					9		1
Antisolarium egenum	antisolarium						9	
Mytilidae sp.	mussel sp.					8		
Cominella adspersa	speckled whelk				1	6		1
limpet sp.	limpet sp.					8		
Cominella glandiformis	purple-mouthed whelk				3		3	1
Saccostrea cucullata glomerata	rock oyster				4			1
Acteonidae sp.	acteon sp.						6	1
Tawera spissa	morning star						4	3
Evechinus chloroticus	kina (sea urchin)				4		1	1
Maoricrypta monoxyla	white slipper shell				5		1	
Diloma subrostrata	mudflat top shell						2	3
Cominella sp.	whelk Cominella sp.							
Austromitra rubiginosa	austromitra						2	1
Haliotis australis	silver paua				3			
Haliotis ?sp.	paua sp.							
Pecten novaezelandiae	queen scallop			1	1			
Scutus breviculus	shield limpet				3			
Tugali elegans	grooved limpet						2	1
Xymene ambiguous	large trophon							1

Table 5.9 Shell raw MNI data from early period Coromandel assemblages, *continued*

Taxon	Common Name	CCK-399-L9	TRN-62-Lower	CCK-399-L7	PJK-53	CL-3	HHB-242-Lower	HHB-242-Middle
Zethalia (Umbonium) zelandica	wheel shell							3
Cantharidus purpureus	purple top shell							2
Cellana ornata	ornate limpet			2				
Eudoxochiton nobilis	noble chiton						1	1
Polinices ?sp.	natcid ?sp.							2
Pratulum pulchellum	heart cockle					1		1
Tucetona laticostata	large dog cockle			1				1
Xymene plebeius	trophon X. plebeius						2	
Amalda murcronata	brown olive shell							1
Amuarochiton glaucus	green chiton						1	
Bonellitia superstes	bonellitia							1
Haustrum scobina	oyster borer							1
Pecten sp.	scallop sp.						1	
Purpurocardia purpurata	purple cockle						1	
Tawera sp.	venus shell sp.							
Zeacumantus sp.	horn shell sp.					1		
TOTAL		**20**	**492**	**904**	**2843**	**9399**	**583**	**710**

Table 5.10 Fish raw MNI data from early period Coromandel assemblages

Taxon	Common Name	CCK-399-L9	TRN-62-Lower	CCK-399-L7	PJK-53	CL-3	HHB-242-Lower	HHB-242-Middle
Pagrus auratus	snapper	2	28	42	4	125	4	8
Meuschenia scaber	leatherjacket	1		20	1	4	18	64
Labridae sp.	wrasses	1	12	10	2		3	16
Latridopsis ciliaris	blue moki		3			24		
Arripis trutta	kahawai	1	7	1	13	3		1
Nemadactylus macropterus	tarakihi					13	1	
Chelidonichthys kumu	red gurnard		9			1	1	1
fish sp.	fish sp.		6					
Latris lineata	trumpeter							4
Nemadactylus douglasi	porae							4
Zeus faber	john dory		2			1		
Notolabrus celidotus	spotty					3		
Thyrsites atun	barracouta				1			1
Parapercis colias	blue cod		1					1
Carangidae sp.	carangidae sp.					1		
Elasmobranch sp.	sharks/rays/skates		1					
Gempylidae sp.	snake mackerel sp.					1		
Genyagnus monopterygius	spotted stargazer					1		
Helicolenus baranthi	sea perch					1		
Scorpis violacea	blue maomao							1
TOTAL		**5**	**69**	**73**	**21**	**178**	**27**	**101**

Table 5.11 Marine & wetland bird raw MNI data from early period Coromandel assemblages

Taxon	Common Name	CCK-399-L9	TRN-62 Lower	CCK-399-L7	PJK-53	CL-2	HHB-242-Middle	HHB-242-Lower
Eudyptula minor	little blue penguin	1	2		2	2	1	1
Anas superciliosa	grey duck	1	2	1		1		
Larus dominicanus	southern black-backed gull		1		4			
Stictocarbo punctatus	spotted shag		2	1	1			
Diomedidae sp.	albatross sp.		2					
Haematopus sp.	oyster catcher sp.		2					
Phalacrocorax varius	pied cormorant	1	1					
Phalacrocoridae sp.	shag Phalacrocoridae sp.	1			1			
Pterodroma sp.	petrel Pterodroma sp.		1		1			
Puffinus gavia	fluttering shearwater						1	1
Puffinus griseus	sooty shearwater					1		
Anas sp.	duck Anas sp.				1			
Himantopus himantopus leucocephalus	pied stilt		1					
Hydroprogne caspia	caspian tern		1					
Larus novaehollandiae	red-billed gull					1		
Macronectes halli?	northern giant petrel?		1					
Pachyptila sp.	prion Pachyptila sp.		1					
Pelecanoides urinatrix	northern diving petrel			1				
Phalacrocorax carbo	great cormorant				1			
Podiceps cristatus	southern crested grebe		1					
Procelleriidae ?sp.	petrel ?sp.			1				
Pterodroma inexpectata	mottled petrel						1	
Pterodroma macroptera gouldi	grey-faced petrel		1					
Puffinus sp.	puffinus sp.	1						
Sterna albostriata	black-fronted tern		1					
Tadorna variegata	paradise shelduck		1					
TOTAL		**5**	**21**	**4**	**11**	**5**	**3**	**2**

Table 5.12 Terrestrial bird raw MNI data from early period Coromandel assemblages

Taxon	Common Name	CCK-399-L9	TRN-62 Lower	CCK-399-L7	PJK-53	CL-3	HHB-242-Middle	HHB-242-Lower
Nestor meridionalis	kaka	3	2	2	44			
Prosthemadra novaeseelandiae	tui	1	5	3				
Hemiphaga novaeseelandiae	NZ pigeon		4	2				
Callaeas wilsoni	NI kokako		1		2			
Corvus antipodum	NZ raven		1		1			
Gallirallus australis	weka		2					
Coturnix novaezelandiae	NZ quail						1	
Cyanoramphus sp.	parakeet sp.				1			
Cyanoramphus auriceps	yellow-crowned parakeet			1				
Cyanoramphus novaezelandiae	red-crowned parakeet		1					
Falco novaeseelandiae	NZ falcon		1					
Porphyrio mantelli	NI takahe				1			
Strigops habroptilis	kakapo		1					
Todiramphus sancta vagens	NZ kingfisher					1		
TOTAL		**4**	**18**	**8**	**49**	**1**	**1**	**0**

Table 5.13 Moa raw MNI data from early period Coromandel assemblages

Taxon	Common Name	CCK-399 L9	TRN-62 Lower	CCK-399 L7	PJK-53	CL-3	HHB-242-Middle	HHB-242-Lower
Dinornis novaezealandiae	NI giant moa		1					
Pachyornis geranoides	Mantell's moa		1					
TOTAL		**0**	**2**	**0**	**0**	**0**	**0**	**0**

Table 5.14 Marine mammal raw MNI data from early period Coromandel assemblages

Taxon	Common Name	CCK-399-L9	TRN-62 Lower	CCK-399 L7	PJK-53	CL-3	HHB-242-Middle	HHB-242-Lower
Arctocephalus forsteri	fur seal - juvenile					2		
	fur seal - adult female					2		
	fur seal - adult male					1		
	fur seal - unknown age/sex		9	1	2			
Phocarctos hookeri	sea lion - unknown age/sex	1	1	1	4			
Mirounga leonina	elephant seal - unknown age/sex		1	1	1			
Otariidae	fur seal/sea lion			1				
Globicephala sp.	pilot whale		1					
	large marine mammal sp.	1						
TOTAL		**2**	**12**	**4**	**7**	**5**	**0**	**0**

Table 5.15 Terrestrial mammal raw MNI data from early period Coromandel assemblages

Taxon	Common Name	CCK-399-L9	TRN-62 Lower	CCK-399-L7	PJK-53	CL-3	HHB-242-Middle	HHB-242-Lower
Canis familiaris	kuri (dog) - sub-adult					1		
	kuri (dog) - adult					1		
	kuri (dog) - unknown age		1	3	4		2	1
Rattus exulans	kiore	2	1	3	1	2	2	1
TOTAL		**2**	**2**	**6**	**5**	**4**	**4**	**2**

5.3.1.2 *EARLY-MIDDLE PERIOD COROMANDEL ASSEMBLAGES*

There are seven Coromandel assemblages that fall in the early-middle 'overlap' period: HHB-242 Upper, WHT-16, CCK-399-L5, CCK-399-L3, HWB-115-Lower, HWB-115 Middle and AHU-944.

In the shell class there are five species that are present in all of the assemblages: *L. smaragdus*, *Nerita atramentosa* (black nerita), *P. australis*, *C. radians* and *P. canaliculus* (Table 5.16). Of these five, there is no one dominant species across the early-period class. Other species present in most assemblages include *Cookia sulcata* (Cooks turban), *Haustrum haustorium* (dark rock shell), *Austrovenus stutchburyi* (cockle), *P. subtriangulata* and *Pecten*

novaezelandiae (queen scallop). A large number of species are present in only one or two species and are likely to have been accidentally gathered.

As in the early period Coromandel assemblages, *P. auratus* is the most common fish species in the early-middle Coromandel assemblages, followed closely by *M. scaber* and Labridae *sp.* (Table 5.17). Other species present in four or five assemblages are *N. macropterus* and *A. trutta*. The remaining species are present in one or two assemblages and can be considered 'opportunistic' catches rather than targeted.

In the early-middle Coromandel marine and wetland bird assemblages, one has no species at all. Otherwise, as in the early period, *E. minor* is the most frequent species, being present in the remaining six assemblages (Table 5.18). *Puffinus griseus* (sooty shearwater) is present in four assemblages. The remaining species are present in only one or two sites.

Only three of the seven early-middle period Coromandel assemblages have terrestrial bird remains (Table 5.19). *P. novaeseelandiae* is present in three assemblages. A further six species are present in two assemblages - Assemblage HWB-115-Lower and -Middle, which are both notable for their large terrestrial bird MNI total, especially HWB-115-Lower and its significant number of *N. meridionalis*.

Only one early-middle Coromandel assemblage, HWB-115 Middle, contains moa remains – one *Euryapteryx curtus* (coastal moa) and one unidentified moa species (Table 5.20).

Six of the seven early-middle period Coromandel assemblages include marine mammal (Table 5.21). Four assemblages contain *A. forsteri* and one contains *Phocarctos hookeri*. All other identifications are not at species level.

All of the early-middle period Coromandel assemblages include terrestrial mammal remains (Table 5.22). *C. familiaris* is present in six assemblages and *R. exulans* is present in five; HWB-115-Lower is notable for high numbers of both species.

Table 5.16 Shell raw MNI data from Coromandel early-middle period assemblages

Taxon	Common Name	HHB-242-Upper	WHT-16	CCK-399-L5	CCK-399-L3	HWB-115 Lower	HWB-115-Middle	AHU-944
Lunella smaragdus	cats eye	175	41	22	263	581	262	376
Paphies subtriangulata	tuatua	54	6	47	704			296
Cominella sp.	whelk Cominella sp.		4					144
Diloma aethiops	spotted top shell			39	1473			37
Nerita atramentosa	black nerita	22	5	13	564	206	90	36
Cookia sulcata	cooks turban	3		2	844	10	4	26
Haustrum haustorium	dark rock shell	15		6	138	40	18	13
Austrovenus stutchburyi	cockle	2	48		11	7	6	7
Paphies australis	pipi	69	41	26	63	153	1	3
Polyplacophora sp.	chiton sp.							3
Ranella australasia	Australian triton							3
Cellana radians	radiate limpet	191	6	73	3462	363	22	1
gastropod sp.	gastropod sp.							1
Haliotis iris	paua	4		8	119			1
Maoricolpus roseus	turret shell	58						1
Pecten novaezelandiae	queen scallop		1	3	74	1	1	1
Perna canaliculus	green-lipped mussel	144	213	97	977	37	7	1
Aethocola glans	knobbed whelk	12						
Amalda australis	southern olive shell	18						
Amalda murcronata	brown olive shell	1						
Amphibola crenata	mudsnail	10	14		2	572	459	
Anomia trigonopsis	golden oyster	16						
Antisolarium egenum	antisolarium	10						
Cantharidus purpureus	purple top shell	8						
Cantharidus sanguineus	oval top shell	1						
Cellana denticulata	Cook Strait limpet			6	6	45	8	
Cellana ornata	ornate limpet			1	31			
Cominella maculosa	spotted whelk	38						
Crassula aequilateralis	triangle shell						5	
Cyclomactra ovata	oval trough shell	1						
Dicathais orbita	white rock shell		3	6	84	4	1	
Diloma sp.	top shell Diloma sp.					83	33	
Divalucina cumingi	lace cockle		2					
Dosinia sp.	venus shell sp.		1		10			
Dosinia anus	ringed venus shell	1		2				
Escalima regularis	escalima	1						
Eudoxochiton nobilis	noble chiton	1						
Evechinus chloroticus	kina (sea urchin)	1					1	
Glycermis modesta	small dog cockle	2						
Haliotis sp.	paua sp.		3			8		
Haustrum scobina	oyster borer	1						
Maoricrypta costata	ribbed slipper shell	218	9					
Patelloida corticata	encrusted limpet	11						
Polinices sp.	natcid sp.	1						
Pratulum pulchellum	heart cockle	2						
Radiacmea inconspicua	limpet R. inconspicua	1						
Sigapatella novaezelandiae	circular slipper shell	33						
Saccostrea cucullata glomerata	rock oyster		2					
Tawera sp.	venus shell sp.		1					
Tawera spissa	morning star	2						
Tucetona laticostata	large dog cockle			2	12			
Turbonilla zealandica	turbonilla					11		

Table 5.16 Shell raw MNI data from early-middle period Coromandel assemblages, *continued*

Taxon	Common Name	HHB-242-Upper	WHT-16	CCK-399-L5	CCK-399-L3	HWB-115-Lower	HWB-115-Middle	AHU-944
Xymene ambiguous	large trophon		2					
Xymene plebeius	trophon X. plebeius	1						
Xymene traversi	trophon X. traversi	2						
Zethalia zelandica	wheel shell	21						
TOTAL		**1151**	**402**	**353**	**8837**	**2121**	**918**	**950**

Table 5.17 Fish raw MNI data from Coromandel early-middle period assemblages

Taxon	Common Name	HHB-242 Upper	WHT-16	CCK-399 L5	CCK-399 L3	HWB-115 Lower	HWB-115 Middle	AHU-944
Pagrus auratus	snapper	8	1	41	44	48	20	14
Meuschenia scaber	leatherjacket	51		16	24	9	4	3
Labridae sp.	wrasse sp.	7	1	4	12	8	2	
Nemadactylus macropterus	tarakihi	2				6	2	1
Arripis trutta	kahawai		1	1	2	2	1	
Latridopsis ciliaris	blue moki		1				2	
Chelidonichthys kumu	red gurnard	1	1					
Parapercis colias	blue cod	1				1		
Thyrsites atun	barracouta		1			1		
Aldrichetta forsteri	yellow-eyed mullet		1					
Anguilla sp.	eel sp.					1		
Myliobatis tenuicaudatus?	eagle ray?	1						
Pseudocaranx dentex	trevally				1			
Pseudophycis bachus	red cod	1						
Rexea solandri	gemfish					1		
Scorpis violacea	blue maomao	1						
Seriolella brama	common warehou					1		
Trachurus declivis	jack mackerel		1					
Zeus faber	john dory		1					
Trachurus sp.	mackerel sp.							1
TOTAL		**73**	**9**	**62**	**83**	**78**	**31**	**19**

Table 5.18 Marine & wetland bird raw MNI data from early-middle period Coromandel assemblages

Taxon	Common Name	HHB-242 Upper	WHT-16	CCK-399-L5	CCK-399-L3	HWB-115-Lower	HWB-115-Middle	AHU-944
Eudyptula minor	little blue penguin	1	2	1	1	5	3	
Puffinus griseus	sooty shearwater		1	1	2	1		
Diomedidae sp.	albatross sp.					2	2	
Procelleriidae sp.	petrel sp.			1	2			
Puffinus gavia	fluttering shearwater	1				1		
Larus dominicanus	southern black-backed gull					1		
Morus serrator	Australasian gannet			1				
Pachyptila vittata	broad-billed prion					1		
Phalacrocorax sp.	shag Phalacrocorax sp.			1				
Pelecanoides urinatrix	northern diving petrel					1		
Phalacrocorax carbo	great cormorant					1		
Phalacrocorax melanoleucos	little cormorant					1		
Pterodroma sp.	petrel Pterodroma sp.					1		
Puffinus sp.	puffinus sp.					1		
Puffinus assimilis	Norfolk little shearwater		1					
Stictocarbo punctatus	spotted shag					1		
TOTAL		**2**	**4**	**5**	**5**	**17**	**5**	**0**

Table 5.19 Terrestrial bird raw MNI data from early-middle period Coromandel assemblages

Taxon	Common Name	HHB-242-Upper	WHT-16	CCK-399-L5	CCK-399-L3	HWB-115-Lower	HWB-115-Middle	AHU-944
Nestor meridionalis	kaka					10		
Prosthemadra novaeseelandiae	tui				2	6	1	
Gallirallus australis	weka					4	1	
Nestor notabilis	kea						5	
Corvus antipodum	NZ raven					4		
Cyanoramphus novaezelandiae	red-crowned parakeet					2	1	
Hemiphaga novaeseelandiae	NZ pigeon					2	1	
Apteryx australis	southern brown kiwi					1	1	
Callaeas wilsoni	NI kokako						2	
Falco novaeseelandiae	NZ falcon					1	1	
Ninox novaeseelandiae	morepork					1	1	
Anas sp.	duck Anas sp.					1		
Anas superciliosa	grey duck				1			
Heteralocha acutirostris	huia					1		
Porphyrio mantelli	NI takahe					1		
Turnagra tanagra	NI piopio					1		
TOTAL		**0**	**0**	**0**	**3**	**35**	**14**	**0**

Table 5.20 Moa raw MNI data from early-middle period Coromandel assemblages

Taxon	Common Name	HHB-242-Upper	WHT-16	CCK-399-L5	CCK-399-L3	HWB-115-Lower	HWB-115-Middle	AHU-944
Euryapteryx curtus	coastal moa						1	
Dinornithiformes	moa NI sp.						1	
TOTAL		**0**	**0**	**0**	**0**	**0**	**2**	**0**

Table 5.21 Marine mammal raw MNI data from early-middle period Coromandel assemblages

Taxon	Common Name	HHB-242 Upper	WHT-16	CCK-399 L5	CCK-399 L3	HWB-115 Lower	HWB-115 Middle	AHU-944
Arctocephalus forsteri	fur seal - unknown age/sex		1			3	2	
	fur seal - adult female							1
	fur seal - subadult male							1
Phocarctos hookeri	sea lion - unknown age/sex			1				
Otariidae	fur seal/sea lion		1	1	1			
Cetacea	cetacean sp.		1					1
	large marine mammal sp.			1				
TOTAL		**0**	**3**	**3**	**1**	**3**	**2**	**3**

Table 5.22 Terrestrial mammal raw MNI data from early-middle period Coromandel assemblages

Taxon	Common Name	HHB-242 Upper	WHT-16	CCK-399 L5	CCK-399 L3	HWB-115 Lower	HWB-115 Middle	AHU-944
Canis familiaris	kuri (dog) - subadult			2	2	5	2	
	kuri (dog) - adult							
	kuri (dog) - unknown age		2					1
Rattus exulans	kiore (Polynesian rat)	1		2	3	10	2	
TOTAL		**1**	**2**	**4**	**5**	**15**	**4**	**1**

5.3.1.3 *MIDDLE PERIOD COROMANDEL ASSEMBLAGES*

There are six assemblages in the middle period from the Coromandel area: MTR-990, WHI-927-B, PAU-1028, WHI-926, WHA-1035 and WHI-624.

The middle period assemblages are dominated by two species, P. australis and A. stutchburyi, which are present in all of the assemblages (Table 5.23). The remaining species occur in low frequencies in some of the assemblages.

Only one of the middle period assemblages include fish remains (Table 5.24). One individual of *C. kumu* and another from the Gempylidae family (snake mackerels) are present in the PAU-1028 assemblage.

None of the middle period Coromandel assemblages include marine and wetland bird, terrestrial bird, moa, marine mammal or terrestrial mammal remains.

Table 5.23 Shell raw MNI data from middle period Coromandel assemblages

Taxon	Common Name	MTR-990	WHI-927-B	PAU-1028	WHI-926	WHA-1035	WHI-624
Paphies australis	pipi	136	4645	10	237	682	168
Austrovenus stutchburyi	cockle	53	2652	10	455	152	907
Struthiolaria papulosa	ostrich foot	1	26	3	7		1
Diloma aethiops	spotted top shell		28				
Lunella smaragdus	cats eye	5	13	4	1		
Paphies subtriangulata	tuatua	1		10	3	4	
Cominella adspersa	speckled whelk				11		4
Cominella sp.	whelk Cominella sp.	4	6			2	
Cominella virgata	red mouthed whelk						11
Zeacumantus sp.	horn shell sp.				11		
gastropod sp.	gastropod sp.				8		
whelk sp.	whelk sp.			5			
Zeacumantus lutulentus	horn shell					1	4
Maoricrypta sp.	slipper shell sp.	4					
Struthiolaria sp.	ostrich foot sp.						4
Zeacumantus subcarinatus	brown horn shell		3				1
Dosinia anus	ringed venus shell		2				
Amphibola crenata	mudsnail					1	
Calliostoma punctulatum	spotted tiger shell						1
Mytilus galloprovincialis	blue mussel		1				
Ostrea chilensis	mud oyster/ bluff oyster	1					
Saccostrea cuccullata glomerata	rock oyster	1					
Scutus breviculus	shield limpet						1
TOTAL		**206**	**7376**	**42**	**733**	**842**	**1102**

Table 5.24 Fish raw MNI data from middle period Coromandel assemblages

Taxon	Common Name	MTR-990	WHI-927-B	PAU-1028	WHI-926	WHA-1035	WHI-624
Chelidonichthys kumu	red gurnard			1			
Gempylidae sp.	snake mackerel sp.			1			
TOTAL		**0**	**0**	**2**	**0**	**0**	**0**

5.3.1.4 *Middle-Late Period Coromandel Assemblages*

Five assemblages from the Coromandel fall in the middle-late period: WHP-751, MTR-993, WHA-106, WHA-959 and NH-173.

In all of the middle period assemblages, *A. stutchburyi* and *P. australis* are the two dominant species, supplemented with *P. subtriangulata* in three assemblages (Table 5.25). The remaining species are infrequent.

In the fish class, only two middle-late Coromandel assemblages include fish remains (Table 5.26). The NH-173 assemblage contains one individual of *P. auratus*, while the MTR-993 assemblage has one individual from the Gempylidae family (snake mackerels).

As with the middle period assemblages, none of the middle-late period Coromandel assemblages contained remains from the marine and wetland bird, terrestrial bird, moa, marine mammal or terrestrial mammal classes.

Table 5.25 Shell raw MNI data from middle-late period Coromandel assemblages

Taxon	Common Name	WHP-751	MTR-993	WHA-106	WHA-959	NH-173
Paphies australis	pipi	1908	40	95	78	1715
Austrovenus stutchburyi	cockle	651	609	688	542	43
Paphies subtriangulata	tuatua		1761	157	13	
Cominella adspersa	speckled whelk			22	3	5
Xymene sp.	trophon sp.		24			
Amphibola crenata	mudsnail		1	11	4	
Maoricrypta costata	ribbed slipper shell					15
Penion sp.	siphon whelk sp.		12			
Sigapatella tenuis	small circular slipper shell					10
Cominella maculosa	spotted whelk					9
Lunella smaragdus	cats eye		2	2	3	1
Pecten novaezelandiae	queen scallop		6			
Cominella virgata	red mouthed whelk				5	
Aethocola glans	knobbed whelk			3	1	
Cominella sp.	whelk Cominella sp.		4			
Zeacumantus lutulentus	horn shell			2		
gastropod sp.	gastropod sp.		1			
Maoricrypta sp.	slipper shell sp.		1			
Perna canaliculus	green-lipped mussel					1
Taron sp.	whelk Taron sp.		1			
Zethalia zelandica	wheel shell					1
TOTAL		**2558**	**2462**	**980**	**649**	**1800**

Table 5.26 Fish raw MNI data from Coromandel middle-late period assemblages

Taxon	Common Name	WHP-751	MTR-993	WHA-106	WHA-959	NH-173
Pagrus auratus	snapper					1
Gempylidae *sp.*	snake mackerels		1			
TOTAL		**0**	**1**	**0**	**0**	**1**

5.3.1.5 *Late Period Coromandel Assemblages*

Four assemblages from the Coromandel fall in the late period: TRN-62 Upper, WHI-858, WHA-240 and WHI-927-A.

Continuing a trend observed in the middle-late period Coromandel assemblages, the range of shellfish species is further constrained in the late period, although this may be a result of the smaller number of assemblages here (Table 5.27). *P. australis* is present in all four of the assemblages but is always the second most frequent shellfish; in three of the assemblages *A. stutchburyi* is the most abundant species. The WHA-240 assemblage stands out for focusing on *Cominella adspersa* (speckled whelk). The remaining species are non-economic.

Only two late period assemblages include fish remains (Table 5.28); TRN-62-Upper contains one individual of *P. auratus* and WHA-240 has one *A. trutta*.

Only one late period assemblage contains a marine or wetland bird, TRN-62-Upper with one *Himantopus himantopus leucocephalus* (pied stilt; Table 5.29).

TRN-62-Upper is also the only assemblage to include one terrestrial bird species, *Nestor notabilis* (kea; Table 5.30).

No remains from the moa, marine mammal or terrestrial mammal classes were present in late period Coromandel assemblages.

Table 5.27 Shell raw MNI data from Coromandel late period assemblages

Taxon	Common Name	TRN-62 Upper	WHI-858	WHA-240	WHI-927-A
Austrovenus stutchburyi	cockle	593	1574		393
Paphies australis	pipi	536	488	51	255
Cominella adspersa	speckled whelk		7	1320	
Zeacumantus lutulentus	horn shell		54	15	
Xymene ambiguous	large trophon		41		
Struthiolaria papulosa	ostrich foot		15		
Amphibola crenata	mudsnail		11		
Cominella glandiformis	purple-mouthed whelk			9	
Macoma liliana	large wedge shell			7	
Mytilidae sp.	mussel sp.			4	
Lunella smaragdus	cats eye		1		
Ostrea chilensis	mud oyster/ bluff oyster			1	
Saccostrea cuccullata glomerata	rock oyster			1	
TOTAL		**1129**	**2191**	**1408**	**648**

Table 5.28 Fish raw MNI data from Coromandel late period assemblages

Taxon	Common Name	TRN-62 Upper	WHI-858	WHA-240	WHI-927-A
Pagrus auratus	snapper	1			
Arripis trutta	kahawai			1	
TOTAL		**1**	**0**	**1**	**0**

Table 5.29 Marine & wetland bird raw MNI data from Coromandel late period assemblages

Taxon	Common Name	TRN-62 Upper	WHI-858	WHA-240	WHI-927-A
Himantopus himantopus leucocephalus	Pied stilt	1			
TOTAL		**1**	**0**	**0**	**0**

Table 5.30 Terrestrial bird raw MNI data from Coromandel late period assemblages

Taxon	Common Name	TRN-62 Upper	WHI-858	WHA-240	WHI-927-A
Nestor notabilis	kea	1			
TOTAL		**1**	**0**	**0**	**0**

5.3.1.6 *Coromandel Results Summary*

Although the numbers of assemblages is small within each time period, some tentative, broad observations can be made. Generally speaking, the assemblages show a narrowing of species range from the early to late period, both at the class and species level. The early period Coromandel assemblages include fauna from all faunal classes; by the middle and middle-late periods the focus is mainly on one faunal class, shellfish. In the late period one assemblage is the exception to this trend, but otherwise the late period focuses mainly on shellfish.

5.3.2 Western Bay of Plenty

5.3.2.1 *Early Period Western Bay of Plenty Assemblages*

There is one early period Western Bay of Plenty assemblage which meets the radiocarbon date and assemblage data criteria, MAS-187. The assemblage is notable for the absence of shellfish and the presence of only one fish, *P. auratus* (Table 5.31). Also rather unusual for a Western Bay of Plenty assemblage is the presence of three moa individuals – two *Dinornis novaezealandiae* and one *Euryapteryx curtus* (Table 5.32). The remainder of the small assemblage is made up of two individuals of *C. familiaris* of unknown age (Table 5.33). In

addition to the absence of shellfish in this assemblage, there were no species present from the marine and wetland bird, terrestrial bird or marine mammal classes.

Table 5.31 Fish raw MNI data from early period Western Bay of Plenty assemblages

Taxon	Common Name	MAS-187
Pagrus auratus	snapper	1
TOTAL		1

Table 5.32 Moa raw MNI data from early period Western Bay of Plenty assemblages

Taxon	Common Name	MAS-187
Dinornis novaezealandiae	North Island giant moa	2
Euryapteryx curtus	Coastal moa	1
TOTAL		**3**

Table 5.33 Terrestrial mammal raw MNI data from early period Western Bay of Plenty assemblages

Taxon	Common Name	MAS-187
Canis familiaris	kuri (dog) - unknown age	2
TOTAL		**2**

5.3.2.2 *Early-Middle Period Western Bay of Plenty Assemblages*

Six early-middle Western Bay of Plenty assemblages are all in early-middle period: KTR-78, BWT-875, CHE-1920, TEH-584, ROW-1972 and TUI-2897-2.

Amongst the shellfish species, *P. australis* is present in all of the early-middle assemblages but is the most abundant in only one assemblage (Table 5.34). *A. stutchburyi* is present in five assemblages and the most frequent in four; *P. subtriangulata* is present in four assemblages and the most abundant species in one. *A. crenata* is present in four assemblages and significant in three. *P. canaliculus* is a notable presence in TEH-584 assemblage but is present in only one other assemblage, in low abundance. The remaining species are non-economic.

The fish remains in the early-middle period assemblages are meagre, with four of the six assemblages including fish (Table 5.34). *P. auratus* is present in three assemblages; *A. trutta*.

C. kumu and *Trachurus sp.* (mackerel species) are each present in one assemblage. The TEH-584 assemblage stands out with the highest fish MNI total of 4.

No marine or wetland bird, terrestrial bird, moa, marine mammal or terrestrial mammal remains are present in the early-middle period Western Bay of Plenty assemblages.

Table 5.34 Shell raw MNI data from early-middle period Western Bay of Plenty assemblages

Taxon	Common Name	KTR-78	BWT-875	CHE-1920	TEH-584	ROW-1972	TUI-2897-2
Austrovenus stutchburyi	cockle	192	54	189	3326	372	
Paphies subtriangulata	tuatua	86			778	1	323
Paphies australis	pipi	1	1	272	132	213	1
Amphibola crenata	mudsnail	183		1	242	45	
Perna canaliculus	green-lipped mussel			2	300		
Struthiolaria papulosa	ostrich foot	1		2	11		10
Mytilus galloprovincialis	blue mussel	22	1				
Cominella sp.	whelk Cominella sp.	13	5	1		1	
Mactra discors	deep trough shell				7		
Gastropod sp.	gastropod sp.					6	
Cyclomactra ovata	oval trough shell			4			
Saccostrea cucullata glomerata	rock oyster	3					
Cominella glandiformis	purple-mouthed whelk		1				
Dicathais orbita	white rock shell	1					
Dosinia anus	ringed venus shell					1	
Lunella smaragdus	cats eye		1				
Penion sulcatus	siphon whelk	1					
Polyplacophora sp.	chiton sp.		1				
Zethalia zelandica	wheel shell	1					
TOTAL		**504**	**64**	**471**	**4796**	**639**	**334**

Table 5.35 Fish raw MNI data from early-middle period Western Bay of Plenty assemblages

Taxon	Common Name	KTR-78	BWT-875	CHE-1920	TEH-584	ROW-1972	TUI-2897-2
Pagrus auratus	snapper		2	1	1		
Arripis trutta	kahawai				2		
Chelidonichthys kumu	red gurnard				1		
Trachurus sp.	mackerel sp.					1	
TOTAL		**0**	**2**	**1**	**4**	**1**	**0**

5.3.2.3 *Middle Period Western Bay of Plenty Assemblages*

There are nineteen assemblages from the Western Bay of Plenty which fall within the middle period.

In the shell class (Table 5.36), *P. australis* occurs in seventeen assemblages and is the most abundant in nine; *A. stutchburyi* is present in 15 assemblages but is only the dominant species

in four. *P. subtriangulata* occurs in thirteen assemblages, and is the most abundant species in three. *Struthiolaria papulosa* (ostrichfoot) is less frequent but still appears in eleven assemblages, with significant contributions to two. *A. crenata* is the dominant species in one assemblage but is only present in five others, in generally low frequencies.

Only six middle period assemblages include fish remains (Table 5.37). *Trachurus sp*. are present in four of the assemblages, of which it is the most abundant species in one, the fourth most abundant in another, and the only species represented in two. *P. auratus* is present in three assemblages, and the fifth most abundant of one of these. The ASH-2912 and MAN-188 assemblages are notable for having large fish MNI totals of 258 and 29 respectively, compared to n=1 or n=55 for the remaining assemblages containing fish. The ASH-2912 assemblage contains high proportions of *Parapercis colias* (blue cod), *N. macropterus* and *T. atun*. As well as the other fish species mentioned previously in this time period, *Rexea solandri* (gemfish) and *Lotella rhacina* (rock cod) also make supplementary contributions to the assemblage. A further seven species are present in low frequencies of n=1-4.The dominant fish species from MAN-188 is Carangidae sp. with an MNI of 17. It should be noted that the Carangidae family includes the two jack mackerel *Trachurus* species, which is the fourth most common species in ASH-2912. The second most common species in MAN-188 is A. trutta (n=5), which is only present in one other assemblage, ASH-2912 (n=1). Five other species are present within MAN-188 with n=1-2.

Marine and wetland bird remains were present in only two Western Bay of Plenty middle period assemblages (Table 5.38). TAR-3230-H contained one individual each of *Porphyrio melanotus* (pukeko) and unidentified marine bird; ASH-2912 included one *Larus dominicanus* (southern black-backed gull) and one *Pterodroma nigripennis* (black-winged petrel).

Only one middle period assemblage from the Western Bay of Plenty included any species from the terrestrial bird class (Table 5.39). TAR-3230-H contained one individual *Apteryx sp*. (kiwi).

No remains from the moa or marine mammal classes were present in the middle period assemblages from the Western Bay of Plenty.

C. familiaris was the only terrestrial mammal present in the middle period assemblages (Table 5.40), with two individuals in MAN-188 and one in ROW-3218.

Table 5.36 Shell raw MNI data from middle period Western Bay of Plenty assemblages

Taxon	Common Name	ORO-3216	ROW-3218	CHE-3193	ORO-1945	ORO-3056	ANA-46-Lower	MAT-2351	MAN-188	BAP-3269-T1	TEP-3221	FPC-3305	WHB-1275	BAP-3269-F6	SUP-2888	ORO-1941	ORO-3197	GSP-3113	TAR-3230-H	ASH-2912
Paphies subtriangulata	tuatua		100	9	3	1	21		121			8	195		3	144		158	5153	7901
Paphies australis	pipi	676	944	299	663	838	29	2165	783	184	1064	218		5		722	1994	1	206	37
Austrovenus stutchburyi	cockle	38	472	1594	859	53	47	732	186		4	124		36		39	34		1	228
Struthiolaria papulosa	ostrich foot		19	3	1		1		97			2	1		17			345	1108	556
Amphibola crenata	mudsnail		105		1		31			1650	2									10
Crassula aequilateralis	triangle shell								7									2	30	359
Zethalia zelandica	wheel shell							1					3					1	101	148
gastropod sp.	gastropod sp.	1	3			1	3	4		77				2		14				
Mactra discors	deep trough shell		21						23										1	5
Aethocola glans	knobbed whelk											6	3							32
Dosinia sp.	venus shell sp.				1				7										28	
Thorsitella sp.	topshell sp.								32		1									
Lunella smaragdus	cats eye							1	14			2								7
Cominella glandiformis	purple-mouthed whelk							8	4											2
Cominella adspersa	speckled whelk							10												
Saccostrea cucullata glomerata	rock oyster						1			8										8
Dosinia anus	ringed venus shell														1			1	1	12
Amalda australis	southern olive shell								13											1
Xymene ambiguous	large trophon			10				1				1								
Buccinulum sp.	whelk Buccinulum sp.											12								
Perna canaliculus	green-lipped mussel			2												10				
Glycermis modesta	small dog cockle								5											6
Zeacumantus lutulentus	horn shell							3												5
Haustrum haustorium	dark rock shell																			10
Janthina janthina	violet snail						10													
Tawera sp.	venus shell sp.						1		9											
Cyclomactra ovata	oval trough shell																		9	
Diloma aethiops	spotted top shell						5		3											
Maoricolpus roseus	turret shell											6								1

Table 5.36 Shell raw MNI data from middle period Western Bay of Plenty assemblages, *continued*

Taxon	Common Name	ORO-3216	ROW-3218	CHE-3193	ORO-1945	ORO-3056	ANA-46-Lower	MAT-2351	MAN-188	BAP-3269-T1	TEP-3221	FPC-3305	WHB-1275	BAP-3269-F6	SUP-2888	ORO-1941	ORO-3197	GSP-3113	TAR-3230-H	ASH-2912
Cominella sp.	whelk Cominella sp.		2	2					1									1		
Pecten novaezelandiae	queen scallop																		1	5
Evechinus chloroticus	kina (sea urchin)								5											
Maoricrypta monoxyla	white slipper shell																			3
Maoricrypta ?sp.	slipper shell ?sp.								3											
Dicathais orbita	white rock shell								2											
Limnoperna pulex	little black mussel								2											
Linucula hartvigiana	nut shell							1												
Macoma liliana	large wedge shell							1												
Maoricrypta costata	ribbed slipper shell											1							1	
Nerita atramentosa	black nerita								1											1
Polyplacophora sp.	chiton sp.							1												
Amalda murcronata	brown olive shell																			1
Buccinulum pallidum powelli	lined whelk																			1
Cookia sulcata	cooks turban																	1		
Divalucina cumingi	lace cockle																			1
Paphies venticosa	toheroa																			1
Semicassis pyrum	helmet shell								1											
Tanea zealandica	necklace shell																		1	
Total		**715**	**1666**	**1919**	**1528**	**893**	149	**2928**	**1319**	**1919**	**1071**	**380**	**202**	**43**	**21**	**929**	**2028**	**510**	**6641**	**9341**

Table 5.37 Fish raw MNI data from middle period Western Bay of Plenty assemblages

Taxon	Common Name	ORO-3216	ROW-3218	CHE-3193	ORO-1945	ORO-3056	ANA-46-Lower	MAT-2351-	MAN-188	BAP-3269-T1	TEP-3221	FPC-3305	WHB-1275	BAP-3269-F6	SUP-2888	ORO-1941	ORO-3197	GSP-3113	TAR-3230-H	ASH-2912
Parapercis colias	blue cod																			83
Nemadactylus macropterus	tarakihi								1											62
Thyrsites atun	barracouta																			33
Trachurus sp.	jack mackerel sp.		1														1		4	27
Carangidae sp.	caranx sp.								17											
Pagrus auratus	snapper								1										1	15
Rexea solandri	gemfish																			15
Lotella rhacina	rock cod																			7
Arripis trutta	kahawai								5											1
Meuschenia scaber	leatherjacket																			4
Peltorhamphus novazeelandiae	New Zealand sole																			3
Pseudocaranx dentex	trevally																			3
Chelidonichthys kumu	red gurnard								2											
Labridae sp.	wrasse sp.																			2
Pleuronectiforme sp.	flounder sp.								2											
Scomber australasicus	blue mackerel																			2
fish sp.	fish sp.				1															
Lepidopus caudatus	frostfish								1											
Pseudophycis bachus	red cod																			1
Total		**0**	**1**	**0**	**1**	**0**	**0**	**0**	**29**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**5**	**258**

Table 5.38 Marine and wetland bird raw MNI data from middle period Western Bay of Plenty assemblages

Taxon	Common Name	ORO-3216	ROW-3218	CHE-3193	ORO-1945	ORO-3056	ANA-46-Lower	MAT-2351	MAN-188	BAP-3269-T1	TEP-3221	FPC-3305	WHB-1275	BAP-3269-F6	SUP-2888	ORO-1941	ORO-3197	GSP-3113	TAR-3230-H	ASH-2912
Larus dominicanus	southern black-backed gull																			1
Porphyrio melanotus	pukeko																		1	
Pterodroma nigripennis	black-winged petrel																			1
marine bird sp.	marine bird sp.																		1	
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**

Table 5.39 Terrestrial bird raw MNI data from middle period Western Bay of Plenty assemblages

Taxon	Common Name	ORO-3216	ROW-3218	CHE-3193	ORO-1945	ORO-3056	ANA-46-Lower	MAT-2351	MAN-188	BAP-3269-T1	TEP-3221	FPC-3305	WHB-1275	BAP-3269-F6	SUP-2888	ORO-1941	ORO-3197	GSP-3113	TAR-3230-H	ASH-2912
Apteryx sp.	kiwi Apteryx sp.																		1	
TOTAL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

Table 5.40 Terrestrial mammal raw MNI data from middle period Western Bay of Plenty assemblages

Taxon	Common Name	ORO-3216	ROW-3218	CHE-3193	ORO-1945	ORO-3056	ANA-46-Lower	MAT-2351	MAN-188	BAP-3269-T1	TEP-3221	FPC-3305	WHB-1275	BAP-3269-F6	SUP-2888	ORO-1941	ORO-3197	GSP-3113	TAR-3230-H	ASH-2912
Canis familiaris	kuri (dog) - adult								1											
	kuri (dog) - unknown age		1						1											
TOTAL		**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

5.3.2.4 *Middle-Late Period Western Bay of Plenty Assemblages*

There are eleven assemblages from the Western Bay of Plenty in the middle-late period: FTP-1465, WHA-1229, EVA-3256, ANA-46-Upper, KAI, STR-780, TAU-2402, BWT-874, BWT-876, SUP-2891 and WHB-1246

In the shell class (Table 5.41), *A. stutchburyi* is present in ten of the assemblages, and is the most abundant species in three. *P. australis* is included in nine of the assemblages and the most abundant in six. Seven of the assemblages contain *P. subtriangulata* which is the lead species in two assemblages. The remaining shellfish species are represented in low frequencies.

Five of the middle-late assemblages from the Western Bay of Plenty include fish remains (Table 5.42). *T. atun* is present in three assemblages and the second most abundant species in one. *P. auratus* and *Trachurus sp.* are present in two assemblages – the latter is the only species present in SUP-2891, and is the dominant species in EVA-3256. *P. auratus* is the most abundant species in STR-780 (with an MNI of 2) and the third most abundant species in ANA-78-Upper; the latter is notable for the large size of the fish class total MNI at 24, compared to the other middle-late assemblages of 1-6.

No remains are present from the marine and wetland bird, terrestrial bird, moa, marine mammal or terrestrial mammal classes for the middle-late period assemblages from the Western Bay of Plenty.

Table 5.41 Shell raw MNI data from middle-late period Western Bay of Plenty assemblages

Taxon	Common name	FTP-1465	WHA-1229	EVA-3256	ANA-46-Upper	KAI	STR-780	TAU-2402	BWT-874	BWT-876	SUP-2891	WHB-1246
Paphies australis	pipi	3230	108	1115	89	325	154	753	179	205		
Austrovenus stutchburyi	cockle	1332	65	1	257	1041	23	1071	21	1		8
Paphies subtriangulata	tuatua	3	3		130		88	1	20		492	263
Macoma liliana	large wedge shell					340						
gastropod sp.	gastropod sp.	18			18	49						
Lunella smaragdus	cats eye	1			14		47		1			
Crassula aequilateralis	triangle shell			7			12	2				
Struthiolaria papulosa	ostrich foot			10	1		2				6	1
Zethalia zelandica	wheel shell			7	2							11
small mudshell sp.	small mudshell sp.				16							
Cominella adspersa	speckled whelk						10		2			
Amphibola crenata	mudsnail				6		3					
Mytilus galloprovincialis	blue mussel									9		
Amphibola crenata?	mudsnail ?				8							
Haustrum haustorium	dark rock shell						6					
Cominella glandiformis	purple-mouthed whelk				4							
Cookia sulcata	cooks turban						3					
Paphies venticosa	toheroa				2							
Aulacomya maoriana	ribbed mussel						1					
Barnea similis	rock borer				1							
Cominella sp.	whelk Cominella sp.	1										
Dicathais orbita	white rock shell								1			
Diloma subrostrata	mudflat top shell				1							
Dosinia anus	ringed venus shell				1							
Dosinia sp.	venus shell sp.											1
Janthina janthina	violet snail				1							
Limnoperna pulex	little black mussel				1							
Mactra discors	deep trough shell			1								
Myadora striata	battleaxe											1
Pecten sp.	scallop sp.			1								
Pecten novaezelandiae	queen scallop			1								
Protothaca crassicostata	ribbed venus			1								
TOTAL		**4585**	**176**	**1144**	**552**	**1755**	**349**	**1827**	**224**	**215**	**498**	**285**

Table 5.42 Fish raw MNI data from middle-late period Western Bay of Plenty assemblages

Taxon	Common name	FTP-1465	WHA-1229	EVA-3256	ANA-78 Upper	KAI	STR-780	TAU-2402	BWT-874	BWT-876	SUP-2891	WHB-1246
fish sp.	fish sp.				11				1			
Thyrsites atun	barracouta			1	6		1					
Pagrus auratus	snapper				5		2					
Trachurus sp.	mackerel sp.			4							3	
Elasmobranch sp.	sharks/rays/skates			1								
Parapercis colias	blue cod						1					
Pseudocaranx dentex	trevally				1							
Trachurus novaezelandiae	horse mackerel				1							
TOTAL		**0**	**0**	**6**	**24**	**0**	**4**	**0**	**1**	**0**	**3**	**0**

5.3.2.5 *Late Period Western Bay of Plenty Assemblages*

There are seven assemblages from the Western Bay of Plenty that date to the late period: TAR-3231, GSP-3116, HAM-9, TAR-3230-G, TUI-2897-3, TUI-2897-1 and SUP-2889.

In the shellfish class, five of the assemblages have *P. subtriangulata* as their most abundant species (Table 5.43); the inland assemblage from Rotorua, HAM-9, not surprisingly is dominated by a freshwater species, *Hyridella menziesii* (kakahi, freshwater mussel). The small number of remaining shellfish species are 'non-economic' species.

Only two assemblages from the late period Western Bay of Plenty group include fish remains, HAM-9 and TAR-3230-G (Table 5.44). The MNI totals are so small that no one species is more abundant than another. *P. auratus*, *Scomber australasicus* (blue mackerel) and *Trachurus sp.* are all represented by one individual. None of the assemblages yielded any bird or mammal remains.

Table 5.43 Shell raw MNI data from late period Western Bay of Plenty assemblages

Taxon	Common Name	TAR-3231	GSP-3116	HAM-9	TAR-3230-G	TUI-2897-3	TUI-2897-1	SUP-2889
Paphies subtriangulata	tuatua	272	974		819	243	100	295
Hyridella menziesii	kakahi (freshwater mussel)			667				
Zethalia zelandica	wheel shell	3	1		5	1	1	
Struthiolaria papulosa	ostrich foot		1		1			8
Aethocola glans	knobbed whelk				0			10
Crassula aequilateralis	triangle shell		1				1	8
Austrovenus stutchburyi	cockle	1			2			
Dosinia anus	ringed venus shell							3
Maoricrypta costata	ribbed slipper shell	1						
Paphies australis	pipi		1					
Pecten novaezelandiae	queen scallop					1		
TOTAL		**277**	**978**	**667**	**827**	**245**	**102**	**324**

Table 5.44 Fish raw MNI data from late period Western Bay of Plenty assemblages

Taxon	Common Name	TAR-3231	GSP-3116	HAM-9	TAR-3230-G	TUI-2897-3	TUI-2897-1	SUP-2889
Pagrus auratus	snapper				1			
Scomber australasicus	blue mackerel			1				
Trachurus sp.	mackerel sp.				1			
TOTAL		**0**	**0**	**1**	**2**	**0**	**0**	**0**

5.3.2.6 *Western Bay of Plenty Results summary*

Compared to the Coromandel, with the exception of the early period, a larger number of assemblages from the Western Bay of Plenty meet the research criteria, particularly in the middle and middle-late periods. The early period is only represented by one assemblage and therefore it must be treated with caution as a biased and tentative indicator of faunal resource use in the Western Bay of Plenty. This early assemblage is notable for the absence of shellfish and presence of only one fish, but with three moa individuals represented; terrestrial mammals were represented by two dogs. No marine and wetland bird, terrestrial bird or marine mammal species were present. In complete contrast, the early-middle period is notable for its focus on only two animal classes, shellfish and fish; though this may be a reflection of the low number of assemblages (n=6). The middle period, with a total of nineteen assemblages, generally focuses on the same two classes, but with less emphasis on fish, and only two assemblages making contributions to marine and wetland bird, terrestrial bird and terrestrial mammal classes. The eleven assemblages of the middle-late period continue the trend of focusing only on the shellfish and fish classes; although only five assemblages contain individuals from the latter, the species selection is much wider between and within these assemblages than in the early-middle period (with four species represented), and also the middle period, where most of the species range is within one exceptional assemblage. The late period is represented by seven assemblages which met the research criteria, and a much narrower focus within the shellfish class is clear, with only one main saltwater economic species featuring (and one main freshwater economic species in one inland assemblage). The fish class is also less prominent with only two assemblages containing this animal class, representing only three taxa.

5.4 ASSEMBLAGE PERCENTAGE ENERGY VALUES BY STUDY AREA, PERIOD AND FAUNAL CLASS

This section presents the assemblages by period with their energy values in raw (kcal) and relative (%kcal) forms. In the tables of relative energy, the first, second and third highest proportions by faunal class are shaded blue, pink and green respectively. It should be noted that 'non-economic' shellfish species, i.e. those shellfish species which were unlikely to have been specifically targeted, have been included in the energy yield calculations, as it is not possible to determine that they were not eaten; also the numbers of these 'non-economic' species are usually very low, and the energy yield they contribute to the overall assemblage becomes very minor in terms of percentages. It is also acknowledged that plant sources were a significant source of energy in most prehistoric communities, and that while the analysis here focuses solely on faunal sources of energy, plant sources such as *Ipomoea batatas* (kumara), *Colocasia esulenta* (taro), *Lagenaria siceraria* (hue, bottle gourd), *Dioscorea* spp. (uwhi, yam) and *Cordyline fruticosa* (tī pore, Pacific cabbage tree) would have also been an integral part of the diet in the prehistoric communities of the Coromandel and Western Bay of Plenty. Unfortunately, due to the manner of preservation and identification of plant species at archaeological sites – using pollen, biogenic silica (phytoliths, diatoms, and sponge spicules), and starch residues (starch grains and xylem), (Horrocks 2004) – and the specialist skills involved in their identification and analysis, plant species are rarely reported on in consultants' reports, and there is no comparative method for calculating floral energy yield data that can be integrated with that of faunal classes.

5.4.1 COROMANDEL PENINSULA

All time periods are represented in the Coromandel Peninsula assemblages. Tables of raw data are in the Appendix.

5.4.1.1 *EARLY COROMANDEL PENINSULA ASSEMBLAGE ENERGY VALUES*

The early period Coromandel Peninsula assemblages gather their energy sources from a wide range of faunal classes (Table 5.45). Five of the seven assemblages derive the largest proportion of their energy yield from marine mammals, ranging from 88.07% to 47.2%; in the remaining assemblages marine mammals are completely absent, with the largest source of energy being fish (79.31% and 61.40%). Fish is otherwise the second or third largest source of energy in early Coromandel assemblages (1.61% to 30.99%). Marine and wetland birds

rank in second or third place in four assemblages (1.31% to 9.47%), as do terrestrial mammals (3.91% to 23.12%). Shellfish, terrestrial bird and moa classes generally are not significant sources of energy in early Coromandel assemblages. The average relative energy values for the early period rank marine mammal first (56.21%), followed by fish (28.56%) and then terrestrial mammal (9.08%). The moa classes makes the lowest average energy contribution (0.41%), the terrestrial bird class the second lowest (0.63%), and shellfish the third lowest (1.47%). The marine bird class average is a minor contribution to energy yields (3.63%).

Table 5.45 Early period Coromandel Peninsula assemblage percentage energy yields by faunal class

	CCK-339 -L9	TRN-62 -Lower	CCK-339 -L7	PJK-53	CL-3	HHB-242-Lower	HHB-242-Middle	Average
Shellfish %kCal	0.11	0.07	0.92	0.25	0.79	6.01	2.15	1.47
Fish %kCal	3.77	6.21	16.64	1.61	30.99	61.40	79.31	28.56
Marine & Wet Bird %kCal	5.94	3.63	0.63	1.31	0.72	9.47	3.71	3.63
Terrestrial Bird %kCal	1.99	0.63	0.51	0.96	0.23	-	0.12	0.63
Moa %kCal	-	2.90	-	-	-	-	-	0.41
Marine Mammal %kCal	88.07	86.13	77.39	94.70	47.21	-	-	56.21
Terrestrial Mammal %kCal	0.13	0.43	3.91	1.18	20.07	23.12	14.71	9.08
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

5.4.1.2 *Early-Middle Coromandel Peninsula Assemblage Energy Values*

Marine mammals were still the main source of energy in six assemblages, from 49.35% to 89.13%, with fish the dominant source in the remaining assemblage at 91.98% (Table 5.46). The second most significant faunal class was fish in four assemblages (8.01% to 33.52%), with marine and wetland birds, terrestrial mammals and terrestrial birds in second position in one assemblage each (4.03%, 5.96% and 25.47% respectively). The third highest contribution of energy in the assemblages was even more variable, with shellfish (3.8% and 13.62%), fish (4.85% and 10.49%) and terrestrial mammals (2.91% and 2.11%) ranking third in two assemblages each, and marine and wetland birds in one (8.57%). Moa is a source of energy in only one assemblage (5.18%). The averages for the early-middle period of Coromandel assemblages places marine mammals as the largest source of energy (58.00%), followed by fish (26.53%) and then terrestrial birds (4.30%). Logically, the moa class makes the lowest average contribution (0.74%), and shellfish the second lowest (2.89%). Marine and wetland bird and terrestrial mammal classes also make minor contributions (3.85% and 3.69% respectively).

Table 5.46 Early-middle period Coromandel Peninsula assemblage percentage energy yields by faunal class

	HHB-242-Upper	WHT-16	CCK-399-L5	CCK-399-L3	HWB-115-Lower	HWB-115-Middle	AHU-944	Average
Shellfish %kCal	3.83	0.50	0.39	13.62	0.82	0.35	0.75	2.89
Fish %kCal	91.98	4.85	16.69	33.52	20.17	10.49	8.01	26.53
Marine & Wet Bird %kCal	4.03	2.84	2.62	2.99	8.57	5.88	-	3.85
Terrestrial Bird %kCal	-	-	-	0.07	4.58	25.47	-	4.30
Moa %kCal	-	-	-	-	-	5.18	-	0.74
Marine Mammal %kCal	-	85.86	77.40	45.05	59.22	49.35	89.13	58.00
Terrestrial Mammal %kCal	0.16	5.96	2.91	4.74	6.65	3.27	2.11	3.69
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

5.4.1.3 *Middle Period Coromandel Peninsula Assemblage Energy Values*

The faunal classes contributing to energy yield narrow considerably in the middle period assemblages from the Coromandel Peninsula (Table 5.47). Only two classes make contributions, shellfish and fish. Five of the six assemblages have shellfish as their sole source of energy. In the remaining assemblage, fish is the main source of energy at 98.02%, with shellfish contributing 1.98%. The averages for the middle period Coromandel assemblages have shellfish as the lead source of energy (83.66%) and fish the second source (16.34%).

Table 5.47 Middle period Coromandel Peninsula assemblage percentage energy yields by faunal class

	MTR-990	WHI-927-B	PAU-1028	WHI-926	WHA-1035	WHI-624	Average
Shellfish %kCal	100.00	100.00	1.98	100.00	100.00	100.00	83.66
Fish %kCal	-	-	98.02	-	-	-	16.34
Marine & Wet Bird %kCal	-	-	-	-	-	-	-
Terrestrial Bird %kCal	-	-	-	-	-	-	-
Moa %kCal	-	-	-	-	-	-	-
Marine Mammal %kCal	-	-	-	-	-	-	-
Terrestrial Mammal %kCal	-	-	-	-	-	-	-
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

5.4.1.4 *Middle-Late Period Coromandel Peninsula Assemblage Energy Values*

The trend of a narrow range of faunal class energy sources is continued in the five middle-late period Coromandel Peninsula assemblages (Table 5.48). Shellfish are the sole source of energy in three of the assemblages, and the largest source of energy in one (66.32%). Fish is the dominant source of energy in one assemblage (69.30%) and second-ranked in the other assemblage it is present in (33.68%). Marine and wetland birds, terrestrial birds, moa, marine mammals and terrestrial mammals do not provide energy for any of these assemblages. Similar to the middle-period Coromandel assemblages, the averages for energy yields have shellfish as the largest source (82.44%) and fish the second and only other source (17.16%).

Table 5.48 Middle-late period Coromandel Peninsula assemblage percentage energy yields by faunal class

	WHP-751	MTR-993	WHA-106	WHA-959	NH-173	Average
Shellfish %kCal	100.00	66.32	100.00	100.00	30.70	82.84
Fish %kCal	-	33.68	-	-	69.30	17.16
Marine & Wet Bird %kCal	-	-	-	-	-	-
Terrestrial Bird %kCal	-	-	-	-	-	-
Moa %kCal	-	-	-	-	-	-
Marine Mammal %kCal	-	-	-	-	-	-
Terrestrial Mammal %kCal	-	-	-	-	-	-
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

5.4.1.5 *Late Coromandel Peninsula Assemblage Energy Values*

There are only four late period Coromandel Peninsula assemblages, therefore observations here are treated as even more tentative (Table 5.49). The trend seen in the middle and middle-late period assemblages is weakened in the late period, with the faunal classes providing energy broadening to include terrestrial bird and marine and wetland bird in one assemblage. The shellfish class is the sole source of energy in two assemblages, and the second largest source in one (34.11%), and the third in the remaining assemblage (18.17%). Fish is the largest source of energy in two assemblages (45.00% and 65.89%). Terrestrial birds are the second largest source of energy in one assemblage (24.54%). The averages of the faunal class energy yields give shellfish the largest contribution (63.07%), followed by fish (27.72%), terrestrial bird (6.14%) and marine bird (3.07%). It should be noted that only one assemblage is contributing to the weakening of the trend established for Coromandel assemblages in the previous two time periods.

Table 5.49 Late period Coromandel Peninsula assemblage percentage energy yields by faunal class

	TRN-62-Upper	WHI-858	WHA-240	WHI-927-A	Average
Shellfish %kCal	18.17	100.00	34.11	100.00	63.07
Fish %kCal	45.00	-	65.89	-	27.72
Marine & Wet Bird %kCal	12.29	-	-	-	3.07
Terrestrial Bird %kCal	24.54	-	-	-	6.14
Moa %kCal	-	-	-	-	-
Marine Mammal %kCal	-	-	-	-	-
Terrestrial Mammal %kCal	-	-	-	-	-
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

5.4.2 Western Bay of Plenty

5.4.2.1 *Early Period Western Bay of Plenty Assemblage Energy Values*

There is one Western Bay of Plenty assemblage in the early period, MAS-187 (Table 5.50). The lead source of energy is from the Marine mammal class (54.68%), followed by moa (33.18%) and lastly terrestrial mammal (5.62%). Marine bird makes a similar contribution (5.38%), but fish and terrestrial bird contribute less than 1% each of the total energy yield of the assemblage. Significantly, shell does not contribute any energy yield at all.

Table 5.50 Early period Western Bay of Plenty assemblage percentage energy yields by faunal class

	MAS-187
Shellfish %kCal	-
Fish %kCal	0.67
Marine Bird %kCal	5.38
Terrestrial Bird %kCal	0.47
Moa %kCal	33.18
Marine Mammal %kCal	54.68
Terrestrial Mammal %kCal	5.62
Total	**100.00**

5.4.2.2 *Early-Middle Period Western Bay of Plenty Assemblage Energy Values*

There are six assemblages in the early-middle period from the Western Bay of Plenty (Table 5.51). Fish is the largest contributor of energy in four of the assemblages (54.37% to 86.10%); shellfish is the only source of energy in two assemblages. Marine and wetland birds are the second largest contributor of energy in one assemblage (25.63%). The averages of the early-middle period have shellfish and fish contributing almost identical proportions of energy (48.53% and 47.20% respectively), with marine and wetland birds the third source of energy (4.27%).

Table 5.51 Early-middle period Western Bay of Plenty assemblage percentage energy yields by faunal class

	KTR-78	BWT-875	CHE-1920	TEH-584	ROW-1972	TUI-2897-2	Average
Shellfish %kCal	100.00	1.17	13.90	45.63	30.48	100.00	48.53
Fish %kCal	-	73.20	86.10	54.37	69.52	-	47.20
Marine & Wet Bird %kCal	-	25.63	-	-	-	-	4.27
Terrestrial Bird %kCal	-	-	-	-	-	-	-
Moa %kCal	-	-	-	-	-	-	-
Marine Mammal %kCal	-	-	-	-	-	-	-
Terrestrial Mammal %kCal	-	-	-	-	-	-	-
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

5.4.2.3 *Middle Period Western Bay of Plenty Assemblage Energy Values*

There are nineteen assemblages from the Western Bay of Plenty which date to the middle period (Table 5.52).

Thirteen of the assemblages use only one faunal class as a source of energy – shellfish. Three assemblages use both fish and shellfish as energy sources, with fish providing greater energy yields (54.78% to 90.38%). Fish is also the third source of energy in one assemblage (19.58%). In another assemblage, the lead source of energy is terrestrial bird (58.06%), with marine and wetland bird the second source (24.94%) and shellfish the third (9.07%); fish is the faunal class with the lowest energy contribution (7.93%). Terrestrial mammal was the second and third largest source of energy in two assemblages (21.42% and 2.51% respectively). Marine and wetland bird was present in two assemblages as second lowest and lowest sources of energy (15.56% and 0.77%); terrestrial bird was present in one assemblage as the smallest source of energy (5.58%).

The averages of all of the eighteen middle period assemblages places shellfish as the lead source of energy (80.20%), followed by fish (12.5%) and terrestrial bird (3.54%). Marine and wetland bird and terrestrial mammal make the second smallest and smallest energy contributions (2.29% and 1.33% respectively).

5.4.2.4 *Middle-Late Western Bay of Plenty Assemblage Energy Values*

There are eleven Western Bay of Plenty assemblages which fall in the middle-late period (Table 5.53). Six of the assemblages source their energy from just one faunal class, shellfish. The five remaining assemblages have fish as the lead source of energy (from 73.94% to 98.24%), with shellfish the only other source of energy (1.76% to 26.06).

The average values for the middle-late period Western Bay of Plenty assemblages place shellfish is the lead source of energy (59.15%), with fish the secondary source (40.85%). This continues a trend from the early-middle and middle periods, with shellfish becoming a more important source of energy as the range of species and faunal classes utilised diminishes.

5.4.2.5 *Late Western Bay of Plenty Assemblage Energy Values*

There are seven assemblages in the Western Bay of Plenty late period (Table 5.54Table 5.54). Three of the assemblages source energy from only one faunal source, shellfish. Two

assemblages have shellfish as the lead energy source (68.37% and 50.01%) and another two have fish as the lead source of energy (71.12% and 96.72%). No other animal classes are sources of energy in the late period.

The averages for the late period assemblages from the Western Bay of Plenty have shellfish as the lead source of energy (56.43%) and shellfish as the secondary source (43.57%).

The late period Western Bay of Plenty assemblages continue the trend from the previous three periods, with the focus on shellfish as the main source of energy and supplemented with fish, although the relative difference in proportions is not as large as it is in the middle-late period.

Table 5.52 Middle period Western Bay of Plenty assemblage percentage energy yields by faunal class

%kCal	ORO-3216	ROW-3218	CHE-3193	ORO-1945	ORO-3056	ANA-78-Lower	MAT-2351	MAN-188	BAP-3269-T1	TEP-3221	FPC-3305	WHB-1275	BAP-3269-F6	SUP-2888	ORO-1941	ORO-3197	GSP-3113	TAR-3230-H	ASH-2912	Ave
Shellfish	100.00	9.07	100.00	45.22	100.00	100.00	100.00	2.06	100.00	100.00	100.00	100.00	100.00	100.00	100.00	45.05	100.00	37.85	6.35	**80.20**
Fish	-	7.93	-	54.78	-	-	-	64.25	-	-	-	-	-	-	-	54.95	-	19.58	90.38	**12.65**
M/W Bird	-	24.94	-	-	-	-	-	33.69	-	-	-	-	-	-	-	-	-	15.56	0.77	**2.29**
T Bird	-	58.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.58	-	**3.54**
Moa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
M Mam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
T Mam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.42	2.51	**1.33**
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 5.53 Middle-late period Western Bay of Plenty assemblage percentage energy yields by faunal class

	FTP-1465	WHA-1229	EVA-3256	ANA-46-Upper	KAI	STR-780	TAU-2402	BWT-876	BWT-874	SUP-2891	WHB-1246	Averages
Shellfish %kCal	100.00	100.00	3.10	1.76	100.00	8.76	100.00	100.00	10.94	26.06	100.00	59.15
Fish %kCal	-	-	96.90	98.24	-	91.24	-	-	89.06	73.94	-	40.85
Marine & Wet Bird %kCal	-	-	-	-	-	-	-	-	-	-	-	-
Terrestrial Bird %kCal	-	-	-	-	-	-	-	-	-	-	-	-
Moa %kCal	-	-	-	-	-	-	-	-	-	-	-	-
Marine Mammal %kCal	-	-	-	-	-	-	-	-	-	-	-	-
Terrestrial Mammal %kCal	-	-	-	-	-	-	-	-	-	-	-	-
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 5.54 Late period Western Bay of Plenty assemblage percentage energy yields by faunal class

	TAR-3231	GSP-3116	HAM-9	TAR-3230-G	TUI-2897-3	TUI-2897-1	SUP-2889	Average
Shellfish %kCal	100.00	68.37	28.88	50.01	100.00	100.00	3.28	56.43
Fish %kCal	-	31.63	71.12	49.99	0.00	0.00	96.72	43.57
Marine & Wetland Bird %kCal	-	-	-	-	-	-	-	-
Terrestrial Bird %kCal	-	-	-	-	-	-	-	-
Moa %kCal	-	-	-	-	-	-	-	-
Marine Mammal %kCal	-	-	-	-	-	-	-	-
Terrestrial Mammal %kCal	-	-	-	-	-	-	-	-
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

5.4.3 Relative Energy Yield Conclusions

Tables 5.55 and 5.56 present the average energy yields for faunal classes by time period in the Coromandel Peninsula and the Western Bay of Plenty. The Coromandel Peninsula has a broad range of faunal classes the early and early-middle periods, with marine mammals as the lead source of energy. In the middle and middle-late periods the focus narrows on shellfish and fish, with shellfish the lead source of energy. In the late period, the focus widens to four faunal classes but still focusing on shellfish and fish as the two main sources of energy.

There is only one early period assemblage in the Western Bay of Plenty, and there are parallels and differences in the pattern observed over time in the trends for this study area with the Coromandel. While the early period assemblage is dominated by energy yields from the marine mammal and the moa classes, with all other classes represented except, significantly, shellfish, the early-middle period utilises three faunal classes with shellfish and fish contributing almost equal large yields of energy, supplemented with a small energy yield from marine and wetland birds. In the middle period, five faunal classes contribute to energy yield, with shellfish the lead source, followed by fish and terrestrial bird. In the middle-late period, the focus narrows to two faunal classes, with shellfish the lead source of energy followed by fish. This is repeated in the late period assemblages also.

Whether the broadening of faunal classes utilised in the Coromandel Peninsula late period, and also in the Western Bay of Plenty middle period, is amplified by statistical sampling, or a reliable observation, only data from future excavations will be able to clarify. Apart from the dearth of early Western Bay of Plenty assemblages, with the one assemblage present only lacking the shellfish class, the middle and late periods of assemblages are the points of

difference between the trends in faunal class utilisation in the two study areas. If we emphasise the fact that over 90% of the late Coromandel Peninsula assemblage energy yield is from shellfish (63.07%) and fish (27.72%) combined, it could be argued that the trend to an overwhelming reliance on these two faunal classes continues in these assemblages. Shellfish (80.20%) and fish (12.65%) also make up over 90% of the energy yield in the middle period Western Bay of Plenty assemblages; this is also true of the early-middle period assemblages from the Western Bay of Plenty. Therefore, while it can be generalised that the Coromandel assemblages changed from a broad to narrow focus of energy sources over time, the Western Bay of Plenty assemblages made a much less dramatic change in the range of faunal classes they utilised.

Table 5.55 Faunal class energy yield averages by time period, Coromandel Peninsula assemblages

	Early Coromandel Average	Early-Middle Coromandel Average	Middle Coromandel Average	Middle-Late Coromandel Average	Late Coromandel Average
Shellfish %kCal	1.47	2.89	83.66	82.84	63.07
Fish %kCal	28.56	26.53	16.34	17.16	27.72
Marine & Wetland Bird %kCal	3.63	3.85	-	-	3.07
Terrestrial Bird %kCal	0.63	4.30	-	-	6.14
Moa %kCal	0.41	0.74	-	-	-
Marine Mammal %kCal	56.21	58.00	-	-	-
Terrestrial Mammal %kCal	9.08	3.69	-	-	-
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 5.56 Faunal class energy yield averages by time period, Western Bay of Plenty assemblages

	Early Western Bay of Plenty	Early-Middle Western Bay of Plenty Average	Middle Western Bay of Plenty Average	Middle-Late Western Bay of Plenty Average	Late Western Bay of Plenty Average
Shellfish %kCal	-	48.53	76.08	59.15	56.43
Fish %kCal	0.67	47.20	15.36	40.85	43.57
Marine & Wetland Bird %kCal	5.38	4.27	3.95	-	-
Terrestrial Bird %kCal	0.47	-	3.35	-	-
Moa %kCal	33.18	-	-	-	-
Marine Mammal %kCal	54.68	-	-	-	-
Terrestrial Mammal %kCal	5.62	-	1.26	-	-
Total	**100.00**	**100.00**	100.00	**100.00**	**100.00**

5.5 CLUSTER ANALYSIS

Assemblage data from the faunal class energy percentages are presented in Table 5.57; the assemblages are arranged by area, with 'C' indicating Coromandel and 'WBoP' representing Western Bay of Plenty, and by time period, with 'E' for early, 'EM' for early-middle, 'M' for middle, 'ML' for middle-late and 'L' for late. Some patterns in the data are present. For example, early period assemblages from the Coromandel appear to be 'generalised' with a range of faunal classes utilised; many of the middle to late period assemblages from the Western Bay of Plenty appear to be extremely restricted, with assemblages containing only one faunal class, shellfish.

In order to see if the patterns in the data could be understood in terms of time period, and also to determine if the data justified treating the data as two geographical areas (instead of one large area, or numerous smaller areas), the data was examined with hierarchical cluster analysis, using SPSS (version 22) statistical software in order to group sites on the basis of similarities in diet as measured by the relative importance of different faunal classes measured in energy percentages. Cluster analysis was used because it is "a data reduction tool that creates subgroups that are more manageable than individual datum" (Burns & Burns 2008:552). It is used to cluster data (in this case, assemblages) into groups that are similar, and separate them from dissimilar assemblages. The SPSS software was used to carry out hierarchical cluster analysis using Ward's Method (a method for deciding at what distance clusters merge) and Squared Euclidean Distance (a measure of similarity between pairs of assemblages) to generate a dendrogram. Different variations of the data were used: percentage values, ranked values and presence-absence values.

There is very little difference in the groups clustered using percentage data or ranked data. The presence-absence data proved to be coarse in its clustering of assemblages in comparison with the percentage and ranked data. The percentage data did not produce reliable results in the multi-dimensional scaling scatter-plot analysis, although it did group the sites into sensible groups matching the dendrogram results.

The dendrogram for percentage values is presented in Figure 5.5. The assemblages fall into four main clusters (Tables 5.58 - 5.71). The 12 assemblages in Group A all have marine mammal as the lead resource, and generally utilise a wide range of resources; in Group B all of the eighteen assemblages have fish as the lead resource, generally with a more restricted range of classes; shellfish is often the second lead resource. The nine Group C assemblages

are fall into two patterns; shellfish and fish are the only two resources and the proportions are similar, or there are four or five resources present but no third, fourth or fifth-ranked fauna classes represent less than 5.58% of the percentage energy yield for each assemblage. For ease of labelling, these assemblages are described as balanced resource assemblages, as there is much less of a dominant first ranked resource pattern. Group D is the largest group with thirty-four assemblages; these assemblages contain only one faunal class, shellfish logically make up 100% of the energy yield for ach assemblage.

Table 5.62 shows the numbers of assemblages by period, group and region. This highlights that there is one early period assemblage from the Western Bay of Plenty, and that Group D is the largest group in both regions. In the Coromandel, Group A and D are the largest groups with eleven assemblages each, while Group D is the largest from the Western Bay of Plenty with 23 assemblages. There is one Group A assemblage in the Western Bay of Plenty; Group B and C assemblages are poorly represented in the Coromandel. These patterns differ somewhat from the total assemblage pattern, which has similar proportions of Groups A, B and C but with a much larger group D.

It should be noted that the Coromandel area has more assemblages in the early and early-middle periods, which is a potential bias in the results of the assemblage groups from this area. The potential for period bias is also present in the Western Bay of Plenty, with the middle period accounting for more than half of all assemblages, but the early, early-middle and late periods are under-represented.

The patterns identified in these results will be further explored in Chapter Six.

Table 5.57 Energy percentages from all assemblages sorted by area and period

Assemblage	Period & Region	Shellfish %kCal	Fish %kCal	Marine & Wetland Bird %kCal	Terrestrial Bird %kCal	Moa %kCal	Marine Mammal %kCal	Terrestrial Mammal %kCal	Total
CCK-339-L9	EC	0.11	3.77	5.94	1.99	-	88.07	0.13	100.00
TRN-62-Lower	EC	0.07	6.21	3.63	0.63	2.9	86.13	0.43	100.00
CCK-339-L7	EC	0.92	16.64	0.63	0.51	-	77.39	3.91	100.00
PJK-53	EC	0.25	1.61	1.31	0.96	-	94.7	1.18	100.00
CL-3	EC	0.79	30.99	0.72	0.23	-	47.21	20.07	100.00
HHB-242-Middle	EC	2.15	79.31	3.71	0.12	-	-	14.71	100.00
HHB-242-Lower	EC	6.01	61.40	9.47	-	-	-	23.12	100.00
HHB-242-Upper	EMC	3.83	91.98	4.03	-	-	-	0.16	100.00
WHT-16	EMC	0.50	4.85	2.84	-	-	85.86	5.96	100.00
CCK-399-L5	EMC	0.39	16.69	2.62	-	-	77.4	2.91	100.00
CCK-399-L3	EMC	13.62	33.52	2.99	0.07	-	45.05	4.74	100.00
HWB-115-Lower	EMC	0.82	20.17	8.57	4.58	-	59.22	6.65	100.00
HWB-115-Middle	EMC	0.35	10.49	5.88	25.47	5.18	49.35	3.27	100.00
AHU-944	EMC	0.75	8.01	-	-	-	89.13	2.11	100.00
MTR-990	MC	100.00	-	-	-	-	-	-	100.00
WHI-927-B	MC	100.00	0.00	-	-	-	-	-	100.00
PAU-1028	MC	1.98	98.02	-	-	-	-	-	100.00
WHI-926	MC	100.00	-	-	-	-	-	-	100.00
WHA-1035	MC	100.00	-	-	-	-	-	-	100.00
WHI-624	MC	100.00	-	-	-	-	-	-	100.00
WHP-751	MLC	100.00	-	-	-	-	-	-	100.00
MTR-993	MLC	66.32	33.68	-	-	-	-	-	100.00
WHA-106	MLC	100.00	-	-	-	-	-	-	100.00
WHA-959	MLC	100.00	-	-	-	-	-	-	100.00
NH-173	MLC	30.70	69.30	-	-	-	-	-	100.00
TRN-62-Upper	LC	18.17	45.00	12.29	24.54	-	-	-	100.00
WHI-858	LC	100.00	-	-	-	-	-	-	100.00
WHA-240	LC	34.11	65.89	-	-	-	-	-	100.00
WHI-927-A	LC	100.00	-	-	-	-	-	-	100.00
MAS-187	EWBoP	-	0.67	5.38	0.47	33.18	54.68	5.62	100.00
KTR-78	EMWBoP	100.00	-	-	-	-	-	-	100.00
BWT-875	EMWBoP	1.17	73.20	25.63	-	-	-	-	100.00
CHE-1920	EMWBoP	13.90	86.10	-	-	-	-	-	100.00
TEH-584	EMWBoP	45.63	54.37	-	-	-	-	-	100.00
TUI-2897-2	EMWBoP	100.00	-	-	-	-	-	-	100.00
ORO-3216	MWBoP	100.00	-	-	-	-	-	-	100.00
ROW-3218	MWBoP	9.07	7.93	24.94	58.06	-	-	-	100.00
CHE-3193	MWBoP	100.00	-	-	-	-	-	-	100.00
ORO-1945	MWBoP	45.22	54.78	-	-	-	-	-	100.00
ORO-3056	MWBoP	100.00	-	-	-	-	-	-	100.00
ANA-46-Lower	MWBoP	100.00	-	-	-	-	-	-	100.00
MAT-2351	MWBoP	100.00	-	-	-	-	-	-	100.00
MAN-188	MWBoP	2.06	64.25	33.69	-	-	-	-	100.00
BAP-3269-T1	MWBoP	100.00	-	-	-	-	-	-	100.00
TEP-3221	MWBoP	100.00	-	-	-	-	-	-	100.00
FPC-3305	MWBoP	100.00	-	-	-	-	-	-	100.00
WHB-1275	MWBoP	100.00	-	-	-	-	-	-	100.00
BAP-3269-F6	MWBoP	100.00	-	-	-	-	-	-	100.00
SUP-2888	MWBoP	100.00	-	-	-	-	-	-	100.00
ORO-1941	MWBoP	100.00	-	-	-	-	-	-	100.00

Table 5.62 Energy percentages from all assemblages sorted by area and period, *continued*

Assemblage	Period & Region	Shellfish %kCal	Fish %kCal	Marine & Wetland Bird %kCal	Terrestrial Bird %kCal	Moa %kCal	Marine Mammal %kCal	Terrestrial Mammal %kCal	Total
ORO-3197	MWBoP	45.05	54.95	-	-	-	-	-	100.00
GSP-3113	MWBoP	100.00	-	-	-	-	-	-	100.00
TAR-3230-H	MWBoP	37.85	19.58	15.56	5.58	-	-	21.42	100.00
ASH-2912	MWBoP	6.35	90.38	0.77	-	-	-	2.51	100.00
HAM-9	MWBoP	28.88	71.12	-	-	-	-	-	100.00
ROW-1972	MWBoP	30.48	69.52	-	-	-	-	-	100.00
FTP-1465	MLWBoP	100.00	-	-	-	-	-	-	100.00
WHA-1229	MLWBoP	100.00	-	-	-	-	-	-	100.00
EVA-3256	MLWBoP	3.10	96.90	-	-	-	-	-	100.00
ANA-46-Upper	MLWBoP	1.76	98.24	-	-	-	-	-	100.00
KAI	MLWBoP	100.00	-	-	-	-	-	-	100.00
STR-780	MLWBoP	8.76	91.24	-	-	-	-	-	100.00
TAU-2402	MLWBoP	100.00	-	-	-	-	-	-	100.00
BWT-876	MLWBoP	100.00	-	-	-	-	-	-	100.00
BWT-874	MLWBoP	10.94	89.06	-	-	-	-	-	100.00
SUP-2891	MLWBoP	26.06	73.94	-	-	-	-	-	100.00
WHB-1246	MLWBoP	100.00	-	-	-	-	-	-	100.00
TAR-3231	LWBoP	100.00	-	-	-	-	-	-	100.00
GSP-3116	LWBoP	68.37	31.63	-	-	-	-	-	100.00
TAR-3230-G	LWBoP	50.01	49.99	-	-	-	-	-	100.00
TUI-2897-3	LWBoP	100.00	-	-	-	-	-	-	100.00
TUI-2897-1	LWBoP	100.00	-	-	-	-	-	-	100.00
SUP-2889	LWBoP	3.28	96.72	-	-	-	-	-	100.00

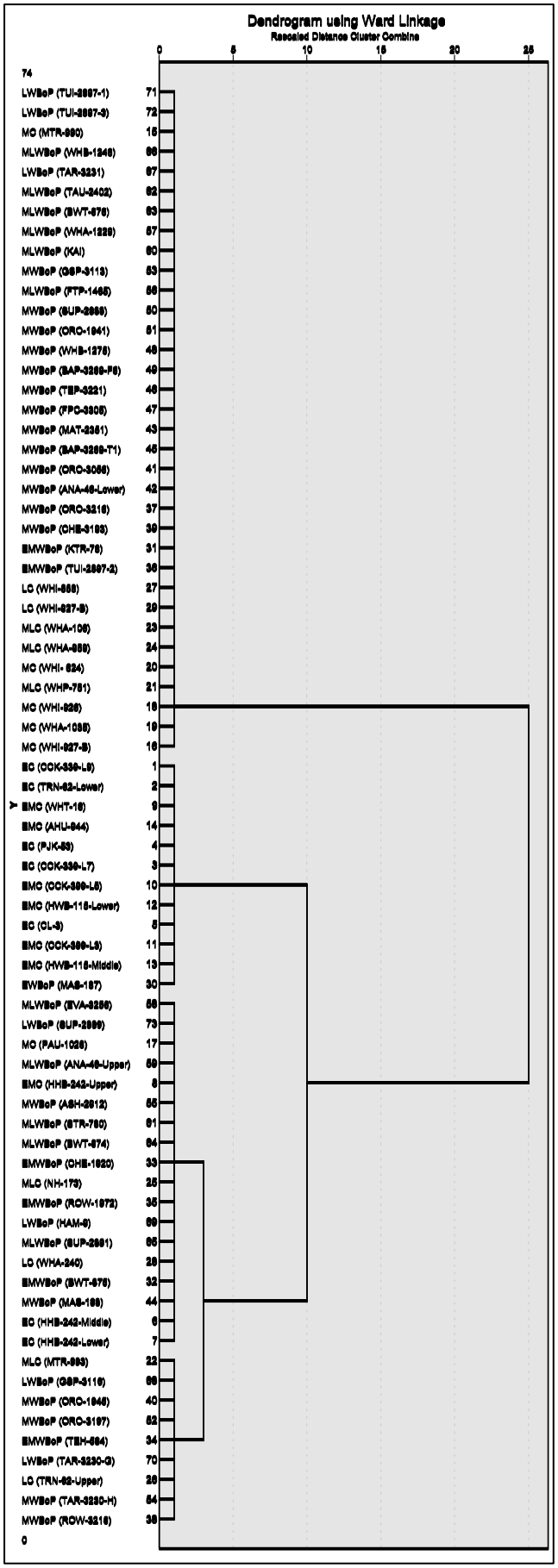

Figure 5.5 Cluster analysis dendrogram of all faunal assemblages from the Coromandel Peninsula and Western Bay of Plenty on percentage data using a squared Euclidean distance measure and Ward's linkage

Table 5.58 Group A: marine mammal lead resource

Assemblage Code	Period Region	Shellfish %kCal	Fish %kCal	M & W Bird %kCal	Terr Bird %kCal	Moa %kCal	Mar Mam %kCal	Terr Mam %kCal	Total
CCK-339-L9	EC	0.11	3.77	5.94	1.99	-	88.07	0.13	100.00
TRN-62-Lower	EC	0.07	6.21	3.63	0.63	2.9	86.13	0.43	100.00
PJK-53	EC	0.25	1.61	1.31	0.96	-	94.70	1.18	100.00
CL-3	EC	0.79	30.99	0.72	0.23	-	47.21	20.07	100.00
CCK-339-L7	EC	0.92	16.64	0.63	0.51	-	77.39	3.91	100.00
MAS-187	EWBoP	-	0.67	5.38	0.47	33.18	54.68	5.62	100.00
AHU-944	EMC	0.75	8.01	-	-	-	89.13	2.11	100.00
WHT-16	EMC	0.50	4.85	2.84	-	-	85.86	5.96	100.00
CCK-399-L3	EMC	13.62	33.52	2.99	0.07	-	45.05	4.74	100.00
CCK-399-L5	EMC	0.39	16.69	2.62	-	-	77.40	2.91	100.00
HWB-115-Lower	EMC	0.82	20.17	8.57	4.58	-	59.22	6.65	100.00
HWB-115-Middle	EMC	0.35	10.49	5.88	25.47	5.18	49.35	3.27	100.00

Table 5.59 Group B: fish lead resource

Assemblage Code	Period Region	Shellfish %kCal	Fish %kCal	M & W Bird %kCal	Terr Bird %kCal	Moa %kCal	Mar Mam %kCal	Terr Mam %kCal	Total
HHB-242 Middle	EC	2.15	79.31	3.71	0.12	-	-	14.71	100.00
HHB-242 Lower	EC	6.01	61.40	9.47	-	-	-	23.12	100.00
HHB-242 Upper	EMC	3.83	91.98	4.03	-	-	-	0.16	100.00
BWT-875	EMWBoP	1.17	73.20	25.63	-	-	-	-	100.00
CHE-1920	EMWBoP	13.90	86.10	-	-	-	-	-	100.00
PAU-1028	MC	1.98	98.02	-	-	-	-	-	100.00
ROW-1972	MWBoP	30.48	69.52	-	-	-	-	-	100.00
HAM-9	MWBoP	28.88	71.12	-	-	-	-	-	100.00
ASH-2912	MWBoP	6.35	90.38	0.77	-	-	-	2.51	100.00
MAN-188	MWBoP	2.06	64.25	33.69	-	-	-	-	100.00
NH-173	MLC	30.7	69.3	-	-	-	-	-	100.00
EVA-3256	MLWBoP	3.10	96.9	-	-	-	-	-	100.00
ANA-46-Upper	MLWBoP	1.76	98.24	-	-	-	-	-	100.00
BWT-874	MLWBoP	10.94	89.06	-	-	-	-	-	100.00
STR-780	MLWBoP	8.76	91.24	-	-	-	-	-	100.00
SUP-2891	MLWBoP	26.06	73.94	-	-	-	-	-	100.00
WHA-240	LC	34.11	65.89	-	-	-	-	-	100.00
SUP-2889	LWBoP	3.28	96.72	-	-	-	-	-	100.00

Table 5.60 Group C: Balanced resources

Assemblage Code	Period Region	Shellfish %kCal	Fish %kCal	M & W Bird %kCal	Terr Bird %kCal	Moa %kCal	Mar Mam %kCal	Terr Mam %kCal	Total
TEH-584	EMWBoP	45.64	54.36	-	-	-	-	-	100.00
TAR-3230-H	MWBoP	37.85	19.58	15.56	5.58	-	-	21.42	100.00
ORO-1945	MWBoP	45.22	54.78	-	-	-	-	-	100.00
ORO-3197	MWBoP	45.05	54.95	-	-	-	-	-	100.00
ROW-3218	MWBoP	9.07	7.93	24.94	58.06	-	-	-	100.00
MTR-993	MLC	66.32	33.68	-	-	-	-	-	100.00
TRN-62-Upper	LC	18.17	45.00	12.29	24.54	-	-	-	100.00
TAR-3230-G	LWBoP	50.01	49.99	-	-	-	-	-	100.00
GSP-3116	LWBoP	68.37	31.63	-	-	-	-	-	100.00

Table 5.61 Group D: shellfish only resource

Assemblage Code	Period Region	Shellfish %kCal	Fish %kCal	M & W Bird %kCal	Terr Bird %kCal	Moa %kCal	Mar Mam %kCal	Terr Mam %kCal	Total
TUI-2897-2	EMWBoP	100.00	-	-	-	-	-	-	100.00
KTR-78	EMWBoP	100.00	-	-	-	-	-	-	100.00
WHI-624	MC	100.00	-	-	-	-	-	-	100.00
WHA-1035	MC	100.00	-	-	-	-	-	-	100.00
MTR-990	MC	100.00	-	-	-	-	-	-	100.00
WHI-927-B	MC	100.00	-	-	-	-	-	-	100.00
WHI-926	MC	100.00	-	-	-	-	-	-	100.00
ANA-46-Lower	MWBoP	100.00	-	-	-	-	-	-	100.00
WHB-1275	MWBoP	100.00	-	-	-	-	-	-	100.00
TEP-3221	MWBoP	100.00	-	-	-	-	-	-	100.00
ORO-3216	MWBoP	100.00	-	-	-	-	-	-	100.00
SUP-2888	MWBoP	100.00	-	-	-	-	-	-	100.00
ORO-1941	MWBoP	100.00	-	-	-	-	-	-	100.00
ORO-3056	MWBoP	100.00	-	-	-	-	-	-	100.00
MAT-2351	MWBoP	100.00	-	-	-	-	-	-	100.00
GSP-3113	MWBoP	100.00	-	-	-	-	-	-	100.00
CHE-3193	MWBoP	100.00	-	-	-	-	-	-	100.00
FPC-3305	MWBoP	100.00	-	-	-	-	-	-	100.00
BAP-3269-T1	MWBoP	100.00	-	-	-	-	-	-	100.00
BAP-3269-F6	MWBoP	100.00	-	-	-	-	-	-	100.00
WHP-751	MLC	100.00	-	-	-	-	-	-	100.00
WHA-959	MLC	100.00	-	-	-	-	-	-	100.00
WHA-106	MLC	100.00	-	-	-	-	-	-	100.00
BWT-876	MLWBoP	100.00	-	-	-	-	-	-	100.00
WHB-1246	MLWBoP	100.00	-	-	-	-	-	-	100.00
WHA-1229	MLWBoP	100.00	-	-	-	-	-	-	100.00
TAU-2402	MLWBoP	100.00	-	-	-	-	-	-	100.00
KAI	MLWBoP	100.00	-	-	-	-	-	-	100.00
FTP-1465	MLWBoP	100.00	-	-	-	-	-	-	100.00
WHI-927-A	LC	100.00	-	-	-	-	-	-	100.00
WHI-858	LC	100.00	-	-	-	-	-	-	100.00
TUI-2897-3	LWBoP	100.00	-	-	-	-	-	-	100.00
TUI-2897-1	LWBoP	100.00	-	-	-	-	-	-	100.00
TAR-3231	LWBoP	100.00	-	-	-	-	-	-	100.00

Table 5.62 Matrix of assemblage totals by period, group and area

	Coromandel Peninsula					Western Bay of Plenty					Combined Totals
Period / Group	A	B	C	D	Area Total	A	B	C	D	Area Total	
Early	5	2	-	-	**7**	1	-	-	-	**1**	**8**
Early-Middle	6	1	-	-	**7**	-	2	1	2	**5**	**12**
Middle	-	1	-	5	**6**	-	4	4	13	**21**	**27**
Middle-Late	-	1	1	3	**5**	-	5	-	6	**11**	**16**
Late	-	1	1	2	**4**	-	1	2	3	**6**	**10**
TOTALS	**11**	**6**	**2**	**10**	**29**	**1**	**12**	**7**	**24**	**44**	**73**

6 DISCUSSION

6.1 INTRODUCTION

This chapter examines the data presented in the last two chapters and pulls together trends that appear. First, an overview of the resource use at the case study site, Cabana Lodge, is presented. Next, cluster analysis is applied to the results of the percentage energy yields of different faunal classes from the seventy-one assemblages presented in Chapter Four. This in turn is used to look for resource use patterns within time and space. These patterns are then compared to earlier models of settlement and resource use in the literature.

6.2 SUBSISTENCE PATTERNS AT CABANA LODGE

The results of the faunal analysis of the assemblages from the case study of Cabana Lodge (T12/3), Whangamata were presented in Chapter Four. These tell us about the species that were important in the subsistence activities and diet of the inhabitants of this 15th century site. However, other excavations have been carried out previously at Cabana Lodge, and an examination of the economy that has previously been outlined for the site provides interesting similarities and parallels with the 2006 assemblage analysed here. Although ethnographic accounts of contact period subsistence practices are not a direct mirror for activities that were undertaken at Cabana Lodge and Whangamata during the 15th century, they do, however, allow some insight and are worth noting.

6.2.1 EXPLOITED ECOLOGICAL ZONES

The Cabana Lodge site (T12/3) is located beside the Whangamata Harbour (Figure 6.1); the littoral environment in the immediate locale of the site includes estuarine, rocky coast and open sand zones; access to the marine environment is nearby, south-east of the site via the harbour mouth; and terrestrial resources are of course available to the south, west and north of the site. While there are no major rivers that enter the harbour, there are minor sources of fresh water; however no identifiable remains of freshwater species (such as eels *Anguilla dieffenbachii* and *A. australis*) are present in the faunal remains.



Figure 6.1 GoogleEarth satellite image of Whangamata, showing the littoral (estuarine harbour, rocks and sandy beaches), marine (open ocean) and terrestrial zones

The faunal resources utilised at Cabana Lodge are divided into three main ecological zones: marine, littoral and terrestrial. Using both %MNI as a proxy for measuring the effort expended gathering resources in each zone, and %energy yield as way of measuring importance in the diet gives us a balanced picture of both daily activities and nutritional value of faunal resources utilised at the Cabana Lodge site (Table 6.1).

Table 6.1 Marine, littoral and terrestrial faunal resource classes by %MNI and %energy yield for Cabana Lodge assemblage Fz L2 and 3

Ecological Zone	Faunal class	% MNI	% Energy Yield
Marine	Fish	1.69	37.90
	Marine Total	**1.69**	**37.90**
Littoral	Shellfish	98.13	0.96
	Mammal	0.05	57.79
	Bird	0.04	0.88
	Littoral total	**98.23**	**59.63**
Terrestrial	Mammal	0.04	2.46
	Bird	0.04	0.01
	Moa	0.00	0.00
	Terrestrial Total	**0.08**	**2.47**
TOTAL		**100.00**	**100.00**

6.2.1.1 *MARINE ENVIRONMENT*

In this analysis, faunal resources from the marine environment consist of one class, fish. The range of fish represented in the main assemblage from Cabana Lodge is broad with eleven

species represented (Table 6.2), but it focuses on mainly one, *Pagrus auratus* (snapper, *tamure*), with a few supplementary species (i.e. *Latridopsis ciliaris* and *Nemadactylus macropterus*); otherwise the remaining species seem to have been taken opportunistically and were not deliberately targeted. The total MNI for the fish assemblage was 178 individuals, or 1.86% of total assemblage MNI. Fish produced 37.90% of the energy yield for the main Cabana Lodge assemblage. These figures indicate that the fishing catch was a significant source of energy.

P. auratus is the overwhelmingly dominant fish species from the main Cabana Lodge assemblage, and contributes over 70% of the total fish energy harvest. It is a demersal (bottom-dwelling) fish, found in a number of marine environments, such as in loose schools above sand or mud floors, but are most commonly found near rocky reef areas (Ayling & Cox 1982; Paul 2000). Smaller *P. auratus* are found in deep water reefs without kelp forests, while larger individuals can be found in rocky reefs covered with sponges and encrusting animals from depths of 25 m to the edge of the continental shelf (Ayling & Cox 1982). *P. auratus* spawn in late spring and summer and are easily caught as they shoal at this time; they tend to migrate for warmer water - in late spring to early autumn the inshore coastal waters are at their warmest, but in winter the coastal offshore waters are warmer (Leach, B.F. 1979). Leach notes that they are commonly taken in medium depth waters over sandy bottoms with baited hooks (1979). Crosby describes 19th century Maori taking *P. auratus* in the surf on sandy beaches with a hook and line; they were also taken with seine nets (1966). Shawcross notes that in the Houhora area *P. auratus* are observed in the harbour in winter months (1967c). These are most likely larger solitary individuals which are known to overwinter inshore. As the main Cabana Lodge assemblage is dominated by *P. auratus*, it is unlikely that these snapper were caught during winter in the Whangamata Harbour, which is when lower numbers would be expected (Leach, B.F. 1979). *P. auratus* readily take a baited hook (Crosby, E.B.V. 1966; Leach, B.F. & Davidson 2000). It is possible that nets such as *matarau* circular hoop nets and *kōrapa* scoop nets would have been used to catch *P. auratus* in rocky areas, where it would have been impractical to use drag nets or seine nets (Paulin 2007).

Table 6.2 Fish species %MNI, niche environment and probable catch method; Cabana Lodge Area Fz Layer 2 and 3

Species	Common name	%MNI	%Energy Harvest	5.1. Habitat	Catch Method
Pagrus auratus	snapper	70.22%	71.76%	rocky reef, sand & mud bottom	baited hook, dragged nets, set nets (Coutts 1975; Leach, B.F. & Davidson 2000)
Latridopsis ciliaris	blue moki	13.48%	18.68%	rocky reef & sand bottom	line (Paul 2000); hook and line (Coutts 1975)
Nemadactylus macropterus	tarakihi	7.30%	4.01%	mud bottom & rocky reef	multiple hook and line, seine and set nets? (Coutts 1975); specialised hook and line (Paul 2000)
Parika scaber	leatherjacket	2.25%	0.60%	rocky reef, sand & mud bottom	set nets? (Coutts 1975; Mann 2009)
Arripis trutta	kahawai	1.69%	2.19%	pelagic (to 50m), sand & mud bottom	lure hook and line, nets, seine nets (Coutts 1975); specialised trolling lures (Paul 2000)
Notolabrus celidotus	spotty	1.69%	1.00%	rocky reef & mud bottom	hook and line, hoop and set nets? (Coutts 1975)
Chelidonichthys kumu	red gurnard	0.56%	0.16%	sand & mud bottom	line and seine net (Paul 2000)
Genyagnus monopterygius	spotted stargazer	0.56%	0.10%	sand & mud bottom	seine nets? (Coutts 1975)
Helicolenus percoides	sea perch	0.56%	0.10%	sand bottom	hook and line? (Coutts 1975)
Zeus faber	john dory	0.56%	0.32%	rocky reef, sand & mud bottom	(no references found)
Carangidae sp.	mackerel ?sp.	0.56%	0.29%	unknown	(no references found)
Gempylidae sp.	snake mackerel ?sp.	0.56%	0.72%	unknown	barracouta - jigged on feather or shell decorated wooden lures (Paul 2000); lure hook and rod (Coutts 1975)
Fish totals		**100.00%**	**100.00%**		

Latridopsis ciliaris (blue moki) is a supplementary species at Cabana Lodge. They are found around New Zealand but are more abundant around the South Island, particularly along the east coast from Banks Peninsula in the South Island to East Cape on the North Island, and dwell on rocky reefs and sandy bottoms from 20 to 100 m in depth (Ayling & Cox 1982; Paul 2000). Only occasionally are large specimens (3-10 kg) seen in the far north (Ayling & Cox 1982). Paul notes that

> …moki were important to early Maori, particularly in the eastern Bay of Plenty and near East Cape, where large quantities were caught seasonally by line, and where it remains a culturally important fish. Considerable knowledge and skill, and special catching techniques were required as moki seldom take a normal baited hook (2000:208).

Modern fishing methods usually involve netting or spearing over reefs or among weed, and also using a light line with a small shellfish bait (Paul 2000). *L. ciliaris* can be caught in quantity with set nets from September to November when they school at the surface during

spawning (Leach, B.F. 1979). Crosby notes that *L. ciliaris* school around Cape Runaway (northern East Cape) in winter, and are taken on large baited hooks (1966). It is unlikely that *L. ciliaris* would have been netted at Whangamata, as they are less abundant north of East Cape, and it is probable that they would have been caught, perhaps opportunistically, on baited hook.

Nemadactylus macropterus (tarakihi) is the other supplementary species in the main Cabana Lodge fish assemblage. They are found around New Zealand, but are most abundant over soft mud bottoms on the East Cape and the east and west coasts of the South Island. Sometimes they are observed swimming near rock reefs over 25 m deep. *N. macropterus* move in shoals and can be taken on deep trolling lures and baited hooks; information on their seasonal abundance is unclear (Crosby, E.B.V. 1966; Leach, B.F. 1979). It is also possible that *N. macropterus* were taken with set nets laid close inshore (Coutts 1975). However, given the low numbers of *N. macropterus* in the Cabana Lodge main assemblage, and its lower abundance generally north of the East Cape, it is more likely that fish were caught with baited line and hook.

Meuschenia scaber (leatherjacket, *kokiri*) occurs in low numbers in the main Cabana Lodge assemblage, and is therefore likely to have been caught opportunistically rather than specifically targeted (Paul 2000). *M. scaber* are found around New Zealand in depths up to 100 m. They generally prefer rock reefs but can be found over sand or mud bottoms (Ayling & Cox 1982). It is possible that, as at Whangaruru in Northland, *M. scaber* were taken during summer in *torehe* nets, which were circular and flat, with a sinker, flexible wooden spreaders and bait (Crosby, E.B.V. 1966). *M. scaber* are noted for their small jaws, which would have made them unlikely to have taken a prehistoric Maori bone fishhook. If not taken by hand-held nets, the alternative method for catching *M. scaber* is by using fish traps, of a similar design to that of crayfish pots made from flax (*Phormium tenax*), mānuka (*Leptospermum scoparium*) and supplejack (*Ripogonum scandens*, kareao, pirita) (Witter 1969b; Law 1972; Coutts 1975).

Arripis trutta (kahawai) is a species of minor importance in the main Cabana Lodge assemblage. *A. trutta* are a common pelagic species around New Zealand; in summer they can occasionally be found in shallow harbours and large river mouths (Crosby, E.B.V. 1966; Paul 2000). They spawn in March and April in warm shallow waters and in winter are found in deeper water offshore, up to 100 m deep (Ayling & Cox 1982). Occasionally *A. trutta* can be

found in the surf of sandy beaches (Paul 2000). *A. trutta* could be taken with seine nets or with a trolled lure which could be towed from a canoe, or used by hand from the shore. On canoes with multiple fisherman, rods were used to keep the lines out of the way of paddlers (Crosby, E.B.V. 1966). In the Bay of Plenty the traditional season for *A. trutta* was February to March, this possibly may have extended up the Coromandel to Whangamata (Crosby, E.B.V. 1966). As the numbers for *A. trutta* in the assemblage are so low, it is not likely that they were taken in seine nets (which presumably produce large catch numbers). They may have instead been caught with unbaited trolled lures, or with a baited hook (Crosby, E.B.V. 1966; Leach, B.F. 1979).

Notolabrus celidotus (spotty, *paketi, pākirikiri, tāngahangaha, kopukopu, tāngāngā*) is also a minor species in the Cabana Lodge assemblage (Leach, B.F. 2006). They are common around New Zealand, in waters less than 30 m deep, and are particularly abundant in harbours and estuaries, and are also numerous on reefs on open coasts in waters less than 30 m deep, but in greater concentrations at turbid weedy depths to 12 m (Leach, B.F. & Anderson 1979; Ayling & Cox 1982; Paul 2000; Leach, B.F. 2006). They are also found in open coastal waters to depths of 30 m, usually in the upper 10 m (Ayling & Cox 1982). *N. celidotus* are active during daylight hours but at night hide in crevices (Leach, B.F. 2006); they readily take a baited (modern) jabbing hook and can be caught all year round (Leach, B.F. & Anderson 1979). They have small mouths and would have required very small hooks to have been caught by traditional hook and line; they are only rarely caught on rotating hooks of the kind prehistoric Maori used (Leach, B.F. & Anderson 1979). *N. celidotus* would have been more likely caught by set nets laid close to shore in harbours or weedy reefs (Coutts 1975; Leach, B.F. & Anderson 1979). It has been noted that sites with proportions of labrids (i.e. the Labridae family or wrasses, including *N. celidotus, Notolabrus fucicola* and *Pseudolabrus miles*) greater than 5% of MNI probably indicate a preference for inshore fishing when unfavourable sea conditions made it difficult to utilise canoes for deeper water fishing (Leach, B.F. & Anderson 1979; Leach, B.F. 2006). Further, assemblages with high proportions of labrids probably indicate that site inhabitants were under economic strain when they were restricted from deep water fishing (Leach, B.F. & Anderson 1979). However, the low proportion of *N. celidotus* in the Cabana Lodge fish assemblage does not make this a likely scenario at the Whangamata Harbour mouth.

Yet another species of minor importance in the fish assemblage, *Chelidonichthys kumu* (red gurnard) occurs around New Zealand at all depths down to 180 m on mud and sandy bottoms, and are also found near reefs, and in summer are abundant in harbours. They are caught in medium depth water with baited hooks, and are reported to be dominant in catches from August through to October in the Bay of Plenty (Crosby, E.B.V. 1966; Leach, B.F. 1979; Ayling & Cox 1982). *C. kumu* can also be taken with seine nets (Paul 2000). Due to the low proportion of *C. kumu* in the main Cabana Lodge assemblage, it is likely that it was not targeted and therefore more likely to have been taken opportunistically on hook and line while fishing for other species. *C. kumu* can be caught by surf casting from beaches or bottom fishing in sandy bays, and take a variety of baits (Paul 2000).

Genyagnus monopterygius (spotted stargazer) are found around New Zealand in depths of a few metres down to 100 m on the continental shelf, usually completely concealed in sand or mud; they are also seen above the water level at low tide (Ayling & Cox 1982:272; Forster & Starling 1982; Paulin, Stewart et al. 2001). They are occasionally found buried in fine muddy sand in harbours (Grace, R.V. 1971; Roberts & Stewart 2006). It is likely that prehistoric Maori took *G. monopterygius* in shallow bays; they can be trawled or taken by beach seine (Paul 2000). *G. monopterygius* are generally not common in archaeological fish assemblages; it is possible that the individual in the main Cabana Lodge assemblage was taken by accident with hook and line, or seine net.

Helicolenus percoides (sea perch) is found around New Zealand, but is more common off the east coast of the South Island (Leach, B.F. 1979; Ayling & Cox 1982; Paul & Horn 2009). They live on the continental shelf and slope in depths from 5 to 1000 m, but are more common between 100-700 m over open sand (Ayling & Cox 1982; Paul & Horn 2009). They are frequently caught near reefs by anglers, and are common in rocky areas down to depths of 50 m (Paul 2000). *H. percoides* take large baited hooks and are often taken while cod fishing (Coutts 1975; Leach, B.F. 1979:119). They can also be taken with set nets (Coutts 1975). It is possible the one individual *H. percoides* in the main Cabana Lodge assemblage was taken while netting or caught on hook and line inadvertently while fishing for targeted species.

There was only one *Zeus faber* (John dory) individual in the main Cabana Lodge assemblage. These fish are present around most of New Zealand, but are more abundant in the north, particularly from Bay of Plenty northwards, in waters in depths of 20 to 150 m. They are demersal and can be found along reefs and on open sand or mud bottoms (Ayling & Cox

1982; Paul 2000). In winter *Z. faber* move into shallower water; they are slow moving fish and are often caught on a hook and line when they have swallowed another fish whole, already caught on the hook (Ayling & Cox 1982). Because there is only one individual of this species in the assemblage, it is likely that *Z. faber* was not deliberately targeted at Cabana Lodge, and the fish was caught on a hook and line by accident.

There are three species of the Carangidae (jack mackerels) family in New Zealand which are visually similar both alive and in archaeological fish assemblages: *Trachurus novaezelandiae* (horse mackerel, *hature*), *T. declivis* (jack mackerel), *T. murphyi* (slender mackerel) and also the closely related *Decapterus koheru* (koheru). They are generally pelagic species, found at depths down to 300 m, around New Zealand. *T. novaezelandiae* is usually more common in the north-east, occurs in large schools, is said to enter bays and harbours and spawn during summer over the central shelf (Crosby, E.B.V. 1966; Paul 2000). *T. novaezelandiae* can be caught with a lure when it shoals on the water surface, as well as in deep water (Leach, B.F. 1979). *T. declivis* is more common in deeper waters along the western and central coasts. Like *T. novaezelandiae, T. declivis* swim in large schools and spawn during summer over the central shelf. Not much is known about *T. murphyi* (Ayling & Cox 1982; Paul 2000). *D. koheru* is restricted between North Cape and East Cape in northern New Zealand (Ayling & Cox 1982). They are an inshore pelagic species usually found over rocky reefs rather than open water. *D. koheru* are not as common as *T. declivis*, but regularly school around coastal reefs (Paul 2000). Usually large schools of smaller individuals swim near sea cliffs and rock reefs, along the bottom, while the larger fish are seen as fast swimming schools further from shore (Ayling & Cox 1982:217). It is likely that prehistoric Maori would also have taken *D. koheru* in seine nets (Crosby, E.B.V. 1966). It is probable that at least two of the *Trachurus* species could have been caught in large seine nets by prehistoric Maori (Paul 2000). It is possible that *T. novaezelandiae* and/or *T. declivis* could have been caught in the Whangamata Harbour with seine nets, but as Carangidae are such a minor proportion of the assemblage, it is more likely that they were caught opportunistically with a short rod, line and hook (Crosby, E.B.V. 1966).

One individual from the Gempylidae, or snake mackerel family, possibly *Thyrsites atun* (barracouta, *mangā*) or *Rexea solandri* (gemfish) is represented in the main assemblage from Cabana Lodge (Leach, B.F. 2006). Gempylidae are pelagic or semi-pelagic; there are seven species of the family in New Zealand waters, but most fishermen are only familiar with

barracouta and gemfish (Paul 2000). More is known about barracouta than gemfish so the former will be discussed here. *Thyrsites atun*, while found widely around New Zealand, is more common south of Cook Strait, but is also found in many northern areas. Leach notes that while *T. atun* is not represented in amounts higher than 20% of MNI in North Island archaeological fish assemblages, it is more abundant in assemblages north of Tauranga (2006). *T. atun* frequent surface waters as feeding schools, or as small groups in harbours and reefs. Spawning grounds include the Bay of Plenty, and possibly other areas in north-eastern New Zealand; spawning occurs from late winter though to autumn (Paul 2000). Historic accounts of Maori fishing for *T. atun* record a hook being trolled on the water surface with a short line, attached to a pole (Crosby, E.B.V. 1966). The hook used was probably the *pohau mangā,* a piece of wood with a bone point, often made from a dog mandible, set into the end (Leach, B.F. 2006). Sometimes the hook was decorated with shell or feathers (Paul 2000). A canoe would typically move with the school, as rods and lures were swept and thrashed on the water, and the fish would be caught rapidly and lifted aboard in quick succession (Paul 2000). *Pohau mangā* may have been used to take other surface fish (Crosby, E.B.V. 1966). *T. atun* may also have been taken with *pā kahawai*, shell-lined lures which were purpose made for taking *A. trutta* (Leach, B.F. 2006). However, the sharp teeth of the barracouta would have done great damage to the lashings of a *pā kahawai* (Crosby, E.B.V. 1966). Although *T. atun* are found in harbours, they also frequent reefs in small groups, and may have been caught at the rocks of the Whangamata Harbour mouth (Paul 2000). While Gempylidae, specifically *T. atun*, can be caught in harbours and reefs, schools of *T. atun* also range from close inshore to the shelf edge at 200 m depth, and sometimes beyond (Paul 2000).

6.2.1.2 *LITTORAL ENVIRONMENT*

The littoral environment encompasses the shore estuarine, rock and sandy beaches zones. Faunal resources from these zones include shellfish (Table 6.3), sea mammals (specifically seals) and marine birds.

The Whangamata Harbour estuarine environment includes a combination of mudflats and sandflats, which are typical environments for the main shellfish species in the Cabana Lodge assemblage, *Austrovenus stutchburyi* (cockle, *tuangi, tuaki*) and *Paphies australis* (pipi). *A. stutchburyi* are often the dominant bivalve in mudflats at mid-tide level, and can reach sizes of up to 6 cm, though they are usually much smaller. They form dense beds and are shallow burrowers (Crowe 1999; Paul 2000). *P. australis* are found in muddy and sandy shores and

live buried just below mid-tide, on silty sandbars or sandy beaches just inside harbour entrances, and small beds are sometimes located near river mouths. Their average size is 4-6 cm, though some measure up to 8 cm. *P. australis* do not bury deeply and are sometimes partially exposed; they have short siphons (Crowe 1999; Paul 2000).

Table 6.3 Cabana Lodge shellfish %MNI, % energy harvest and habitat

Taxon	Common Name	%MNI	%Energy Harvest	Habitat
Austrovenus stutchburyi	cockle	50.82	51.30	mudflat
Paphies australis	pipi	34.34	16.53	mud/sand
Turbo smaragdus	cats eye	5.39	20.18	rocky
Paphies sp.	Paphies sp.	4.99	4.67	sandy
Paphies subtriangulata	tuatua	1.44	3.71	sandy
bivalve sp.	bivalve sp.	0.89	0.84	unknown
gastropod sp.	gastropod sp.	0.70	0.66	unknown
Nerita melanotragus	black nerita	0.31	0.29	rocky
whelk sp.	whelk sp.	0.27	0.25	unknown
Struthiolaria sp.	ostrich foot sp.	0.19	0.38	mud/sand
Amalda australis	southern olive shell	0.13	0.12	sandy
Penion sulcatus	siphon whelk	0.10	0.27	rocky
limpet sp.	limpet sp.	0.09	0.08	rocky
Mytilidae sp.	mussel sp.	0.09	0.08	rocky
Cominella adspersa	speckled whelk	0.06	0.12	mudflat
Maoricrypta costata	ribbed slipper shell	0.06	0.12	rocky
Amphibola crenata	mudsnail	0.04	0.04	mudflat
Cookia sulcata	cooks turban	0.02	0.04	rocky
Austrofusus glans	knobbed whelk shell	0.02	0.30	sandy
Pratulum pulchellum	strawberry cockle	0.01	0.01	deep water
Zeacumantus lutulentus?	horn shell?	0.01	0.01	mudflat
Sigaptella novaezelandiae	circular slipper shell	0.01	0.02	rocky
Struthiolaria vermis	small ostrich foot	0.01	0.01	sandy
Totals		**100.00**	**100.00**	

The shellfish class contributed only 0.96% of the total energy harvest for the assemblage, while making up 98.04% of assemblage MNI, indicating that while shellfish was a low-return faunal resource in terms of energy, it was used as a staple supplement in the diet. Shellfish from the mudflat and mud/sand zones give a combined total of 85% of MNI (Table 6.4).

The north side of the Whangamata Harbour mouth provided the inhabitants of the Cabana Lodge site (T12/3) with access to rocky coast resources. Rocky shore shellfish species make up only 6.06% of shellfish MNI indicating that generally-speaking, little time was spent there gathering shellfish. Out of the rocky shore shellfish species, *Lunella smaragdus* (cats eye, *ataata*, *pupu*) which is found on intertidal rocks, was the most common (Crowe 1999).

Table 6.4 Cabana Lodge shellfish %MNI and habitat classes

shellfish habitat	%MNI	%Energy Harvest
mudflat	50.94	51.47
mud/sand	34.54	16.91
sandy	6.59	8.81
rocky	6.06	21.08
unknown	1.86	1.75
deep water	0.01	0.01
TOTAL	**100.00**	**100.00**

The rocks at the Whangamata Harbour mouth also provide the nearest location to the Cabana Lodge site where cropping of *Arctocephalus forsteri* (New Zealand fur seal, *kekeno*) would have occurred. The remains of two juvenile (unknown sex), two adult female and two adult male fur seals are present. The species is found on rocky coastlines of New Zealand from Three Kings Islands in the north, to Macquarie Island in the south, a range of ca. 2700 km, as well as in Western and Southern Australia (King 2005). Usually *A. forsteri* are encountered at rookeries (breeding colonies) or hauling grounds (non-breeding colonies), and occasionally individuals haul out by themselves (Smith, I.W.G. 2005). The *A. forsteri* breeding season runs from November to January, when most are restricted to the breeding colony. From late October onwards, males start to congregate at rookeries, in order to establish their breeding territories; not long after adult females return from feeding at sea and begin pupping. Non-breeding animals gather at nearby hauling grounds. In mid- to late December most pups are born; mating usually occurs by mid-January. From this time on adult females start to feed at sea and adult males leave the rookeries. Outside of the breeding season, adult females and pups stay within the breeding range; females forage close to the rookeries as they suckle their pups for up to 10 months. In the non-breeding season adult males scatter to hauling grounds beyond the breeding range, along with sub-adult males and some juveniles. Between the end of July and early October the pups are weaned, and usually remain at the rookeries until late November. Fur seals have a strong diurnal rhythm; they generally rest or sleep during daylight hours, and do most of their foraging at night-time feeding upon various pelagic cephalopod and teleost fish species. There is marked sexual dimorphism with *A. forsteri*, the adult females rarely exceed 50 kg, while adult males can reach up to 185 kg (Smith, I.W.G. 2005). With regards to prehistoric Maori hunting of *A. forsteri*, Smith notes

> In the northern North Island, securely dated evidence of regular cropping is confined to the late 13th or 14th centuries, coinciding with the presence of breeding colonies. Opportunistic encounter hunting was also evident at smaller or more specialised sites of the same age and appears to have persisted for about a century

> after the demise of northern breeding populations, but after c. 1,500AD fur seals completely disappear from the northern archaeological record (Smith, I.W.G. 2005:10).

During the prehistoric period, two major exploitation strategies were employed in the hunting of *A. forsteri*. Opportunistic *encounter hunting* is evident at archaeological sites where *A. forsteri* MNI is low (typically MNI≤2) and the sites are located at least 10 km from the nearest rocky shore. The sites often have generalised faunal assemblages or are focused on shellfishing or fishing. The skeletal elements of *A. forsteri* present in these sites include those from low and high meat utility units indicating that the fur seals had been captured nearby during a chance encounter with an individual. Sites where *regular cropping* is in evidence have higher MNI values for fur seals, but also usually have generalised faunal assemblages, and are located within a few kilometres of regularly occupied fur seal colonies. In sites where regular cropping took place, skeletal elements usually represent high meat utility units as low meat utility units were abandoned at the butchery sites, with the exception of small animals which were transported back to the main site whole.

The *A. forsteri* elements identified by age and sex are listed in Table 6.5. The elements identified as belonging to adult females are from fore (ulna, radius) and rear (femur) limbs and the pelvis, while the elements from the adult male are digits (metacarpals, phalanx). The elements identified as belonging to juveniles are from the fore limbs (radius) and pelvis. Other elements which could not be assigned to age or gender are from the torso (scapulae, ribs, vertebrae, pelvis) and the skull (teeth). The MNI total of 5 and the range of skeletal elements present at Cabana Lodge indicate the occupants there utilised the *regular cropping* foraging strategy for hunting fur seals. The five *A. forsteri* individuals represent almost 60% of the energy yield, but only 0.05% of the Cabana main assemblage MNI.

The open beach to the south of the Cabana Lodge site provided only a minor contribution to the MNI, with 6.59% of the shellfish assemblage MNI. *Paphies subtriangulata* (tuatua) was the most common shellfish from the sandy beach environment. They are found on open sandy beaches at intertidal or lower tide levels (Crowe 1999; Paul 2000).

The sandy beach to the south is the most likely place that the occupants of Cabana Lodge site would have encountered *Eudyptula minor* (little blue penguin, *korora*). *E. minor* spend a large amount of time at sea, but from August return to land to breed, usually in burrows, caves or

under driftwood, nesting near the coast. Sometimes they travel a kilometre or more inland and also climb steep cliff faces. In December the birds come ashore again to moult; they cannot eat or swim for two weeks (Crowe 2001). In the north, two white eggs are laid between July and January; both sexes incubate for 33-40 days (Moon 1996). *Larus novaehollandiae scopulinus* (red-billed gull, *akiaki*, *tarapunga*) are common around New Zealand, in large flocks on or near the coast, in coastal cities and occasionally further inland. Colonies of up to 6000 pairs sometimes nest on sand spits and beaches, but they are more likely to nest in smaller colonies on headlands and remote offshore islands (Crowe 2001). Two brown eggs are laid between September and December, with both sexes incubating for 24-26 days (Moon 1996). *Puffinus griseus* (sooty shearwater, *titi*) is common around New Zealand waters, particularly around Stewart Island. This species is seen as the main muttonbird species targeted by Maori; they nest in burrows on numerous offshore islands, as well as on Banks and Otago Peninsulas. Single, white eggs are laid in late November and both sexes incubate the egg for 52 days on average. After breeding, many migrate to the North Pacific (Moon 1996).

Table 6.5 *Arctocephalus forsteri* skeletal portions by age/sex, Cabana Lodge Area Fz Layers 2 & 3

Age/Sex	Element	Side	Portion	NISP	MNE
adult female	pelvis	L	part acetabulum +ilium frag	1	1
adult female	ulna	L	PS-MS	1	1
adult female	femur	L	C**	1	1
adult female	pelvis	R	acetabulum	1	1
adult female	radius	R	C**	1	1
adult female	radius	R	P*-DS	1	1
adult female	ulna	R	MS	1	1
adult male	metacarpal1	L	MS-D	1	1
adult male	metatarsal 2	R	P+M	1	1
adult male	metatarsal 5	L	C	1	1
adult male	phalanx 1st	R	C	1	1
adult unknown sex	metacarpal1	L	DS-DS	1	1
juvenile unknown sex	radius	L	P*-DS	1	1
juvenile female	pelvis	L	ilium	1	1
juvenile female	radius	L	C**	1	1
?	pelvis	L	Ilium frag + acetabulum frag	1	1
?	ribs	?	C**	1	1
?	scapula	L	>1/2	3	1
?	scapula	R	>1/2	2	1
?	tooth-canine	?	C	1	1
?	tooth-lower canine	?	C	1	1
?	tooth-post canine	?	C	1	1
?	tooth-post canine	?	C	1	1
?	tooth-post canine	?	C	1	1
?	tooth-post canine	?	frag	1	0
?	tooth-upper 3rd incisor	?	C	1	1
?	tooth-upper incisor	?	C	1	1
?	vertebra	A	>1/2	1	1
?	vertebra-axis	A	>1/2	1	1
?	vertebra-cervical	A	>1/2	1	1
?	vertebra-cervical1	A	C	1	1
?	vertebra-lumbar	A	>1/2	1	1
?	vertebra-thoracic	A	C	1	1
?	vertebra-thoracic	A	C**	1	1
?	vertebra-thoracic	A	C**	1	1
?	vertebra-thoracic	A	C**	1	1
?	vertebra-thoracic	A	centrum**	1	1
TOTAL				40	36

6.2.1.3 *TERRESTRIAL ENVIRONMENT*

The terrestrial environment is in the immediate vicinity of the Cabana Lodge site, and extends to the west. Resources in this zone include forest, wetland and open country birds, dogs, rats and moa.

Only one species was identified in the terrestrial bird class in the main Cabana Lodge assemblage, *Halcyon sancta vagans* (New Zealand kingfisher, *kotare*). This species is New Zealand's only native kingfisher, and is more common in the North Island than in the South Island. It is found in a wide range of habitats including open forest, along the shores of estuaries, farmland, near rivers and lakes, near the high tide line on sandy beaches and also along rocky shores. *H. sancta vagans* migrate to coastal areas during the winter (Moon 1996). For a nest, they fly head-first into rotten trees or banks and create an upward-inclining tunnel and chamber, where 4-5 white eggs are laid between November and January (Kelly, C.T. 1982; Moon 1996; Crowe 2001). Crowe reports that "Maori rarely ate kingfishers, for the lizards they eat represent death. This may also explain why the birds' beautiful blue feathers were not generally used to decorate clothing" (2001:55). Unfortunately, Crowe does not reference this information regarding Maori use of the species so it is difficult to treat this as an authoritative and reliable source.

Two species were identified in the terrestrial mammal class from the Cabana Lodge main assemblage, *Canis familiaris* (Polynesian dog, *kuri*) and *Rattus exulans* (Polynesian rat, *kiore*). One subadult and one adult dog and two rats were identified.

In addition to some Pacific Islands (Tonga, the Tuamotus, Society and Hawaiian Islands), *C. familiaris* were present on the three main New Zealand islands, as well as small offshore islands including Raoul, D'Urville and Great Barrier, but not the Chatham or subantarctic islands (Clark, G.R. 2005). *C. familiaris* are not present in the fossil record prior to the arrival of humans in New Zealand; the first Polynesian colonists introduced *C. familiaris* from the tropical Pacific. They were the only domesticate of pre-European Maori, and their habitat would have been shared with their human masters throughout New Zealand. It is unclear if feral populations existed alongside those bred and culled for meat and skins by their human owners.

During prehistory *Rattus exulans* (Polynesian rat, *kiore*) were found in a variety of habitats including grasslands, shrublands and forests throughout the three main islands and many

offshore islands, as well as several outlying islands (Atkinson & Towns 2005). It is reported, based on ethnographic accounts of the 19th century (Wilson, D.C. 1878; Downes 1926; Best, E. 1942) that Maori trapped *R. exulans* extensively for food, using either snares made out of *Ripogonum scandens* in spring, or pit traps (1.2 - 1.5 m deep) baited with berries. Near the end of the trapping season in August, *R. exulans* generally moved from forests to scrub and fernland; sometimes shorter vegetation was burnt and *R. exulans* were removed from holes in the ground. They were plucked of their fur and cooked (in an *umu* or steam oven) and either eaten immediately or packed in gourd-vessels or kelp bags, with their own fat (Atkinson & Towns 2005).

6.2.1.4 *SUMMARY*

It appears that most time was spent hunting and gathering resources in the littoral zone, with 98.23% of total assemblage MNI; the littoral zone also produced the largest proportion of energy at almost 60% of total energy yield. While shellfish gathering took up the largest amount of time with over 98% of the MNI in the littoral zone, it actually provided very little energy in comparison (less than 1% of total assemblage energy yield). On the other hand very little time was spent hunting littoral zone mammal (0.05% of assemblage MNI) yet it contributed most of the energy in the littoral zone at almost 58% of total assemblage energy yield, and therefore was hugely significant in the diet. Little time was spent catching littoral zone birds and they were not important in the diet.

The next most important ecological zone for the inhabitants of Cabana Lodge was the marine zone. This consists of only one faunal class, fish. Relative to the littoral zone, little time was spent in the marine zone fishing, with fish contributing only 1.69% of total assemblage MNI. However, the fish were a significant source of energy in the diet, providing almost 38% of total energy yield.

The terrestrial zone was the least significant source of fauna in the diet for the people living at Cabana Lodge. Little time was spent on hunting terrestrial zone mammals (0.04% MNI) and they were not significant in the diet either (at 2.46% of total assemblage energy yield). While an equally small amount of time was spent on catching terrestrial birds, they were even less important in the diet (at 0.01% of total assemblage energy yield). No economic moa remains were recovered from the Gumbley and Hoffmann assemblage; they may have been present in other parts of the site that have previously been damaged or remains unexcavated. North

Island densities of moa are known to have been lower than that of the South Island, and it is likely that moa in the area were initially hunted until resource depression resulted in them becoming effectively extinct at the local level.

The overall picture of ecological zone use shows that the littoral and marine zones were both sources of low-time and -energy expenditure hunting activities, with high energy return results; the littoral zone provided a stable resource that required larger time and energy inputs for significantly lower energy returns. While fishing and seal hunting would have been dependent on weather and sea conditions in the marine zone, and opportunity in the littoral zone, usually undertaken by individuals or smaller groups of people, shellfishing could be undertaken in most conditions and by large groups of people. These three resource activities and the fauna they harvested provided the mainstay of the energy (and no doubtedly protein and fat) in diet of the late fourteenth century inhabitants at Cabana Lodge.

6.2.2 Previous Analyses of Faunal Resource Use at Cabana Lodge and Whangamata Wharf

As mentioned earlier, the issue of selective sampling of the faunal remains (necessitated by the proposed development at Cabana Lodge), is attempted to be overcome by discussing the results of previous faunal analyses from T12/2 and T12/3. This may not be a perfect solution, but inevitably, unless an entire archaeological deposit is completely excavated and analysed, there is always a chance that the areas where faunal samples are taken from may not represent all subsistence activities undertaken. Best practice favours leaving archaeological sites intact (when this option is available and appropriate) so that future developments in excavation, technology and analytical method may be applied. Additionally, few excavations of substantial hamlets, villages or kainga have the luxury of thorough and complete sampling and investigation. Hence, there is usually a tension between the primary reason for excavation (cultural resource management or academic research), the size of the archaeological site, the budget, time and staff available and how much of the site has previously been damaged or destroyed. The potential sampling biases that may be present in this data are not easily overcome, but nor are they uncommon across much archaeological faunal analysis data.

There is one small assemblage from Cabana Lodge excavated by Wilfred Shawcross in 1963 (Shawcross 1964b) and a more substantial assemblage excavated by Allo in 1969 (Allo 1972). In the Shawcross assemblage, which was stored at the Auckland Museum, Gumbley and

Hoffman noted that cockles (*Austrovenus stutchburyi*), cooks turban (pupu karikawa, *Cookia sulcata*), ostrich foot (totorere, *Struthiolaria papulosa*) and white rock shell (hopetea, *Dicathais orbita*) were the predominant species (2008). The assemblage has not been quantified by weight or MNI, but it is apparent that while the estuarine species *A. stutchburyi* was common, the rocky shore species (*C. sulcata* and *D. orbita)* and sandy beach species (*S. papulosa*) were not. Allo's analysis of shellfish use at Cabana Lodge involved a 300 kg sample of midden, where only whole shells or those with a hinge were sorted into species. The three most important species were *A. stutchburyi*, *P. australis* and *P. subtriangulata*. Allo used the weight of sorted shell to calculate meatweight, based on Shawcross' proportion of meatweight to shell weight at approximately 32.5% (1967c), included unspecified gastropods, and calculated a total meatweight for shellfish of 96.76 kg (Allo 1972). This approach to meatweight calculation is no longer favoured in modern methods of faunal analysis, as shells are subject to many taphonomic variables which can affect weight.

The assemblage excavated by Allo had low numbers of fish, with a total MNI of six. These included three *P. auratus*, one *Pseudocaranx dentex* (trevally, *araara*), one *Nemadactylus douglasii* (porae) and one individual of unidentified species, the latter two of which are additional to those identified in the present study. *P. dentex* is a member of the Carangidae or jack mackerel family (discussed in Section 6.2.1.1). They are pelagic fish seen in northern waters around New Zealand, but are most abundant around the north-east and north-west coasts of the North Island to depths of 80 m. They range across different habitats, including shallow harbours, exposed surface waters over the central shelf and near reefs. *P. dentex* in the range of 15 to 40 cm in length often school in coastal waters, feeding from sand or mud bottoms. Specimens over 40 cm in length form large schools at the surface, around offshore islands and pinnacles on the east coast of the North Island (Ayling & Cox 1982; Paul 2000). *N. douglasii* belong to the same family as *N. macropterus*, Cheilodactylidae, sharing the same genus. They are generally found in warmer waters from East Cape to North Cape. They are demersal fish, feeding on sandy bottoms, most abundantly near rocky reefs in depths of 20 to 60 m, and are also often seen over rocky reefs. *N. douglasii* take a bait easily (Ayling & Cox 1982; Paul 2000). *P. dentex* and *N. douglasii* are not as well documented in archaeological fish catches as *P. auratus*, *L. ciliaris* or *N. macropterus*, but it seems likely that *P. dentex* could have been caught in the Whangamata Harbour and *N. douglasii* near the rocks at the harbour mouth, or in open water. Allo calculated an approximate value for total fish meatweight of 8.6kg (1972). Gumbley and Hoffmann note that the Shawcross assemblage

includes a substantial amount of fish bone, a large proportion of which is *P. auratus*, but no MNI values are available for the complete assemblage (2008).

Allo's assemblage included seven species of bird, including three shags (Phalacrocoracidae sp.), one duck (Anatidae sp.), one kiwi (*Apteryx* sp.), one tui (*Prosthemadera novaeseelandiae*), one white heron (*Egretta alba modesta*) and one little blue penguin (*E. minor).* These gave a total meatweight of 8.68 kg. One juvenile moa, (possibly *Euryapteryx gravis*) was also identified, with a meatweight of 15.00 kg. Allo identified two *A. forsteri* in her assemblage, which were the largest source of edible meat; her calculations do not specify age or sex but give a total of 252 kg of edible weight (1972). The Allo assemblage is notable for having an MNI of 17 *C. familiaris*, giving a meatweight of 102.5 kg. *C. familiaris* bone is present in the stored Shawcross assemblage (Gumbley & Hoffmann 2008). The Allo assemblage yielded 0.24 kg of meat from *R. exulans*.

Evidence of marine bird resource use is limited to *E. minor*, *L. novaehollandiae scopulinus* and *P. griseus*. The former would have been easy targets, coming ashore in the evenings. Only the remains of one terrestrial bird from the prehistoric period were recovered, that of *H. sancta vagans*. This bird is found in coastal areas during winter. The feathers of the *E. minor* and the *H. sancta vagans* may have been used on *pā kahawai* lures at Cabana Lodge. The bird meatweight in the Gumbley and Hoffmann assemblage came to 2.3255 kg. No diagnostic moa bones were identified in the Gumbley and Hoffmann assemblage.

Only one species of marine mammal is identified in the faunal remains from Cabana Lodge, that of *A. forsteri*. The rocky coastline to the south-east of the site would have been a convenient location for regular cropping of fur seals. Gumbley and Hoffmann's main assemblage included two juvenile, two adult female and one adult male of A. *forsteri,* giving a meatweight total of 183.26 kg, or 38.41% of the assemblage total.

C. familiaris and *R. exulans* were present in the assemblage, but are not restricted by season or environment. *C. familiaris* would likely have been bred and managed for hunting and as a source of meat (Clark, G.R. 1997); while Best (1942:447) reported that *R. exulans* were considered a valuable food source by Maori, who set traps for them along trails or near where trees dropped their fruit. *C. familiaris* yielded a meatweight of 16.0kg (or 3.35% of the total) from the Gumbley and Hoffmann assemblage; the same assemblage yielded 0.2 kg for *R. exulans* meatweight (1972).

6.2.3 SUBSISTENCE ARTEFACTS AND METHODS AT CABANA LODGE

While reviewing the subsistence focus of the prehistoric inhabitants of the Cabana Lodge site, it is useful to review artefacts recovered from both the T12/3 and T12/2 sites that were used in hunting and gathering activities.

Artefacts recovered from Allo's excavation included a one-piece fish-hook in pieces, described as having a "flat-topped backward pointing head" (Allo 1972:64; Gumbley & Hoffmann 2008). Two tabs of whale bone, probably in the early stages of fishhook manufacture, were not associated with the prehistoric midden but the later 19th century deposit. Allo reported the blade of an adze rough-out and the butt of a larger adze, and a number of obsidian flakes associated with scattered dog bones, but no further artefacts associated with fishing (1972).

In Gumbley and Hoffmann's preliminary excavation report, they recorded that Area F (including the area Fz, where the main Cabana Lodge assemblage is from) yielded a total of 4000 artefacts, including one-piece bone fishhooks and related pieces, tabs and cores from fishhook manufacture, bone or ivory lure hook points (i.e. from two-piece hooks with wooden shanks), two broken bone hook shanks and one stone lure shank. Most of the artefacts came from the midden layer (Layer 2), and in particular this is where almost all of the fishing kit came from (Gumbley & Hoffmann 2008). Further analysis on the artefacts is yet to be undertaken (Gumbley pers. com.).

Generally speaking, archaeological analysis has established that in early Maori prehistory, fishhooks were more commonly one-piece (Furey 1996), or lures with stone shanks and simple non-barbed points ('minnow lures') (Hjarno 1967). Stone or shell shanks that were triangular or rounded are similar to early Polynesian-style hooks found elsewhere in the Pacific, and are typical of early Maori prehistoric assemblages (Davidson 1984b; Anderson & Gumbley 1996; Paulin 2007:32-3). In northern New Zealand, rounded shanks were more common than triangular shanks (Paulin 2007:33). Traditional suspended *matau* hooks were used for catching demersal or bottom-dwelling fish, while pelagic or surface-dwelling fish were caught with trolled lures such as *pā kahawai* (for kahawai) and *pohau mangā* (for barracouta); stone and shell 'gorges' (a sharp piece of bone on a line which catches in a fish's throat when pulled) were also used (Paulin 2007). Rods were generally only used for *pā kahawai* and *pohau mangā;* otherwise baited hooks were used on hand lines (Paulin 2007). Instead of using bait, *pā kahawai* were decorated with feathers from *korora* (blue penguin,

Eudyptula minor), *kotare* (kingfisher, *Halcyon sancta*) and kiwi (*Apteryx* spp.). *Pohau mangā* were straight, and simple, constructed of long pieces of reddish wood such as *tawhai* (southern beech, *Northofagus* spp.) or rimu (*Dacrydium cupressinum*). These could withstand the sharp teeth of the barracouta, which would have easily cut flax lashings. Decorated with tufts of feathers, a single bone barb was embedded at the distal end of the lure of the *pohau mangā* (Paulin 2007).

The artefacts associated with fishing in the various Cabana Lodge assemblages indicate use of *matau* hooks for bottom-dwelling fish and also trolled lures for pelagic fish such as barracouta and kahawai. It appears that no stone sinkers associated with nets have been found in any of the three investigations at Cabana Lodge and Whangamata Wharf. Early European observations of Maori fishing noted that nets were much more important than hook and line fishing; many nets were impressive in their size and most of the community were involved in their production, from undressed and dressed *harakeke* (flax, *Phormium tenax*) and *kiekie* (*Freycinetia banksii*). As well as large *kaharoa* (seine nets up to 1.6 km in length), *matarau* (simple hoop nets which were baited, sunk with stones and then drawn up vertically, in rocky areas), *kōrapa* (scoop nets that were worked sideways with a rigid wooden handle, also in rocky areas), *hīnaki* (set nets or traps left in streams or channels), *ahuriri* or *ririkai* (large funnel-shaped nets measuring up to 25m long, used in tidal rivers and frequently caught up to 1000lb of fish) were other types of nets used in specific environments (Paulin 2007). The only physical remains of these nets that would survive would be stone sinkers; the *harakeke* and *kiekie* net, lashings and wooden components are unlikely to be preserved (Paulin 2007:24).

Although there is absence of evidence of netting at Cabana Lodge and Whangamata Wharf, this should not be taken as 'evidence of absence' of this fishing technique – the three main artefact assemblages have yielded quite different ranges of artefacts, with Allo's presenting a lack of fishing gear but a substantial amount of obsidian flakes (1972), while the Gumbley-Hoffmann assemblage yielded substantially more fishing gear (2008). This indicates that within the large extent of site there are areas of variable function, containing different types of features, artefacts and faunal remains. No other artefacts indicative of specific hunting, gathering, butchering or food processing techniques have been noted in the reporting for any of the three assemblages.

6.2.4 CABANA LODGE: CONCLUSIONS

Integrating the results of the Gumbley-Hoffman assemblage analysis with those of the Allo (1972) assemblage, together with artefacts associated with fishing, establishes a case for intensive fishing and dog-rearing, and opportunistic culling of fur seals. A variety of fish, including the dominant species, *P. auratus*, were available in the immediately accessible harbour; they could be netted or caught with hooks. The dominant shellfish species, *A. stutchburyi*, and *P. australis*, were from the muddy harbour; other shellfish and fish could also be collected, the latter caught in small nets or on hook and line on the rocks at the north side of the Whangamata Harbour mouth. Finally, the open coast, fine-sand beach to the south provided further access to *P. subtriangulata* and other shellfish, pelagic fish and marine birds. Terrestrial birds were seemingly unimportant as a dietary resource; indeed the focus on terrestrial resources clearly lies on *C. familiaris* as a source of food and hunting companions. Moa remains were sparse, and only further excavation of different areas of the Cabana Lodge could clarify if they were actually more important than the Allo and Gumbley-Hoffmann assemblages indicate. It is apparent that moa bones were definitely used in fishhook manufacture at Cabana Lodge.

It must be underlined that the Auckland Museum collection was not the result of rigorous sampling – it contains surface collections in addition to the material excavated by Jolly (Shawcross 1964b; Jolly 1978b; Gumbley 2003b:2). This means that interpretation of this extensive site in terms of differentiated areas of site function and the variability of faunal remains is problematic and inconclusive. Comparisons made with other sites and their assemblages must therefore be tentative and based on the securely sampled, recorded and analysed material from Cabana Lodge. It is probable that the occupation at Cabana Lodge was at least a semi-permanent settlement, based on its size and the activities identified in the Allo and Gumbley-Hoffmann excavations: the culling of a significant number of dogs and a stone-working floor.

6.3 REGIONAL PATTERNS IN TIME AND SPACE

Returning to faunal assemblage data for dated sites in the Coromandel and Western Bay of Plenty, the Cabana Lodge main assemblage (excavated by Gumbley and Hoffmann) fits into one of the four groups organised by cluster analysis in Section 5.3. Here the groups were examined for patterns in time, and later in space. These patterns are affected by biases from

assemblage collection criteria for this research, rates of residential and coastal development, trends in development location, previous disturbance from human activities and natural disasters, and the rigour of excavation, sampling recording and radiocarbon dating; the latter was sometimes correlated with the period at which excavation took place in terms of the development of methodology, sometimes not.

Table 6.6 summarises all of the assemblages from both study areas by time period. The periods with the greatest number of assemblages are the middle (almost 37% of all assemblages) and the middle-late (approximately 22%). The early period has the smallest sample (ca.11% of assemblages), with the early-middle and late periods comprising ca. 16% and 14% of assemblages respectively.

Table 6.6 Faunal assemblages by time-period

Period	Number of Assemblages	Percent of Assemblages
Early	8	10.96
Early-Middle	12	16.44
Middle	27	36.99
Middle-Late	16	21.92
Late	10	13.70
Total	73	100.00

Before analysing groups by time period, it is useful to look for patterns in the assemblages in space solely by period. In
Figure 6.2, assemblages are assigned different colours based on which time period they fall in. Although some assemblages are obscured by site density (such as at Whangamata in the Coromandel, and in Tauranga in the Western Bay of Plenty), the map illustrates the biases towards the middle period assemblages with lower proportions of assemblages from the early and late periods. The various biases have resulted in a reasonably even spread of assemblages through all of the five periods in the Coromandel, although slightly skewed towards the early and early-middle periods, while in the Western Bay of Plenty there is only one assemblage representing the early period, and the middle period has significantly more assemblages than any other period

6.3.1 First-order Summarising by Time

The assemblages analysed in Chapter Five are presented here with their assigned time periods (based on their calibrated radiocarbon dates), in the groups generated by the cluster analysis (Section 5.5).

The twelve Group A (Table 6.7) assemblages all have marine mammal as the lead energy source, but are also characterised by a wide range of faunal resources. Early and early-middle period assemblages each make up 50.0% of this group. This cluster group has a strong association with the early and early-middle periods, and is not present in the middle, middle-late or late periods.

The cluster Group B assemblages (Table 6.8) are characterised by fish as the lead source of energy, with three or fewer other faunal classes contributing relatively small amounts of energy, typically shellfish, marine and wetland bird or terrestrial mammal. One exception has a fourth faunal class represented, terrestrial bird. The eighteen cluster Group B assemblages are represented in all time periods, with early period at 11.1%, early-middle period at 16.7%, the middle period at 27.8%, the middle-late period comprising the largest proportion of

assemblages at 33.3%, and the late period at 11.1%. Cluster Group B assemblages become most prevalent during the middle and middle-late periods, but occur in very low frequencies in the early, early-middle and late periods.

The cluster Group C (Table 6.9) assemblages fall into a pattern where there are no 'dominant' sources of energy, although the lead sources are either shellfish, fish or terrestrial bird (the latter is a lead resource in only one assemblage). These are described as 'balanced resource' assemblages, as the attribute they have in common is the spread of energy yield across two to five faunal classes. There are nine assemblages in this group spread across four time periods; 11.1% are from the early-middle period, 44.4% are from the middle period, 11.1% from the middle-late period and 22.2% are from the late period. The cluster Group C is absent in the early period, but by the middle period it has peaked, and decreases in the middle-late and late periods.

In Group D there are thirty-four assemblages, which are all composed solely of shellfish (Table 6.10). There are no early period assemblages in this group; the early-middle period accounts for 5.9% of assemblages, while the middle period contributes 52.9%, the middle late period 26.5% and the late period 14.7%. Similar to the cluster Group C, cluster Group D is absent in the early period, but by the middle period it peaks, and then drops in the subsequent periods.

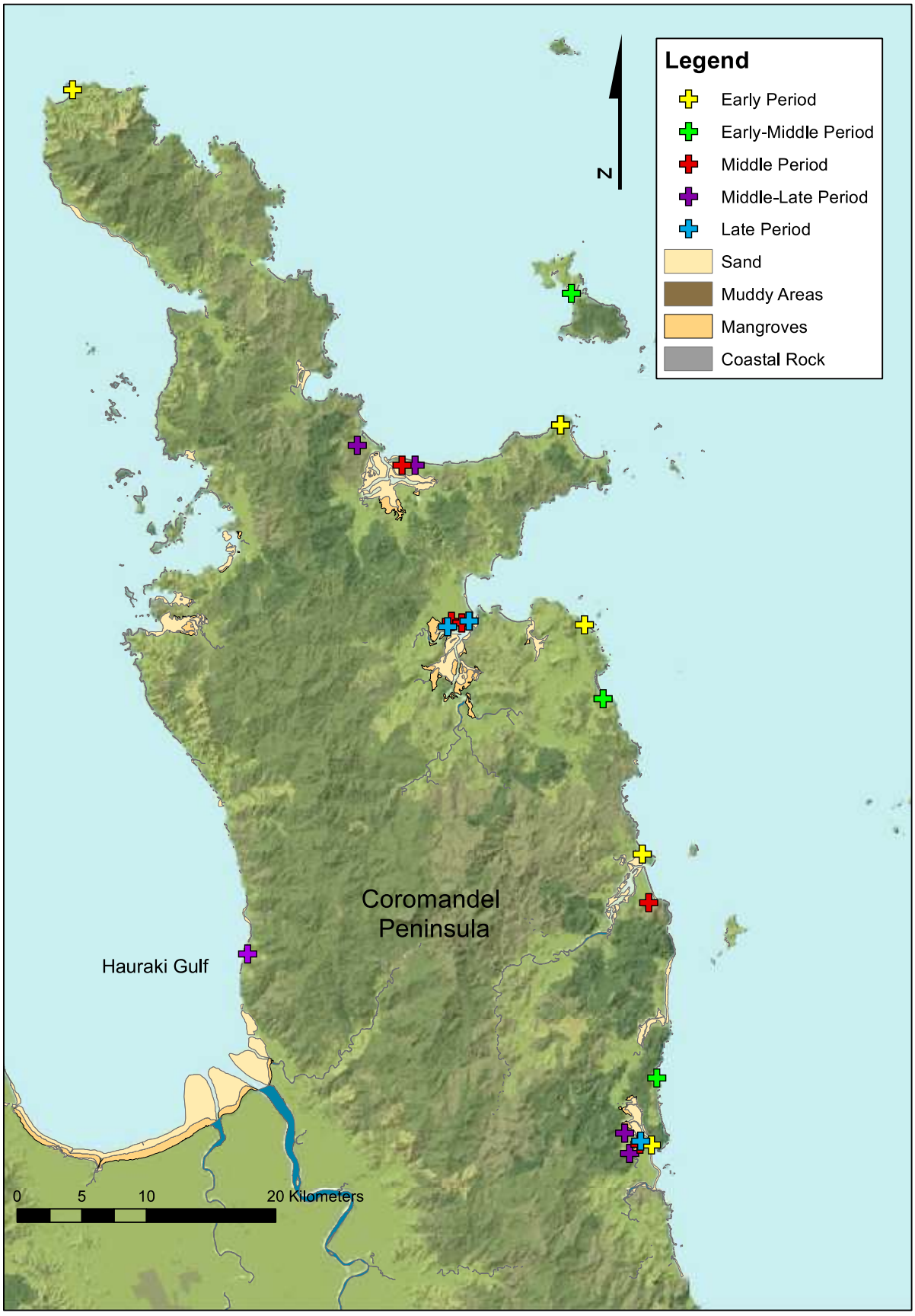

Figure 6.2 Map of the Coromandel Peninsula showing locations of faunal assemblage sites by time period

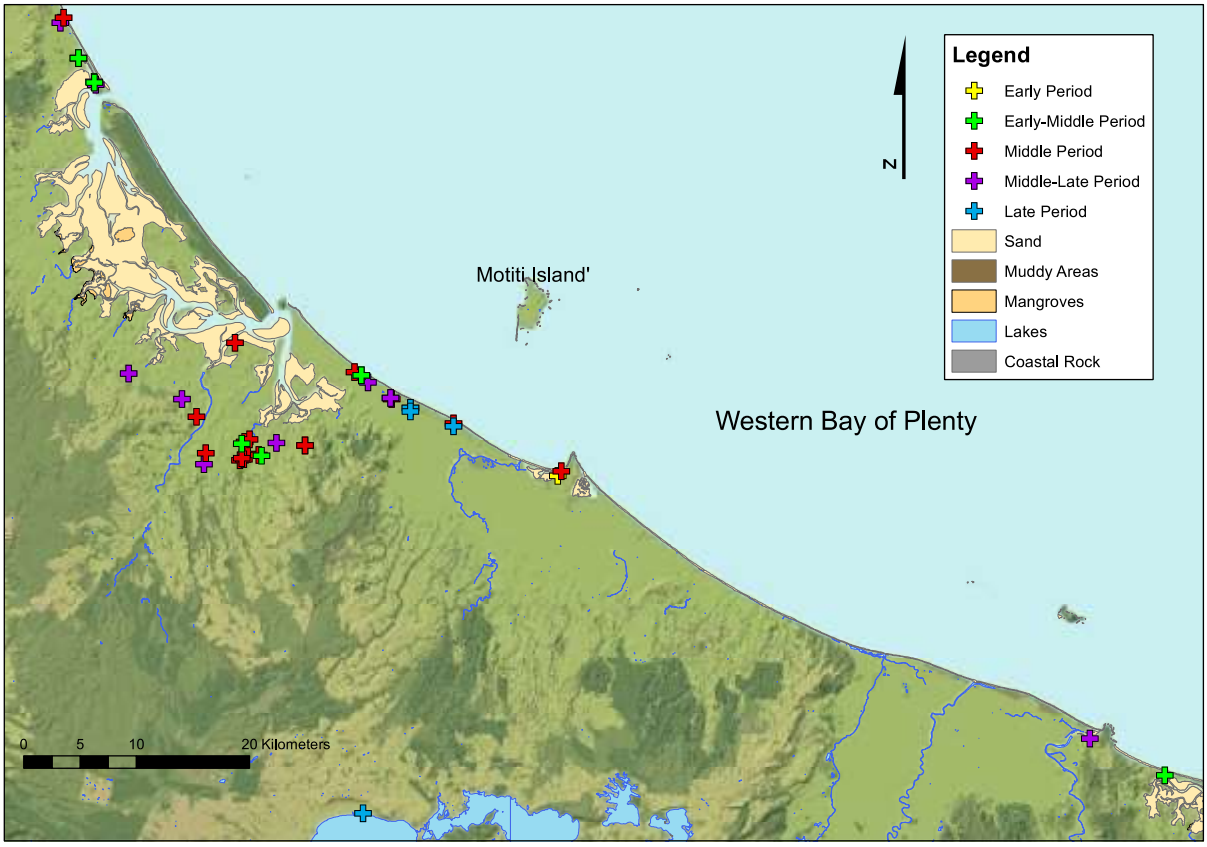

Figure 6.3 Map of the Western Bay of Plenty showing locations of faunal assemblage sites by time period

Table 6.7 Group A assemblages by time period

Group	Assemblage	Period
A	CCK-339-L9	E
A	TRN-62-Lower	E
A	CCK-339-L7	E
A	PJK-53	E
A	CL-3	E
A	MAS-187	E
A	WHT-16	EM
A	CCK-399-L5	EM
A	CCK-399-L3	EM
A	HWB-115-Lower	EM
A	HWB-115-Middle	EM
A	AHU-944	EM

Table 6.8 Group B assemblages by time period

Group	Assemblage	Period
B	HHB-242-Lower	E
B	HHB-242-Middle	E
B	BWT-875	EM
B	CHE-1920	EM
B	HHB-242-Upper	EM
B	ASH-2912	M
B	PAU-1028	M
B	MAN-188	M
B	EVA-3256	ML
B	ANA-46-Upper	ML
B	STR-780	ML
B	BWT-874	ML
B	SUP-2889	L

Table 6.9 Group C assemblages by time period

Group	Assemblage	Period
C	TEH-584	EM
C	ROW-1972	EM
C	ORO-1945	M
C	ORO-3197	M
C	ROW-3218	M
C	TAR-3230-H	M
C	GSP-3116	M
C	SUP-2891	ML
C	MTR-993	ML
C	NH-173	ML
C	HAM-9	L
C	TAR-3230-G	L
C	TRN-62-Upper	L
C	WHA-240	L

Table 6.10 Group D assemblages by time period.

Group	Assemblage	Period
D	KTR-78	EM
D	TUI-2897-2	EM
D	ORO-3216	M
D	CHE-3193	M
D	ORO-3056	M
D	ANA-46-Lower	M
D	MAT-2351	M
D	BAP-3269-F6	M
D	BAP-3269-T1	M
D	TEP-3221	M
D	FPC-3305	M
D	WHB-1275	M
D	GSP-3113	M
D	SUP-2888	M
D	ORO-1941	M
D	MTR-990	M
D	WHA-1035	M
D	WHI-926	M
D	WHI-624	M
D	WHI-927-B	M
D	FTP-1465	ML
D	WHA-1229	ML
D	KAI	ML
D	TAU-2402	ML
D	BWT-876	ML
D	WHP-751	ML
D	WHA-106	ML
D	WHA-959	ML
D	WHB-1246	ML
D	TAR-3231	L
D	TUI-2897-3	L
D	TUI-2897-1	L
D	WHI-858	L
D	WHI-927-A	L

It should be noted that these patterns are influenced by the disparate distribution of assemblages across time periods, as illustrated in Table 6.11. There are much fewer assemblages from the early period than in any other time period, so it is expected that this period will have lower numbers in all cluster groups. The middle period has the largest number of assemblages and therefore is likely to contribute higher numbers of assemblages in all cluster groups. While these cluster groups are affected by a number of factors, such as sample size, site selection driven by land development, reliable radiocarbon determinations, etc., some patterns do emerge and some tentative conclusions can be drawn.

Table 6.11 All assemblages by group and period

	Assemblage Groups				
Period	A	B	C	D	TOTALS
Early	6	2	-	-	8
Early-Middle	6	3	2	2	13
Middle	-	3	5	18	26
Middle-Late	-	4	3	9	16
Late	-	1	4	5	10
TOTALS	12	13	14	34	73

Group A assemblages, because of the wide range of resource types present, indicate that inhabitants had access to an unrestricted range of faunal *class* resources; many of these are large, substantial sites, such as the case study assemblage, Cabana Lodge (T12/3). This group of assemblages is clearly associated with the early and early-middle periods.

Group B assemblages are more restricted, with fish as the dominant faunal resource, with three or fewer minor resources playing a supplementary role. This group is more evenly spread through time than Group A, but is generally more common in the middle and middle-late periods. There are assemblages which indicate that species *within* a faunal resource class may have been becoming restricted, such as Nichol's (1986) analysis of site T11/242 (referred to in the present research as HHB-242-Lower, -Middle and –Upper, which date to the early period for the Lower and Middle assemblages, and the early-middle for the Upper assemblage), where he noted the "small size and poor quality of most of the fish being taken", as well as the decline in favoured shellfish species such as *Cookia sulcata*, and the decline in the numbers of *Canis familiaris*. He noted that the main function of a site, whether for storage or consumption, could also explain the species proportions in the assemblage. Nichol also observed the small scale of the excavation had resulted in midden samples that could have provide skewed faunal analysis results. He stated there were too many variables involved to conclude that the people who produced these assemblages were under economic stress, but it could be deduced that the local environment was under stress.

Assemblages in the Group C balanced resource group have fish, shellfish or terrestrial bird as the lead but not dominant resource, with a few assemblages including small proportions of energy from other faunal classes. The early period is not represented in this group, and the distribution of assemblages is skewed to the middle period.

The largest of the four groups, Group D assemblages are extremely restricted, focusing entirely on shellfish. All periods except the early period are represented in group D; more than half of the assemblages fall in the middle period, after which the proportion drops, reflecting

the overall distribution of all assemblages distributed across time. The assemblages in Group D are often samples taken from sole midden features, possibly representing only a few meals at most. The middle and middle-late assemblages combined account for 79.4% of the Group D assemblages, and show a trend towards smaller sites with small, specialised middens (rather than permanent occupations with extensive middens) with a focus one resource, shellfish.

In Figure 6.4 to Figure 6.8, the percentage of assemblages by cluster group, from both study areas combined, are presented for each period. Group A assemblages, which are varied and have marine mammal as their main source of energy, are dominant in the early and early-middle periods at 75% and 46% of assemblages respectively, and are absent in the middle, middle-late and late periods.

There is a discernible trend from varied assemblages in the early period to restricted assemblages in the late period. However, it is important to note the absence of early period sites in the Western Bay of Plenty, which may be exaggerating this trend. To reach a conclusive interpretation, this issue will require analysis of more assemblages dated from the early period in the Western Bay of Plenty, should they become available.

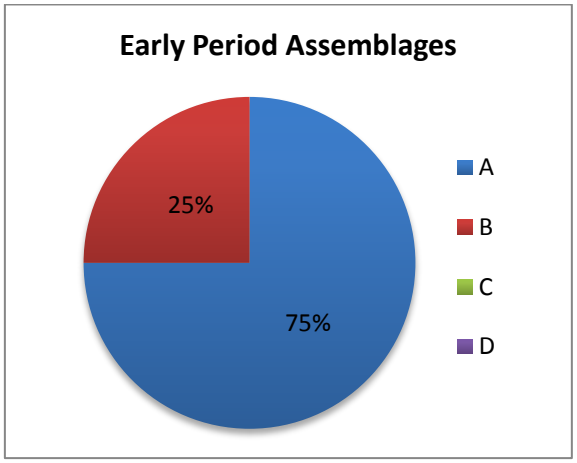

Figure 6.4 Percentage of all early period assemblages by cluster group

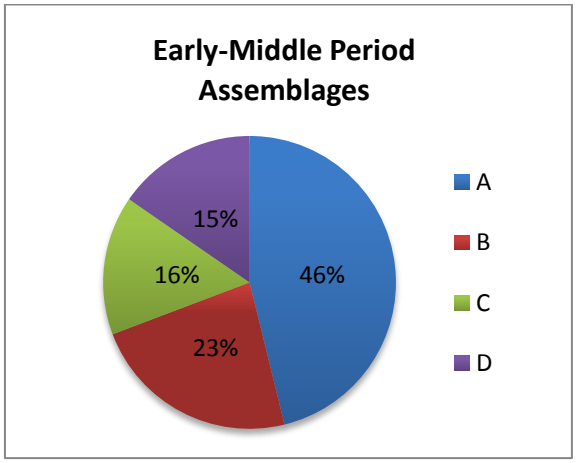

Figure 6.5 Percentage of all early-middle period assemblages by cluster group

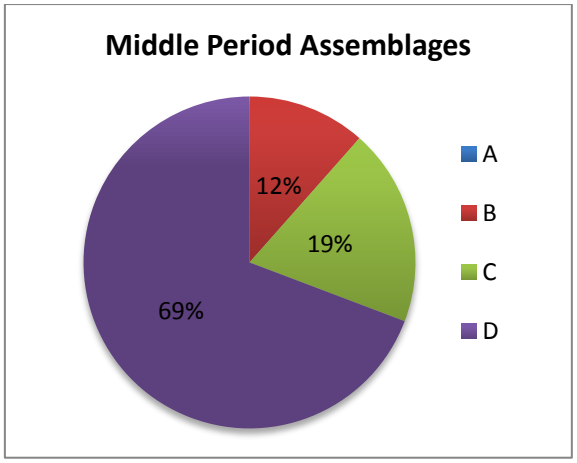

Figure 6.6 Percentage of all middle period assemblages by cluster group

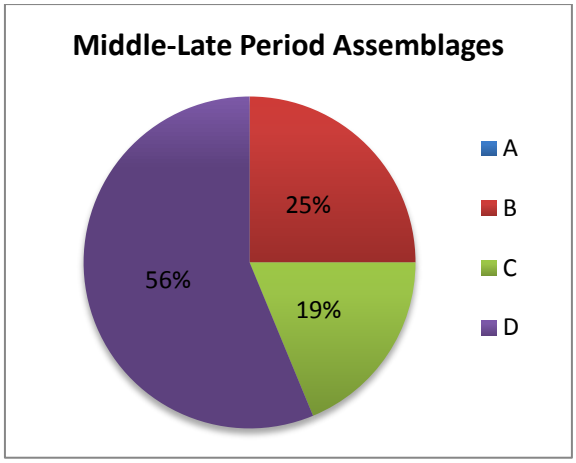

Figure 6.7 Percentage of all middle-late period assemblages by cluster group

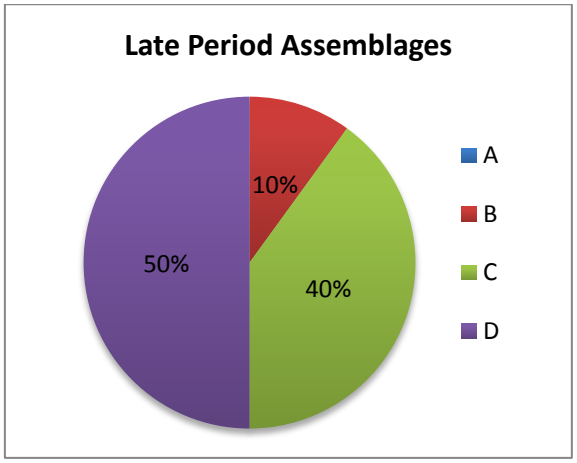

Figure 6.8 Percentage of all late period assemblages by cluster group

6.3.1.1 *COROMANDEL*

We can further analyse these patterns of assemblage type by investigating how the groups fall by period in each region. The assemblages from the Coromandel area are listed by period and assemblage type in Table 6.12. In Figures 6.8-12 the Coromandel assemblages are presented by group for each period as percentages.

Table 6.12 Coromandel assemblages by group and period

	Assemblage Group				
Period	**A**	**B**	**C**	**D**	**TOTALS**
Early	5	2	-	-	**7**
Early-Middle	6	1	-	-	**7**
Middle	-	1	-	5	**6**
Middle-Late	-	1	1	3	**5**
Late	-	1	1	2	**4**
TOTALS	**11**	**6**	**4**	**10**	**29**

As in the previous analyses for the combined study area, in the Coromandel assemblages the cluster Group A (assemblages with marine mammal as the lead resource, with a wide range of supplementary resources) is dominant in the early and early-middle assemblages with 71% and 86% of assemblages in each period respectively, but is absent from the subsequent periods. In the early period Group B is at its peak at 29% of assemblages, but thereafter ranges between 14% and 25% in the four remaining periods; it is never dominant. Group C assemblages with balanced resources are absent in the first three periods and make up 20.0% and 25% of middle-late and late period assemblages respectively; they also are not a dominant group in Coromandel assemblages. Group D shellfish only assemblages are absent in the first two periods, but account for 83%, 60.0% and 50.0% of middle to late periods respectively; this specialised assemblage type is obviously dominant from the middle period onwards.

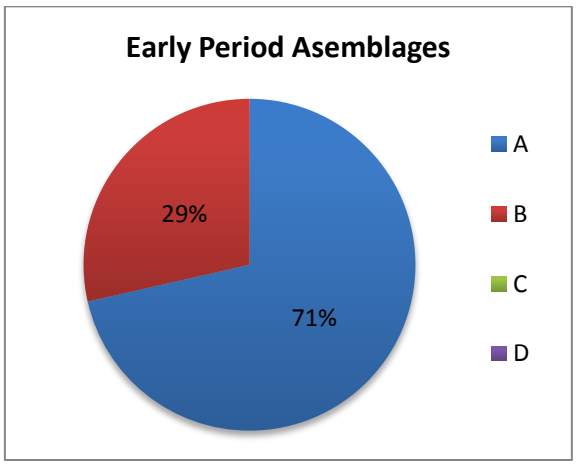

Figure 6.9 Percentage early period Coromandel assemblages by cluster group

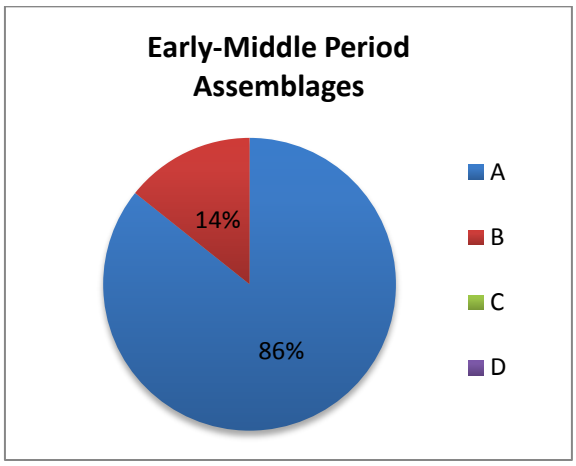

Figure 6.10 Percentage early-middle period Coromandel assemblages by cluster group

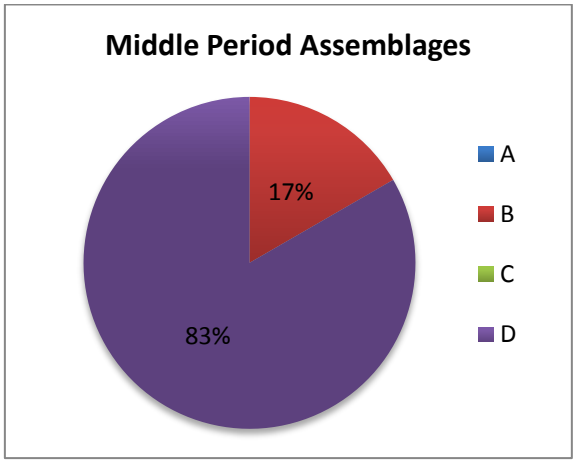

Figure 6.11 Percentage middle period Coromandel assemblages by cluster group

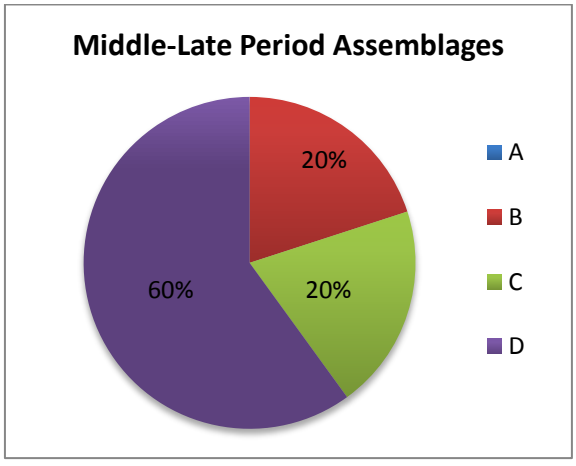

Figure 6.12 Percentage middle-late period Coromandel assemblages by cluster group

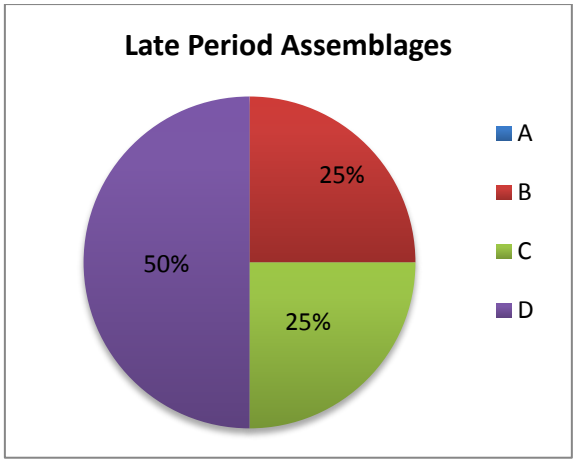

Figure 6.13 Percentage late period Coromandel assemblages by cluster group

These results cannot be used to argue for increased 'pressure' on subsistence resources in the Coromandel, as much finer analysis of individual assemblages is required - the size of species caught, analysis of element representation to determine site function (i.e. storage vs. consumption). This data is not consistently available for all of the assemblages utilised and therefore comparisons cannot be undertaken.

6.3.1.2 *Western Bay of Plenty*

The assemblages for the Western Bay of Plenty are presented by period and assemblage group in Table 5.13. The number of assemblages fluctuates greatly between periods, ranging from none in the early period, two in the early-middle period, six in the late period, thirteen in the middle-late period to an exceptional twenty-four in the middle period. This perhaps makes interpretations of trends in the relative proportions of assemblage groups within each period less reliable.

Table 6.13 Western Bay of Plenty assemblage groups by period

	Assemblage Groups				
Period	**A**	**B**	**C**	**D**	**TOTALS**
Early	1	-	-	-	**1**
Early-Middle	-	2	1	2	**5**
Middle	-	4	4	13	**21**
Middle-Late	-	5	-	6	**11**
Late	-	1	2	3	**6**
TOTALS	**1**	**12**	**7**	**24**	**44**

Figure 6.15 - Figure 6.18 present the percentage of assemblages by group in each period. There is only one early assemblage from the Western Bay of Plenty, which is a Group A

assemblage (marine mammal lead resource); this is the only period that contains this assemblage type in the Western Bay of Plenty. This is most likely associated with the low numbers of Western Bay of Plenty assemblages dating prior to the middle period. Group B assemblages (semi-restricted, with fish as the lead resource) are absent in the early period, account for 40% of early-middle period assemblages, 19% of the middle period, 45% of the middle-late period and 17% of the late period; although never a dominant assemblage type, it is clearly significant in the early-middle and middle-late periods. Group C assemblages (balanced resources) are absent in the early period, make up 20% of early-middle period, are absent in the middle period, 19% of the middle-late period and 33% in the late period; this group is generally not significant throughout prehistory until the late period (although the late period is a small sample and therefore results are subject to sample bias). The Group D assemblages (shellfish only) are absent in the early period, account for 40% of the early-middle period, 62% of the middle period, 55% of middle-late assemblages and 50% in the late period.

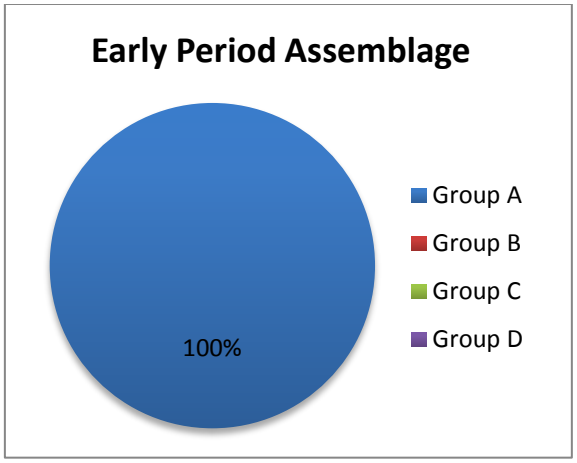

Figure 6.14 Percentage early period Western Bay of Plenty assemblages by group

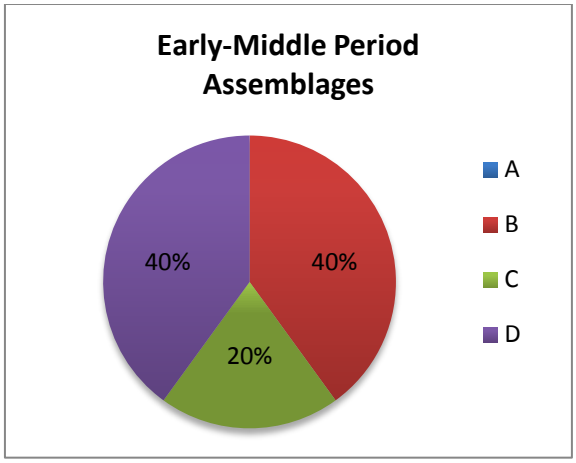

Figure 6.15 Percentage early-middle period Western Bay of Plenty assemblages by group

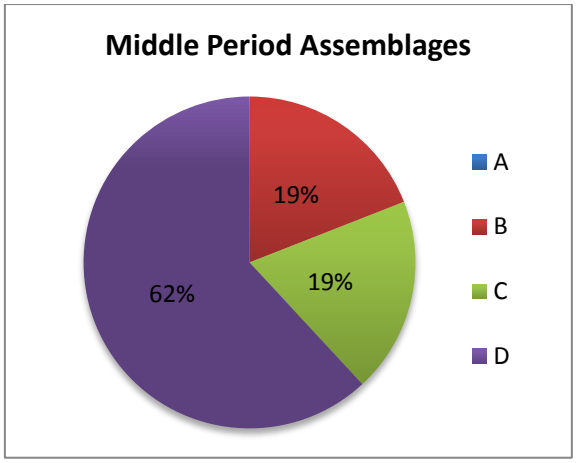

Figure 6.16 Percentage middle period Western Bay of Plenty assemblages by group

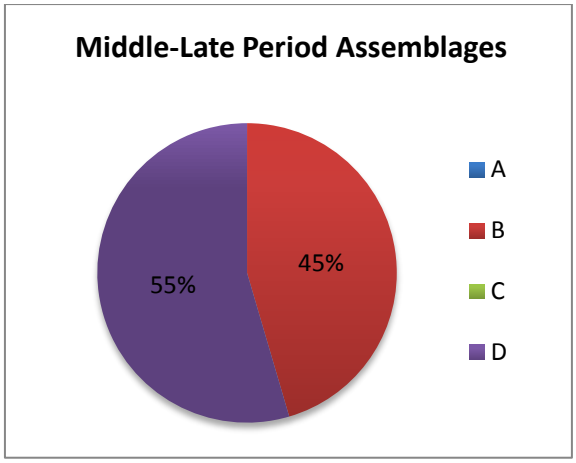

Figure 6.17 Percentage middle-late period Western Bay of Plenty assemblages by group

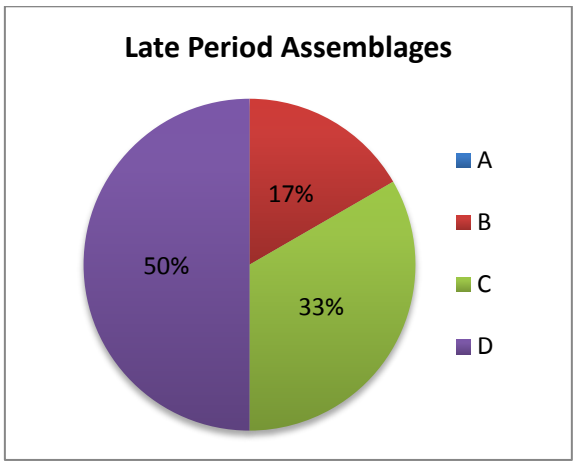

Figure 6.18 Percentage late period Western Bay of Plenty assemblages by group

6.3.2 First-order Summarising – Space

Group A assemblages are characterised as having marine mammal as the lead energy source and also a wide range of faunal resources. Figures 6.19 and 6.20 show clearly that Group A assemblages are located close to harbour mouths and rocky coasts, the latter being important for hunting *Arctocephalus forsteri*, which are less common in the Western Bay of Plenty than in the Coromandel. The low frequency of early period archaeological sites in the Western Bay of Plenty needs further exploration in order to make this observation less tentative for this study area. It has been put forward by McFadgen (2007) that early sites in the Western Bay of Plenty have been destroyed by extreme tectonic events; as evidence of this is difficult to identify, the problem of low numbers of early sites in the Bay of Plenty may only be resolved with ongoing excavation, analysis and radiocarbon dating of a range of site types and locations.

Group B assemblages, which are semi-restricted, with fish as the lead resource and a narrower range of faunal resources represented, comprise eighteen assemblages (Figures 6.21 and 6.22). In the Coromandel these assemblages are from sites at sandy beaches except for one on the bank of an estuary (WHA-240). In the Western Bay of Plenty, while some Group B assemblages are found on or near sandy beaches such as Papamoa and Bowentown, others are situated near river mouth estuaries - Maketu and Whakatane. The exceptions to these two patterns are the headland pa, Anatere, the two sites southwest of the Waimapu Estuary and the inland site on the shore of Lake Rotorua. Except for one assemblage found much further inland, these assemblages are either located adjacent to estuarine or sandy beach/open water marine environments.

Figures 6.23 and 6.24 illustrate the distribution of the nine Group C assemblages, of balanced resources of fish and shellfish. It could be expected that many of these assemblages would be located close to estuaries or harbour mouths, considering they are less exposed to stormy weather events than either rocky reefs or the surf of open sandy beaches, making fishing and shellfish gathering less dangerous possible to do year round. Only one assemblage is located adjacent to a harbour mouth – Tairua Harbour, but three assemblages are located slightly inland, southwest of the estuaries of Welcome Bay, Tauranga Harbour. Five assemblages are located on beach dunes at Ohope, Papamoa and Matarangi Beaches.

The final and largest group of assemblages, Group D, are shown in Figures 6.25 and 6.26. These specialised, shellfish-only middens are not only found near estuaries, harbour mouths and open surf beaches but also further inland, in the area from Tauriko to Oropi, south of the south-eastern extent of the Tauranga Harbour. These middens may be the result of increasing populations forcing people to trek further in land to exploit horticultural soils, and bringing with them the easily gathered shellfish accessed from their other coastal kainga (villages) or pa (defended sites).

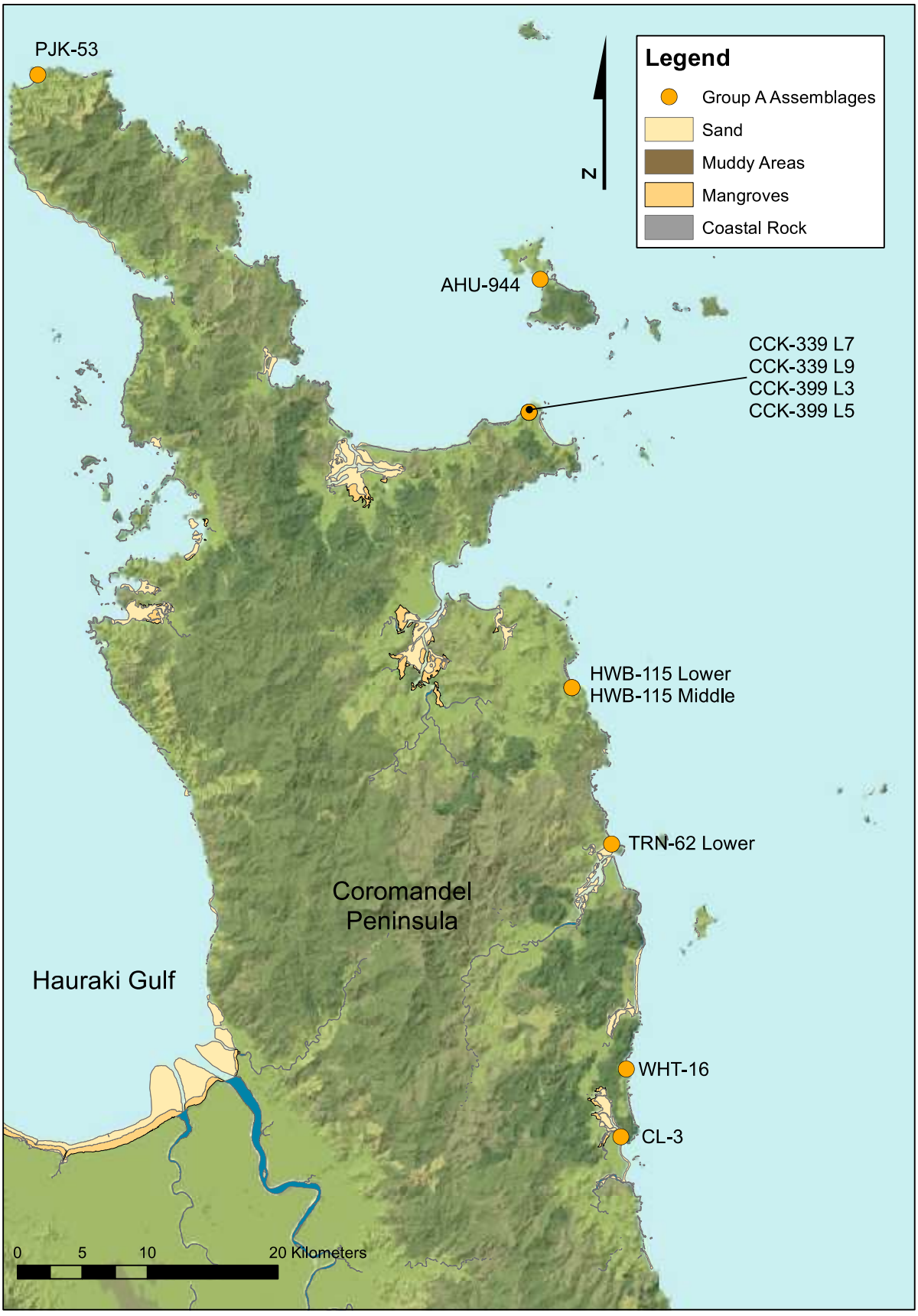

Figure 6.19 Group A (gold dot) assemblages in the Coromandel

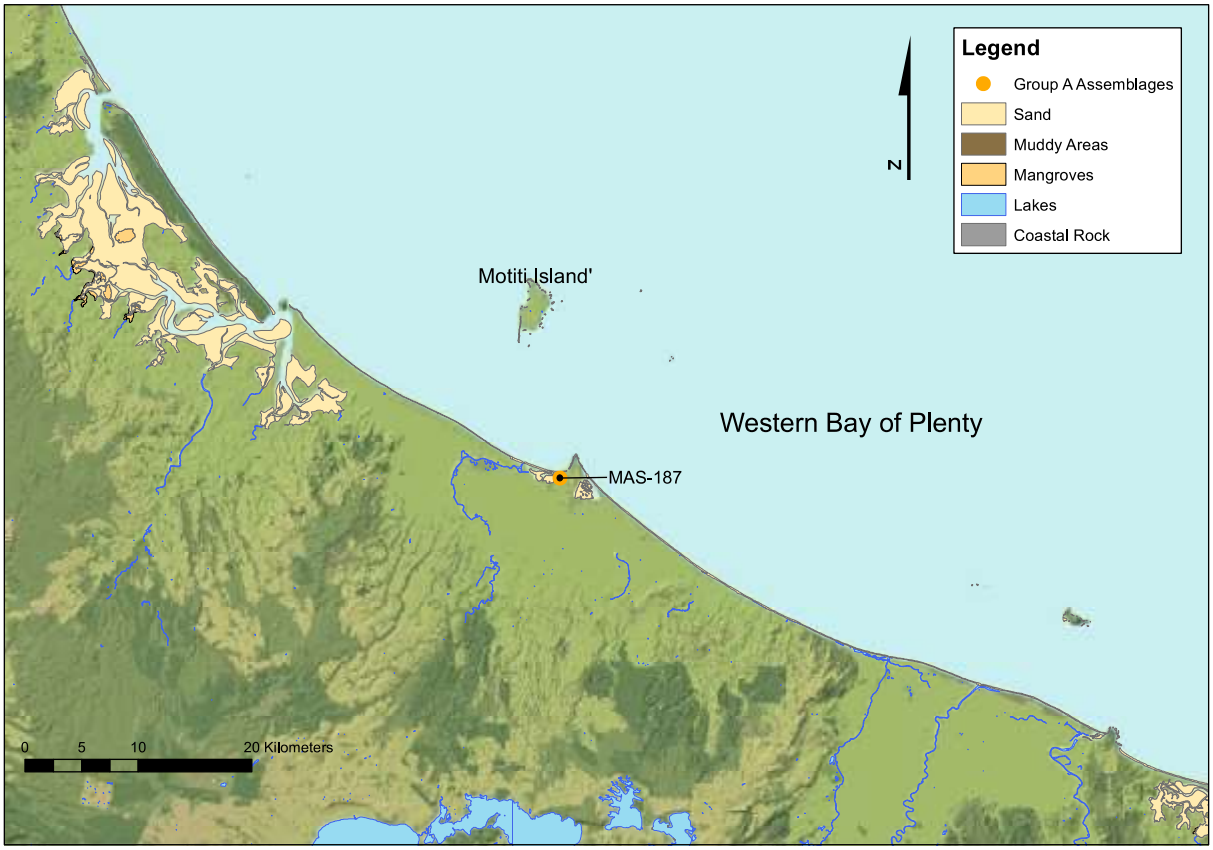

Figure 6.20 Group A (gold dot) assemblages in the Western Bay of Plenty

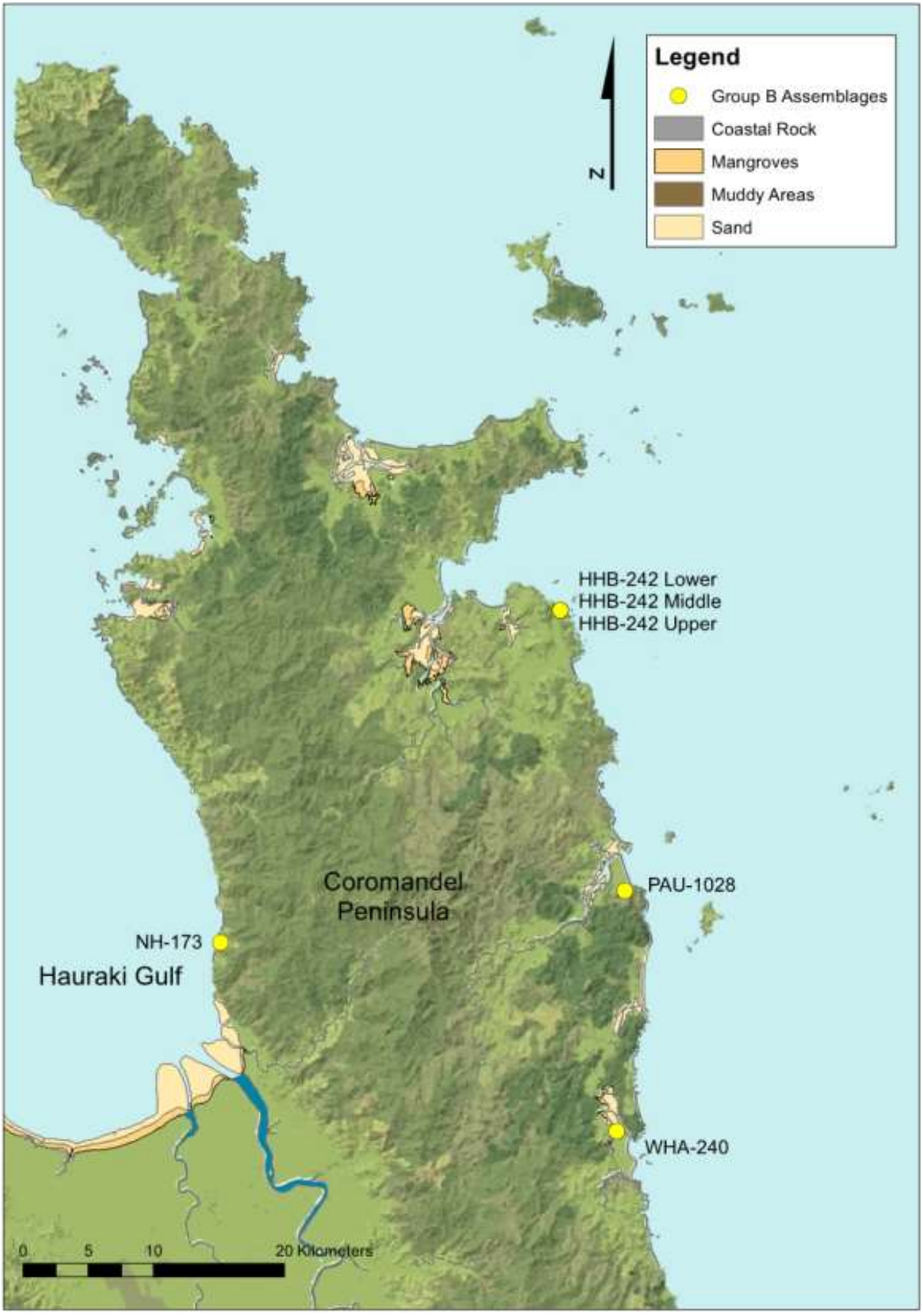

Figure 6.21 Group B (yellow dot) assemblages in the Coromandel

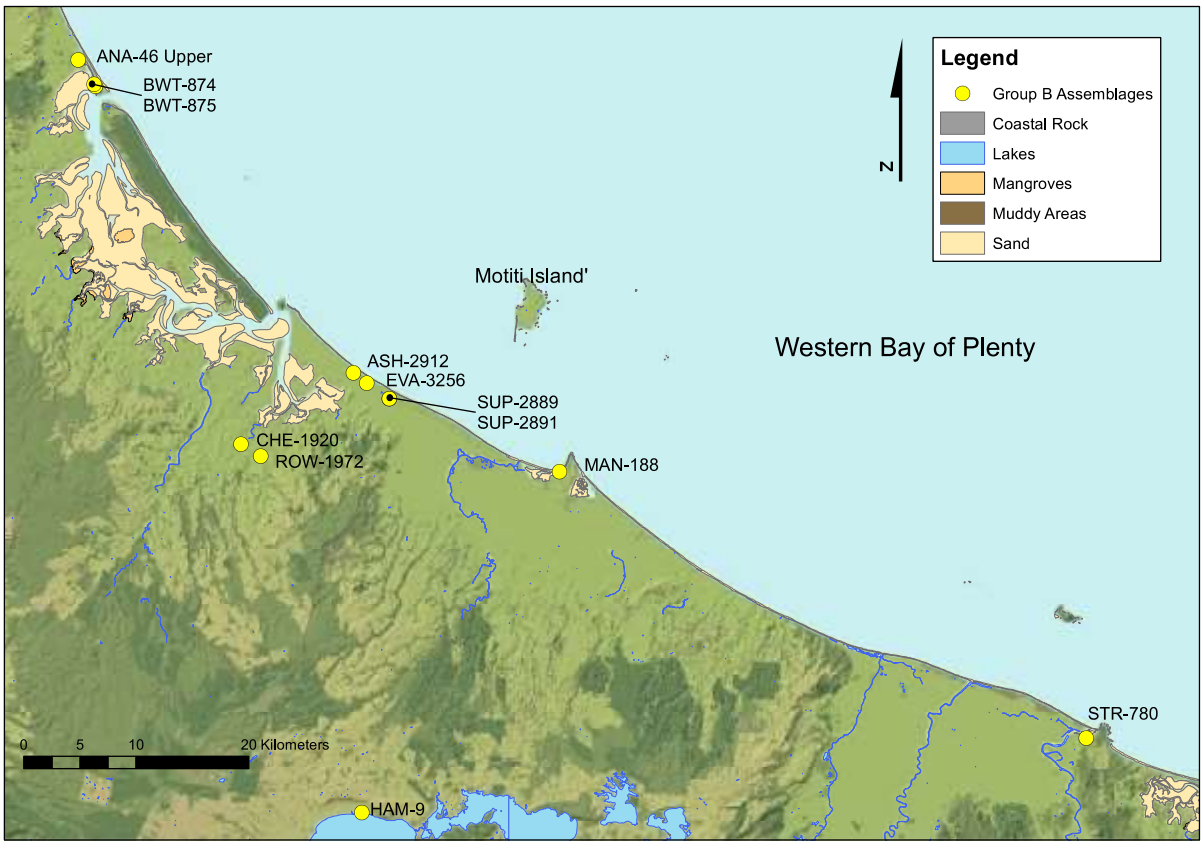

Figure 6.22 Group B (yellow dot) assemblages in the Western Bay of Plenty

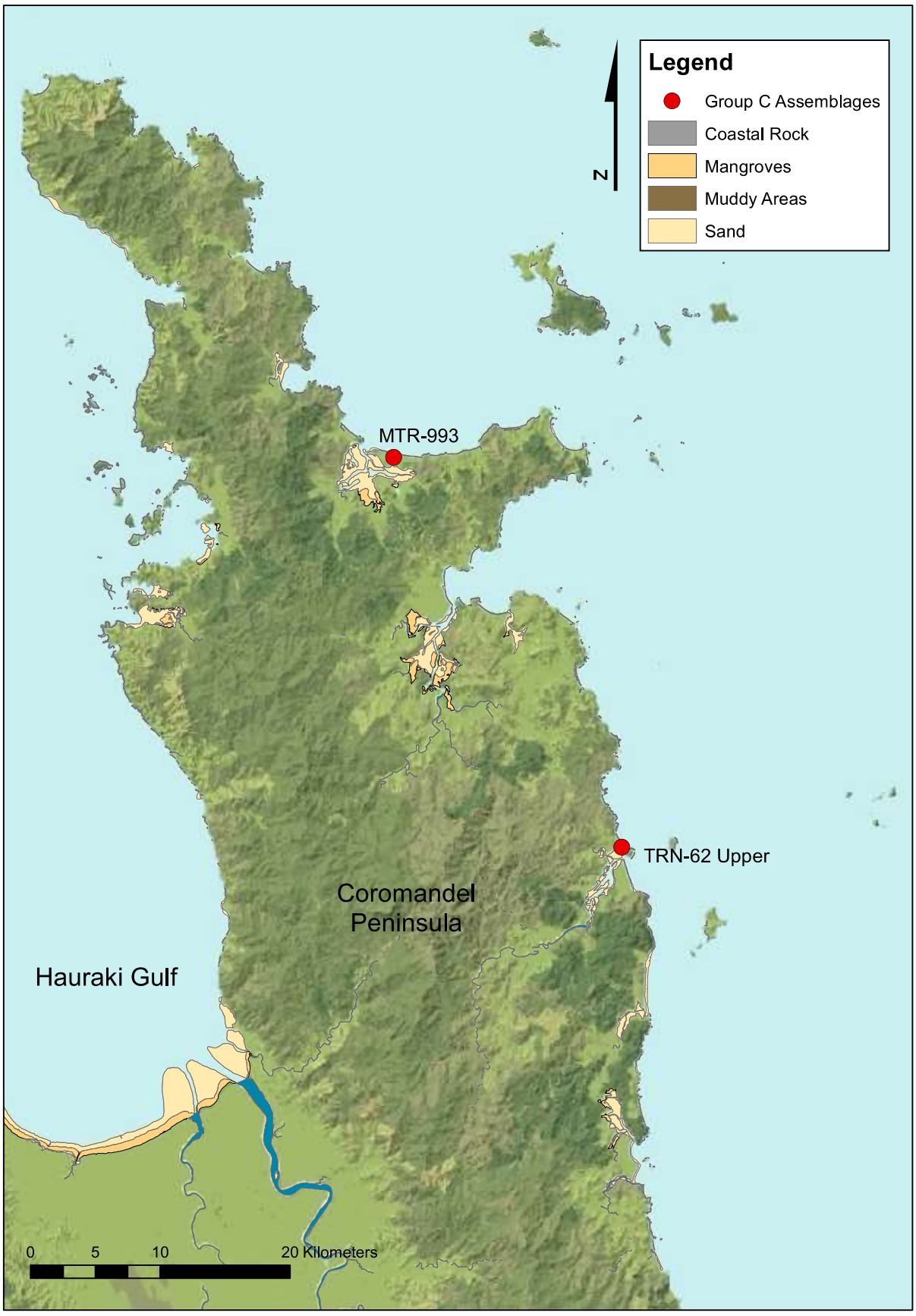

Figure 6.23 Group C (orange dot) assemblages in the Coromandel

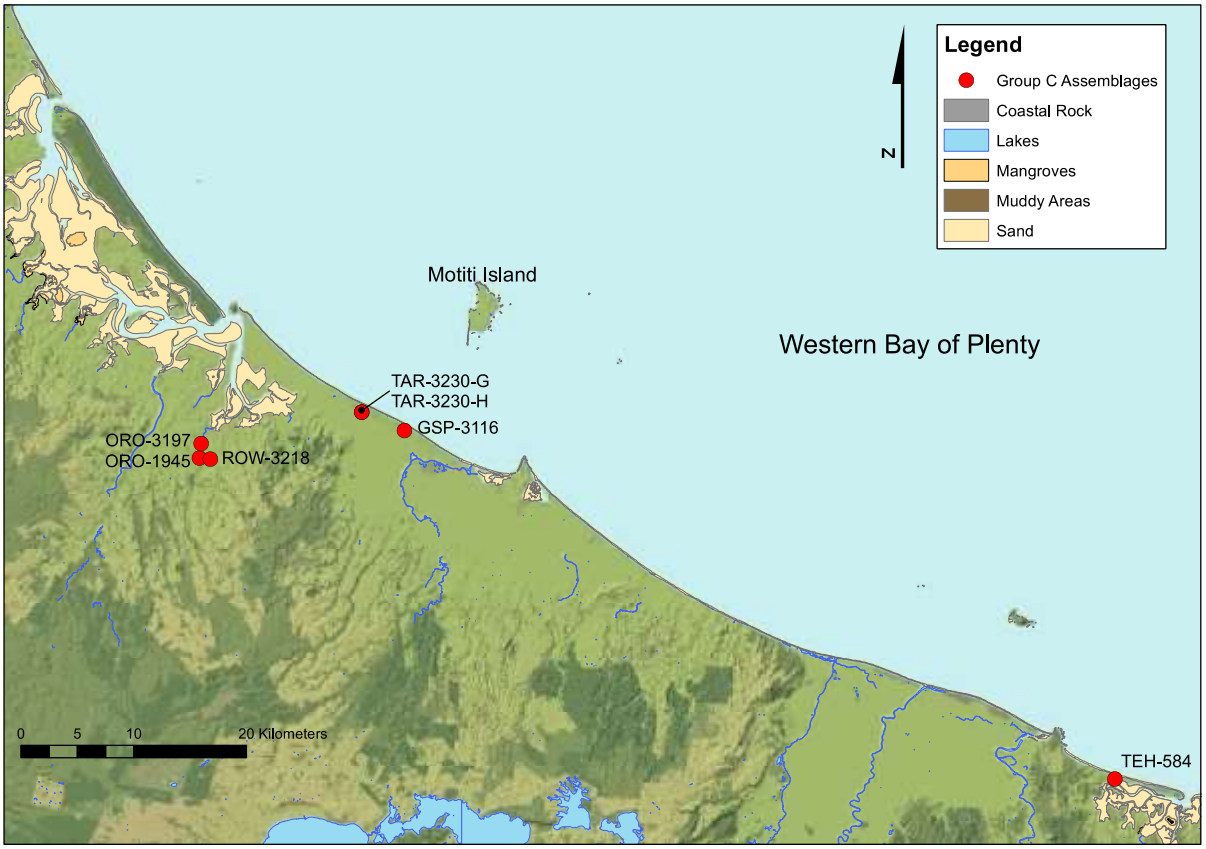

Figure 6.24 Group C (orange dot) assemblages in the Western Bay of Plenty

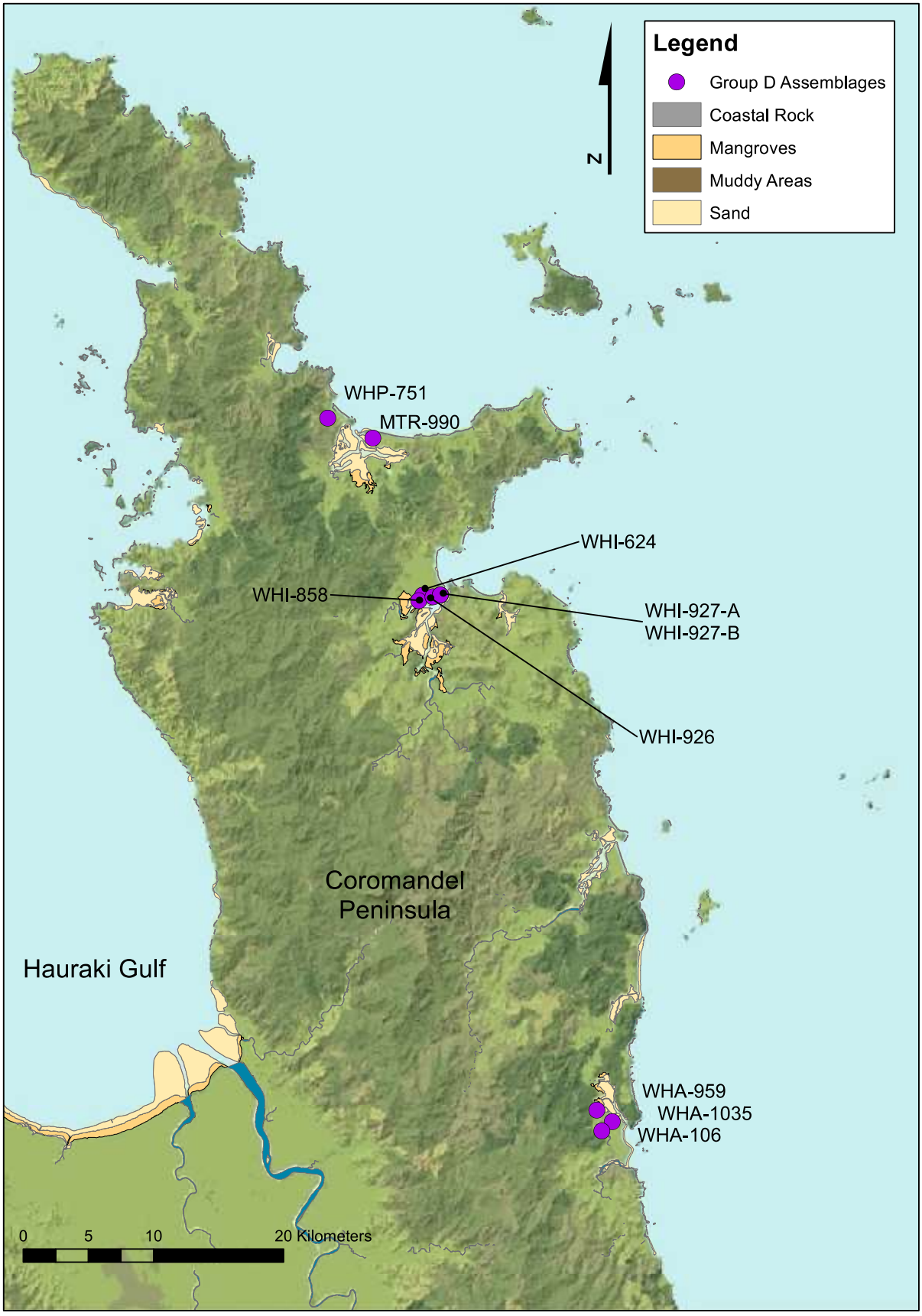

Figure 6.25 Group D (purple dot) assemblages in the Coromandel

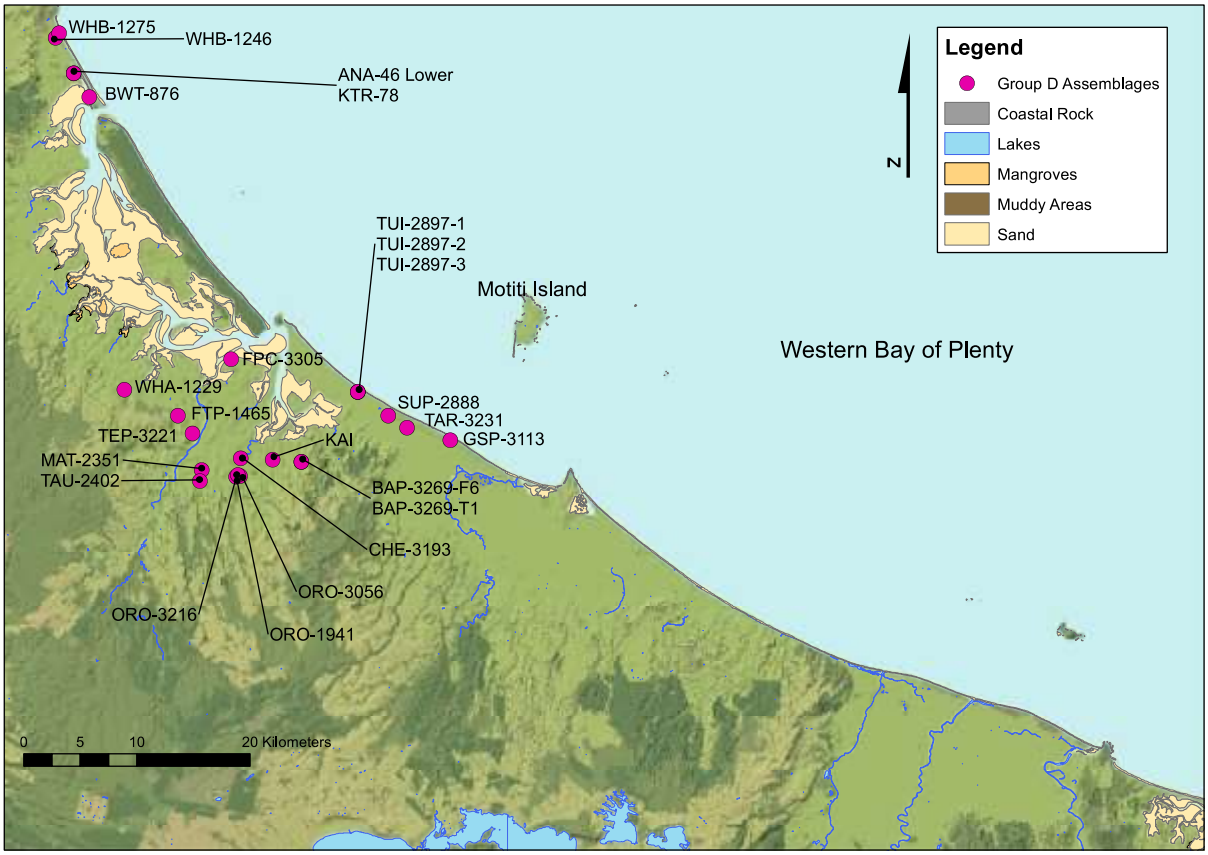

Figure 6.26 Group D (purple dot) assemblages in the Western Bay of Plenty

6.3.3 SUMMARY OF REGIONAL PATTERNS

In terms of subsistence, there seems to be a tendency for diverse resource assemblages in the early and early-middle periods in the Coromandel, and restricted resource availability or use in the middle, middle-late and late periods in both study areas. This pattern could be an indication that unsustainable pressure was put on resources such as moa and *A. forsteri;* the decline of the latter in the North Island during Maori prehistory has been established by Smith (2005). Generally, marine and wetland birds and small terrestrial birds did not make up significant proportions of energy yields even in the early and early-middle period assemblages; how accurate a reflection this is on the original bird catch numbers is difficult to determine, with the fragile nature of bird bones impacting on preservation and therefore faunal analysis results.

The disappearance of marine mammals and moa from the diet would have resulted in faunal subsistence practices that would have concentrated on fish and shellfish, which had previously played more of a supplementary role in energy yields.

Although it is difficult to compare reliance on flora species for energy yields through time with that from fauna, it can be speculated that as faunal resource availability became more restricted, gardening for species such as *Ipomoea batatas* (*kumara*, sweet potato) would have taken on a more important role in energy yields. Of course, horticultural activities were undertaken in the early and early-middle periods; with the reduction in large, energy rich sources such as sea mammal and moa, the contribution of garden crops to energy needs would have increased.

Two of the assemblages that fall into the late period are very isolated from the others: one is on the west coast of the Coromandel Peninsula, facing into the Hauraki Gulf, and the other is a freshwater assemblage on the northern shore of Lake Rotorua. However, examination of general site distribution in the study areas as shown in Figure 6.27 and Figure 6.28, based on pre-1789 archaeological sites held on ArchSite, the NZAA Archaeological Site Recording Scheme website, indicates that these areas were well-settled in prehistory; both the paucity of late period assemblages in the study data set, and the two assemblages from unusual locations are sampling anomalies, and are not indicative of the distribution of late assemblages or population densities in the region. Both the west coast of the Coromandel and the northern shore of Lake Rotorua have been subject to much less development in recent decades in

comparison with the east coast, resulting in much lower numbers of excavations and also assemblages which meet the selection criteria for the current research.

The faunal analysis patterns presented above can inform on patterns of subsistence in this part of north-eastern New Zealand in a relatively rigorous temporal timeframe.

The Coromandel early and early-middle periods are characterised by generalised assemblages with marine mammal as the lead resource, but the lead resource changes to shellfish during the middle period and resource classes are becoming more restricted. By the middle-late and late periods, the range of faunal resources being utilised is became restricted, assemblages mostly composed of fish and shellfish.

In the Western Bay of Plenty, the patterns are much less clear cut. Only one early assemblage met the selection criteria from the Western Bay of Plenty, and fitted the Group A pattern with marine mammal as the lead resource, but was notable for its absence of shellfish and the presence of three individual moa. The small number of early-middle assemblages are restricted to fish and shellfish. The largest period of assemblages in the study area, the middle period, shows a variety of fish lead resource, balanced resources and restricted shellfish only assemblages. The middle-late period shows over half of the assemblages are restricted to shellfish only. The shellfish-restricted assemblages still account for half of the assemblages during the late period. Shellfish were a stable, easily accessible resource that could be gathered by most members of a group, young or old, and were also quick to prepare and eat. Fish, the lead resources in Group B assemblages and in some Group C assemblages, were caught more frequently, due to any number of factors, such as a decrease in social conflict activities, settled weather conditions, etc.

These conclusions are based on only sites that contain analysed faunal material with acceptable radiocarbon dates, which met the selection criteria. Dated middens recorded with garden and/or pa components are under-represented in the analysis.



Figure 6.27 Pre-1789 archaeological site distribution, Coromandel Peninsula

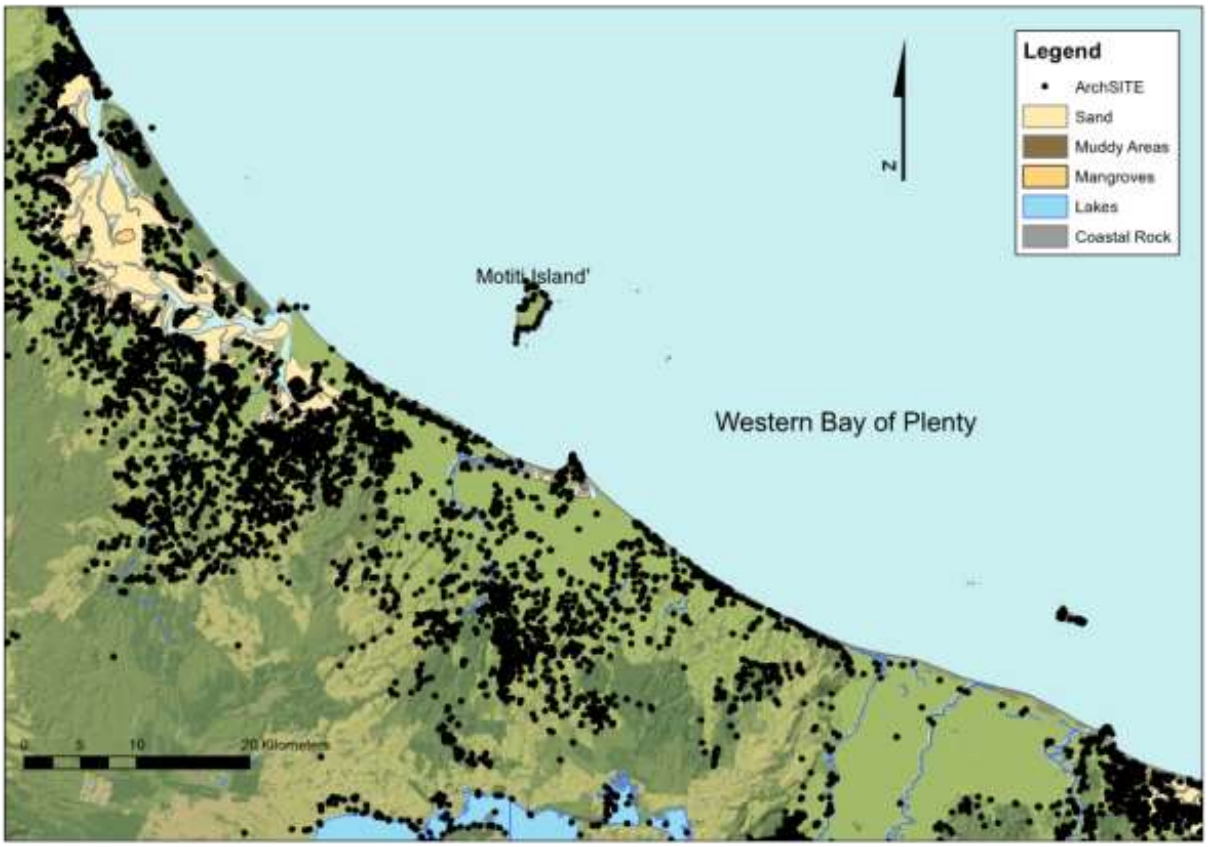

Figure 6.28 Pre-1789 archaeological site distribution, Western Bay of Plenty

6.4 COMPARISON WITH EARLIER MODELS

Chapter One presented settlement and subsistence models developed in New Zealand archaeology, and highlighted that many did not explicitly focus on subsistence, and models based on the present study areas utilised radiocarbon dates that now do not meet modern standards of chronometric hygiene. This section compares the patterns of subsistence and settlement observed in the Coromandel and Bay of Plenty data presented and analysed in the current project.

Green's (1963c; 1970) sequence for the Auckland province including the Coromandel Peninsula, was based on archaeological knowledge and literature of the time rather than excavated sites, and proposed a sequence of social organisation in six phases. These phases were influenced by factors such as the development of advanced kumara cultivations and storage technologies, climate change and faunal extinction (Marshall 2004:60). The faunal data set from the Coromandel used in this study exhibit some differences from Green's model, but otherwise support the general pattern that he proposed. The recent revision of New Zealand's chronology compressed the time available for the first two or three phases of Green's model, making it likely that they would be equivalent with the period covered by the early and early-middle periods used here. None of the assemblages from these two periods provide evidence for a major focus on moa; they all exhibit low proportions for moa in terms of both MNI and energy yields. However the early and early-middle period assemblages from the Coromandel do support Green's propositions regarding the importance of marine mammals and fish. Green's experimental phase describes a period where moa and seal mammals were becoming infrequent, with an increased reliance on mudflat shellfish. In the Coromandel dataset this matches best with the middle period, as sea mammals are mostly absent from these assemblages. This may also be the case for Green's Proto Maori phase where he noted that the "environment [has been] sufficiently modified by man that former avifauna and many sea mammals are no longer available or do not form a mainstay in the diet except in marginal regions" (1970:46). Some Coromandel Middle period assemblages fit this description, with four of the assemblages comprised of shellfish only, and the remaining assemblage being dominated by fish. This is also the case for most middle-late period Coromandel assemblages, with shellfish being more predominant in four assemblages and fish dominant in the remaining assemblage. In Green's Classic Maori phase the faunal focus was on mudflat shellfish and fishing, with the extent of primary forest removed by this time

allowing systematic agriculture to be profitable with the use of various storage techniques (1970:46). The assemblages dating to the late and the middle-late periods from the Coromandel tend to agree with this phase of Green's model, showing preference or restriction to fish and shellfish. There are even greater differences between the Western Bay of Plenty data set and Green's model. One assemblage from the early period contains moa, as the second-ranked class of energy yield, but this is the only period or assemblage from the study area which contains the rich energy source. It was also the only Western Bay of Plenty assemblage to contain sea mammal remains. The early-middle period assemblages generally have fish as the lead resource; in the middle and middle-late periods shellfish increase in importance.

Beyond the specific study area Leach and Leach's (1979c) model of community settlement patterns developed through their research at Palliser Bay, on the Wairarapa coast of the North Island, incorporated a subsistence component. The six communities who lived at Palliser Bay foraged marine and forest resources, and gardened extensively in a marginal environment. During the early part of the sequence, subsistence involved shellfishing, fishing and marine mammal and bird hunting along with gardening and gathering, undertaken primarily from general purpose settlements. After ca. 1450 A.D., sites became restricted-function settlements due to deteriorating environmental conditions and climate cooling, which resulted in increased mobility and widening of resource and social networks (Marshall 2004; Phillips, C.A. & Campbell 2004). There are some clear parallels in the data analysed in this study. The early and early-middle period assemblages from the Coromandel exhibit the broad range of subsistence pursuits observed in the early Palliser Bay sites, and the detailed study of the Cabana Lodge site presented here provides evidence of the artefact manufacturing and maintenance, along with hunting, fishing, littoral foraging and dog-rearing that would be expected of a general-purpose village or hamlet. Both the Coromandel and Western Bay of Plenty datasets exhibit greater restriction on the range of resources being exploited during the middle to late periods, and a large number of the middle, middle-late and late period assemblages are classified as temporary camps (Table 6.14). The present analysis has not involved explicit examination of possible changes in environmental conditions or cooling of the climate, as proposed by Leach and Leach, but these must remain as potential contributing factors for the Coromandel and Western Bay of Plenty regions.

Table 6.14 Assemblages by site type, period and assemblage type

Assemblage Code	Site Type	Period	Group
CCK-399-L9	undefended settlement	E	A
TRN-62-Lower	temporary camp	E	A
CCK-399-L7	undefended settlement	E	A
PJK-53	undefended settlement	E	A
CL-3	undefended settlement	E	A
HHB-242-Lower	temporary camp	E	B
HHB-242-Middle	temporary camp	E	B
MAS-187	temporary camp	E	A
WHT-16	undefended settlement	EM	A
CCK-399-L5	undefended settlement	EM	A
CCK-399-L3	undefended settlement	EM	A
HWB-115-Lower	undefended settlement	EM	A
HWB-115-Middle	undefended settlement	EM	A
AHU-944	temporary camp	EM	A
HHB-242-Upper	temporary camp	EM	B
BWT-875	undefended settlement	EM	B
CHE-1920	pit complex/temporary camp	EM	B
TEH-584	temporary camp	EM	C
ROW-1972	temporary camp	EM	C
KTR-78	temporary camp	EM	D
TUI-2897-2	temporary camp	EM	D
PAU-1028	undefended settlement	M	B
ASH-2912	pit complex/temporary camp	M	B
MAN-188	temporary camp	M	B
ROW-3218	defended settlement	M	C
ORO-1945	temporary camp	M	C
TAR-3230-H	temporary camp	M	C
ORO-3197	temporary camp	M	C
MTR-990	temporary camp	M	D
WHI-927-B	temporary camp	M	D
WHI-926	temporary camp	M	D
WHA-1035	temporary camp	M	D
WHI-624	temporary camp	M	D
ORO-3216	pit complex/temporary camp	M	D
ORO-3056	temporary camp	M	D
CHE-3193	pit complex/temporary camp	M	D
ANA-46-Lower	undefended settlement	M	D
MAT-2351	defended settlement	M	D
BAP-3269-T1	pit complex/temporary camp	M	D
TEP-3221	temporary camp	M	D
FPC-3305	temporary camp	M	D
WHB-1275	temporary camp	M	D

Table 6.14 Assemblages by site type, period and assemblage type, *continued*

Assemblage Code	Site Type	Period	Group
BAP-3269-F6	pit complex/temporary camp	M	D
SUP-2888	?	M	D
ORO-1941	pit complex/temporary camp	M	D
GSP-3113	temporary camp/horticultural soils	M	D
BWT-874	temporary camp	ML	B
EVA-3256	temporary camp	ML	B
ANA-46-Upper	defended settlement	ML	B
STR-780	undefended settlement	ML	B
MTR-993	temporary camp	ML	C
NH-173	undefended settlement	ML	C
SUP-2891	temporary camp	ML	C
WHA-106	temporary camp	ML	D
WHA-959	undefended settlement	ML	D
FTP-1465	pit complex/temporary camp	ML	D
WHA-1229	temporary camp	ML	D
KAI	temporary camp	ML	D
TAU-2402	temporary camp	ML	D
BWT-876	pit complex	ML	D
WHP-751	undefended pit complex	ML	D
WHB-1246	undefended settlement	ML	D
SUP-2889	undefended settlement	L	B
WHA-240	temporary camp	L	C
TRN-62-Upper	temporary camp	L	C
GSP-3116	temporary camp/horticultural soils	L	C
HAM-9	temporary camp	L	C
TAR-3230-G	temporary camp	L	C
WHI-858	temporary camp	L	D
WHI-927-A	temporary camp	L	D
TAR-3231	temporary camp	L	D
TUI-2897-3	temporary camp	L	D
TUI-2897-1	temporary camp	L	D

Anderson and Smith's (1996a) transient village model for southern New Zealand saw the early phase transient villages positioned near rich resource clumps of seals and moa, where their economy also included hunting, fishing and gathering. As the stocks of these high meat- and fat-yielding resources were depleted, transient villages became less substantial as occupants moved to and transported dispersed resources. The most obvious difference between the assemblages of the present study areas and those of the southern hunters is that the former were able to garden and store kumara and were therefore not as reliant on wild, seasonally available resources. Some of the early Coromandel sites and their assemblages are large, but not as large as those of the southern South Island (i.e. Cabana Lodge, Tairua, Cross Creek, Hahei Beach) with large occupation areas and generalised assemblages. Over time

Coromandel sites and assemblages become smaller and more restricted, with narrow ranges of faunal classes and species. The Western Bay of Plenty sites do not match the transient village pattern. There are few early period sites, and in the present data set only five are present in the early-middle period; no generalised (Group A) assemblages occur in any Western Bay of Plenty time periods. Many of the Western Bay of Plenty sites are relatively ephemeral and may consist of only middens with no or few other features; some of them are located considerably far inland from the coast.

Caroline Phillips' (1994; 2000e) work identified five cycles or causes of mobility and settlement along the Waihou River in the Hauraki Plains, west of the Western Bay of Plenty. Her model did not focus on faunal subsistence, although it was encompassed by terms such as 'economy' and 'seasonal resources'. Her model identified that long cycles (50-100 years) were caused partly by economic development and resulted in movement in to new areas and the development of new site types, and short cycles (2-3 years) were partly based on economic variables, which resulted in new gardens and kainga (villages) being established. The most relevant cycle, from a subsistence perspective, in Phillips' model is the annual cycle, which was based on the seasonal availability of resources, with people moving to gardens and areas for fishing, birding and plant gathering. The presence of generalised faunal resource assemblages in the early and early-middle periods in the Coromandel could be interpreted as either part of Phillips' long or short cycles, with the establishment of gardens and kainga; however after this time in the Coromandel, and after the early period in the Western Bay of Plenty, generalised faunal resource assemblages are generally lacking. The trends towards restricted and specialised faunal assemblages in both the Coromandel and the Western Bay of Plenty fit better with Phillips' annual cycle of movement to gardens and seasonally available resources. It is not surprising that Phillips' model is not an easy fit with the data of the present research – Phillips' model is primarily focused on settlement along a linear river environment on the Hauraki Plains, while the present work is faunal focused, mainly on coastal (with a small amount of inland) resources from a much larger study area.

Barber's (1994; 1996; 2010; 2012a; 2012b; 2013) research on pre-European culture change in NTWP put forward an anthropological model of culture change based on diminishing faunal and lithic resources over time. Barber suggested that as the diminishing faunal and lithic resources were perceived as linked during the 14-16th centuries, distinctive ideologies, institutions and technologies were developed as a result. He noted the alluvial soils were

altered for horticultural use during this time, while swidden clearance for these cultivations also encouraged bracken fern (*Pteridium esculentum*); these changes in economy allowed a focus on land-based production associated with pa construction. The analysis of faunal results presented in this research, while not presented with lithic analysis or identification of garden soils (due to the focus and scale of the data set), can at least be compared against Barber's model of culture change in NTWP. The assemblages from the Coromandel indicate a trend from generalised resources in the early and early-middle periods, to restricted and specialised in the subsequent periods, in parallel with the loss of seal and moa in NTWP. However, Western Bay of Plenty assemblages were sparse in the early and early-middle periods, and the latter period consisted of restricted assemblages, which makes it difficult to assess with any certainty about the decline of these resources and reactions to this decline during the middle and middle-late periods. However the presence of large numbers of assemblages from the middle-late and late periods of specialised shellfish-only assemblages in the Western Bay of Plenty suggests that these represent small, short-duration events away from the village or home base, where the villages perhaps further inland near gardens and areas of storage pits were the living spaces and pa markers of mana or status.

While Irwin's (2004b) edited volume on the inland Bay of Plenty swamp pa, Kohika, examined subsistence, settlement and environmental change at the site and wider regional level, it did not explicitly propose a model of settlement and subsistence. While the faunal analysis was strictly just for the Kohika site, a sequence of settlement can be extrapolated for the larger area. Environmental reconstruction observed that prior to the arrival of Polynesians in the Bay of Plenty, the coastal lowlands were blanketed by tall, conifer/broadleaved forests while the large Rangitaiki Plains wetlands (where Kohika was located) were densely vegetated with complex mosaics of swamp forest, scrub, sedges and flax (McGlone & Jones 2004:40). In spite of the variety of plants and animals it supported, the latter environment impeded human mobility and was not chosen for settlement. With the resource depression of birds in coastal forests, this habitat could not provide the same energy returns; subsequent burning of the swamp forests made the swamps and their resources (eels, freshwater fish and birds) easier to access and allowed bracken, ti (*Cordyline*) and tutu (*Coriaria* sp.) to spread. By the time Kohika was occupied, the forest had been cleared and the swamp pa was beside the lake and swamp. The faunal subsistence at Kohika included mammal (human, marine mammal, dog), birds, fish and shellfish (Irwin, Nichol et al. 2004). The results noted that for a late prehistoric Maori assemblage, it was not remarkable except for the large relative

abundance of dogs. The assemblage identified that a range of environments were utilised during subsistence activities: fowling was undertaken in forest, estuary, swamp and open coast environments; fish were mainly caught in the nearby estuary with some also caught on the open coast; mollusca were gathered from mudflat, open coast, lake and sheltered soft-shore environments. Analysis of macrofossils and pollen present in dog coprolites indicated that the regular diet contained fish and gathered plants. Kohika appeared to be occupied during summers of the 17th century, probably for a duration as short as 70-80 years (Irwin & Jones 2004). As a generalised, inland fauna assemblage dating to the middle-late period, Kohika is relatively unique in terms of its site type, an inland swamp pa, but as an assemblage with more than two fauna resources it fits with the semi-generalised assemblages which make up 45% of the Western Bay of Plenty middle-late assemblages. The Western Bay of Plenty assemblages are found in both coastal and inland locations, compared to those of the Coromandel; whether this is a result of greater impetus for the excavation of inland areas in the Western Bay of Plenty is difficult to assess here, and would require further analysis of other site types to reach a conclusion.

Allen's (2006) work at Tauroa Point, in the northern North Island, did not specifically propose a model of subsistence and settlement; although it did examine subsistence, settlement and chronology in a regional context for the Northland region. She noted that the earliest Tauroa occupation had the longest duration and was functionally most varied; fishing was a significant faunal resource, with some seal and whale also exploited. Coastal sites in the Northland region after this earliest occupation become far less frequent. Between AD 1400 and 1650, Tauroa Point continued to be exploited for shell and finfish, but at a less intensive level. This pattern is similar to that observed in the assemblages of the Coromandel area throughout prehistory, which generally trended from exploiting generalised and semi-generalised ranges of faunal resources to semi-restricted and restricted ranges. Allen proposed that from AD 1400, people were moving inland to establish gardens, and relied less on the coast for faunal resources. The Western Bay of Plenty data includes faunal assemblages from sites dating from the early-middle period and then throughout the rest of prehistory, and assemblages from coastal sites are also present, with rivers likely to have been an important mode of transport between inland and coastal habitats. Again the Coromandel data set used here lacks any assemblages from inland sites, so this factor is not able to be assessed for this area.

Walter, Smith & Jacomb's (2006) settlement model is based on sedentary but transient villages, fluctuating population structures and landscapes of community mobility. It has early communities focused on hunting and gathering economies (e.g. Houhora) and some also including horticulture (e.g. Sarah's Gully and Washpool); while later sedentary settlements vary from small *kainga* (hamlets) to *pa* (fortifications) which acted as 'bases', from which occupants travelled to exploit resources further afield (e.g. Oruarangi and Kohika), with subsistence activities including fishing, terrestrial foraging and horticulture. Again, the Coromandel data set fits this model, with early settlement sites providing evidence of hunting, fishing, gathering and horticulture, and later sites increasing their focus on horticulture and fishing and shellfish gathering. The Western Bay of Plenty data is not a good fit; the data set has an inadequate sample of early period assemblages; assemblages from the middle to late periods are generally more restricted, with only evidence for terrestrial bird and terrestrial mammal classes being utilised.

Jacomb, Walter and Jennings (2010) reviewed the archaeology of Foveaux Strait, in the southern South Island, and combined analyses of artefact types and raw materials to develop three alternate models for the prehistory of Foveaux Strait. The results were a best fit for the *Resource Network Model,* which was influenced by external resource networks of economy and population. With the rapid exploration of New Zealand during the first century after Polynesian arrival, raw materials were quickly identified, and in Foveaux Strait the exploration took place almost immediately although at low levels. The archaeological record indicated that while low-level hunting of moa and seal occurred in the Foveaux Strait area, there was no evidence for sustained settlement or exploitation during the early phase. The extreme conditions and low density of moa limited permanent human settlement there. When moa populations declined in the early 15th century, southern South Island Maori populations declined along with travellers to Foveaux Strait. The strait remained virtually uninhabited until the late 18th century with the appearance of sealers, whalers and flax traders. In response to European arrival and expansion, the population of southern Maori in the Foveaux Strait region increased, with the first appearance of permanent Maori settlement (Jacomb, Walter et al. 2010:51). Early sites were generally small, focused on single activities, or represented irregular visits; they were concentrated in particular areas where key resources, such as argillite outcrops and sheltered estuaries for shellfish gathering and fishing were located. The recorded sites of Foveaux Strait date to the early and historic periods, but sites from the 17th and 18th centuries are absent, supporting the *Resource Network Model's* premise that the

southern coast was no longer part of resource networks focused further north. Prehistoric Maori also abandoned part of the coast further north; Maori populations also fell elsewhere after the decline in moa and sea mammal resources, further supporting the model. At the same time as parts of the South Island became deserted or suffered reduced populations, southern argillite seems to have disappeared, further suggesting the collapse of trade networks. The Resource Network Model is appropriate for the Foveaux Strait as the region has harsh conditions and would have been seen as a marginal environment in terms of resources and settlement. Neither the Coromandel Peninsula nor the Western Bay of Plenty could be considered to have marginal environments; the Western Bay of Plenty has much less rocky coastline compared to the Coromandel Peninsula, and the apparent lack of early sites may be a function of tephra blanketing early sites in the former area, or erosion, or possibly vegetation dieback from eruptions making the Western Bay of Plenty an undesirable location for settlement during the early period.

6.5 Evaluation: Answering the Questions

6.5.1 What was the range of subsistence activities undertaken at each study site, and where was each site located in relation to the environments from which those resources are most likely derived?

The sites examined in this study exhibit variation from very generalised assemblages in which a wide range of subsistence activities are represented to highly specialised assemblages with evidence for only one primary subsistence activity. The former, categorised here as Group A, were almost all located on the Coromandel Peninsula (except for MAS-187) and confined chronologically to the Early and Early-Middle periods. All of these showed evidence of marine mammal hunting, fishing, harvesting marine and/or terrestrial birds, shellfish gathering and the use of domestic or commensal terrestrial mammals. Three sites also disclosed evidence of moa hunting. Of these pursuits marine mammal hunting was by far the most important in terms of dietary contribution, with fur seals the predominant target. This almost certainly provides at least part of the explanation for the restriction of these sites to the Coromandel Peninsula, with the rocky coasts favoured by this species relatively common there but scarce in the Western Bay of Plenty.

Analysis of the Cabana Lodge assemblage provided a detailed case study of the ecological zones exploited at one example of a Group A site. This showed that most time was spent hunting and gathering resources in the littoral zone, with estuarine and sandy beaches exploited as well as the rocky shore. The marine zone was also important, with fishing provided a significant proportion of dietary energy. The terrestrial zone was least important in terms of faunal resources, although it would have been the location of gardens and the source of gathered plant foods. Overall, this suggests that site location was determined not solely by proximity to rocky shores, but also by ease of access to a diverse range of resource zones. Similar ecotonal settings are apparent for the remaining Group A sites. Like Cabana Lodge, one other is near the mouth of a harbour with sandy or muddy estuarine flats and both rocky outcrops and a sandy coastal beach nearby. All other are on or near sandy beaches with rocky outcrops or headland within walking distance. All have rivers or streams nearby. The consistency of in this pattern provides strong evidence that these ecotonal locations were the preferred setting for early settlements in the Coromandel.

The Group B assemblages exhibited a more restricted range of subsistence pursuits. Fishing and shellfish gathering were represented in all twelve assemblages while just under half exhibited evidence of birding and/or use of terrestrial mammals. In all cases fishing provided the majority of dietary energy. Not surprisingly access to both the marine and littoral zones figure strongly in the location of these sites. The six Group B assemblages from the Coromandel Peninsula derive from four sites. One is located at the foot of a hill adjacent to a sand spit making up the southern head of Tairua Harbour mouth; the other is adjacent the sandy Hahei Beach. In the Western Bay of Plenty, nine of the twelve sites are from coastal locations; four close to Papamoa Beach, three around the estuary of the Waiau River near to Athenree and Bowentown, and a further two close to the river mouths at Maketu and Whakatane. In addition to providing places from which to launch canoes for fishing, these locations provided access to either or both sandy or estuarine shores for shellfishing, and in some cases also to habitats for fowling. As with the Group A sites, soils for gardening are likely to have been available near at hand.

The exceptional Group B assemblages are CHE-1920, ROW-1972 and HAM-9. CHE-1920 is from a small pit complex at Cheyne Rd, Oropi, which is approximately 10 km from the ocean coast, although located adjacent to a navigable river. ROW-1972 was an eroding shell midden located on a steep bank in Ohauiti, approximately 11 km from the coast, but near the Pukekonui Stream. Both of these assemblages are relatively small, so there must be some caution about their reliability as a reflection of subsistence practices. Nonetheless they do indicate that fish and shellfish were transported inland to areas used for gardening. HAM-9 is an exceptional case located more than 35 km from the sea on the shores of Lake Rotorua, containing freshwater shellfish.

Group C assemblages also show a marked concentration on fishing and shellfishing, although in this case they contribute more evenly to the dietary intake. Again coastal locations predominate, with the two Coromandel Peninsula examples located adjacent to the Tairua and Whangapoua harbours. In the Western Bay of Plenty one is located adjacent to the Ohiwa Harbour and three are close to Papamoa Beach. As with Group B, there are some inland examples, with three assemblages from Oropi. Overall the locational requirements for Group C sites appear to be similar to those for Group B.

The largest group of assemblages is the study sample where those in which subsistence activity was restricted to shellfishing. The ten examples from the Coromandel Peninsula area

all located around the Whangamata, Whitianga and Whangapoua harbours. In some cases they are nearer to the upper reaches of these harbours than close to the harbour mouths as was the case with Group A sites. In the Western Bay of Plenty half of the twenty-four Group D assemblages are located near the coast, either on the sandy Papamoa or Waihi beaches, or around the estuarine shores of the Tauranga harbour. The other half are located in a band *ca.* 10 km inland from the open coast in contexts that include at least one large defended settlement, several pit complexes and temporary camps, perhaps associated with gardening activity. None of these are far from navigable waterways that would have assisted the transport of shellfish inland from the coast.

In summary, there appears to be an inverse relationship between the range of subsistence activities represented in a site and the environmental constraints on its location. Sites with the widest subsistence range occurred only in ecotonal locations from which a wide range of resource zones could be accessed. Sites with a narrower subsistence range were located in a more diverse range of settings, some at considerable distance from the resources being exploited. Before considering the reasons for this it is important to also consider potential inter-relationships, and the distribution of the various site types and subsistence practices through time.

6.5.2 WERE THERE DIFFERENCES BETWEEN THE SUBSISTENCE ACTIVITIES REPRESENTED IN CONTEMPORARY SITES IN EACH OF THE STUDY AREAS THAT MIGHT SUGGEST THAT THAT THESE SITES WERE INTERRELATED ECONOMICALLY?

In order to evaluate subsistence patterns at a regional level it is necessary to consider whether the communities living there utilised a range of different sites types during the course of their annual activity cycle. One component of the evidence that can be used to assess this resides in the similarities or differences evident in the faunal assemblages derived from contemporary sites within the region. As emphasised in Chapter One, this is likely to provide an incomplete reflection of the interrelation of sites, but it is a way of using the evidence compiled in this study as a starting point for a more wide-ranging analysis.

The early period sites in the Coromandel Peninsula study set were predominantly generalised assemblages with evidence for a broad range of subsistence activities (Group A). As argued above they were located in prime ecotonal settings to facilitate this broad-spectrum food quest. On this basis it can be proposed that these sites were relatively independent of each

other, and if more than one was used by the same community they were utilised in much the same way. There were also two early period assemblages, both from the same site, which exhibited a somewhat more restricted subsistence range (Group B). One way of interpreting this site is that it was a satellite camp of one of the communities based at a Group A settlement. Some support for this can be found in the site type classifications (Table 5.2) which categorised both Group B assemblages from Hahei Beach as small temporary camps, whereas the Group A assemblages were classified as Large undefended settlements. However, as analysis of comparable sites in East Otago has shown, detailed analysis of artefact assemblages is necessary to confirm such interpretations (Smith, I.W.G. 1999).

Coromandel sites from the early-middle period exhibit a very similar pattern. Six of the seven assemblages exhibited the generalised, broad-ranging subsistence strategy that places them in Group A, and were classified as either large undefended settlements or small to medium sized temporary camps. The remaining assemblage was placed in Group B and categorised as a small temporary camp. Again this suggests a settlement pattern that combined primary settlements focussed on prime ecotonal locations integrated with some smaller satellite camps, that shared a similar locational and subsistence orientation.

Middle, middle-late and late period assemblages from the Coromandel show a very different pattern. There were no sites with a broad generalised subsistence base, and only one of the five assemblages from these three periods assigned to the semi-generalised Groups B and C had evidence of anything other the fishing and shellfishing. The remaining ten assemblages showed that subsistence activity was restricted solely to shellfish gathering. On subsistence grounds alone it can be proposed that the sites exhibiting only shellfish remains must have been linked through community mobility with sites that provided evidence of marine fishing. There was no consistent relationship between subsistence practices and site types through this time period. The middle period sample included one large undefended settlement (Group B) and five small temporary camps (Group D). Two small undefended settlements were identified in the middle-late period sample, with one assigned to Group C and the other to Group D, along with two small temporary camps (one each in Groups C and D) and a large undefended pit complex (Group D). The four sites in the late period were all temporary camps, evenly distributed between Groups C and D. While the sample sizes for each of these periods is small, the impression that they give is of a more mobile settlement pattern.

The Western Bay of Plenty dataset shows similarities with the later pattern identified in the Coromandel. In four of the five time periods there are no assemblages with a broad, generalised subsistence base, and more than half (57%) have evidence of only shellfish collecting. Only one assemblage, the sole early period site represented, MAS-187, falls in to the Group A pattern of a broad subsistence base. As argued above, this implies an inter-relationship with sites from which fishing and, in a small number of cases, bird hunting or dog-rearing took place. Sites identified as either undefended or defended settlements were most commonly in Group B (3 sites), with smaller numbers in Group C (1) and D (2), suggesting that there was a preference for locating primary settlements in places from which marine fishing could be conducted. Adding to the impression of mobility and inter-relatedness of sites is the presence of both fish and shellfish in sites located at a distance from the ocean coast.

6.5.3 WERE THERE CHANGES OVER TIME IN EITHER OR BOTH STUDY AREAS IN THE RANGE AND RELATIVE IMPORTANCE OF SUBSISTENCE ACTIVITIES AND/OR THE INDICATIONS OF INTERRELATIONS BETWEEN CONTEMPORARY SITES?

As demonstrated above the Coromandel dataset exhibits strong evidence of a shift from a generalised subsistence base to one focussed on a restricted range of activities. During the early and early-middle periods subsistence was based around hunting fur seals and marine fishing, supplemented by catching terrestrial, marine and wetland birds, hunting moa, raising dogs, and of course gathering shellfish. From the middle period onward fur seals and moa were no longer exploited, birds were hunted less frequently and the primary subsistence activities were restricted to fishing and shellfish gathering. In the earlier phase there is a limited amount of evidence for the integration of sites within a regional settlement pattern. This is implied more strongly for the later phase.

The Western Bay of Plenty dataset does not show a major shift in subsistence focus over time, with sites from the early-middle period onwards focused predominantly on fishing and shellfish gathering, with only limited evidence for fowling and dog-rearing at a handful of sites. There are strong indications that a range of site types were inter-related within a settlement pattern that involved movements of people and/or food resources. One trend that is apparent through time in the Western Bay of Plenty is increasing use of areas at a distance from the ocean coast.

6.5.4 WHAT EXPLANATIONS CAN BE FORWARDED FOR ANY OF THE OBSERVED CHANGES?

It is likely that the changes in prehistoric faunal subsistence observed in the Coromandel Peninsula are strongly correlated with the extirpation of local fur seal colonies (Smith, I.W.G. 2005) and the small moa population that occupied this area at the time of first human settlement (Worthy & Holdaway 2002). It is noteworthy that sites from the middle, middle-late and late periods occupy very similar locations to those used in earlier times, indicating that they would have had access to the resources favoured during the early and early-middle periods if they had been available.

The lack of evidence for major change in the Western Bay of Plenty may relate to the dearth of data for the early period. Sites that are likely to have produced faunal assemblages similar to the early sites in the Coromandel have been reported from ecotonal settings at Mount Maunganui (Hooker, R.H. 2010e) and Whakatane (Phillips, K.J.S. 2007a), but were not available for the present study. The relative scarcity of such sites in this region is likely due to the limited number of locations that this study shows were favoured by the earliest settlers. Whether or not that is the case, what the Western Bay of Plenty evidence shows is that the transition to the style of subsistence that characterised later prehistory in both study areas happened earlier here than in the Coromandel. In part this may reflect the greater availability of ecotonal locations in the Coromandel that sustained the early subsistence and settlement patterns for longer. Recorded sites with horticultural components have comparable densities in the study areas, although recorded evidence of taro, ditches and channels and stone structures are more common in the Coromandel Peninsula, while recorded horticultural soils are more common in the Western Bay of Plenty (Furey 2006:62, 69). No argument can easily be made on the current evidence that one study area was more suitable for horticulture than the other, or that the soils of the Western Bay of Plenty were able to support more rapidly growing populations than the Coromandel Peninsula.

Three Western Bay of Plenty assemblages, two from the middle period (ROW 3218, MAT 2351) and one from the middle-late period (ANA 46 Upper) are from sites with earthwork defences. Fortified sites, or pa, began to appear in New Zealand, particularly in the North Island, from approximately 1500 AD century throughout New Zealand (Schmidt 1996a:447), and are generally interpreted as a response to increased competition between communities as a result of population growth (Marshall 2004; Phillips, C.A. & Campbell 2004; Walter, R.,

Smith et al. 2006). Pa are a significant part of the archaeological landscapes of the two study areas where they occur predominantly around coastlines, in foothills at the edge of dune systems and plains, and alongside lakes, swamps and rivers. Exactly how many have been excavated in the two study areas has not been established, but they make up just under 20% of the excavated sites in Law's (2008) review of Bay of Plenty archaeology. Their much lower representation in the study samples (7% of the Western Bay of Plenty sample; 0% in Coromandel) may indicate that faunal remains were not routinely deposited at all pa, although the sampling strategies of those excavating these sites could also have played a part. Whichever is the case, the scarcity of pa sites in the study sample places some limitations on the ways in which data from this study can be used to explain the integration of pa into subsistence and settlement patterns in the study areas.

Nonetheless, three important observations can be made. Firstly, almost three quarters (73%) of the study assemblages derive from the middle period or later, which corresponds with the time when pa proliferated, supporting the hypothesis that human population growth was one of the underlying reasons for the emergence of pa. This is particularly evident in Western Bay of Plenty where there is a dramatic increase in study sites between the early-middle (11% of sample) and middle (48%) periods. The pattern is less clear in the Coromandel where the number of study sites per period declines slightly after the early-middle period. It seems more likely that this is a product of archaeological sampling than a reflection of population decline, although this cannot be demonstrated from the evidence in this study.

Secondly, it was noted above that over time an increasing number of settlements were located at distances of up 10km from marine food gathering locations, providing another probable indication of population pressure on resources. This is consistent with evidence from the inland swamp pa at Kohika, which dates to approximately the middle-late and late periods (Irwin 2004b). As outlined previously, the establishment of this pa has been attributed to declining resource availability of the coast, and the generalised faunal exploitation practised there was achieved through mobility via river and swamp. A trend towards increasing mobility can also be inferred from the present study which shows that over time there were more functionally differentiated sites integrated within the settlement patterns of each study area.

The third observation from this study is that some, or perhaps most, harvesting and consumption of animal foods was taking place at settlements that did not require earthwork

defences. This suggests that even after the emergence of pa, some components of the settlement system remained substantially unchanged. This parallels the proposition by Walter et al (2006:285) that pa were "not so much a discrete monumental site type…but are defended versions of, or adjuncts to, settlement forms that persisted throughout the prehistoric sequence."

The primary aim of this thesis has been to identify and explain changes in subsistence patterns in two adjacent study areas on the northeast coast of the North Island. This has shown a consistent pattern of narrowing breadth of faunal resource exploitation which can be explained by resource depression as a consequence of human exploitation. A secondary aim was to explore what these results might imply about the nature of settlement patterns and how they changed through time. It has been suggested that the settlement patterns became more dispersed and mobile in response to the changes in subsistence patterns. It was never the intention of this study to outline a fully developed model of subsistence or to address broader aspects of culture change; to do this would have required analysis of a larger suite of data on artefacts, features, site types and their locations, which was beyond the scope of the present study. However the evidence of subsistence change that is offered here and the changes in settlement patterns that they imply provide a starting point for future analysis of these broader issues.

7 CONCLUSION

7.1 REFLECTING ON AIMS

This thesis has reassessed subsistence patterns on the Coromandel Peninsula and Western Bay of Plenty areas of the northern North Island, New Zealand, during the prehistoric period and used them to evaluate models of subsistence and settlement developed previously in New Zealand archaeology. In order to do this, three main research questions were investigated: 1) what was the range of subsistence activities undertaken at each study site, and where was each site located in relation to the environments from which those resources are most likely to have derived; 2) were there differences between the subsistence activities represented in contemporary sites in each of the study areas that might suggest that these sites were interrelated economically; and 3) were there changes over times in either or both study areas in the range and relative importance of subsistence activities and/or the indications of interrelations between contemporary sites?

Firstly, this research has examined seventy-three assemblages of faunal material from across the Coromandel Peninsula and the Western Bay of Plenty, as well as a case study assemblage from the Cabana Lodge site in the Coromandel Peninsula. The results in chapter five and the discussion in chapter six show that the assemblages fall into four main groups of faunal class subsistence activity patterns, from those that included hunting marine mammal supplemented with a wide range of other subsistence activities including fishing, bird and mammal hunting and shellfishing (mostly Group A), those that focussed on fishing with a few supplementary subsistence activities (Group B), those that balanced two subsistence activities, mainly fishing and shellfish gathering (Group C), and those which focused solely on shellfishing (Group D). In chapter six it was observed that Group A assemblages were restricted to sites where rocky coastlines were present in order to access *Arctocephalus forsteri*, mainly on the Coromandel Peninsula. Group B assemblages were from sites in coastal locations, often sandy beaches or near harbour mouths, but also sites further inland near estuaries, providing launching spots for canoes in which to go fishing, and access to sandy or estuarine shores for shellfish gathering; some of these locations were also utilised for fowling. Group C is similar to Group

B, with assemblages from sites near sandy beaches or harbours, as well as inland sites near estuaries. Group D assemblages occur in a wider range of locale types, including areas far from navigable waterways, important for inland transport – suggesting that these assemblages indicate consumption or processing locations, not just shellfishing access points. This research has demonstrated an apparent inverse relationship between the range of subsistence activities represented in a site and the environmental constraints on its location.

Secondly, this research has used assemblages with radiocarbon dates meeting strict criteria, in order to assign them to five time periods within New Zealand prehistory. These assemblages and their sites were examined by time period and study area. Differences were identified between the two study areas in terms of the range of subsistence activities represented, and within the two study areas different ranges of activities are apparent in different periods, although the trends are not identical. These results build a picture of mobility and inter-relatedness.

Thirdly, this research examined the assemblages by time period for changes in either or both study areas in the range and relative importance of subsistence activities, looking for possible indications of interrelations between contemporary sites. The Coromandel dataset is found to exhibit a shift from a generalised subsistence base to one focused on a restricted range of activities from the middle period onwards. In comparison the Western Bay of Plenty dataset does not exhibit a major shift in subsistence focus over time with all but one site exhibiting a restricted range of subsistence activities. From the early-middle period onwards inland areas were used in comparable rates to those of coastal Western Bay of Plenty assemblages.

This research looked for possible explanations for the observed patterns changes, and identified different factors for the two study areas. It was proposed that the Coromandel Peninsula was attractive for early settlers because it had numerous ecotonal locations with rocky shores, sandy beaches, estuaries in close proximity to coastal forests and garden soils. These were settings in which a generalised subsistence strategy could flourish from village or hamlet settlements with minimal need for satellite sites for distant resource procurement. The demise of the generalised subsistence strategy is strongly correlated with the extirpation of local seal colonies and the small moa population, prompting greater reliance on a narrower range of fish and shellfish resources. Although similar locations were utilised for settlements in the middle, middle-late and late periods, the presence of numerous shellfish-only middens

strongly indicates that there was a greater need for mobility and procurement of distant resources.

Only one site in the Western Bay of Plenty dataset dated to the early period, and as in the Coromandel it was located in a ecotonal setting and exhibited a generalised subsistence regime. Both the scarcity of such sites and examination of coastal topography suggest that this region had comparatively few of the ecotonal locations from which a generalised subsistence strategy could easily operate. When settlement proliferated beyond these few localities, from the early-middle period onwards, reliance upon a more restricted faunal subsistence strategy was the only option. Thus the near absence of change in the faunal record for this area reflects the near absence of early period settlement. At the same time the reliance upon a more restricted subsistence regime which integrated functionally differentiated site types emerged earlier here than it did in the Coromandel.

7.2 IMPLICATIONS

An important aspect of the results of this research is that it reaffirms that there was no move from small transient camps in early prehistory, to larger, sedentary villages in late prehistory in northern New Zealand prehistory; indeed the evidence appears to suggest the reverse. A number of early sites in the Coromandel are sedentary villages exhibiting various activities from subsistence to stone tool manufacture (e.g. Cabana Lodge), and by the middle period both the Coromandel and Western Bay of Plenty show increasing numbers of small, temporary camp sites, many of which consist of small shellfish-only middens.

This pattern indicates proliferating groups of people during the middle period in the Western Bay of Plenty as resource availability and subsistence activities changed. This pattern shows some resemblance to the Strandlooper concept, initially raised in relation to the Pacific by Groube (1971:312), who hypothesised that Lapita potters subsisted primarily on marine resources and expanded ahead of later colonising agriculturalists. Anderson (1996a) later used the Strandlooper concept in his model of late settlement for East Polynesia, where "predation took early precedence over horticultural expansion and that since preferred faunal resources were depleted fairly easily and quickly, there was an incentive for some people to move on in search of new reserves quite soon after colonization, instead of remaining to invest more energy in horticultural expansion" (1996:367-368). Davidson and Leach (2001) pointed to unanswered questions about "the nature of the subsistence economy of colonising

populations" in the central and eastern Pacific, and used an example from central New Zealand prehistory. While this thesis does not address horticulture specifically, and does not make attempts to identify first colonisation or evidence of the earliest practice of horticulture, it has indicated that settlement in the early period focused on 'sweet spots' of abundant resources, and that horticulture was practiced at this time, but later in the middle period expansion into areas of less abundant faunal resources is strongly associated with the emergence of pa.

As noted in Chapter One, two-phase models of culture change have predominated in reconstructions of New Zealand's prehistory. This study has shown that while there is evidence of change in subsistence and settlement patterns in the study regions its does not fit neatly into a two-phase model; both the pattern and timing of changes identified above differ between the two study areas. This emphasises the importance of taking a regional approach to the study of change. While some parts of New Zealand have been the subject of intense investigation and review, others have been neglected or poorly studied. Only through detailed evaluation of multiple regional sequences will it be possible to assess the overall reliability and utility of generalised models of settlement and subsistence change.

7.3 CONTRIBUTION

This research has demonstrated regional variation in two adjacent study areas in spite of their temporal and spatial proximity. This underscores that even adjacent regions in virtually identical climates can be affected by differences in geomorphology, volcanic activity (especially ash and tephra fall), vegetation, watercourses and shore types. Not only are trajectories of change in the two adjacent regions reaching different endpoints, the timing of evident changes are not contemporaneous. This further reinforces that generalisations across time and space for adjacent regions inevitably overlook the fine-grained detail of spatial and temporal subsistence change which has been identified in this research.

Walter, R., Smith et al. (2006) argued that upon arrival in New Zealand, the Polynesian settlers brought with them their subsistence and settlement practices as a 'village lifestyle' and tried to maintain these in the New Zealand setting. Hunting large game such as moa and marine mammals allowed them to maintain these practices initially, but Polynesian village practices had to be modified for the greatly different New Zealand setting. This current research has demonstrated two trajectories of change in Walter et al.'s (2006) 'transient

village'. The Coromandel Peninsula had early villages with generalised subsistence strategies persisting longer, which were succeeded by a narrower but still relatively generalised strategy. In the Western Bay of Plenty, however, the region was generally settled later, very few villages were present, and the inhabitants typically followed a 'dispersed community' settlement pattern.

These differing trajectories support an argument for greater variation than the 'transient village' model originally allowed for. As further regions are studied or re-valuated, further examples of increased variation between 'village lifestyle' subsistence and settlement patterns are expected.

7.4 OBSERVATIONS

One of the issues encountered in the gathering of data for this research project is the inconsistency with which faunal data are presented, particularly in the grey literature of consultants' reports. Issues ranged from some faunal classes not being analysed or reported for an assemblage; inconsistent quantification with a mixture of MNI and Presence/Absence methods used for different faunal classes within an assemblage; only relative abundance (e.g. %MNI) being reported with no indication of how big or small the assemblages were.

A further issue relates to radiocarbon dates – sometimes the original radiocarbon laboratory reports are not included in consultant report appendices, making recalibration of dates near impossible. Some reports do not list a clear and precise feature context from which the sample was taken (e.g. F24 firescoop in Area 4, Layer 3); some reports use charcoal but do not identify the tree species; some charcoal samples are from long-lived species which may have in-built ages. An obvious deduction of this research is that if the grey literature of consultants' reports is to be utilised by other consultants and researchers, faunal and radiocarbon data needs to be presented clearly, consistently and accurately. Otherwise it is of little value as a contribution to the wider archaeological knowledge base.

Both of the above issues have restricted the vast number of assemblages that could have been otherwise included in this analysis; had they been complete data sets with clearly described radiocarbon samples and laboratory numbers, the tentative observations made in this research would have been far more conclusive.

Furthermore, reporting of methods of analysis of all sources is never likely to be consistent. For example, in this research it was not possible to take into consideration the impact of sieve screen size on results, as more often than not it was unspecified.

7.5 Future Research Directions

Further investigation of single- and multi-function sites in both the Coromandel and Western Bay of Plenty areas is needed to address temporal and spatial patterns in faunal assemblages in these areas more thoroughly. Also, this research could be supplemented with the results of excavations and detailed faunal analysis and accurate radiocarbon dates from sites within the current study area, particularly where there is a dearth of assemblages such as the west coast of the Coromandel Peninsula, and also in adjacent areas such as the eastern Bay of Plenty beyond Ohope. Pa sites in particular would provide greater insight into subsistence and settlement patterns.

Material culture assemblages could also be analysed in order to examine whether there are changes in form, material or function from sites in north-eastern New Zealand, particularly the Western Bay of Plenty.

On a more practical level, this research has demonstrated that data from consultant's unpublished reports is a valuable resource for archaeological research. This vast amount of data is impossible to generate by university and institute research programmes. This reinforces the need for consistency in archaeological field methods reports; they need to be clearly structured with well documented methods for analysis and sample selection (especially for radiocarbon dating), assign site record numbers to be included in the reports, and also include appendices that present basic data (i.e. raw NISP, MNE and MNI data) so that issues of sample size and calculation method can be taken into account for later comparison. This is of pivotal importance when one considers the bulk of today's excavations are done by consultants. It is this work which is expanding our knowledge of New Zealand prehistory and has the potential to fill in many 'gaps' in the understanding of regional sequences, and correct long-held assumptions based on small samples and erroneous radiocarbon dates. Efforts to improve the standard of reports have been made by the New Zealand Historic Places Trust by providing guidelines and giving consultants feedback; the Professional Development Cell has been running workshops on different fields of archaeological skills and analysis since 2006. However, some consultants are resistant to making changes, and keeping costs within budget

is an additional constraint. However, most of the suggestions here just require more detail in the reporting process, and do not equate to additional time during fieldwork or analysis. The importance of archaeological reporting is that once the site is investigated and destroyed, it cannot be re-investigated. If investigations are not reported to a standard that allows inter-site comparison for further research, then it can be argued the reports are next to valueless.

The implications of this research relate to the assumptions or generalisations that are often made about northern New Zealand prehistory, which are sometimes based on a small number of early excavations, unreliable radiocarbon dates and erratic faunal quantification. Old, established assumptions need to be tested in order to place the archaeology of New Zealand prehistory on stable foundations.

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APPENDICES

A1 LITERATURE TABLES

A1.1 COROMANDEL PENINSULA LITERATURE

Table A.1 Sites excavated within the Coromandel Peninsula study area

Site Name	Site No.	Location	References	Investigation Method
Sting Ray Point Pa	T10/169 (N40/11)	Matakawau Point, Great Mercury Island	(Golson 1955; Green 1963a).	Excavation
Opito Beach / Skippers Midden	T10/161 (N40/3)	Opito Bay, Kuaotunu Peninsula	(Golson 1959a; 1959c; Scarlett 1962; Trower 1962; Green 1963a; Boileau 1980)	Excavation
Skipper's Ridge	T10/165 (N40/7)	Opito Bay; Kuaotunu Peninsula	(Golson 1959c; Parker 1959; 1960; 1962; Green 1963a; Bellwood 1968; 1969; Davidson 1974; 1975; Davidson & Green 1975; Davidson 1976)	Excavation
Sarah's Gully	T10/167 (N40/9)	Whaorei Bay, Kuaotunu Peninsula	(Golson 1959a; 1959c; Golson & Gathercole 1962; Green 1963a; 1972a; Scarlett 1974; Davidson 1986)	Excavation
Sarah's Gully Pa	T10/168 (N40/10)	Whaorei Bay, Kuaotunu Peninsula	(Golson 1959c; Birks 1960; Green 1963a; Birks & Birks 1970; Green 1972a; Birks & Birks 1973).	Excavation
Tairua	T11/62 (N44/2)	Tairua Harbour	(Yaldwyn 1959; Smart & Green 1962; Davidson 1964a; 1964b; Green 1967; Jones 1973; Rowland 1975; 1977b; 1977a; Smith, I.W.G. 1978; Davidson 1979; Schmidt & Higham 1998).	Excavation
Curry and Moore Gate site	T10/159 (N40/1)	Opito Bay; Kuaotunu Peninsula	(Jolly & Green 1962; Trower 1962; Green 1963a).	Excavation
Sarah's Midden	T10/171 N40/13	Whaorei Bay, Kuaotunu Peninsula	(Green 1963a; 1972a; Davidson 1979)	Excavation
Harataonga Bay Pa	T08/3 (N30/3)	Harataonga Bay; Great Barrier Island	(Spring-Rice, W. 1962; Spring-Rice, W. 1963; Law 1972; Morwood 1974; Law 1975b)	Excavation
Harataonga Bay Eastern Midden	T08/4 (N30/4)	Harataonga Bay; Great Barrier Island	(Spring-Rice, W. 1962; Spring-Rice, W. 1963; Law 1972; Morwood 1974; Law 1975b)	Excavation
Harataonga Bay Western Midden	T08/5 (N30/5)	Harataonga Bay; Great Barrier Island	(Spring-Rice, W. 1962; Spring-Rice, W. 1963; Law 1972; Morwood 1974; Law 1975b)	Excavation
First Pohutukawa Midden	T10/170 (N40/12)	Opito Bay; Kuaotunu Peninsula	(Shaw 1963)	Excavation

Table A.1 Sites excavated within the Coromandel Peninsula study area, *continued*

Site Name	Site No.	Location	References	Investigation Method
Whiritoa	T12/500 (N53/4)	Whiritoa Beach, between Whangamata and Waihi Beach	(Jolly & Green 1962; Crosby, E.B.V. 1963; Foreman & Jolly 1965; Crosby, E.B.V. 1977; Davidson 1979).	Excavation
Skippers Ridge II	T10/226 (N40/73)	Opito Bay, Kuaotunu Peninsula	(Bellwood 1969)	Excavation
Poikeke Pa	T12/6 (N49/6)	Mercury Bay, Poikeke Island	(Moore, P.R. 1977c)	Excavation - test
Home Bay	U12/5 (N49/43)	Slipper Island	(Rowland 1978)	Excavation – test; MA thesis
South Bay	U12/9 (N49/48)	Slipper Island	(Willan 1974; Rowland 1978)	Excavation – test; MA thesis
Te Puia Pa	T12/152 (N49/184)	Tairua State Forest, north of Whangamata Harbour mouth	(Jones 1981c)	Excavation - test
Brier Block sites	T11/210, 219 & 226 (N44/182, 191 & 198)	Whangapoua State Forest 169, inland between Manaia and Coromandel Harbours	(Furey 1982c; 1982a; 1983a; 1986b; 1987c)	Excavation
Port Jackson	S10/299 (N35/38)	Far north Coromandel Peninsula	(Best, S.J. 1975; Davidson 1979; Foley 1981; Foster 1983b)	Excavation; salvage; surface collection
-	N40/586	Otama Block, Whangapoua State Forest 169, Kuaotunu Peninsula	(Furey 1983c; 1984b; 1984c; 1984a)	Damage assessment, excavation & restoration
Cross Creek	T10/399 (N40/260)	Sarah's Gully, Whaorei Bay, Kuaotunu Peninsula	(Sewell 1983; 1984a; 1986; 1988)	Excavation; MA thesis
-	T11/242 (N44/215)	Hahei beach	(Nichol 1986; 1988)	Excavation - test
-	T12/617	Tairua Forest, north of Whangamata Harbour	(Furey 1987a)	Excavation
-	T11/643, 644, 648	Holzgang Block, Whangapoua State Forest	(Crosby, A., Sewell et al. 1987)	Excavation
-	-	Whitipirorua	(Furey 1988)	Excavation
-	T12/654	Compartment 140, Tairua State Forest	(Short 1988)	Excavation
-	T12/999	Moana Park subdivision, Whangamata	(Phillips, C.A. 1996a)	Excavation – nature & extent testing
-	T12/959	Moana Park subdivision, Whangamata	(Phillips, C.A. 1997)	Excavation – nature & extent testing
-	T12/985	Totara, south of Thames	(Gumbley 1997b; 1997a)	Excavation - mechanical
-	T11/836	South of the Te Mata River, west coast	(Twohill, N.F. 1996; Gumbley 1998a; Twohill, N.F. 1998)	Excavation
-	T12/984	Kopu Pa complex, south of Thames	(Phillips, C.A. 2000f; 2000d)	Excavation
-	T12/985	Te Totara, Thames	(Phillips, C.A. 2000b)	Excavation

Table A.1 Sites excavated within the Coromandel Peninsula study area, *continued*

Site Name	Site No.	Location	References	Investigation Method
-	T12/937	Tararu, Thames	(Sewell 2001)	Excavation
-	T12/125	Hikuai Block, Tairua Forest	(Gumbley 2002e)	Excavation
-	T12/1152	Main Block, Tairua Forest	(Gumbley 2002c)	Excavation
-	T12/1053	Ohui Block, Tairua Forest	(Gumbley 2002a)	Excavation
-	T11/624 & 858	Whitianga Waterways	(Furey 2002a)	Excavation
-	T12/1028	Pauanui	(Gumbley 2003c)	Excavation
-	T11/624	Whitianga	(Furey 2003b)	Excavation
-	T11/927	Club Marina Apartments, Whitianga	(Campbell & Gumbley 2004a)	Excavation
-	T11/1184	Rennie St, Tararu	(Phillips, C.A. 2004a)	Excavation
-	T12/91 & 1170	Tairua Forest, Whangamata	(Gumbley 2004e)	Excavation
-	T12/300	at Kopu, Thames	(Phillips, C.A. 2005d)	Excavation
-	T12/1044	Whangamata	(Gumbley 2005a)	Excavation
-	T11/981	Whangapoua Forest, Whitianga	(Felgate 2005b)	Excavation
-	T11/454	Compartment 104, Whangapoua Forest, Whitianga Harbour	(Gumbley 2007a)	Excavation
-	T10/229, 227 & 777	Skipper's Road, Opito Bay, Kuaotunu Peninsula	(Gumbley & Hoffmann 2007b)	Excavation, archaeological assessment
-	T12/1243	Whangamata	(Mallows 2009b)	Excavation
-	T10/751, 752 & 753	Whangapoua	(Gumbley 2008)	Excavation
	T12/372, 373 & 1236	Totara Palms, Thames	(Phillips, C.A. 2008)	Excavation
-	T12/172 & 173	Ngarimu Heights	(Hoffmann 2008)	Excavation
-	T12/3	Cabana Lodge, Whangamata	(Gumbley & Hoffmann 2008)	Excavation
-	T10/1084 & 1086	Whangapoua	(Furey 2008a)	Excavation & extent testing
-	-	White Beach, Great Mercury Island (Ahuahu)	(Furey 2009a)	Excavation
-	T12/1035	Beach Rd, Whangamata	(Hoffmann 2009c)	Excavation & monitoring
	T10/824	Kuaotunu	(Hoffmann 2009a)	Excavation

Table A.2 Sites investigated by surface collection, salvage excavation or inspection, from the Coromandel Peninsula study area

Site Name	Site No.	Location	References	Investigation Method
Fisher's Midden	T10/162 (N40/4)	Mahinapua Bay; Kuaotunu Peninsula	(Fisher 1936; Green 1963a)	Surface collection
Dentalium Shell Necklace 'Workshop'	T10/163 (N40/5)	Mahinapua Bay; Kuaotunu Peninsula	(Golson 1959c; Scarlett 1962; Green 1963a);	Surface collection
Whangamata Wharf / Cabana Lodge	T12/2 & 3 (N49/2 & 3)	Whangamata	(Jolly & Green 1962; Shawcross 1964b; Allo 1972; Jolly 1978b).	Surface collection / excavation - salvage
Headland Pa	T10/173 (N40/15)	Opito Bay; Kuaotunu Peninsula	(Golson 1957);	Surface collection
Tahanga Quarry	T10/166 (N40/8)	Tahanga Hill; Kuaotunu Peninsula	(Shaw 1963)	Surface collection
Wellman site	T10/174 (N40/16)	Opito Bay; Kuaotunu Peninsula	(Wellman 1962; Green 1963a)	Description of exposure
Parker's Midden / Pohutukawa Flaking Floor	T10/160 (N40/2)	Opito Bay; Kuaotunu Peninsula	(Jolly & Green 1962; Green 1963a; Murdock & Jolly 1967; Jolly & Murdock 1973; Davidson 1979)	Excavation - salvage
Hot Water Beach	T11/115 (N44/69)	Hot Water Beach	(Leahy 1971; 1974)	Excavation - salvage
-	-	Whangapoua & Tairua State Forests	(Davidson 1973)	Inspections
Whitipirorua	T12/16 (N49/16)	Onemana, north of Whangamata	(Jolly 1978a; Furey 1988; 1990; 1991)	Surface collection; Excavation
Opito	T10/174 (N40/16)	Opito Bay, Kuaotunu Peninsula	(Calder & Calder 1977)	Excavation - salvage
T10/223	N40/70	Opito Bay, Kuaotunu Peninsula	(Jolly 1979; 1981)	Excavation - salvage
Hahei	T11/326 (N44/97)	Hahei	(Edson & Brown 1976; 1977; Edson 1979; Harsant 1979; 1983; 1985)	Excavation - salvage
Aputa Pa	T12/139	Thames Coast Road, Te Puru	(Gumbley 2004d)	Remedial works

Table A.3 Site surveys undertaken in the Coromandel Peninsula study area

Survey Area	Reference	Type
Coromandel coast - Whiritoa Beach, Whangamata Harbour, Opoutere Beach, Hikuai, Tairua Harbour, Hahei Beach, Coroglen	(Green 1959)	Survey – multiple sites
Tuhua (Mayor Island)	(Pos 1961)	Survey – multiple sites
West side of the Coromandel Peninsula, near Port Jackson	(Diamond, J.T. 1962)	Survey – multiple sites
Great Barrier Island	(Spring-Rice, W. 1962)	Survey – multiple sites
Harataonga, Great Barrier Island	(Spring-Rice, W. 1963)	Survey – multiple sites
Kuaotunu Point, Kuaotunu Peninsula	(Buist 1965)	Survey – multiple sites
Little Barrier Island	(Hurley & Swadling 1969)	Survey – multiple sites
Whakau (Red Mercury Island)	(Moore, P.R. 1972b)	Survey – multiple sites
Opito and Otama	(Calder 1972; 1975)	Survey – multiple sites
Great Barrier Island	(Atwell 1973)	Survey – multiple sites
Alderman Islands	(Moore, P.R. 1973b)	Survey – multiple sites
Kaitoke-Harataonga, Great Barrier Island	(Coster & Johnston 1975c)	Survey – multiple sites
Port Jackson - Port Charles	(Best, S.J. 1975)	Survey – multiple sites
Wentworth and Ohui Blocks, Tairua State Forest	(Coster & Johnston 1975b)	Survey – multiple sites
Whenuakite, Hikuai, Ohui & Wentworth Blocks; Tairua State Forest	(Coster & Johnston 1975a)	Survey – multiple sites
Shoe and Slipper Island group	(Atwell, Spencer et al. 1975)	Survey – multiple sites
Mount Maungatawhiri area; north Whitianga	(Puch 1975)	Survey – multiple sites
Slipper Island	(Rowland 1975)	Survey – multiple sites
Port Charles	(Walmsley & Barton 1976)	Survey – multiple sites
Tapu-Thorntons Bay	(Diamond, L. 1976)	Survey – multiple sites
Coromandel Town and Tatahoa Stream	(Edson 1976)	Survey – multiple sites
Waikawau Bay	(Reynolds & Tippett 1976)	Survey – multiple sites
Hahei Islands and mainland Hahei	(Moore, P.R. 1976e)	Survey – multiple sites
Tairua and Whangapoua State Forests	(Nugent & Nugent 1977)	Survey – multiple sites
Colville Bay	(Boileau & Tippett 1977)	Survey – multiple sites
Kennedy Bay	(Mangan, Hansen et al. 1977)	Survey – multiple sites
Tapu-Thorntons Bay, West Coast Thames	(Coster & Johnston 1977)	Survey – multiple sites
Blocks IX and X; Coromandel Town	(Hansen & Barton 1978a)	Survey – multiple sites
Kaitoke-Tryphena Harbour; Great Barrier Island	(Butts & Fyfe 1978)	Survey – multiple sites
Southern Kennedy Bay	(Hansen & Barton 1978b)	Survey – multiple sites
Opoutere; Wharekawa Harbour	(Phillips, C.A. 1978)	Survey – multiple sites
Kaitoke Tryphena Harbour, Great Barrier Island.	(Butts & Fyfe 1978)	Survey – multiple sites
Hikuai Bloc, Tairua State Forest	(Coster & Johnston 1978b)	Survey – multiple sites
Brier Block; Whangapoua State Forest	(Coster & Johnston 1978c)	Survey – multiple sites
Hikuai Block; Tairua State Forest	(Coster & Johnston 1978b)	Survey – multiple sites
Brier and Griffen Blocks; Whangapoua State Forest	(Coster & Johnston 1978d)	Survey – multiple sites
H.G. Leach and Co. Quarry	(Coster & Johnston 1978a)	Survey – multiple sites
Compartment 125; Tairua State Forest Whangamata	(Furey & Williams 1979)	Survey – multiple sites
Lower Kauaeranga-Matatoki	(Twohill, N.F. 1979)	Survey – multiple sites
Lower Tairua Valley	(Diamond, L. 1979)	Survey – multiple sites
Waiaro	(Boileau & Tippett 1979)	Survey – multiple sites

Table A.3 Site surveys undertaken in the Coromandel Peninsula study area, *continued*

Survey Area	Reference	Type
Matawhawhau Point, Great Barrier Island	(Butts 1979)	Survey – multiple sites
Lower Tairua Valley	(Coster & Johnston 1979a)	Survey – multiple sites
Great Barrier State Forest 165, Great Barrier Island	(Furey 1980a; Furey & Stuart 1980)	Survey – multiple sites
Kennedy Bay	(Barton 1980)	Survey – multiple sites
Whitipirorua Reserve	(Furey 1980c)	Survey – multiple sites
Whitipirorua Farm	(Furey 1980b)	Survey – multiple sites
Moehau Block, Coromandel State Forest Park 149	(Pierce & Olsen 1980)	Survey – multiple sites
West Tairua Block, Tairua State Forest	(Pierce & Olsen n.d.-b)	Survey – multiple sites
Otanguru, Waitekuri & Griffen Blocks; Whangapoua State Forest	(Pierce & Olsen n.d.-a)	Survey – multiple sites
Little Barrier Island - Hauturu	(Bartlett n.d.)	Survey – multiple sites
Whangapoua State Forest, Western Otanguru Block	(Coster & Johnston 1979b)	Survey – multiple sites
Ohui-Opoutere-Wharekawa Harbour	(Furey n.d.)	Survey – multiple sites
Lower Kauaeranga-Matatoki	(Twohill, N.F. 1979)	Survey – multiple sites
Tairua State Forest 150	(Olsen, K. 1980b)	Survey – multiple sites
Opera Point, Whangapoua	(Olsen, K. 1981)	Survey – multiple sites
West Block, Tairua State Forest 150	(Charters 1981)	Survey – multiple sites
Thames-Manaia Coast	(Diamond, L. 1981)	Survey – multiple sites
Eastern Otanguru Block, Whangapoua State Forest 169	(Pierce 1981)	Survey – multiple sites
Tuhua (Mayor Island)	(Seelenfreund, A.C. 1982)	Survey – multiple sites
Beaches of the Coromandel Peninsula, Thames to Whiritoa	(Easdale & Jacomb 1982)	Survey – multiple sites
Great Mercury Island	(Furey 1983b)	Survey – multiple sites
Tairua State Forest 150	(Sewell 1984b)	Survey – multiple sites
Waiparau Pa, Great Mercury Island, Initial Report. Unpublished	(Irwin 1985b)	Survey – single site
Holzgang Block, Whangapoua State Forest	(Furey 1986a)	Survey – multiple sites
Tairua Block, Coromandel Forest	(Furey 1987b)	Survey – multiple sites
Lower Kuaotunu Valley and Lower Kuaotunu	(Twohill, N.F. 1990; 1992)	Survey – multiple sites
Tahanga Hill, Kuaotunu Peninsula	(Clough & Sheppard 1993)	Assessment & excavation
Owera Road to Owera Head, Whangapoua Harbour	(Twohill, N.F. 1993)	Survey – multiple sites
Owera Valley Floor and Koruakomako, Whangapoua Harbour	(Twohill, N.F. 1994)	Survey – multiple sites
Red Mercury Island (Whakau)	(Ritchie, N.A. 1994)	Survey – multiple sites
Otahu River to Whiritoa Beach	(Gumbley 1997c)	Survey – multiple sites
Te Aputa Pa (T12/139), Te Puru, Thames	(Gumbley 1997a)	Assessment
Great Barrier Island	(Best, S.J. 1999)	Survey – multiple sites
Owera, Whangapoua Harbour	(Twohill, N.F. 2000)	Survey – multiple sites
Opito Bay	(Darmody 2001)	Survey – multiple sites
Pauanui Sewerage Treatment Plant, Settlement Road, Pauanui	(Gumbley, Campbell et al. 2001)	Assessment
Okiwi Airfield, Okiwi, Great Barrier Island	(Prince & Clough 2001)	Assessment & monitoring
Coastal lifestyles Subdivision at Hotwater Beach	(Simmons, A. 2002a)	Assessment
Totara, Thames	(Phillips, C.A. 2002a)	Assessment
Whiritoa	(Gumbley 2002b)	Assessment

Table A.3 Site surveys undertaken in the Coromandel Peninsula study area, *continued*

Survey Area	Reference	Type
Thames Storm Water	(Pishief 2004)	Assessment
Whangamata	(Campbell 2004e)	Assessment
Pakirikiri Park Development, Coromandel Town	(Campbell 2005c)	Assessment
Matarangi	(Furey 2005)	Survey – multiple sites
Skipper's Road, Opito Bay	(Gumbley & Hoffmann 2007b)	Assessment

Table A.4 Post-graduate research relating to the Coromandel Peninsula study area

Site No.	Coromandel Locations	References
-	Tairua	(Davidson 1964b)
-	Alderman Islands, Cuvier Island, Tuhua (Mayor Island), Slipper Island, Whakahau, Ahuahu and Great Mercury Island	(Edson 1973)
T11/62, U12/9 & 5 (N44/2, N49/48 & 43)	Tairua , South Bay, Home Bay, Slipper Island	(Rowland 1975)
Numerous	Coromandel Peninsula	(Furey 1981b)
S10/299 (N35/38)	Port Jackson	(Foster 1983a)
T10/399	Cross Creek	(Sewell 1984a)
T11/62 & 115, T10/160, 161 & 167 (N44/2 & 69, N40/2, 3 & 9)	Tairua, Hot Water Beach, Parker's Midden, Opito Beach Midden & Sarah's Gully	(Smith, I.W.G. 1985)
T10/164	Arthur Black's Midden, Opito Bay	(Mann 2009)

Table A.5 Monitoring reports from the Coromandel Peninsula study area

Site No.	Location	References	Type
T10/993	Matarangi Sandspit, Whangapoua Harbour	(Furey 1997; 1998; 1999)	Monitoring
T11/857	Te Mata, Thames	(Phillips, C.A. 2000a)	Monitoring
T10/733	Whangapoua	(Sewell 2000b)	Monitoring
T10/983, 985 & 988 - 991	Matarangi Beach	(Sewell 2000a; 2003b)	Monitoring
T10/1091	Sealey St, Thames	(Phillips, C.A. 2001a)	Monitoring
S08/406 - 415	Okiwi Airfield, Great Barrier Island	(Prince & Clough 2001)	Monitoring
T10/640 & 735	Tangiroa Ave and Te Punga Rd, Whangapoua	(Sewell 2002a)	Monitoring
T10/70 & 315; T11/71, 96, 97, 612 & 613	Ferry Landing to Cooks Beach	(Sewell 2002b)	Monitoring
T11/593	Purangi Reserve	(Simmons, A. 2002b)	Monitoring
T11/508 & 611	Purangi Road, Cooks Beach	(Sewell 2003a)	Monitoring
T11/926	Cook Drive, Whitianga	(Furey 2003a)	Monitoring
T11/906	Ocean Beach Road, Tairua	(Gumbley 2004a)	Monitoring
-	Richmond St, Thames	(Phillips, C.A. 2005c)	Monitoring
-	Tararu, Thames	(Phillips, C.A. 2005a; 2006a)	Monitoring
T10/737	Anarake subdivision, Whangapoua	(Sewell 2005)	Monitoring
T12/139	Aputa Pa	(Gumbley 2007c)	Monitoring
T11/977	Whitianga	(Mallows 2007a)	Monitoring
T11/62	Tairua	(Furey 2009b)	Monitoring
T12/1035	Beach Rd, Whangamata	(Hoffmann 2009c)	Monitoring

Table A.6 Post-harvest reports from the Coromandel Peninsula study area

Site No.	Location	References
T12/152, 452, 900, 931, 953 & a-k	Compartments 123 and 125 , Tairua Forest, Whangamata	(Hooker, R.H. 1994a)
T12/965, 966 & 969	Tairua Forest, Whangamata	(Barr 1996)
T12/153	Whangamata Peninsula	(Barr 1997)
T10/291, 733 & T11/598	Whangapoua Forest	(Gumbley 2002d)
T10/724 & 755		(Gumbley 2003a)
Numerous	Windy Ridge Road, Ohui Block, Tairua Forest	(Simmons, A. 2003a; 2003b; 2003c; Gumbley 2006c)
T11/904, 905, 939, 940, 941	Compartment 103, Whangapoua Forest	(Gumbley 2004f)
T11/599, 903, 929, 938	Compartment 33, Whangapoua Forest	(Gumbley 2004c)
T12/1221 & 1222	Warahoe Forest	(Gumbley 2004g)
T11/961, 965, 966 & 975	Whangapoua Forest	(Gumbley 2005c)
T12/52 & 82	Waikiekie Stream	(Gumbley 2005d)
T11/147, 480 & 481	Compartments 87, 68, 106 & 104, Whangapoua Forest	(Gumbley 2006d)
T11/967, 968, 152, 969 & 970	Compartments 7, 50, 73 & 88, Whangapoua Forest	(Gumbley 2007b)
T11/976, 151, 248, 246, 249, 250, 251, 334, 335, 152, 935, 959, 969, 970, 154, 966, 336, 964, 975, 243, 244, 245, 247, 339, 84, 149 & 153	Compartments 62-85, Whangapoua Forest	(Hoffmann 2009b)

Table A.7 Published articles and other reports relating to the Coromandel Peninsula

Site No.	Location	References	Focus
-	Thames	(Phillips, W.J. 1952)	Maori houses and food stores
N40/5	Mahinapua Bay	(Scarlett 1958)	description of a Dentalium shell necklace workshop
N40/6	Mahinapua Bay, Arthur Black's Midden	(Scarlett 1962)	Interim list of moa species identified from NI sites
-	Darkie Stream	(Diamond, J.T. 1963)	Pa without visible earthwork defences
-	Tairua	(Davidson 1964a)	Middens
-	Coromandel Harbour	(Bellwood & Witter 1967)	Rescue observation of midden deposits
N30/3, 4 & 5; N40/1 - 3, 7 – 13; N44/2	Harataonga Bay, Sting Ray Point Pa, Sarah's Gully Pa, Sarah's Midden, Sarah's Gully, Opito, Skipper's Ridge, Curry and Moore Gate Site, First Pohutukawa Midden, Pohutukawa Flaking Floor, Tahanga Quarry, Tairua.	(Law 1969a)	Review of sites excavated in the northern North Island
N53-53/47	Whiritoa North Cave	(Law 1969b)	Petroglyph description
-	McGregor Bay, Coromandel Harbour	(Witter 1969a)	Observation on midden and adze
-	Harataonga Bay, Great Barrier Island.	(Law 1970)	File manufacturing technique
-	Mercury Bay, Whiritoa,	(Trotter & McCulloch 1971)	Prehistoric rock art
-	Great Barrier Is, Opito, Hot Water Beach, Sarah's Gully, Skipper's Ridge,	(Green 1972b)	Moa-hunters and agriculture
-	Great Barrier Island (Te Ahumata, Awana), Fanal Island, Cook's Bay, Tairua, Hahei	(Ward 1973)	Obsidian source localities in the NI
N30/3 - 5	Harataonga Bay, Great Barrier Island	(Morwood 1974)	Functional analysis of obsidian
N40/9	Sarah's Gully	(Scarlett 1974)	Prehistoric moa
-	Tahanga Hill, Opito, Kuaotunu Peninsula	(Keyes 1975)	Prehistoric trade in New Zealand
N40/8, 261 & 262	Tahanga Hill, Opito, Kuaotunu Peninsula	(Moore, P.R. 1975b; 1976d)	Description of Tahanga basalt
-	Tahanga Hill, Opito, Kuaotunu Peninsula	(Best, S.J. 1976)	Tahanga adzes in Cook Islands assemblage
-	Kuaotunu Peninsula	(Best, S.J. & Merchant 1976)	Siliceous sinter
-	Skipper's Ridge, Opito, Mercury Bay, Totara	(Fox 1976)	Discussion of pa
N30/4 & 5; N40/1, 3, 7 & 9; N44/2, & 69	Great Barrier Island, Western Midden, Eastern Midden, Hotwater Beach, Tairua, Sarah's Gully, Curry and Moore Gate Site, Skipper's Ridge, Opito	(Rowland 1976)	*Cellana denticulata* as a temporal horizon in middens on the Coromandel Coast
N44/2 & 69; N40/7 & 9	Tairua, Skipper's Ridge, Sarah's Gully, Hot Water Beach, Tahanga Quarry & Mayor Island	(Best, S.J. 1977)	Change in adze material & form
N40/9, 12 & 16	Opito, Sarah's Gully, Great Mercury Island	(Houghton, P. 1977a)	Human skeletal material
N30-32/130	Kaiarara, Great Barrier Island	(Houghton, P. 1977b)	Human skeletal material
	Whiritoa, Tairua, Hot Water Beach, Opito Beach, Sarah's Gully	(Trotter 1977)	Review of research on sites containing moa bone since 1956
-	Tahanga Hill, Opito, Kuaotunu Peninsula	(Moore, P.R., Keyes et al. 1979)	Analysis of the side-hafted adze
-	Coromandel Peninsula and adjacent off-shore islands	(Furey 1980d)	Annotated bibliography of archaeological site surveys

Table A.7 Published articles and other reports relating to the Coromandel Peninsula, *continued*

Site No.	Location	References	Focus
-	Opito, Mercury Bay, Kuaotunu Peninsula	(Olsen, C. 1980a)	Forensic report on single human burial
N40/3, N44/69, N49/43 & 48	Hot Water Beach, Opito Beach, Slipper Island	(Wilson, B.M. 1980)	Conchiolin dates
-	Coromandel Peninsula	(Furey 1982b)	Review of excavation literature
-	Tairua State Forest, Te Puia Pa	(Hamel & Jones 1982)	Guide to vegetation management on archaeological Sites
-	Oruarangi, Thames, Harataonga, Kennedy Bay, Sarah's Gully, Skipper's Ridge, Opito, Tahanga, Hot Water Beach, Tairua, Whitipirorua, Whangamata, Whiritoa	(Law 1982)	Regional overview
-	Cooks Beach & Hahei	(Moore, P.R. 1983)	Geology and geochemistry of obsidian deposits
N49/652	Wharekawa Harbour, Tairua S.F. 150	(Olsen, K. 1983)	Forensic report on two human burials
-	Woody Hill, Tairua	(Moore, P.R. & Coster 1984)	Obsidian deposits
-	Coromandel Peninsula	(Furey 1985)	Obsidian artefacts in the Auckland Museum
-	Tahanga, Opito, Kuaotunu Peninsula	(Jones 1987)	stone and wood technology
-	Coromandel Town	(Furey 1989)	Petroglyph sites
-	Kauri Point	(Green 1990)	Open settlements
-	Opito and Otama, Kuaotunu Peninsula	(Sewell 1990)	Review of archaeological fieldwork since 1963
-	Sarah's Gully, Mt Tahanga, Wharetaowa,	(Jones 1994)	Aerial photographs
-	Tahanga, Opito	(Turner & Bonica 1994)	Adze production on the Coromandel East Coast
-	Harataonga, Sarah's Gully;	(Schmidt 1996a)	Commencement of pa construction in New Zealand prehistory
-	Great Mercury Is, Whangapoua, Kaimarama, Tairua, Onemana, Whangamata	(Higham & Hogg 1997)	C14 dates & evidence for late Polynesian colonisation of New Zealand
-	Mercury Bay, Whitianga	(Moore, P.R. 1999a)	Radiocarbon dates
-	Whangamata	(Moore, P.R. 1999b)	Whangamata
T10/399	Cross Creek, Opito, Kuaotunu Peninsula	(Leach, B.F. & Davidson 2000)	Pre-European catches of snapper (*Pagrus auratus*)
-	Harataonga Bay, Great Barrier Island	(Horrocks, Jones et al. 2002)	Plant microfossils in prehistoric coprolites
-	Thames Coast	(Phillips, C.A. 2005b)	Cultural resource strategy
-	Whanaoua Bay and Harataonga Bay, Great Barrier Island; Waikawau Bay, Sarah's Gully, Korapuki Island, Opito, Otama Beach, Hahei, Hot Water Beach, Tairua, Opoutere, Whitipirorua & Whangamata	(McFadgen 2007)	Impact of tectonic and volcanic events on archaeological evidence
T08/3 - 5 (N30/3 - 5)	Harataonga, Great Barrier Island	(Allen, M.S. & Holdaway 2010)	Avifauna
-	Aotea (Great Barrier Island)	(Bulmer n.d.)	Management strategy

A1.2 Western Bay of Plenty Literature

Table A.8 Sites excavated within the Western Bay of Plenty study area

Site No.	Location	References	Type
U15/145 (N67/2)	Pakatore, Matapara, Paengaroa	(Golson 1959b; Golson & Stafford 1959; Golson 1960)	Excavation
U13/4 (N53/5)	Owarau Pa (Kauri Point Pa), Kauri Point, Katikati	(Golson 1961b; 1961c; 1961a; Melvin 1961a; Schofield 1961)	Excavation
Unknown	Thornton, Whakatane	(Pullar 1961a)	Excavation
W15/1 (N69/1)	Karearea Pa, Kaea; Camellia Lane, Whakatane	(Kingsley-Smith, Pullar et al. 1961; Mabon 1961)	Excavation
W15/22 (N69/24)	Ana-O-Muriwai (Muriwai's Cave), Muriwai Drive, Whakatane	(Pullar 1961b; Stafford 1962)	Excavation & cave stratigraphy
U13/4 (N53/5)	Kauri Point Swamp, Kauri Point, Katikati	(Ambrose 1962; Shawcross 1962; 1963; 1964c; Ambrose 1967; Law 1975a; Shawcross 1977; Green 1978; Maingay 1984; Phillips, C.A., Johns et al. 2002)	Excavation
U13/8 (N53/10)	Ongari Point Pa, Ongare Point, Katikati	(Schofield 1964; Shawcross 1964a; 1966)	Excavation
Unknown	Thornton, Whakatane	(Shawcross 1965)	Excavation
W15/82 (N69/87)	Hikutaia (?), Port Ohope Recreation Reserve, Ohiwa Harbour	(Moore, K.W. 1972a)	Excavation - salvage
V15/80 (N68/104)	Kohika, Matata	(Irwin 1975; Lawlor 1975; Moore, K.W. 1975a; London 1976; McGlone & Pullar 1976; Moore, K.W. 1976a; Lawlor 1980; Wallace & Irwin 1999; Irwin 2000; Horrocks, Irwin et al. 2003; Holdaway, S.J. 2004b; Irwin 2004b; Irwin & Jones 2004; Irwin, Nichol et al. 2004; Moore, P.R. 2004b; Wallace, Irwin et al. 2004; Irwin, Wallace et al. 2007)	Excavation
V16/199 (N77/574)	Valley Road, Kawerau	(Walton, A.J. 1980)	Excavation - salvage
V16/216-20, 238 (N77/584-8, 606)	Maruka, Hardie Ave, Tuwharetoa Road, Beattie Road, Shepherd Road, Kawerau	(Furey 1981c; 1981a; Lawlor 1981a; 1981b; Lawlor, Allen et al. 1981; Moore, K.W. 1981a; Lawlor 1982 ; Furey 1983d; Lawlor 1983a; 1984; Moore, K.W. 1991)	Excavation - salvage
V16/199 (N77/574)	Fenton Valley Mill Road, Kawerau	(Walton, A.J. 1981)	Excavation - salvage
U13/44, 47, 50 (N53/77, 80, 83)	Koutunui, Koutunui Road and Adela Stewart Drive, Athenree	(McFadgen 1982b)	Excavation and survey
W16/85 (N78/141)	Hui Te Rangiora Pa, Manawa o Tuhoe Block, Paekoa Road, Whakatane Valley, Bay of Plenty	(Jones 1981a)	Section profiles
W16/119, 181, 183, 189, 190 (N78/189, 324, 339, 345, 346)	Pukehau, Waiotahi Valley	(Jones 1984a)	Excavation
V18/16 (N95/32)	Whirinaki, Kaingaroa	(Jones 1984b)	Excavation
U14/38 (N67/72)	Ruahihi Pa, Ruahihi Road, Lower Kaimai	(McFadgen & Sheppard 1984)	Excavation

Table A.8 Sites excavated within the Western Bay of Plenty study area, *continued*

Site No.	Location	References	Type
U14/243, 2240, 2482	SH2, Papamoa; Birch Ave, Judea; Holmburn Street, Welcome Bay, Tauranga	(Anon. 1985; McFadgen 1985)	Excavation - NZHPT
U15/35	Tupakaria, Hamurana Road, Lake Rotorua	(Kahotea 1988)	Excavation
W15/32, 33 & 35	Tuwhare Pa, Whakatane	(Bowers, L.C. & Jones 1990; 1991)	Excavation and restoration
U14/539	Grant Place, Papamoa Beach	(Kahotea 1993)	Excavation
U13/46, 47, 78 (N53/79, 80, 115)	Anatere Pa, Koutunui Road, Athenree	(Gumbley 1994)	Excavation
U14/2824, 2825, 2828, 2829	Blake Boulevard, Papamoa	(Hooker, R.H. 1995c; McGovern-Wilson & Hooker 1995b)	Excavation - mitigation
U13/46 (N53/79)	Anatere Pa, Koutunui Road, Athenree	(McGovern-Wilson & Hooker 1995a; Phillips, C.A. & Allen 1996b; 1996a)	Excavation - mitigation
U14/2841	Longview Drive, Papamoa	(Fredericksen, Barber et al. 1995)	Excavation
U14/2789 - 2793	Sandhurst Drive, Papamoa	(Hooker, R.H. 1995b)	Excavation
U14/1717	Santa Fe Key, Papamoa	(McGovern-Wilson 1995)	Excavation
V15/1209, W15/582	Tokitoki, Ohiwa Harbour & Kopeopeo Dunes, Matata	(McGovern-Wilson 1996)	Excavation
U14/1978, 1977	Boscabel Drive, Ohauiti, Tauranga	(Kahotea 1996)	Excavation
U14/2847	Suffolk Close, Papamoa Beach	(Hooker, R.H. 1997)	Excavation
U14/518	Fourth Avenue, Tauranga	(Bowers, L.C. & Phillips 1997a)	Excavation
U14/2873	Parton Road, Papamoa Beach	(Bowers, L.C. & Phillips 1997b)	Excavation
W15/584	Te Horo Drive, Ohope Beach	(Bowers, L.C. & Phillips 1997c)	Excavation
U14/1721, 2833- 2887	Evans Road, Doncaster Drive & Opal Drive, Papamoa Beach	(Hooker, R.H. 1998i; 1998a; 1998b)	Excavation
U14/2246	Ohauiti Road, Welcome Bay.	(Hooker, R.H. 1998e)	Excavation
U14/534	Gordon Spratt Reserve, Parton Road, Papamoa	(Hooker, R.H. 1998d; 1999a)	Excavation
U14/1675	Reid Road, Papamoa	(Bowers, L.C. & Phillips 1998d)	Excavation
U14/1711 -1713, 2820, 2893 & 2894	Grenada Street, Te Kuia Te Parewaitai Subdivision, Papamoa	(Hooker, R.H. 1998c; 1998g; 1999c; Hooker, R.H. 1999f)	Excavation
U14/526	Domain Road, Papamoa.	(Hooker, R.H. 1998f)	Excavation
U14/1710, 2895 & 2896	Kahira Crescent, Pacific View Road and Papamoa Beach Road, Te Hana Mount View Subdivision, Papamoa	(Hooker, R.H. 1998h; 1999e)	Excavation
U14/175, 202 & 196	Maungatapu, Otumoetai, Motuhoa	(Walton, A.J. 1998)	
U14/2032, 2035 & 2037	Aurora Avenue and Oteki Park drive, Welcome Bay, Tauranga	(Hooker, R.H. 1999d; 2000f)	Excavation
U13/1110	Athenree Road, Athenree	(Moore, P.R. 2000)	Excavation
U14/2897 & 2898	Papamoa Beach Road, Seacrest Resort, Papamoa	(Hooker, R.H. 2001e)	Excavation
U14/3064 & 3066	Mayfield Lane, Bethlehem, Tauranga	(Phillips, K.J.S. 2003d)	Excavation
U14/1945	Oropi Road, Oropi Downs, Tauranga	(Campbell 2003b; Campbell & Piahana 2003; Campbell 2004a)	Excavation
U13/1270 & 1326	Wilson Park, Waihi Beach	(Moore, P.R. 2003b; 2003c)	Excavation

Table A.8 Sites excavated within the Western Bay of Plenty study area, *continued*

Site No.	Location	References	Type
U14/3197	Oropi Park, Poike Road, Tauranga	(Phillips, K.J.S. 2003g; Campbell 2004b)	Excavation
U14/3119	Mana St, Otumoetai, Tauranga	(Phillips, K.J.S. 2003h)	Excavation
U14/1224	State Highway 2, Apata	(Hooker, R.H. 2004b)	Excavation
U13/78	Koutunui Rd, Athenree	(Moore, P.R. 2004a)	Excavation
U14/3211	Carmichael Road, Bethlehem, Tauranga	(Prince 2004b)	Excavation
U14/1920 & 3193	Cheyne Road, Tauranga	(Furey 2004b)	Excavation
U14/2888 - 2892	Domain and Gravatt Roads, Papamoa	(Felgate 2004; 2005a; 2005c)	Excavation & damage report
U14/3113 & 3116	Papamoa Beach Road, Papamoa	(Gumbley & Phillips 2004)	Excavation
U14/2866	Papamoa Junction, Parton Road, Papamoa	(Campbell 2004h; Gumbley 2005b; 2006a).	Nature & extent testing excavation (S18);
U13/874, 875 & 876	Pio Rd, Bowentown, Waihi Beach	(Moore, P.R. 2004c)	Excavation
U14/1810	Poplar Lane, Papamoa	(Gumbley 2004b)	Excavation
U14/3207	Richmond Park, Hollister Lane, Tauranga	(Campbell 2004g)	Excavation
U14/3205	Waiorohi Subdivision, Ohauiti Road, Welcome Bay	(Hooker, R.H. 2004e)	Excavation
U15/9	Paketuri, Hamurana Road, Rotorua	(Campbell & Phillips 2005; Campbell & Horrocks 2006)	Excavation
U14/2039	Highgrove Subdivision, Kaitemako Road, Welcome Bay, Tauranga	(Hooker, R.H. 2005d)	Excavation
T13/859	Mayor View Terrace, Northern Heights Subdivision, Waihi Beach	(Moore, P.R. 2005d)	Excavation
U14/1972, 3218 & 3235	Rowesdale, Ohauiti, Tauranga	(Campbell 2005a)	Excavation
U14/1358	Whakamarama Road, Whakamarama	(Hooker, R.H. 2005e)	Excavation
U13/1261, 1328, 1329 & 1331	Angus Lane and Citrus Avenue, Quayside Estate Subdivision, Waihi Beach	(Moore, P.R. 2005c)	Excavation
U14/2029, 2031 & 2028	Waikite Road, Welcome Bay, Tauranga	(Hooker, R.H. 2005b)	Excavation
U14/885	Walden Lane, Wairoa, Tauranga	(Moore, P.R. 2005a)	Excavation
U14/3107	Cliff Road, Tauranga	(Prince 2005)	Excavation
V15/1331	Clem Elliot Drive, Matata	(Phillips, K.J.S., McGovern-Wilson et al. 2005)	Excavation S18
U15/501 & 502	Allport Road, Paengaroa	(Moore, P.R. 2006a)	Excavation
W15/780	The Strand, Whakatane	(Phillips, K.J.S. 2006b)	Excavation
V15/5 & 587	Old Coach Road, Paengaroa	(Hooker, R.H. 2006b)	Excavation
U15/355, 356, 713 & 715	SH3, Paengaroa	(Moore, P.R. 2006c)	Excavation
U14/2899	Papamoa Beach Rd, Papamoa	(Felgate 2006b)	Excavation
U14/2903, 2907 & 2906	Papamoa Beach Road, Papamoa Gateway Subdivision, Papamoa	(Gumbley 2006b)	Excavation
U14/3271 - 3273	Rosella Drive, Welcome Bay, Tauranga	(Prince 2006)	Excavation
U13/1246	The Crescent, Waihi Beach	(Moore, P.R. 2006b)	Excavation
U14/521 & 524	Domain Road, Landsdale Subdivision, Papamoa.	(Hooker, R.H. 2007f)	Excavation

Table A.8 Sites excavated within the Western Bay of Plenty study area, *continued*

Site No.	Location	References	Type
U14/3270	Harbour View Road, Omokoroa	(Hooker, R.H. 2007b)	Excavation
U14/2876	Parton Road, Papamoa	(Phillips, K.J.S. 2007b)	Nature & extent testing excavation (S18)
U14/3081	Poplar Lane, Papamoa Quarry, Tauranga.	(Gumbley & Hoffmann 2007a)	Excavation
U14/3218	Rowesdale, Ohauiti, Tauranga	(Campbell & Harris 2007)	Excavation
U14/3221	350 Wairoa Road, Te Puna	(Campbell 2008)	Excavation
U14/1465 & 3239	Florence Lane, Te Puna, Tauranga	(Furey 2008b)	Excavation
-	Kaitemako, Welcome Bay, Tauranga	(Gumbley & Farley 2008)	Excavation
-	Kaitemako substation, Welcome Bay, Tauranga	(Campbell & Farley 2008)	Excavation
U14/3056, 3216 & 1941	Oropi Downs, Oropi Road, Tauranga	(Campbell & Hudson 2008)	Excavation
U13/1285	Seaforth Road, Waihi Beach	(Moore, P.R. 2008b)	Excavation
U13/692 & 770	Tuapiro Point Reserve	(Moore, P.R. 2008a).	Excavation
U13/579, 581 & 582	Tanners Point Road, Tanners Point	(Moore, P.W. 2009i)	Excavation
U14/2065 & 3269	Balintoy Park, 166 Waikite Road, Welcome Bay	(Harris & Campbell 2009)	Excavation
U14/2351	Mataraua, Gargan Road, Tauriko, Tauranga	(Campbell & Hudson 2009)	Excavation
U14/1611	Waikite Road, Welcome Bay, Tauranga	(Moore, P.R. 2009c)	Excavation
U14/2713	Westminster Drive, Judea, Tauranga	(Prince & Turner 2009)	Excavation
U14/2402	Tauriko, Tauranga	(Harris 2009)	Excavation

Table A.9 Site surveys and archaeological assessments undertaken in the Western Bay of Plenty study area

Survey Area	Reference	Type
Rotorua	(Stafford 1960)	Survey
Ongari Point	(Ambrose 1961)	Survey (description of rock carvings)
Kapu-te-Rangi (Toi's Pa), Whakatane	(Mabon & Pullar 1961)	Survey – single site; oral tradition & history
Whakatane	(Stafford 1962)	Survey
Paparoa Pa, Ohiwa Harbour	(Pullar 1962b)	Survey – single site
Kauaea Pa, Kapu Te Rangi Pa, Muriwai Cave and Tauaroa Pa, Whakatane	(Pullar 1962a)	Survey – multiple sites
Kawerau	(Moore, K.W. 1962)	Survey – single site & excavation
Kauri Point	(Green 1963b)	Survey – multiple sites; excavation
Tamurenui Site, Onepu, Rangitaiki Plains	(Moore, K.W. & Pullar 1963)	Survey – single site
Tuanui Pa, Taneatua, Whakatane	(Mabon & Pullar 1963b; 1963a)	Survey – single site
Kauri Point	(Green 1964)	Survey – multiple sites
Whakatane, Matata, Kawerau, Te Teko, Ruatoiki, Taneatua	(Mabon, Pullar et al. 1964b; 1964a)	Survey – multiple sites
Onepu, Rangitaiki Plains	(Moore, K.W. 1965)	Survey – multiple sites
Kaka-Tarahae Pa site, Owhakatoro Valley	(Moore, K.W. 1966)	Survey – single site
Lake Okataina	(Johnson, N. & Calcott 1967)	Survey – single site
Whale Island (Motuhora Island)	(Hayward 1971)	Survey – single site
Bay of Plenty region	(Moore, K.W. 1974a)	Survey – multiple sites
Kohika	(Moore, K.W. 1975a)	Survey – single site
Whakatane & Ohope	(Moore, K.W. 1976b)	Survey – multiple sites
Rakei Hopukia , Te Teko	(Moore, K.W. 1976c)	Survey – single site
Te Koutu Pa, Lake Okataina	(Moore, K.W. 1977a)	Survey – single site
Ballantrae Block, Long/Marshall Block, Maruka, Kawerau	(Lawlor, Allen et al. 1981)	Survey – multiple sites & excavation
Kawerau	(Phillips, C.A. 1981b; 1981a; 1981c)	Survey – multiple sites
Waiotahi and Whakatane Valleys	(Tawhio 1980)	Survey – multiple sites
Davies Block, Omataroa Forest, Taneatua	(Jones 1981b)	Survey – multiple sites
Matakana and Rangiwaea Islands	(McFadgen & Walton 1981)	Survey – multiple sites
Lake Okataina	(Grace, R. 1982)	Survey – single site
Tuhua (Mayor Island)	(Seelenfreund, A.C. 1982; Seelenfreund, A.H. 1983)	Survey – multiple sites
Motuhua Island, Tauranga Harbour	(Walton, A.J. 1983)	Survey – multiple sites
Tauranga	(McFadgen 1984)	Survey – multiple sites
Motuhora (Whale Island)	(Bain 1985; 1987; Hayward, Moore et al. 1987)	Survey – multiple sites
Judea, Kopurererua Stream, Cambridge Road, Cameron Road, Tauranga	(Stodart 1989)	Survey – multiple sites
Taheke-Paengaroa	(Grouden 1990)	Survey – multiple sites
Judea, Tauranga	(Stodart 1992)	Survey – multiple sites
Matata and Ohope Scenic Reserves	(Grouden 1993)	Survey – multiple sites

Table A.9 Site surveys and archaeological assessments undertaken in the Western Bay of Plenty study area, *continued*

Survey Area	Reference	Type
Compartment 3, Stands 2, 3 & 4, Purakau Block, Matakana Island	(Marshall, Paama et al. 1993a)	Survey – multiple sites
Compartment 20, Stands 2,3,4 & 5, Paretata Block, Matakana Island	(Marshall, Paama et al. 1993b)	Survey – multiple sites
Compartment 3, Stands 2-4; Compartment 12, Stands 1-5; Compartment 14, Stand 2 and Compartment 20, Stands 1-5, Matakana Island	(Marshall, Paama et al. 1994a)	Survey – multiple sites
Papamoa Coast	(Fredericksen, Kahotea et al. 1996; Fredericksen, Felgate et al. 1997)	Survey – multiple sites
Ruatuna Road, Ohiwa	(Bowers, L.C. 1996b)	Survey – multiple sites & damage report
Te Papa Forest, Murupara	(Bowers, L.C. 1996a)	Assessment – multiple sites; forestry
Beach Road, Maketu	(Kahotea 1997)	Assessment – single site
Pyes Pa Road, Tauranga	(Bowers, L.C. & Phillips 1997d)	Assessment – residential subdivision; no sites identified
Te Tumu Kaituna Blocks 14 and 7b, Papamoa	(Bowers, L.C. & Phillips 1998a)	Assessment – multiple sites; forestry
Chelmsford Street, Kauri Point.	(Bowers, L.C. & Phillips 1998c)	Assessment – no sites
Tauranga Eastern Arterial, Domain Road Interchange to Wairakei confiscation boundary, Papamoa	(Bowers, L.C. & Phillips 1998b)	Assessment - no sites
Hiwaru Block, Ohiwa Harbour	(Gumbley 1998b)	Survey and excavation – single site; forestry
Tauranga Eastern Arterial, Te Puke and Waitangi	(Kahotea 1998)	Assessment – one site
Proposed Reservoir, Lots 6 & Part Lot 7 Kairua Road, Tauranga	(Phillips, C.A. 1999e)	Assessment – multiple sites
Lot 3, Kairua Road, Tauranga	(Phillips, C.A. 1999e)	Assessment – multiple sites
Marjorie Lane to Kaituna River Mouth, Papamoa	(Gumbley & Phillips 2000)	Assessment – multiple sites; heritage study
Tauranga Eastern Arterial, Mangatawa Lane to Truman Road, Papamoa	(Bowers, L.C. 1999b)	Assessment - no sites
Ohauiti Road, Tauranga	(Phillips, C.A. 1999d)	Assessment – one site
Poplar Lane Quarry, Papamoa	(Bowers, L.C. 1999a)	Assessment – multiple sites
Poplar Lane Quarry, Papamoa	(Phillips, K.J.S. 1999g)	Assessment – one site
Kairua Road, Tauranga	(Phillips, C.A. 1999c)	Assessment – multiple sites
Pyes Pa and Domain Road, Tauranga	(Phillips, C.A. 2000g)	Assessment – multiple sites
Steele Road, Athenree	(Phillips, C.A. 2000c)	Assessment – multiple sites
Cambridge Road, Tauriko	(Phillips, K.J.S. 2000j)	Assessment – no sites identified
Carmichael Road, Bethlehem	(Phillips, K.J.S. 2000k)	Assessment – multiple sites
Old-Coach Road-Rotoehu Road, Pongakawa Valley	(Hooker, R.H. 2000d)	Assessment – multiple sites
Te Ihu-o-te- Koura Pa, Paradise Valley, Rotorua	(Phillips, K.J.S. 2000h)	Assessment – one site
North Bethlehem, Tauranga	(Phillips, K.J.S. 2000i)	Assessment – multiple sites
Ohauiti Road, Welcome Bay, Tauranga	(Hooker, R.H. 2001g)	Assessment – multiple sites
Bowentown Domain, Bowentown	(Phillips, K.J.S. 2001c)	Assessment – multiple sites
Rocky Cutting Road, Welcome Bay, Tauranga	(Hooker, R.H. 2001f)	Assessment – multiple sites
Gate Pa, Tauranga	(Phillips, K.J.S. 2001b)	Assessment – no sites identified
Carmichael Road, Bethlehem, Tauranga	(Hooker, R.H. 2002a)	Assessment – multiple sites

Table A.9 Site surveys undertaken in the Western Bay of Plenty study area, *continued*

Survey Area	Reference	Type
Bellevue Road and Graham Place, Bellevue, Tauranga	(Phillips, K.J.S. 2002e)	Assessment – multiple sites
Miles Lane, Tauriko, Tauranga	(Phillips, K.J.S. 2002f)	Assessment – no sites identified
Waihi Beach Road, Waihi Beach	(Prince & Clough 2003)	Assessment – multiple sites
Freeburn Road - Pengary Lane, Pyes Pa, Tauranga	(Prince 2002)	Assessment – one site
Welcome Bay Road, Welcome Bay, Tauranga	(Hooker, R.H. 2002b)	Assessment – one site
Mayor View Terrace, Waihi Beach	(Phillips, K.J.S. 2002b)	Assessment – one site
Burma Road & Taneatua Road, Mokoroa Forest, Whakatane	(Phillips, K.J.S. 2002d)	Assessment – no sites; forestry
Papamoa Domain, Papamoa Beach Road, Papamoa	(Kahotea 2002)	Assessment – multiple sites
Mill Road, Whakatane	(Phillips, K.J.S. 2002g)	Assessment – multiple sites
Pyes Pa Road, Tauranga.	(Phillips, K.J.S. 2002h)	Assessment – no sites identified
Waterford Park, Kairua, Tauranga	(Phillips, K.J.S. 2002i)	Assessment – no sites identified
Little Waihi Rd, Otumakoro Creek, Wilson Road and Town Point Road, Maketu	(Phillips, K.J.S. 2003a)	Assessment – multiple sites
Mauao Historical Reserve, Mt Maunganui, Tauranga	(Phillips, K.J.S. 2003b)	Assessment – multiple sites
Kopurererua Valley Reserve, Greerton, Tauranga	(Bowers, L.C. & Phillips 2003)	Assessment – multiple sites
Te Tumu Ouwe Pa (U14/257), Maungatapu, Tauranga	(Phillips, K.J.S. 2003c)	Assessment – one site
Pyes Pa Road, Manor Park and Joyce Rd, Pyes Pa, Tauranga.	(Phillips, K.J.S. 2003e)	Assessment – no sites identified
Tuapiro Point Reserve, Katikati	(Phillips, K.J.S. 2003f)	Assessment – multiple sites
Waitaha Road and Osprey Road, Welcome Bay, Tauranga	(Prince 2003)	Assessment – no sites identified
Oropi Downs Stage 3, Tauranga	(Campbell 2003a)	Assessment – multiple sites
Ngapeke Road, Welcome Bay, Tauranga	(Hooker, R.H. 2004a)	Assessment – one site
Bell Road, Papamoa	(Phillips, K.J.S. 2004c)	Assessment – one site
Kairua Road, Welcome Bay, Tauranga	(Judge 2004)	Assessment – multiple sites
Papamoa East, Papamoa	(Phillips, K.J.S. 2004g)	Assessment – no sites identified
Papamoa East, Papamoa	(Phillips, K.J.S. 2004f)	Assessment – multiple sites
Te Rae o Papamoa - Papamoa Hills Cultural Heritage Regional Park	(Boffa Miskell 2004)	Assessment – multiple sites
Alice Johnson Reserve, Parton Road, Papamoa	(Campbell & Gumbley 2004b)	Assessment – multiple sites
Poplar Lane, Papamoa	(Bader & Hawkins 2004)	Assessment – one site
Rowensdale, Ohauiti, Tauranga	(Campbell 2004f)	Assessment – multiple sites
Tanners Point and Waihi Beach North, Waihi Beach	(Prince 2004a)	Assessment – multiple sites
Kopurerua Stream , Tauriko, Tauranga	(Campbell 2004d; 2004c)	Assessment – multiple sites
Tuihana, Papamoa Beach Road, Papamoa	(Bader, Hawkins et al. 2004)	Assessment – multiple sites
Waitaha Road, Welcome Bay, Tauranga	(Hooker, R.H. 2004d)	Assessment – one site
Waitaha Road, Welcome Bay, Tauranga	(Hooker, R.H. 2004c)	Assessment – no sites identified
Oropi East, Ohauiti East, Waitaha Road, Ranginui Road, Tauriko West, Kairua West, Kairua North, Kairua East, & Te Maunga	(Phillips, K.J.S. 2004e)	Survey – multiple sites
Waikite Road, Welcome Bay, Tauranga	(Hooker, R.H. 2005c)	Assessment – one site
Whakamarama Road, Whakamarama	(Judge 2005g)	Assessment – no sites identified
Gluepot Road, Oropi	(Judge 2005f)	Assessment – multiple sites
Kaitemako Road, Welcome Bay	(Judge 2005e)	Assessment – multiple sites

Table A.9 Site surveys undertaken in the Western Bay of Plenty study area, *continued*

Survey Area	Reference	Type
Lochead Road, Te Puna	(Judge 2005d)	Assessment – one site
Ohakana Island, Ohiwa Harbour	(Judge 2005c)	Assessment – multiple sites
Canon Road, Katikati	(Judge 2005b)	Assessment – multiple sites
Water Lane, Welcome Bay, Tauranga	(Judge 2005a)	Assessment – one site
Oropi Downs Stage III, Oropi Road, Tauranga	(Campbell 2005b)	Assessment – multiple sites
Bell Road, Papamoa	(Phillips, K.J.S. 2005e)	Assessment – multiple sites
Mauao, Mt Maunganui, Tauranga	(Anon. 2006)	Assessment – one site
Windermere, Poike, Tauranga	(Cable 2006b)	Assessment – one site
Kaitemako Road, Tauranga	(Campbell 2006a)	Assessment – multiple sites
Matapihi Road, Matapihi, Tauranga	(Campbell 2006a)	Assessment – one site
Inverness Drive, Te Ranga, Tauranga	(Hooker, R.H. 2006c)	Assessment – no sites identified
Goodall Road, Whakamarama	(James-Lee 2006)	Assessment – one site
Matapihi Road, Matapihi	(Mallows 2006b)	Assessment – one site
The Mall, Mt Maunganui, Tauranga	(Mallows 2006a)	Assessment – one site
Omokoroa Road, Omokoroa	(Phillips, K.J.S. 2006c)	Assessment – multiple sites
Pillans Road, Pillans Point, Otumoetai, Tauranga	(Phillips, K.J.S. & Clough 2006)	Assessment – multiple sites
State Highway 33, Paengaroa	(Hooker, R.H. 2007d)	Assessment – one site

Table A.10 Post-graduate research relating to the Western Bay of Plenty study area

Site No.	Locations	References
-	Tuhua & Motiti islands	(Edson 1973)
N68/104	Kohika	(Lawlor 1979)
N68/104	Kohika	(Williams 1980)
-	Tauranga	(Kahotea 1983)
-	Tuhua (Mayor Island)	(Seelenfreund-Hirsch 1985)
N68/104	Kohika	(Nichol 1988)
-	Western Bay of Plenty	(O'Keeffe 1991)
-	Waihi, Maketu, Lake Rotoiti, Lake Rotokawau, Ngongotaha, Whakarewarewa, Lake Tarawera	(Holroyd 1993)
-	Matakana Island	(Petchey 1993a)
U13/4 (N53/5)	Kauri Point	(Palmer 1994)
-	Tokitoki, Ohiwa Harbour, Rangitaiki Dunes, Whakatane Headland	(Phillips, K.J.S. 1996b)

Table A.11 Monitoring reports undertaken in the Western Bay of Plenty study area

Site No.	Location	References	Type
U14/2240	Birch Avenue, Judea, Tauranga	(Kahotea 1994a)	Monitoring
U14/2012 – 2014 & 2017	Wade Place, Kaitemako Heights subdivision, Welcome Bay, Tauranga	(Kahotea 1994b)	Monitoring
U14/2753	Papamoa	(Hooker, R.H. 1994b)	Monitoring
U16/61	Spencer Road, Te Miro Point, Lake Tarawera	(Hooker, R.H. 1995a)	Monitoring
U14/1820	Kairua Road, Tauranga	(Phillips, C.A. 1999f)	Monitoring
U14/2027	Estates Terrace, Welcome Bay, Tauranga	(Hooker, R.H. 2000a)	Monitoring
U15/642	Maungarangi Rd, Paengaroa	(Hooker, R.H. 2000b)	Monitoring
U13/1239	Chelmsford Street, Kauri Point, Katikati	(Hooker, R.H. 2001d)	Monitoring
U14/2028	Ocean Drive, Welcome Bay, Tauranga	(Hooker, R.H. 2001c).	Monitoring
U13/89, 46, 50, 911, 1246, 1247, 1267- 1322	Waihi Beach North	(Moore, P.R. & Phillips 2002)	Monitoring
W15/238 - 240	Compartment 3, Kererutahi Forest, Wainui Road, Nukuhou	(Hooker, R.H. 2003d)	Monitoring & forestry
W15/221, 222, 596 & 597	Compartment 404, Stanley Forest, Stanley Road, Nukuhou	(Hooker, R.H. 2003a)	Monitoring & forestry
U13/1317	Pohutukawa Drive, Athenree	(Moore, P.R. 2003a)	Monitoring
U14/3112	Windermere Drive, Poike, Tauranga	(Simmons, A. 2003d)	Monitoring
U14/1613	Waitaha Community Reserve , Corner Welcome Bay and Waitaha Roads, Welcome Bay, Tauranga	(Hooker, R.H. 2005a)	Monitoring
U14/201	SH2, Matapihi, Tauranga	(Cable 2005)	Monitoring
U13/782 - 783	Tuapiro Road, Ongare Point	(Hooker, R.H. 2005f)	Monitoring
U14/3256	Evans Road, Papamoa, Tauranga	(Felgate 2006a)	Monitoring
U14/1286	Snodgrass Road, Omokoroa	(Cable 2006a)	Monitoring
U14/2347, 2349 & 2361	Whiore Avenue, Tauriko Business Estate, Tauranga	(Campbell 2006b; 2009)	Monitoring
U14/363	The Mall, Mt Maunganui, Tauranga	(Mallows 2007b)	Monitoring
U14/3270	Harbour View Road, Omokoroa	(Hooker, R.H. 2007b)	Monitoring & excavation
-	Welcome Bay Road, Welcome Bay, Tauranga	(Hooker, R.H. 2007g)	Monitoring
U13/1275	Dillon Street, Waihi Beach	(Moore, P.R. 2007)	Monitoring
W15/1044	Ohope and Cliff Roads, Whakatane	(Cable 2007c)	Monitoring
W15/780	The Strand, Whakatane	(Cable 2007a)	Monitoring
U14/3088	Waikite Road, Welcome Bay, Tauranga	(Cable 2007b)	Monitoring
U14/312, 1612 & 3237	Welcome Bay Road, Welcome Bay, Tauranga	(Hooker, R.H. 2007e; 2007g)	Monitoring
U14/5, 7, 63, 1846 & 1863	Waitangi	(Cable 2008a)	Monitoring
U14/160, 1229, 1230 & 1231	Whakamarama Road	(Cable 2008b)	Monitoring
V14/187 & 188	Beach Road, Maketu	(Moore, P.R. 2008c; Moore, P.R., Taylor et al. 2009)	Monitoring
U13/1335 - 1337	Pio and Tatai Roads, Bowentown, Waihi Beach	(Moore, P.R. 2008d)	Monitoring
U13/692 & 770	Tuapiro Point Reserve	(Moore, P.R. 2008a)	Monitoring

Table A.11 Monitoring reports undertaken in the Western Bay of Plenty study area, *continued*

Site No.	Location	References	Type
U13/1338	Moana Drive, Tanners Point	(Moore, P.R. 2008f)	Monitoring
U13/1343 - 1345	Seaview Road, The Terrace, Pacific Road, Beach Road, Hinemoa Street, Waihi Stream, Shaw Road, Edinburgh Street, Two Mile Creek, Seaforth Road, Ayr Street, The Loop, Te Rau Aroha Camp, Waihi Beach	(Moore, P.R. 2008e)	Monitoring
U13/104	Motukoura, Bridgman Lane, Tanners Point	(Coster 2009)	Monitoring
U14/703, 3276, 3302, 3255, 3326, 3311 & 3327	Tinopai Drive and Omokoroa Road, Omokoroa	(Moore, P.R. 2009f)	Monitoring
U14/764 & 765	Junction of Omokoroa Road and SH 2, Omokoroa	(Hooker, R.H. 2009b)	Monitoring
None	Papamoa Hills Regional Park, Te Puke	(Walter, L. 2009)	Monitoring
U13/896, 897, 898, 1339 & 1341	Bowentown Domain, Seaforth Road, Bowentown	(Moore, P.R. 2009e)	Monitoring
U14/2560 & 3324	Matapihi Road, Matapihi Peninsula, Tauranga	(Mallows 2009a)	Monitoring
None	Roretana Drive and Athenree Road, Athenree	(Moore, P.R. 2009g)	Monitoring
T13/359, 505 & 360	Omokoroa Road & SH 2 Junction, Athenree	(Moore, P.R. 2009d)	Monitoring
U13/1434 & 1435	Tanners Point Road, Tanners Point	(Moore, P.R. 2009b)	Monitoring
None	Matahiwi Road, Te Puna	(Moore, P.R. 2009a)	Monitoring
U13/1273, 1274, 1342 & 1247	Dillon Street & Shaw Road, Waihi Beach	(Moore, P.R. 2009h)	Monitoring
U14/701	Omokoroa Road, Omokoroa	(Moore, P.R. 2010)	Monitoring

Table A.12 Damage assessments undertaken in the Western Bay of Plenty study area

Site No.	Location	References	Type
W15/229, 403 & 641	Ruatuna Road, Ohiwa	(Bowers, L.C. 1996b)	Damage assessment & survey
U14/209	Tamapahore Pa, Mangatawa Lane, Papamoa, Tauranga	(Phillips, C.A. 1999b)	Damage assessment
U154/609	Minden Road, Te Puna	(Hooker, R.H. 2000e)	Damage assessment
W15/690 & 694	Paparoa Road, Ohope	(Phillips, K.J.S. 2002c)	Damage assessment
U14/3117	Matahiwi Road, Te Puna, Tauranga	(Hooker, R.H. 2003e)	Damage assessment
U13/1280	Oceanview Road, Waihi Beach	(Moore, P.R. 2003d)	Damage assessment & archaeological assessment
Unknown	Gravatt Rd, Papamoa	(Felgate 2004)	Damage assessment & excavation report
U14/3092	Thornton Ridge, Tauranga	(Phillips, K.J.S. 2004b)	Damage assessment

Table A.13 Post-harvest reports from the Western Bay of Plenty study area

Site No.	Location	References
V15/95 & 1238	Compartments 17 and 104, Rotoehu Forest	(Hooker, R.H. 1999b)
V15/1226 - 1233	Compartments 5, 6 and 7, Hereperu Forest, Matata	(Hooker, R.H. 2000c)
W15/216	Stanley Forest, Taneatua	(Hooker, R.H. 2001a)
W15/181	Kererutahi Forest, Taneatua	(Hooker, R.H. 2001l)
V15/1254 - 1257	Kawerau A4 Block, Kawerau	(Hooker, R.H. 2001k)
U15/107	Taheke Forest	(Hooker, R.H. 2001j)
U15/58, 623-626, 638 & 639	Tikitere Forest	(Hooker, R.H. 2001i)
V16/63	Tarawera Forest	(Hooker, R.H. 2001b)
U15/621 & 632	Pinnacles Forest	(Hooker, R.H. 2001h)
V15/217-220, 225-28, 230-32, 337, 338, 340, 342, 347, 348, 351, 355-57, 358, 360, 362, 363, 525, 531, 537-39, 541, 542, 545 & 1292	Onepu Forest, Lake Rotama	(Phillips, K.J.S. 2002j)
-	Kawerau A2 & A3 blocks, Kawerau	(Hooker, R.H. 2003b)
U14/136	Oropi	(Hooker, R.H. 2003c)
U15/620, 648, 650 - 654	Compartments 751 & 752, Sun Valley Forest	(Hooker, R.H. 2004f)
U15/706, 711 & 712	GSL Capital Forests Gavin Block. Rotoiti	(Hooker, R.H. 2006a)
V15/1294-1318	Hereperu Forest, Matata	(Hooker, R.H. 2007c)
V15/560, 561, 562, 1334, 1335, 1336,	Mangaone Forest	(Hooker, R.H. 2007a)
W16/164, 165, 277, 400-402	Sisams Forest	(Hooker, R.H. 2008b)
V16/7, 8, 9, 11, 12 & 13	Compartment 7, Tuhoe Forest, Waiohou	(Hooker, R.H. 2008a)
V16/5 & 6	Compartment 8, Tuhoe Forest, Waiohou	(Hooker, R.H. 2009a)
W16/119	Compartment 4, Waiotahi Forest	(Hooker, R.H. 2009c)
V18/44	Compartment 129 P Basin Road, Whirinaki Forest	(Hooker, R.H. 2010f)
W16/155	Compartment 447, Taneatua Forest	(Hooker, R.H. 2010a)
V18/16	Compartment 129 P Basin Road, Whirinaki Forest	(Hooker, R.H. 2010b)
W16/192	Waiotahi Forest	(Hooker, R.H. 2010c)
W16/12	Sisams Forest	(Hooker, R.H. 2010d)
V16/259 - 261	Compartment 13, Tuhoe Forest, Waiohou	(Hooker, R.H. 2010g)

Table A.14 Published articles and other reports relating to the Western Bay of Plenty

Site No.	Location	References	Focus
-	Tuhua (Mayor Island)	(Gold-Smith 1884)	Description of pa
-	Katikati	(Mair 1902)	Description of artefacts froma workshop
-	Te Pehu, Rotorua	(Cowan 1908)	Cave and artefact description
	Tauranga	(Semadeni 1912)	Artefact descriptions
-	Matata	(Fulton 1921)	Artefact description
-	Bay of Plenty	(Skinner 1921)	Culture areas
-	Kaingaroa	(Hamilton 1925)	Petroglyph description
-	Tauranga	(Anon. 1928)	Artefact description
-	Maungatawa	(Anon. 1931)	Artefact description
-	Waihi Beach to Bowentown	(Mitchell 1939)	Artefact description
-	Whakatane	(Phillips, W.J. 1952)	Maori houses and food stores
-	Lake Rotoiti	(Phillips, W.J. 1953)	Sarcophagus description
-	Puranomia, Lake Tarawera	(Gregg 1956)	Rock art descriptions
-	Kaingaroa Block	(Davis, F.W. 1958b)	Petroglyph description
-	Kaingaroa Block	(Davis, F.W. 1958a)	Petroglyph description
-	Pakatere Pa, Paengaroa	(Pullar 1959a)	Kaharoa ash
-	Bay of Plenty	(Pullar 1959b)	Kaharoa ash & archaeology
W15/1	Karerea Pa	(Kingsley-Smith, Pullar et al. 1961; Mabon 1961)	Pa description
-	Ongari Point, Katikati	(Melvin 1961b)	Petroglyph description
-	Whakatane	(Pullar 1961c)	Description
-	Kauri Point	(Pullar 1961d)	Description
	Kapu-te-Rangi Pa, Whakatane	(Pullar 1961e)	Description
	Kapu-te-Rangi (Toi's Pa), Whakatane	(Halbert 1962)	Pa description
-	Thornton	(London 1962)	Maori carvings
-	Whakatane	(Pullar 1962c)	Kaharoa ash
-	Bay of Plenty	(Pullar 1962d)	Maori soils
-	Ongari Point, Katikati	(Schofield 1962)	Cave dwellings and petroglyphs
-	Murupara, Rotorua	(Wilson, M.G.` 1962)	The Great Fleet
-	Pohaturoa Rock, Whakatane	(London 1963)	Rock description
-	Lake Rotoma	(Moore, K.W. 1963)	Palisades
-	Kauri Point	(Davidson 1964a)	Middens
N77/40	Kawerau	(Moore, K.W. 1964)	Pit and terrace site description
-	Kauri Point	(Pullar 1966)	Maori soil
	Kauri Point	(Shawcross 1967b)	NZAA conference
-	Kauri Point	(Ambrose 1967)	Unpublished conference presentation
-	Whakatane	(Pullar 1967)	Early occupation
	Ongari Point, Katikati	(Schofield 1968)	Low sea levels and Maori petroglyphs
N53-54/10, 6, 5, 2; N67/2, N68/7	Ongari Point, Kauri Point Undefended Site, Kauri Point, Kauri Point Swamp, Ongari Point Shelter, Matapara, Thornton Swamp	(Law 1969a)	Review of sites excavated in the northern North Island
-	Katikati	(Simmons, D.R. 1971b)	Artefact description
-	Northern Ahimanawa Range, Whirinaki State Forest	(Keyes & Matheson 1970)	Artefact description

Table A.14 Published articles and other reports relating to the Western Bay of Plenty, *continued*

Site No.	Location	References	Focus
-	Ongare Point & Motiti Island	(Simmons, D.R. 1971a)	Artefact description
-	Murapara, Kaingaroa Forest	(Spiers 1971)	Petroglyph description
-	Murapara, Kaingaroa Forest	(Wilson, M.G. 1971)	Petroglyph description
-	Kauri Point	(Green 1972b)	Moa-hunters and agriculture
N69/20, 28, 29, 38- 45 & 22	Whakatane	(Moore, K.W. 1973a)	Recent fieldwork
N69/1, 2, 10, 11, 63-70	Whakatane	(Moore, K.W. 1974b)	Recent fieldwork
-	Rotorua	(Pullar 1975)	Fish weir
-	Whakatane	(Moore, P.R. 1977b)	Adze assemblage study
-	Tuhua (Mayor Is)	(Leach, B.F. & de Souza 1979)	Mayor Island obsidian in New Zealand prehistory
-	Bay of Plenty	(Moore, K.W. 1979)	Site recording in the Bay of Plenty
-	Te Teko	(Moore, K.W. 1980)	Preservation of archaeological sites
N59/117	Orukei, Maketu	(Moore, P.R. 1981b)	early stone source
-	Whangamata, Toi's Pa, Kohi Point, Whakatane	(Hamel & Jones 1982)	Guide to vegetation management on archaeological sites
-	Kawerau	(Lawlor 1983b)	Comparison of pits
N78/365, 366, 395, 394, 367, 322, 397 & 396.	Waiotahi and Whakatane Valleys	(Jones 1983)	Comparison of pa sites
-	Whakatane	(Leach, H.M.K. 1983)	Artefact description
-	Coromandel Peninsula	(Furey 1985)	Obsidian artefacts in the Auckland Museum
-	Ruahihi	(Nichol 1985)	Rua & smokehouses
-	Whakatane River catchment	(Jones 1986)	Horticultural use patterns
-	Waihi	(Moore, P.R. & Coster 1989)	Waihi obsidian
W15/102	Valley Road, Whakatane	(O'Keeffe & Bristow 1989)	Mapping archaeological sites
-	Kauri Point	(Green 1990)	Open settlements
-	Northern Kaimai-Mamaku Forest Park	(Bowers, L.C. 1991)	Cultural resource management
U13/50, 31, 4, 5 & 6; U14/159, 149, 173, 148 & 233.	Athenree, Te Kura a Maia, Kauri Point, Omokoroa, Mt Maunganui, Moturiki Island, Welcome Bay	(McFadgen & Williams 1991)	Comparison of pa sites in Western Bay of Plenty
-	Te Wairoa, Rotorua Lakes District	(Ritchie, Neville A. 1991)	The Tarawera area before & after the earthquake
numerous	Tauranga	(Kahotea 1992)	Cultural resource inventory
-	Te Paripari Pa Ohope	(Bowers, L.C. 1993a)	Conservation plan
-	Kauri Point	(Groube 1993)	Brief mention of excavations in early New Zealand archaeology
-	Matakerepu, Rotorua	(Bowers, L.C. 1993b)	Conservation plan

Table A.14 Published articles and other reports relating to the Western Bay of Plenty, *continued*

Site No.	Location	References	Focus
-	Pipeline Rd, Matakana Island	(McFadgen & Shepherd 1993)	Environmental research - Kaharoa ash, shorelines & dune ridges
U14/328	Te Irihanga Pa, Crawford Road, lower Kaimai, Tauranga	(Bowers, L.C. 1995)	Conservation plan
U14/187	Ureturituri Pa, Matakana Island	(Ladefoged, McLachlan et al. 1995)	GIS-based image enhancement of conductivity and magnetic susceptibility data
-	Whakatane	(Phillips, K.J.S. & Moore 1996)	NZAA conference
-	Awakeri Conservation area and Latham's Hill Track Covenant Areas, Whakatane	(Bowers, L.C. 1997)	Cultural resource management
-	Athenree and Whakatane	(Challis 1992)	Registration of archaeological sites
	Matakana Island	(Sutton 1994)	Forestry site preparation and archaeological evidence
-	Athenree, Papamoa, Hamurana, Kawerau, Tarawera, Whakatane	(Higham & Hogg 1997)	C14 dates & evidence for late Polynesian colonisation of NZ
-	Papamoa	(Gumbley, McFadgen et al. 1998)	Carved pumice head artefact
-	Lake Rotoma	(Moore, K.W. 1998)	Description of archaeology
-	Matakana Island	(Giles, Newnham et al. 1999)	Impact of tephra fall and environmental change
-	Ongari Point, Kauri Point, Kawerau	(Law 2000)	Comparison of kumara storage pits in northern New Zealand
-	Bay of Plenty	(Leathwick 2000)	Predictive models of archaeological site distribution in New Zealand
T13/16, U13/1242	Orokawa Bay	(Moore, P.R. 2001)	Prehistoric exploitation of andesite
-	Bay of Plenty	(Worthy & Holdaway 2002)	Prehistoric moa
-	Bay of Plenty	(Law 2002a; 2002b)	DoC Conservancy resource statement – surveys and excavations
-	Bay of Plenty	(Lowe, Newham et al. 2000)	Tephras and New Zealand Archaeology
-	Mauao Historic Reserve	(Wildland Consultants 2003)	Conservation plan
U14/3119	Mana St, Otumoetai, Tauranga	(Biggs & Littleton 2004)	Analysis of human remains
U13/8, 31, 46, 89 & 187	Bay of Plenty	(Moore, P.R. 2005b)	Cultural distribution of the Waihi obsidian
-	Bay of Plenty	(Law 2008)	Archaeological Resources of the Bay of Plenty Conservancy of the Department of Conservation
U14/166, 167, 238-243, 316, 432, 1652, 1653, 1660	Papamoa Hills, Papamoa	(Gumbley n.d.)	Application to register Papamoa Hills Landscape

A2 CABANA LODGE PROVENANCE INFORMATION

The following table presents the data collected from labels of bags for midden from the Cabana Lodge (T12/3) site at Whangamata. Some of the material had been pre-sorted prior to arrival at the archaeological laboratories at the University of Otago. The code on each bag directly corresponds to provenance information, but the format varies depending on whether the sample was taken from a trench, square or feature.

Table A.15 Provenance data by area, trench feature, square, quadrant, layer and spit for all midden samples from T12/3, Cabana Lodge, Whangamata

Code	Area	Trench	Feature	Square	Quad	Layer	Spit	Contents
AF8	A		8			3		fish bone
AFillSp2	A		Fill			1	2	fish bone
AS8	A			A8		3		midden feature
AS8	A			A8		3		C14 shell
AT1Sp0-10	A	1				1	0-10cm	shell
AT1Sp2	A	1				1	2	fish bone
AT1Sp20-30	A	1				3	20-30cm	shell
AT1Sp4	A	1				3	4 (30-40cm)	shell (muddy)
AT1Sp6	A	1				3	6 (50-60cm)	rocks
AT2↓75cm	A	2				3	↓75cm	fish bone
BS1	B			B1		-		total sample
BSp1	B						1	fish bone
CS3Sp1	C			3		-	1	
CS4Sp1	C			4			1	
CS4Sp2	C			4			2	shell
CS5Sp1	C			5			1	a few shell & charcoal frags
DF1	D		1			-		shell
ET1L5	E	1				3	5	
ET1Sp2	E	1				1	2	a few shell frags
ET1Sp3	E	1				3	3 (60-70cm)	a few shell frags
ET1Sp3	E	1				3	3(60-70cm)	FCR
ET1Sp4	E	1				3	4	
ET1Sp4	E	1				3	4	rocks
FT4F20S6	F	4	20	6		2		
FT4S1NE	F	4		1	NE	2		unsorted
FT4F20S6	F	4	20	6		2		unsorted midden
FT4S1NW	F	4		1	NW	2		unsorted
FT4S1SE	F	4		1	SE	2		unsorted
FT4S1SE	F	4		1	SE	2		
FT4S1SW	F	4		1	SW	2		unsorted
FT4S2NE	F	4		2	NE	2		unsorted
FT4S2SE	F	4		2	SE	2		
FT4S3NW	F	4		3	NW	2		
FT4S2SW	F	4		2	SW	2		
F Baulk Remove	F	Baulk Remove				2		fish bone
F Baulk Removed	F	Baulk removed				2		1st sort pipi
F Baulk Removed	F	Baulk removed				2		1st sort - pipi
F Baulk Removed	F	Baulk removed				2		sorted - whole pipi

Table A.15 Provenance data by area, trench feature, square, quadrant, layer and spit for all midden samples from T12/3, Cabana Lodge, Whangamata, *continued*

Code	Area	Trench	Feature	Square	Quad	Layer	Spit	Contents
F Baulk Removed	F	Baulk removed				2		bulk sample
F Baulk Removed	F	Baulk removed				2		sorted - whole pipi
F Baulk Removed	F	Baulk removed				2		sorted - whole cockle
F Baulk Removed	F	Baulk removed				2		sorted - whole cockle
F Baulk Removed	F	Baulk removed				2		sorted - whole cockle
F E-W BaulkEL2	F	E-W Baulk			E end	2		cockle
F E-W BaulkEL2	F	E-W Baulk			E end	2		1st sort - cockle
FS3	F		3			3		soil
FT1ToM	F	1				2		fish bone
FT4S2NW	F	4		2	NW	2		
FT4S4NW	F	4		4	NW	2		rocks
FyF22L2	Fy		22			2		midden sample & fish conc
FyF22L2	Fy		22			2		midden - fish bone conc
FyF60	Fy		60			2		fish bone
FyF66	Fy		66			2		fish bone
FyL2F22	Fy		22			2		fish bone
FyL3	Fy					3		fish bone
FyS7NE	Fy			7	NE	2		unsorted
FyS7NWSp1	Fy			7		2		fish bone
FyS7NWSp1	Fy			7	NW	2	1	unsorted
FyS7NWSp2	Fy			7	NW	2	2	
FyS7SE	Fy			7	SE	2		fish bone
FyS7SE	Fy			7	SE	2		unsorted
FyT5	Fy		5					fish bone
FzBaulkE-WL2 Under Midden	Fz	Baulk E-W				2	Under Midden	fish bone
FzBL2	Fz					2		fish bone
FzBoL3F75	Fz		75			3		fish bone
FzEWBaulk	Fz	EW Baulk				2		fish bone
FzEWBaulkL1	Fz	EW Baulk				1		fish bone
FzF19	Fz		19			3		fish bone
FzF19	Fz		19			3		fish bone
FzF5	Fz		5					fish bone
FzF74 base	Fz		74 (umu)			3		soil sample
FzF83	Fz		83 Firescoop			2		fish bone
FzL2	Fz					2		unsieved midden
FzL2	Fz					2		fish bone
FzL2a	Fz					2a		fish bone
FzL2dis	Fz					2dis		fish bone
FzL2F64	Fz		64			2		fish bone
FzL3F81	Fz		81			3		fish bone
Fz N-S baulk	Fz	N-S baulk				2		fish bone
FzT4F91S4NW	Fz	4	91	4	NW (NW corner of quad)	2		sample of F91
FzT4L2Sq4NW	Fz	4			NW	2		fish bone
FzT4S1,2,3L2 base	Fz	4		1,2,3		2base		fish bone
FzT4S1NE	Fz	4		1	NE	2		fish bone
FzT4S1NW	Fz	4		1	NW	2		fish bone

Table A.15 Provenance data by area, trench feature, square, quadrant, layer and spit for all midden samples from T12/3, Cabana Lodge, Whangamata, *continued*

Code	Area	Trench	Feature	Square	Quadrant	Layer	Spit	Contents
FzT4S1SW	Fz	4		1	SW	2		
FzT4S2L2a	Fz	4		2		2a		shell
FzT4S3SW	Fz	4		3	SW	2		unsorted
FzT4S4NW	Fz	4		4	NW	2		
FzT4S4NW	Fz	4		4	NW	2		
FzT4S5	Fz	4		5		2		total sample
FzT4S5L2	Fz	4		5		2		stone
FzT4S6L2	Fz	4		6		2		unwashed midden
FzT4S6L2	Fz	4		6		2		stone
FzToML2	Fz					2	Top of Midden	fish bone

A3 NUTRITIONAL INPUT DATA

The following tables present input data for taxa within each faunal class (shellfish, finfish, marine, bird, terrestrial bird, moa, marine mammal and terrestrial mammal) sourced from Smith 2011.

A3.1 SHELLFISH

Table A.16 Shellfish meatweight, protein, fat, carbohydrate and energy inputs by taxon

Taxon	Common Name	Species MTWT (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
	shellfish ?sp.	0.001	190	10	30	980
Acteonidae sp. (Pupa?)	acteon	0.001	190	10	30	980
Alcithoe arabica	volute	0.002	190	10	30	980
Amalda australis	southern olive shell	0.001	190	10	30	980
Amphibola crenata	mudsnail	0.001	190	10	30	980
Amuarochiton glaucus	green chiton	0.001	190	10	30	980
Anomia trigonopsis	golden oyster	0.001	190	10	30	980
Antalis nana	tusk shell	0.001	190	10	30	980
Antisolarium egenum	antisolarium	0.001	190	10	30	980
Argobuccinum pustulosum	swollen trumpet	0.002	190	10	30	980
Asteracmea suteri	asteracmea	0.001	190	10	30	980
Aulacomya ater (maoriana)	ribbed mussel	0.002	190	10	30	980
Austrofusus glans	knobbed whelk	0.001	190	10	30	980
Austromitra rubiginosa	austromitra	0.001	190	10	30	980
Austrovenus stutchburyi	cockle	0.002	190	10	30	980
Barbatia novaezealandiae	ark shell	0.001	190	10	30	980
Buccinulum pallidum powelli	lined whelk	0.001	190	10	30	980
Buccinulum sp.	whelk B. sp	0.001	190	10	30	980
Buccinulum vittatum vittatum	buccinulum whelk	0.001	190	10	30	980
Calliostoma pellucidum	maurea	0.001	190	10	30	980
Cantharidus sp.	topshell sp.	0.001	190	10	30	980
Cardita aoteana	dog foot cockle	0.001	190	10	30	980
Cellana ?sp.	limpet C sp.	0.002	190	10	30	980
Cellana denticulata	Cook Strait limpet	0.002	190	10	30	980
Cellana ornata	ornate limpet	0.001	190	10	30	980
Cellana radians	radiate limpet	0.002	190	10	30	980
Cellana strigilis	strigils limpet	0.002	190	10	30	980
Chlamys zelandiae	fan scallop	0.001	190	10	30	980
Cominella adspersa	speckled whelk	0.001	190	10	30	980
Cominella glandiformis	purple-mouthed whelk	0.001	190	10	30	980
Cominella maculosa	spotted whelk	0.001	190	10	30	980
Cominella quoyana quoyana	Quoy's whelk	0.001	190	10	30	980
Cominella sp.	whelk C. sp	0.001	190	10	30	980
Cominella virgata	red mouthed whelk	0.001	190	10	30	980
Cookia sulcata	cooks turban	0.015	190	10	30	980
Dicathais orbita	white rock shell	0.001	190	10	30	980
Diloma bicanaliculata	knobbed topshell	0.001	190	10	30	980
Diloma subrostrata	mudflat top shell	0.001	190	10	30	980
Diplodonta striatula	diplodonta	0.001	190	10	30	980
Divaricella huttoniana	lace cockle	0.001	190	10	30	980
Dosinia anus	ringed venus shell	0.002	190	10	30	980

Table A.16 Shellfish meatweight, protein, fat, carbohydrate and energy inputs by taxon, *continued*

Taxon	Common Name	Species MTWT (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Dosinia sp.	venus shell	0.002	190	10	30	980
Eudoxochiton nobilis	noble chiton	0.001	190	10	30	980
Evechinus chloroticus	kina (sea urchin)	0.001	190	10	30	980
Felaniella zelandica	felaniella	0.001	190	10	30	980
Glycermis modesta	small dog cockle	0.001	190	10	30	980
Haliotis australis	silver paua	0.015	190	10	30	980
Haliotis iris	paua	0.150	190	10	30	980
Haliotis sp.	paua sp.	0.015	190	10	30	980
Haustrum lacunosum	white whelk	0.002	190	10	30	980
Haustrum haustorium	dark rock shell	0.015	190	10	30	980
Herpetopoma bella	top shell	0.001	190	10	30	980
Irus reflexus	irregular cockle	0.001	190	10	30	980
Lamellaria ophione	lamellaria	0.001	190	10	30	980
Lepisella scobina	oyster borer	0.001	190	10	30	980
Macomona liliana	large wedge shell	0.001	190	10	30	980
Mactra discors	deep trough shell	0.003	190	10	30	980
Maoricolpus roseus	turret shell	0.001	190	10	30	980
Maoricrypta costata	ribbed slipper shell	0.002	190	10	30	980
Maoricrypta monoxyla	smooth slipper shell	0.002	190	10	30	980
Melagraphia aethiops	spotted top shell	0.003	190	10	30	980
Muricopsis espinosus mariae	muricopsis	0.001	190	10	30	980
Muricopsis octogonus	octagonal murex	0.001	190	10	30	980
Myadora striata	battleaxe	0.001	190	10	30	980
Myllita stowei	myllita	0.001	190	10	30	980
Mytilus galloprovincialis	blue mussel	0.003	190	10	30	980
Nerita atramentosa	black nerita	0.001	190	10	30	980
Nucula hartvigiana	nut shell	0.001	190	10	30	980
Ostrea chilensis	mud oyster	0.002	190	10	30	980
oyster sp.	oyster sp	0.002	190	10	30	980
Paphies australis	pipi	0.001	190	10	30	980
Paphies subtriangulata	tuatua	0.002	190	10	30	980
Patelloida corticata	encrusted limpet	0.001	190	10	30	980
Pecten novaezelandiae	scallop	0.003	190	10	30	980
Pecten sp.	scallop sp.	0.001	190	10	30	980
Penion sulcatus	siphon whelk	0.001	190	10	30	980
Perna canaliculus	green-lipped mussel	0.004	190	10	30	980
Phenatoma rosea	pink tower shell	0.001	190	10	30	980
Protothaca crassicostata	ribbed venus	0.001	190	10	30	980
Purpurocardia purpurata	purple cockle	0.001	190	10	30	980
Rissoina sp.	rissoinia	0.001	190	10	30	980
Saccostrea glomerata	rock oyster	0.001	190	10	30	980
Scutus breviculus	shield limpet	0.001	190	10	30	980
Sigapatella novaezelandiae	circular slipper shell	0.001	190	10	30	980
Spisula aequilateralis	triangle shell	0.003	190	10	30	980
Struthiolaria papulosa	ostrich foot	0.002	190	10	30	980
Struthiolaria vermis	small ostrich foot	0.001	190	10	30	980
Taron sp.	whelk T. sp.	0.001	190	10	30	980
Tawera sp.	venus shell sp.	0.001	190	10	30	980
Tawera spissa	morning star	0.002	190	10	30	980
Trochus viridius	green top shell	0.001	190	10	30	980
Tucetona laticostata	large dog cockle	0.001	190	10	30	980
Tugali elegans	grooved limpet	0.001	190	10	30	980
Turbo smaragdus	cats eye	0.004	190	10	30	980
Turbonilla (Chemnitzia) zealandica	turbonilla	0.001	190	10	30	980

Table A.16 Shellfish meatweight, protein, fat, carbohydrate and energy inputs by taxon, *continued*

Taxon	Common Name	Species MTWT (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Xenostrobus pulex	little black mussel	0.001	190	10	30	980
Xymene ambiguous	large trophon	0.001	190	10	30	980
Xymene plebeius	trophon pleb	0.001	190	10	30	980
Xymene traversi	trophon trav	0.001	190	10	30	980
Zeacumantis lutulentus	horn shell	0.001	190	10	30	980
Zediloma sp.	topshell sp.	0.001	190	10	30	980
Zegalerus tenuis	small circular slipper shell	0.001	190	10	30	980
Zemitrella sp.	zemitrella sp.	0.001	190	10	30	980
Zethalia (Umbonium) zelandica	wheel shell	0.001	190	10	30	980

A3.2 FINFISH

Table A.17 Finfish meatweight, protein, fat, carbohydrate and energy inputs by taxon

Taxon	Common name	BWT (kg)	MTWT (kg)	Protein (g/kg)	Fat (g/kg)	Carb g/kg)	Energy (kcal/kg)
Aldrichetta forsteri	yellow-eyed mullet	1.60	1.12	182	46	2	1150
Anguilla sp.	eel sp.	1.50	1.05	166	45	2	1077
Arripis trutta	kahawai	3.00	2.10	194	116	2	1828
Carangidae sp.	carangidae sp.	1.30	1.05	192	89	2	1283
Chelidonichthys kumu	red gurnard	1.50	1.05	186	29	2	1013
Colistium guntheri	brill	0.50	0.35	181	25	2	957
Coridodax pullus	butterfish/greenbone	1.30	1.05	167	36	2	1000
Elasmobranchii ?sp.	sharks/rays/skates	10.00	7.00	179	69	2	1339
fish sp.	fish sp.	1.50	1.05	180	50	2	1178
Gempylidae sp.	snake mackerel sp.	0.70	186.00	182	55	2	1225
Genyagnus monopterygius	spotted stargazer	1.50	1.05	173	30	2	970
Genypterus blacodes	ling	1.80	1.26	185	15	2	883
Goniistius spectabilis	red moki	1.50	1.05	189	108	2	1736
Helicolenus papillosa	sea perch	1.50	1.05	138	15	2	695
Hyperoglyphe antarctica	bluenose warehou	2.30	1.61	180	51	2	1187
Labridae sp.	wrasses	1.50	1.05	167	36	2	1000
Latridopsis ciliaris	blue moki	2.70	1.89	194	57	2	1297
Latris lineata	trumpeter	3.00	2.10	194	57	2	1297
Lotella rhacina	rock cod	1.00	0.70	160	18	2	810
Mugil cephalus	grey mullet	1.00	0.70	195	107	2	1751
Myliobatis tenuicaudatus	eagle ray	9.00	6.30	167	36	2	1000
Nemadactylus douglasii	porae	2.30	1.61	197	92	2	1624
Nemadactylus macropterus	tarakihi	2.30	1.61	189	108	2	1736
Notolabrus celidotus	spotty	1.50	1.05	167	36	2	1000
Nototheniidae sp.	black cods	1.60	1.12	178	20	2	900
Pagrus auratus	snapper	2.20	1.54	179	50	2	1174
Parapercis colias	blue cod	1.60	1.12	178	20	2	900
Parika scaber	leatherjacket	1.50	1.05	172	17	2	849
Peltorhamphus novaezeelandiae	NZ sole	0.50	0.35	183	25	2	985
Pleuronectiforme sp.	flounder sp.	0.50	0.35	181	25	2	957
Polyprion oxygeneios	hapuku	4.70	3.29	186	63	2	1319
Pseudocaranx georgianus	trevally	1.50	1.05	194	45	2	1189
Pseudophycis bachus	red cod	2.00	1.40	160	18	2	810
Rexea solandri	gemfish	2.00	1.40	184	45	2	1149
Scomber australasicus	blue mackerel	1.40	0.98	198	119	2	1871
Scorpaena papillosa	scorpion fish	1.50	1.05	138	15	2	695
Scorpis violacea	blue maomao	0.70	0.49	179	61	2	1273
Selachimorpha sp.	shark ?sp.	5.00	3.50	167	36	2	1000
Seriola grandis	kingfish	3.90	2.73	208	27	2	1083
Squalus acanthias	northern dogfish	5.00	3.50	167	36	2	1000
Thyrsites atun	barracouta	2.30	1.61	184	45	2	1149
Trachurus novaezelandiae	horse/jack mackerel	1.50	1.05	186	59	2	1283
Trachurus spp.	mackerel sp.	1.65	1.16	186	16	2	866
Zeus faber	john dory	1.50	1.05	181	32	2	1020

A3.3 MARINE AND WETLAND BIRD

Table A.18 Marine and wetland bird meatweight, protein, fat, carbohydrate and energy inputs by taxon

Taxon	Common name	Body Wt (kg)	MtWt (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Botaurus poiciloptilus	Australasian bittern	1.000	0.700	160	290	0	3210
Calidras canutus	eastern knot	0.080	0.056	160	290	0	3210
Casmerodius alba	great white egret/white heron	0.900	0.630	160	290	0	3210
Catharacta skua	subantarctic skua	1.950	1.365	160	290	0	3210
Charadriiformes sp.	wader sp.	0.540	0.378	160	290	0	3210
Charadrius bicinctus	banded dotterel	0.060	0.042	160	290	0	3210
Charadrius frontalis	wrybill	0.055	0.039	160	290	0	3210
Charadrius novaeseelandiae	shore plover	0.060	0.042	160	290	0	3210
Charadrius obscurus	NZ dotterel	0.145	0.102	160	290	0	3210
Coenocorypha barrierensis	North Island snipe	0.105	0.074	160	290	0	3210
Coenocorypha iredalei	Iredale's snipe	0.105	0.074	160	290	0	3210
Daption capense	Cape petrel	0.500	0.350	160	290	0	3210
Diomedea epomorphora	southern royal albatross	8.000	5.600	160	290	0	3210
Diomedea exulans	wandering albatross	8.000	5.600	160	290	0	3210
Diomedeidae sp.	albatross sp.	4.500	3.150	160	290	0	3210
Egretta sacra	reef heron	0.400	0.280	160	290	0	3210
Eudyptes pachyrhynchus	NZ crested penguin	4.000	2.800	160	290	0	3210
Eudyptula minor	little blue penguin	1.100	0.770	160	290	0	3210
Fregetta tropica	black-bellied storm petrel	0.050	0.035	160	290	0	3210
Fulica prisca	NZ coot	1.000	0.700	160	290	0	3210
Gallinula hodgenorum	Hodgen's waterhen	0.450	0.315	160	290	0	3210
Gallirallus philippensis	banded rail	0.170	0.119	160	290	0	3210
Garrodia nereis	grey-back storm petrel	0.035	0.025	160	290	0	3210
Haematopus finschi	Finsch's oystercatcher	0.550	0.385	160	290	0	3210
Haematopus ostralegus	pied oystercatcher	0.550	0.385	160	290	0	3210
Haematopus unicolor	variable oystercatcher	0.725	0.508	160	290	0	3210
Halobaena caerulea	blue petrel	0.200	0.140	160	290	0	3210
Himantopus leucocephalus	pied stilt	0.220	0.154	160	290	0	3210
Himantopus novaezelandiae	black stilt	0.220	0.154	160	290	0	3210
Ixobrychus novaezelandiae	NZ little bittern	0.150	0.105	160	290	0	3210
Laridae sp.	gull sp.	0.197	0.138	160	290	0	3210
Larus bulleri	black-billed gull	0.250	0.175	160	290	0	3210
Larus dominicanus	kelp gull (black-backed)	0.850	0.595	160	290	0	3210
Larus novaehollandiae	red-billed gull	0.260	0.182	160	290	0	3210
Leucocarbo carunculatus	king shag	2.500	1.750	160	290	0	3210
Limosa lapponica	eastern bar-tailed godwit	0.400	0.280	160	290	0	3210
Macronectes giganteus	southern giant petrel	4.500	3.150	160	290	0	3210
Macronectes halli	northern giant petrel	4.500	3.150	160	290	0	3210
Megadyptes antipodes	yellow-eyed penguin	5.250	3.675	160	290	0	3210
Morus serrator	Australasian gannet	2.300	1.610	160	290	0	3210
Numenius phaeopus	Asiatic whimbrel	0.400	0.280	160	290	0	3210
Oceanites maorianus	NZ storm petrel	0.050	0.035	160	290	0	3210
Pachyptila ?sp	prion ?sp.	0.917	0.642	160	290	0	3210
Pachyptila crassirostris	fulmar prion	0.150	0.105	160	290	0	3210
Pachyptila turtur	fairy prion	0.125	0.088	160	290	0	3210
Pachyptila vitata	broad-billed prion	0.200	0.140	160	290	0	3210
Pelagodroma marina	white-faced storm petrel	0.045	0.032	160	290	0	3210
Pelecanoides georgicus	South Georgian diving petrel	0.120	0.084	160	290	0	3210
Pelecanoides urinatrix	northern diving petrel	0.130	0.091	160	290	0	3210
Pelecanus conspicillatus	Australian pelican	2.000	1.400	160	290	0	3210
Phalacrocoracidae ?sp.	shag ?sp.	0.442	0.309	160	290	0	3210
Phalacrocorax ?sp.	shag Phal ?sp.	0.750	0.525	160	290	0	3210

Table A.18 Marine and wetland bird meatweight, protein, fat, carbohydrate and energy inputs by taxon, *continued*

Taxon	Common name	Body Wt (kg)	MtWt (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Phalacrocorax carbo	great cormorant	2.200	1.540	160	290	0	3210
Phalacrocorax melanoleucos	little cormorant	0.700	0.490	160	290	0	3210
Phalacrocorax sulcirostris	little black shag	0.900	0.630	160	290	0	3210
Phalacrocorax varius	pied cormorant	2.000	1.400	160	290	0	3210
Phoebetria palpabrata	light-mantled sooty albatross	4.500	3.150	160	290	0	3210
Podiceps cristatus	southern crested grebe	1.100	0.770	160	290	0	3210
Poliocephalus rufopectus	NZ dabchick	0.250	0.175	160	290	0	3210
Porphyrio mantelli	North Island takehe	3.500	2.450	160	290	0	3210
Porphyrio melanotus	pukeko	1.000	0.700	160	290	0	3210
Porzana pucilla	Baillon's crake	0.040	0.028	160	290	0	3210
Porzana tabuensis	spotless crake	0.045	0.032	160	290	0	3210
Procellaria aequinoctialis	white-chinned petrel	1.100	0.770	160	290	0	3210
Procellaria cinerea	grey petrel	1.100	0.770	160	290	0	3210
Procellaria parkinsoni	Parkinson's petrel	0.700	0.490	160	290	0	3210
Procellaria westlandica	westland petrel	1.100	0.770	160	290	0	3210
Procellariiformes sp.	petrel sp.	0.325	0.228	160	290	0	3210
Pterodroma sp.	pterodroma sp.	0.967	0.677	160	290	0	3210
Pterodroma cookii	Cook's petrel	0.200	0.140	160	290	0	3210
Pterodroma inexpectata	mottled petrel	0.325	0.228	160	290	0	3210
Pterodroma lessonii	white-headed petrel	0.500	0.350	160	290	0	3210
Pterodroma macroptera	grey-faced petrel	0.500	0.350	160	290	0	3210
Pterodroma magentae	Chatham taiko	0.500	0.350	160	290	0	3210
Pterodroma nigripennis	black-winged petrel	0.180	0.126	160	290	0	3210
Pterodroma pycrofti	Pycroft's petrel	0.160	0.112	160	290	0	3210
Puffinus sp.	puffinus sp. NI	0.433	0.303	160	290	0	3210
Puffinus assimilis	Norfolk little shearwater	0.200	0.140	160	290	0	3210
Puffinus bulleri	Buller's shearwater	0.900	0.630	160	290	0	3210
Puffinus carneipes	flesh-footed shearwater	0.900	0.630	160	290	0	3210
Puffinus gavia	fluttering shearwater	0.300	0.210	160	290	0	3210
Puffinus griseus	sooty shearwater	0.800	0.560	160	290	0	3210
Puffinus huttoni	Hutton's shearwater	0.350	0.245	160	290	0	3210
Puffinus spelaeus	Scarlett's shearwater	0.250	0.175	160	290	0	3210
Puffinus tenuirostris	short-tailed shearwater	0.600	0.420	160	290	0	3210
Puffinus haurakiensis	North Is little shearwater	0.200	0.140	160	290	0	3210
Spheniscidae sp.	penguin sp.	0.400	0.280	160	290	0	3210
Stercoraria parasiticus	Arctic skua	1.400	0.980	160	290	0	3210
Sterna albostriata	black-fronted tern	0.080	0.056	160	290	0	3210
Sterna caspia	caspian tern	0.700	0.490	160	290	0	3210
Sterna nereis	fairy tern	0.070	0.049	160	290	0	3210
Sterna striata	white-fronted tern	0.160	0.112	160	290	0	3210
Sternidae sp.	tern sp.	0.253	0.177	160	290	0	3210
Stictocarbo punctatus	spotted shag	1.200	0.840	160	290	0	3210
Thalassarche bulleri	southern Buller's albatross	4.500	3.150	160	290	0	3210
Thalassarche cauta	white-capped albatross	4.500	3.150	160	290	0	3210
Thalassarche chrysostoma	grey-headed albatross	4.500	3.150	160	290	0	3210
Thalassarche eremita	Chatham Island albatross	4.500	3.150	160	290	0	3210
Thalassarche melanophris	black-browed albatross	4.500	3.150	160	290	0	3210
Thalassarche salvini	Salvin's albatross	4.500	3.150	160	290	0	3210

A3.4 TERRESTRIAL BIRD

Table A.19 Terrestrial bird meatweight, protein, fat, carbohydrate and energy inputs by taxon

Taxon	Common name	Body Wt (kg)	MtWt (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Acanthisitta chloris	rifleman	0.007	0.005	280	60	0	1760
Aegotheles novaezelandiae	NZ owlet-nightjar	0.200	0.140	280	60	0	1760
Anas sp.	duck sp.	0.104	0.072	160	290	0	3210
Anas chlorotis	brown teal	0.500	0.350	160	290	0	3210
Anas gracilis	grey teal	0.425	0.298	160	290	0	3210
Anas rhynchotis	shoveler	0.600	0.420	160	290	0	3210
Anas superciliosa	grey duck	1.000	0.700	160	290	0	3210
Anthornis melanura	NZ bellbird	0.026	0.018	280	60	0	1760
Anthus novaeseelandiae	NZ pipit	0.040	0.028	280	60	0	1760
Apteryx "East South Is"	eastern kiwi	1.400	0.980	280	60	0	1760
Apteryx australis	southern brown kiwi	1.500	1.050	280	60	0	1760
Apteryx haastii	great spotted kiwi	2.200	1.540	280	60	0	1760
Apteryx mantelli	northern brown kiwi	1.500	1.050	280	60	0	1760
Apteryx owenii	little spotted kiwi	1.200	0.840	280	60	0	1760
Aptornis defossor	South Island adzebill	10.000	7.000	280	60	0	1760
Aptornis otidiformis	North island adzebill	8.000	5.600	280	60	0	1760
Aythya novaeseelandiae	NZ scaup	0.650	0.455	160	290	0	3210
Biziura delautouri	NZ musk duck	2.000	1.400	160	290	0	3210
Bowdleria punctata	fernbird	0.035	0.025	280	60	0	1760
Callaeas cinerea	South Island kokako	0.230	0.161	280	60	0	1760
Callaeas wilsoni	North Island kokako	0.230	0.161	280	60	0	1760
Capellirallus karamu	snipe rail	0.275	0.193	280	60	0	1760
Chrysococcyx lucidus	Shining cuckoo	0.025	0.018	280	60	0	1760
Circus approximans	Australasian harrier	0.500	0.350	280	60	0	1760
Circus eylesi	Eyles's harrier	2.500	1.750	280	60	0	1760
Cnemiornis calcitrans	South Island goose	10.000	7.000	160	290	0	3210
Cnemiornis gracilis	North Island goose	8.000	5.600	160	290	0	3210
Corvus "mainland"	NZ raven	0.950	0.665	280	60	0	1760
Coturnix novaezelandiae	NZ quail	0.100	0.070	280	60	0	1760
Cyanoramphus ?sp.	parakeet ?sp	0.048	0.034	280	60	0	1760
Cyanoramphus auriceps	yellow-crowned parakeet	0.040	0.028	280	60	0	1760
Cyanoramphus malherbi	orange-fronted parakeet	0.035	0.025	280	60	0	1760
Cyanoramphus novaezelandiae	red-crowned parakeet	0.070	0.049	280	60	0	1760
Cygnus atratus	black swan	5.000	3.500	160	290	0	3210
Dendroscansor decurvirostris	long-billed wren	0.030	0.021	280	60	0	1760
Eudynamys taitensis	long-tailed cuckoo	0.125	0.088	280	60	0	1760
Euryanus finschi	Finch's duck	0.800	0.560	160	290	0	3210
Falco novaeseelandiae	NZ falcon	0.500	0.350	280	60	0	1760
Gallirallus australis	weka	0.700	0.490	280	60	0	1760
Gerygone igata	grey warbler	0.007	0.005	280	60	0	1760
Harpagornis moorei	Haast's eagle	12.000	8.400	280	60	0	1760
Hemiphaga novaeseelandiae	NZ pigeon	0.650	0.455	280	60	0	1760
Heteralocha acutirostris	huia	0.300	0.210	280	60	0	1760
Hymenolaimus malacorhyncus	blue duck	0.750	0.525	160	290	0	3210
Malacorhynchus scarletti	Scarlett's duck	0.800	0.560	160	290	0	3210
Mergus australis	NZ merganser	0.900	0.630	160	290	0	3210
Mohoua albicilla	whitehead	0.015	0.011	280	60	0	1760
Mohoua novaeseelandiae	Brown creeper	0.011	0.008	280	60	0	1760
Mohoua ochrocephala	yellowhead	0.025	0.018	280	60	0	1760
Nestor meridionalis	kaka	0.425	0.298	280	60	0	1760
Nestor notabilis	kea	0.800	0.560	280	60	0	1760

Table A.19 Terrestrial bird meatweight, protein, fat, carbohydrate and energy inputs by taxon, *continued*

Taxon	Common name	Body Wt (kg)	MtWt (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Ninox novaeseelandiae	morepork	0.175	0.123	280	60	0	1760
Notiomystis cincta	stitchbird	0.030	0.021	280	60	0	1760
Pachyplichas yaldwyni	Stout-legged wren	0.050	0.035	280	60	0	1760
Petroica australis	South Island robin	0.035	0.025	280	60	0	1760
Petroica longipes	North Island robin	0.035	0.025	280	60	0	1760
Petroica macrocephala	yellow-breasted tomtit	0.011	0.008	280	60	0	1760
Petroica toitoi	white-breasted tomtit	0.011	0.008	280	60	0	1760
Philesturnus carunculatus	South Island saddleback	0.070	0.049	280	60	0	1760
Philesturnus rufusater	North Island saddleback	0.070	0.049	280	60	0	1760
Prosthemadra novaeseelandiae	tui	0.090	0.063	280	60	0	1760
Rhipidura fuliginosa	grey fantail	0.008	0.006	280	60	0	1760
Sceloglaux albifaces	laughing owl	0.600	0.420	280	60	0	1760
Strigops habroptilis	kakapo	2.000	1.400	280	60	0	1760
Tadorna variegata	paradise shelduck	1.400	0.980	160	290	0	3210
Todiramphus sancta	sacred kingfisher	0.065	0.046	280	60	0	1760
Traversia lyalli	Lyall's wren	0.022	0.015	280	60	0	1760
Turnagra capensis	South Island piopio	0.130	0.091	280	60	0	1760
Turnagra tanagra	North Island piopio	0.130	0.091	280	60	0	1760
Xencius gilviventris	rock wren	0.020	0.014	280	60	0	1760
Xencius longipes	bush wren	0.016	0.011	280	60	0	1760

A3.5 MOA

Table A.20 Moa meatweight, protein, fat, carbohydrate and energy inputs by taxon

Taxon	Common name	Body Wt (kg)	MtWt (kg)	LegWt (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Anomalopteryx didiformis	little bush moa	50.0	30.0	10.00	300	80	0	2030
Dinornis novaezealandiae	large bush moa	150.0	90.0	30.00	300	80	0	2030
Euryapteryx curtus	coastal moa	20.0	12.0	4.00	300	80	0	2030
Euryapteryx geranoides	stout-legged moa	95.0	57.0	19.00	300	80	0	2030
Pachyornis mappini	Mappin's moa	20.0	12.0	4.00	300	80	0	2030
Dinornithidae sp. NI	moa sp. NI	90.0	54.0	18.00	300	80	0	2030

A3.6 MARINE MAMMAL

Table A.21 Marine mammal meatweight, protein, fat, carbohydrate and energy inputs by taxon

Taxon	BWT (kg)	MTWT complete (kg)	Head (kg)	Fore limb (kg)	Hind limb (kg)	Trunk (kg)	Arbitrary BU (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Arctocephalus forsteri		**fur seal**									
pup	8.60	4.82	0.72	0.72	0.48	1.68		140	220	20	2620
juvenile	25.00	14.38	2.16	2.16	1.44	5.03		140	220	20	2620
sub adult m	100.00	59.00	8.85	8.85	5.90	20.65		140	220	20	2620
adult female	50.00	30.00	4.50	4.50	3.00	10.50		140	220	20	2620
adult male	150.00	94.50	14.18	14.18	9.45	33.07		140	220	20	2620
?age/sex	75.00	44.25	6.64	6.64	4.43	15.49		140	220	20	2620
Phocarctos hookeri		**sea lion**									
pup	12.90	7.22	1.08	1.08	0.72	2.53		140	220	20	2620
juvenile	37.50	17.25	2.59	2.59	1.73	6.04		140	220	20	2620
sub adult m	150.00	88.50	13.28	13.28	8.85	30.98		140	220	20	2620
adult female	75.00	49.50	7.43	7.43	4.95	17.33		140	220	20	2620
adult male	225.00	141.75	21.26	21.26	14.18	49.61		140	220	20	2620
?age/sex	112.50	66.38	9.96	9.96	6.64	23.23		140	220	20	2620
Mirounga leonina		**elephant seal**									
pup	140.00	74.55	10.44	8.20	2.98	41.75		130	240	20	2760
juvenile	200.00	106.50	14.91	11.72	4.26	59.64		130	240	20	2760
sub adult m	500.00	276.25	38.68	30.38	11.05	154.70		130	240	20	2760
adult female	300.00	168.00	23.52	18.48	6.72	94.08		130	240	20	2760
adult male	2000.00	1205.00	168.70	132.52	48.20	674.80		130	240	20	2760
?age/sex	1000.00	550.00	77.00	60.50	22.00	308.00	55.00	130	240	20	2760
Hydrurga leptonyx		**leopard seal**									
adult male	250.00	150.00	21.00	16.50	6.00	84.00		130	240	20	2760
North Is	125.00	68.75	9.63	7.56	2.75	38.50	6.88	130	240	20	2760
Odontoceti sp.		**dolphin sp.**									
dolphin sp.	84.50	51.60					5.16	160	140	10	1940
Globicephala sp.		**pilot whale sp.**									
pilot whale sp.	1360.00	829.60					82.96	160	140	10	1940
Cetacea sp.		**cetacean sp.**									
cetacean sp.							82.96	160	140	10	1940

A3.7 TERRESTRIAL MAMMAL

Table A.22 Terrestrial mammal meatweight, protein, fat, carbohydrate and energy inputs by taxon

Taxon	BWT (kg)	MTWT (kg)	Protein (g/kg)	Fat (g/kg)	Carb (g/kg)	Energy (kcal/kg)
Canis familiaris						
dog - juvenile	5.00	3.00	210	40	0	1260
dog – sub adult	10.00	6.00	210	40	0	1260
dog - adult	12.50	7.50	210	40	0	1260
dog - ?age	10.00	6.00	210	40	0	1260
Rattus exulans						
rat	0.14	0.10	210	40	0	1260

A4 SUMMARY OF ASSEMBLAGES AND CHRONOLOGICAL DATA

The following data presents the contexts of assemblages utilised in this research. The site record number, source, site location, and brief excavation overview are described, and the context of assemblages from units and layers and their associated radiocarbon dates are presented. Each assemblage has been assigned a unique identifier (e.g. MTR-990), and multiple assemblages from same site are distinguished with a suffix (e.g. L2, H, Upper).

A4.1 COROMANDEL

A4.1.1 NGARIMU HEIGHTS, THAMES COAST, T12/173 (NH-173)

Located on the Thames (west) coast of the Coromandel Peninsula at Wood Bays, to the north of Thames is site T12/173, an undefended settlement. Initially recorded in 1977 as a midden deposit, in 2005 a rectangular pit was added to the site record description (Hoffmann 2008). In 2007 the site was excavated as part of works associated with the Ngarimu Heights subdivision. Four areas were excavated, although Area D was disturbed by dumping activities and river bank flood events. Features identified included a possible train sump, storage pit, postholes, a layer of pipi shells and charcoal, firescoops and areas of concentrated chert cobble flaking debris. Three shell samples were submitted for radiocarbon dating (Wk21803, Wk21804 and Wk21805) and were statistically indistinguishable at the 95% confidence level, producing a calibrated date range that falls into the 'late' period. No historic period artefacts were associated with this site. The faunal data from all three midden samples (Area B, square2; Area B, Square 3 and Area D midden) were combined here. The assemblage had a total MNI value of 1801; the site is classified here as multi-function.

A4.1.2 PORT JACKSON, S09/53 (PJK-53)

This undefended settlement site is located near the northern tip of the Coromandel Peninsula, and has been variously recorded as S09/53, S09/109-110 and S09/112 (Wilkes 1999). Patches of midden, ovens and artefacts have been exposed sporadically by dune deflation near the northeast end of Port Jackson. Several excavations of *in situ* deposits have been attributed to the site (Davidson 1979; Foley 1981; Foster 1983), though it is difficult to be certain without site plans of the excavations; thus Smith and James-Lee have selected only faunal data which can be directly attributed to the site and from *in situ* deposits (2010). This analysis uses the

Smith and James-Lee data, which was originally sourced from Foster (1983), Leach and Boocock (1993) and Smith (1985). The total MNI for the assemblage used here is 2934. The sole radiocarbon date for the assemblage is on moa bones from a deflation hollow *underlying* the midden, giving a maximum date for the midden deposition. Artefacts recovered from the site confirm the assemblage's assignment to the early period. This site has been classified here as restricted function.

A4.1.3 WHANGAPOUA, T10/751 (WHP-751)

This undefended pit complex site is located on low ridges at the foot of the hills behind Whangapoua Beach. In 2004 three midden deposits, as well as stakeholes, drains, bin pits, a rua pit, were identified during excavation of five areas (Gumbley 2008). Shell samples for radiocarbon dating were selected from 'Area D/E midden', 'Area A midden 1a' and 'Area C midden over pit3/F23'; these proved to be statistically indistinguishable at the 95% confidence level, and the mean pooled radiocarbon age gave a calibrated range that falls across the 'middle' – 'late' period boundary. Midden samples for faunal analysis were taken from 'Area E midden sample 3', 'Area C extension midden', 'Area E midden sample 2' and 'Area E midden sample 1' and combined for MNI calculations here, giving a combined assemblage MNI total of 2558. This site has been classified here as restricted function.

A4.1.4 MATARANGI BEACH, T10/990 (MTR-990)

Located near the estuarine shore on the Omara Spit, Matarangi Beach in the northern Coromandel Peninsula, the temporary camp site T10/990 comprises five middens. One midden was sampled for radiocarbon dating (Wk8065) and provided a calibrated age that falls in the 'middle' period. Faunal data used here are sourced from Smith and James-Lee (2010), originally recorded in Sewell (2000a). The total MNI value for the assemblage was 206. This site is classified here as single function.

A4.1.5 MATARANGI BEACH, T10/993 (MTR-993)

This temporary camp site is located directly to the north-east of T10/983 on the Omara Sandspit at Matarangi Beach, and was identified during monitoring of a residential subdivision in 1997. Forty-three small middens, some with associated firescoops, were identified and interpreted as evidence of short-term camps for collecting and drying shellfish (Furey 1998). One midden was excavated and three samples were submitted for radiocarbon dating (Wk6377, Wk6378 and Wk6379). These were identical at the 95% confidence level and a pooled mean radiocarbon age provided a calibrated age range that falls across the

boundary for the ‘middle’ and ‘late’ periods. Faunal data used here are sourced in Smith and James-Lee (2010). This was in the form of combined MNI totals from eight samples, but fish were only recorded as presence-absence data (Furey 1998). Thus where a species was recorded as ‘present’, an MNI value of ‘1’ was recorded. The total assemblage value gave an MNI of 2463. This site is classified here as single function.

A4.1.6 AHUAHU, T10/944 (AHU-944)

The temporary camp site T10/944 is situated at White’s Beach on the eastern coast of Ahuahu (also known as Great Mercury Island), to the north of Opito Bay on the Coromandel Peninsula. Deposits at the site were exposed during a storm; under an authority from the New Zealand Historic Places Trust the deposits were recorded and sampled (Furey 2009b). Five exposures visible over 50m were recorded for T10/944, including oven stones, stone flakes, oven scoops, shell midden. The shell midden was sampled for analysis and two samples, charcoal and shell were submitted for radiocarbon dating (Wk25354 from oven #2 and Wk25355 from midden #3, respectively). As the faunal data used here (Smith and James-Lee 2010) is all from midden 3, only the associated sample radiocarbon date, Wk25355, has been used. It provides a calibrated age that falls in the ‘middle’ period. The midden 3 assemblage gave a total MNI of 973. This site is classified here as restricted function.

A4.1.7 CROSS CREEK T10/399 (CCK L3, CCK L5, CCK L7, CCK L9)

The Cross Creek midden site (NZAA site record number T10/399) is located on the at Sarah’s Gully, on the Kuaotunu Peninsula, on the east coast of the Coromandel Peninsula. Excavations conducted in 1983 revealed six stratigraphically distinct phases of occupation (Furey et al. 2008; Sewell 1983; Sewell 1984; Sewell 1986; 1988). The earliest layer, layer 9, had four samples submitted for radiocarbon dating (Wk21355, Wk21363, NZ0576 and Wk21642). The two former dates were from fish bone and the latter two samples from terrestrial birds, so mean pooled radiocarbon ages were calculated separately using the marine calibration curve for the former and the terrestrial curve for the latter. Both MPRAs give calibrated dates that fall within the ‘early’ period. One shell sample from layer 7 was submitted for radiocarbon dating, also providing a calibrated date falling in the ‘early’ period. Layer 5 has one shell sample providing a calibrated date that straddles the ‘early’-‘middle’ boundary. Layer 3 also has one shell sample with a calibrated date that falls across the early-middle divide. The data used here is sourced from that collected and presented in Smith and James-Lee (2010), which used data from Furey et al. (2008) and Sewell (1984; 1988). The total MNI values for the four Cross Creek assemblages were L3 = 8929, L5 = 427, L7 = 999

and L9 = 38. Layers 3 and 5 are large undefended settlements, classified as multifunction; while layers 7 and 9 are undefended settlement sites, classified as restricted function.

A4.1.8 WHITIANGA WATERWAYS, T11/858 (WHI-858)

The temporary camp site T11/858 is located approximately 200m south of T11/624, close to the shore of the Whitianga Harbour estuary (Furey 2002a). Prior to residential development, investigations in 2001 identified eight small areas of midden. Three shell samples were submitted for radiocarbon dating and proved to be identical at the 95% confidence level; the mean pooled radiocarbon age provided a calibrated date range that falls in the 'late' period; no historic artefacts or features are present. As in Smith and James-Lee (2010), MNI data for the three radiocarbon samples were combined for the analysis here, giving a total of 2191. This site is classified as single function.

A4.1.9 WHITIANGA WATERWAYS, T11/624 (WHI-624)

This temporary camp site is situated inland from the Whitianga estuary, and was exposed during residential development in 2003. It consists of a small midden adjacent a cooking area (Furey 2003a), with a total MNI of 1102. A single shell date calibrates a date range which falls in the 'middle' period. This site is classified as restricted function.

A4.1.10 CLUB MARINA APARTMENTS, WHITIANGA T11/927 (WHI-927 A, WHI-927 B)

Situated adjacent to the Whitianga Harbour, this temporary camp site provided evidence of both prehistoric and historic period occupations during investigations undertaken in 2003 (Campbell et al. 2004). Earlier features showed evidence of being partially truncated by later activities in the two areas investigated. In 'Area A' intact prehistoric components included ovenscoops containing midden, while in 'Area B' middens were intact. One shell sample from 'Area B' submitted for radiocarbon dating (Wk14234) provides a calibrated age range that falls in the 'middle' period. A shell sample from Area A (Wk14233) gives a calibrated range that falls late in the 'late' period; no historic period artefacts are present in this area. The A assemblage has a total MNI of 648, while the B assemblage has 7376. Both areas are classified here as single function.

A4.1.11 WHITIANGA WATERWAYS, T11/926 (WHI-926)

The temporary camp site T11/926 is adjacent to the Whitianga Harbour, roughly 400m east of T11/624 and 500m southwest of T11/927. It is a small midden investigated in 2003 (Furey

2003b) with a total MNI of 733; one shell sample provides a calibrated radiocarbon age that falls in the 'middle' period. Faunal data reported here is sourced from Smith and James-Lee (2010). This site is classified as single function.

A4.1.12 Hahei Beach, T11/242 (HHB Upper, HHB Middle, HHB Lower)

Hahei Beach is located on the east coast of the Coromandel. Excavations at this temporary camp site have revealed three occupation layers, here referred to as upper, middle and lower, after Smith and James-Lee (2009). A shell date (NZ6642) sample from the upper layer for radiocarbon dating provides a calibrated date that overlaps the 'early' and 'middle' periods. The shell sampled from the lower layer produced a calibrated radiocarbon date which falls in the 'early' period. The middle layer does not have a sample submitted for radiocarbon dating; here it is assigned to the 'early'-'middle' overlap on the basis of the dating of the upper and lower layers that bookend it. Faunal data from these three layers has been collected from Smith and James-Lee (2009) which utilised data from Nichol (1986). The mammal and bird data includes a mix of MNI and presence-only data; while not ideal, any species noted as 'present' has been treated as a MNI of one, as in Smith and James-Lee (2009). The MNI values for the three assemblages are Upper = 1227, Middle = 819 and Lower = 614. All three layers here are classified as restricted function.

A4.1.13 Hot Water Beach, T11/15 (HWB Middle, HWB Lower)

This undefended settlement site is located at the southern end of Hot Water Beach, at Pye Place in the small settlement named after the beach. Excavations in 1969 identified three main periods of occupation (Leahy 1974). Five radiocarbon dates (NZ1169, NZ1170, NZ1298, NZ1299 and NZA0583) for the 'middle' layer are rejected because the samples are from unidentified charcoal; one date from this layer (NZ1297) on a shell sample is acceptable and provides a calibrated range that straddles the 'early' – 'middle' boundary. The 'lower' layer lacks any radiocarbon dated samples, but it is stratigraphically lower than the 'middle' layer and has therefore been placed in the 'early' period by inclusion. The faunal data for these assemblages was sourced from Smith and James-Lee (2009), originally gathered from Leahy (1974), Leach and Boocock (1993) and Smith (1985). The 'middle' layer assemblage has a total MNI of 976, and the 'lower' layer assemblage 2269. These layers are both classified here as multi-function.

A4.1.14 TAIRUA, T11/62 (TRN LOWER [LAYER 2], TRN UPPER [LAYER 6])

Located in the dunes of a tombolo at the Tairua Harbour mouth, the temporary camp site T11/62 was excavated several times. Two occupation layers were revealed in excavations in 1958-59 and 1964 (Jones 1973; Smart and Green 1962). The early lower layer (layer 2) contained midden, cooking areas and stone working areas, indicative of a small settlement, while the later upper layer (layer 6) was a concentrated shell midden. Layer 2 had six samples submitted for radiocarbon dating (Wk5444, Wk5445, NZ0594, NZ0595, NZA0558, NZ1875), but only two are acceptable (Wk5444, Wk5445). These have been tested and are statistically the same at the 95% level, so a mean pooled radiocarbon age has been calculated and calibrated, placing the Layer 2 assemblage firmly in the 'early' period. The more recent layer, layer 6, has one admissible shell date, which is confirmed as 'late' prehistoric by the lack of historic artefacts. The faunal data used here is sourced from Smith and James-Lee (2010), which in turn is gathered from Smart and Green (1962), Rowland (1975), Smith (1985) and Leach and Boocock (1993) The total MNI values were 616 for the lower assemblage and 1132 for the upper assemblage. Here the lower layer is classified as multi-function and the upper layer as restricted function.

A4.1.15 PAUANUI, T12/1028 (PAU-1028)

This undefended settlement site consists of an extensive area of occupation including terraces and middens, situated on a hillside overlooking the Pauanui sand flats and Tairua Harbour. Several areas were investigated before residential development (Gumbley 2003a). Radiocarbon dates from two shell samples from midden deposits proved to be statistically indistinguishable at the 95% confidence level, and the calibrated mean pooled radiocarbon age falls on the boundary of the 'middle' and 'late' periods. Faunal data used here was gathered from Smith and James-Lee (2010), which was sourced from Gumbley (2003a). The total assemblage MNI was 44. This site is classified as restricted function.

A4.1.16 WHITIPIRORUA, T12/16 (WHT-16)

Located on beach front dunes at Onemana on the Coromandel Peninsula, this undefended settlement site has been subject to surface collections and excavations since the 1950s (Furey 1990). Investigations conducted in in 1986 and 1988 revealed three main layers (Furey 1990); however radiocarbon dates from the uppermost and lowermost layers (Wk1169 and Wk1515 respectively) were statistically identical at the 95% confidence level, and the mean pooled radiocarbon age provided a calibrated date that falls in the 'early' period. The data here is procured from Smith and James-Lee (2010), who combined faunal data from the three layers

into one assemblage; this data was gathered from Furey (1990). The assemblage had a combined total MNI of 420. The site is classified as multi-function.

A4.1.17 MOANA PARK, WHANGAMATA, T12/959 (WHA-959)

The undefended settlement site T12/959 is located on a ridge about 350m east of the Whangamata Harbour estuary and includes a number of terraces, some associated with midden. In 1997 excavations exposed middens and cooking ovens which were interpreted as evidence for repeated use of the area for small settlements associated with shellfish collecting from the nearby estuary and gardening on the flats below (Phillips 1997). Two shell samples were submitted for radiocarbon dating (Wk5650 and Wk5651) and proved to be statistically indistinguishable at the 95% confidence level; the mean pooled radiocarbon age gave a calibrated date that falls in the 'late' period, and is corroborated by the absence of historic artefacts. As in Smith and James-Lee (2010) faunal samples 1-3 were combined for MNI values, which totalled 649. This site is classified here as restricted-function.

A4.1.18 WHANGAMATA, T12/1044 (WHA-1044 LOWER, WHA-1044 UPPER)

An investigation in 2003 revealed evidence for two occupation phases at this medium undefended settlement site located between State Highway 25 and Tirohanga Drive, Whangamata (Gumbley 2005). The earliest (lower) occupation appears to have been a substantial settlement containing terraces, food storage pits and food preparation areas. The later occupation had further features associated with food preparation as well as postholes. The shell samples submitted for radiocarbon dating from each occupation (Wk14471 for the lower occupation, Wk14472 for the upper occupation) are statistically different at the 95% confidence level. The lower occupation calibrated date overlaps the 'early'-'middle' period boundary; the upper occupation yields a calibrated date that overlaps the 'middle'-'late' period boundary. The original source of faunal data in Gumbley (2005) presented the two main shellfish species data as %MNI while incidental species were recorded as raw MNI; as in observed in Smith and James-Lee (2010), there is little option but to use the data as presented. Therefore the lower assemblage has a total MNI of 99, and the upper assemblage 100. Here both layers are classified as restricted function.

A4.1.19 WHANGAMATA RISING MAIN, T12/106 (WHA-106)

This temporary camp site was first recorded on the west side of the Moanaanuanu Estuary in 1975, and then identified in 1997 as midden exposure roughly 200m long along the western bank of State Highway 25, and with an associated terrace. In 2008, during monitoring for the

Whangamata Waste Water Treatment Plant Rising Main, four oven pits, five post-holes, a midden layer and a small localised deposit of burnt soil were identified (Mallows 2009b). Three shell samples were submitted for radiocarbon dating (Wk24975, Wk24976 and Wk24977) and were identical at the 95% confidence level, producing a calibrated date range that falls in the 'late' period. The MNI data from all six samples of midden were combined for the faunal data used here, with a total MNI value of 980. The site is classified here as restricted-function.

A4.1.20 BEACH ROAD, WHANGAMATA, T12/1035 (WHA-1035)

This temporary camp site was identified in 1999 (Mosen 1999), comprising three middens. During monitoring for development of the Whangamata Marina in January 2009 (Hoffmann 2009a) two of these middens were investigated by test trench. Shell samples from each midden were submitted for radiocarbon dating (Wk25357 and Wk25356) and proved to be statistically identical at the 95% confidence level; the mean pooled radiocarbon age calibrated a date that falls over the 'middle' – 'late' period boundaries. The fauna data utilised here is from Hoffmann (2009a), and the assemblage has a total MNI of 842. This site is classified as restricted function.

A4.1.21 WHANGAMATA, T12/240 (WHA-240)

This temporary camp site is situated on the southern bank of the Moanaanuanu estuary, on a wide low dune plane that runs adjacent to the main township are of Whangamata, just north-east of T12/1035 (Hoffmann 2009b). It is located reasonably close to another site, Cabana Lodge (T12/3) and the two may be associated. The site T12/240 was recorded in 1969, and revisited again in 1981 and 1997. In between the latter two dates four layers that had been observed were eroded out; in 1999 when Mosen excavated twelve spade test pits only one cultural layer was identified (Hoffmann 2009b). In May 2009 Hoffmann monitored the construction of the Whangamata Marina sea wall under an authority to modify the site. Two midden concentrations and six firescoops (containing fire cracked stone, charcoal and burnt shell) were identified. Two samples of shell were submitted for radiocarbon dating (Wk26143 and Wk26144) from Area A Feature 3 and Area B Feature 6; these proved to be statistically indistinguishable at the 95% confidence level. A mean pooled radiocarbon age from the two samples provided a calibrated date that falls into the late period; an absence of historic artefacts confirms its prehistoric chronology. The faunal data from all three midden samples – Sample 1 bulk sample Area A, Sample 2 Feature 3, and Sample 3 Feature 6 – were

combined and treated as one assemblage, with a total MNI of 1409. All data was sourced from Hoffman (2009b). This site is classified as restricted function.

A4.1.22 CABANA LODGE, T12/3 (CL-3)

The undefended settlement site, Cabana Lodge (T12/3), is located adjacent to the Whangamata wharf. The assemblage data used here is from the Area Fz Layers 2 and 3 assemblage, which is analysed and presented in Chapter 3 of this thesis. The combined assemblage has an MNI total of 9592. Two shell samples were submitted for radiocarbon dating (Wk21693 and Wk21694), producing calibrated dates that proved to be statistically identical at the 95% level. The mean pooled radiocarbon age produced a calibrated age that falls in the 'early' period. This site is classified as multi-function.

A4.2 WESTERN BAY OF PLENTY ASSEMBLAGES

A4.2.1 WAIHI BEACH, U13/1275 (WHB-1275)

Located near Dillon Street, Waihi Beach, the temporary camp site U13/1275 was encountered during monitoring of the upgrade of stormwater pipelines in late 2006 and early 2007 (Moore 2007). Two midden deposits were recorded and no other features were identified. One shell sample from 'midden 1' was radiocarbon dated (Wk21753) and provided a calibrated date range that falls in the middle period. Faunal data from all four midden samples (two from each midden) is combined to form one assemblage with a total MNI of 202. This site is classified as single function.

A4.2.2 THE CRESCENT, WAIHI BEACH, U13/1246 (WHB-1246)

The undefended settlement site U13/1246 is located roughly 600 m from the shore of Waihi Beach. In 2006 investigations identified evidence for two phases of activity; the earliest was a settlement, possibly defended, while the latter was a brief occupation associated with gardening (Moore 2007). Only one shell sample, from the later occupation, was submitted for radiocarbon dating (Wk19035) and provided a calibrated date range that falls in the 'late' period. As in Smith and James-Lee (2010), faunal data from samples from the later occupation have been combined for use here, totalling 285. This site is classified here as restricted function.

A4.2.3 ANATERE PA, ATHENREE, U13/46 (ANA LOWER, ANA UPPER)

Anatere pa is situated on a headland which overlooks the estuary of the Waiau River, at Athenree, at the northern end of the Tauranga Harbour. Investigations at the pa were conducted in the 1980s, early 1990s and in 1996 (Phillips and Allen 1996). Additionally, Moore and Phillips monitored trenches for a sewerage scheme installation (Moore and Phillips 2002). These investigations have revealed that the first occupation of the site was a small undefended settlement, followed by fortifications and brief use as a large defended settlement before abandonment. From the lower, undefended phase, three shell samples were submitted for radiocarbon dating, which proved to be statistically indistinguishable at the 95% confidence level; the mean pooled radiocarbon age calibrated to a date range that falls into the 'middle' period. Five shell samples from the defended upper phase submitted for radiocarbon dating were statistically identical at the 95% confidence level, and the mean pooled radiocarbon age produced a calibrated date that overlaps the 'middle' – 'late' period boundary. As in Smith and James-Lee (2010), the faunal data utilised here is from 'Trench 4

Layer 22 Terrace foundation' and 'Area 4 Extension A Layer 12', which are combined for the lower undefended phase, and the remainder are combined for the defended upper phase. The former has a combined MNI total of 149, and the latter an MNI total of 576. Both phases are classified as restricted function.

A4.2.4 KOUTUNUI ROAD, ATHENREE U13/78 (KTR-78)

This temporary camp site is located at 74 Koutunui Road in Athenree, a small but developing settlement at the southernmost boundary of the Coromandel Peninsula study area. It consists of several small exposures of midden, one of which was investigated in 2004 by Moore (2004a). A shell sample submitted for radiocarbon dating calibrates a date that overlaps the 'early' and 'middle' periods. Faunal data were sourced from Smith and James-Lee (2010), originally presented in Moore (2004a). The assemblage has an MNI total of 504. This site is classified here as single function.

A4.2.5 BOWENTOWN, U13/876 (BWT-876)

Like U12/875 immediately to the south-east, this pit complex site is on the shore of Tauranga Harbour at Bowentown. During monitoring of trenches dug for a new water main in 2003-2004 it was sampled and recorded (Moore 2004b). A radiocarbon date (Wk14413) on shell from one of the pits has a calibrated range that overlaps the 'middle' – 'late' period boundary. Faunal data used here are sourced from Smith and James-Lee (2010). The assemblage MNI is 215 for this assemblage. This site is classified as restricted function.

A4.2.6 BOWENTOWN, U13/875 (BWT-875)

This undefended settlement site is situated on the shore of the Tauranga Harbour on the Bowentown Peninsula, and includes middens, cooking features, storage pits and evidence of working stone (Moore 2004b). A radiocarbon (Wk14413) date on a shell sample from the base of the deposit produces a calibrated date which overlaps the 'early'-'middle' period boundary. As in Smith and James-Lee (2010), the faunal data used here include only those from the basal component (Samples B23, 25, 38, 53). The combined assemblages give a total MNI of 67. This site is classified here as multi-function.

A4.2.7 BOWENTOWN, U13/874 (BWT-874)

Like U13/785 and U13/786 to the north-west, this temporary camp site is located on the Bowentown Peninsula north of the Tauranga Harbour mouth, and is comprised of three areas of midden separated by darkened soil and charcoal (Moore 2004b). A shell sample from the

base of Midden 2 was submitted for radiocarbon dating (Wk14414) and provided a calibrated date that falls across the 'middle' – 'late' boundary and most of the 'late' period. As in Smith and James-Lee (2010), faunal data from samples B87 and B91 have been combined here with a total MNI of 225. This site is classified as single function.

A4.2.8 WHAKAMARAMA ROAD, WESTERN BAY OF PLENTY, U14/1229 (WHA-1229)

Situated on the western face of a hill, approximately 150 m of Whakamarama Road, to the west of State Highway 2, the temporary camp site U14/1229 was investigated during monitoring of road-widening works at Whakamarama Road in early 2007. Features identified included an in-filled pit and four midden deposits; two possible terraces were identified on the ridge line 20m above road, but these were not affected by the road works. One shell sample from the pit feature was submitted for radiocarbon dating, and yielded a calibrated date range that lies in the 'middle' period. The midden sample 'WKM-01 Base of Pit feature' has been used for faunal data here, giving a total assemblage MNI of 176. This site is classified here as restricted function.

A4.2.9 FLORENCE LANE, TE PUNA, TAURANGA, U14/1465 (FTP-1465)

The two parts of pit complex and temporary camp site, U14/1465, are located on an eastern slope and a 'broad toe' of a narrow ridge in Te Puna, south of Florence Lane. In early 2006 the site was excavated prior to the ridge being used for fill for the adjacent gully, to form a link road for the subdivision of a property into five lifestyle blocks (Furey 2008b). In the first part, Area A, shell midden, several firescoops, several postholes and stakeholes, a small bin-pit and two pits were identified. Area B was visible as fragmented shell midden on the surface; excavation identified a restricted area of shell midden, postholes and nine storage pits. Shell samples from Area A F13 and Area B F74 (Wk20987 and Wk20988 respectively) were radiocarbon dated; they are statistically identical at the 95% confidence level. A mean pooled radiocarbon age provided a calibrated date range that falls in the 'middle' period. All midden samples (Area B F74, Area B F67, Area B F74 10cm, Area B F80, Area B and Area A F13) were combined here to form one assemblage with a total MNI of 4585. This site is classified here as restricted function.

A4.2.10 WAIROA ROAD, TE PUNA, U14/3221 (TEP-3221)

The temporary camp site U14/3221 is situated at 350 Wairoa Road, to the west of the Wairoa River, Te Puna, Tauranga. In 2005 monitoring of top soil stripping revealed an ovenscoop, a

small square pit, a posthole and another ovenscoop; in 2006 monitoring of top soil stripping and investigation identified remnant ovenscoops that had been badly disturbed, undisturbed ovenscoops and a shell midden (Campbell 2008). A shell sample from the shell midden was submitted for radiocarbon dating and provided a calibrated range that falls in the 'middle' period. The sample used for faunal analysis is also from the shell midden, and has a total MNI of 1071. This site is classified here as single function.

A4.2.11 MATARAUA, TAURIKO, U14/2351 (MAT-2351)

The defended settlement Mataraua site, U14/2351, located east of the Wairoa River and State Highway 29, was investigated in 2007 as part of development for the Tauriko Business Estate (Campbell and Hudson 2009). Five areas, A-E, were stripped of topsoil, though Areas C-E showed evidence of modern contouring and were not excavated further. While Area A had a large number of intercutting pits, as well as ovenscoops and postholes, no archaeological features were found in Area B. A further area, Area F, was excavated and revealed nine oven scoops and some midden. A shell sample from F11, an ovenscoop in Area A East, and another from F248, an ovenscoop in Area F, were submitted for radiocarbon dating (Wk24223 and Wk24222 respectively). These dates were statistically indistinguishable at the 95% confidence level, providing a calibrated date that falls in the 'middle' period. The faunal data analysed here is the combined assemblages of F11 and F248 with a total MNI of 2928. This site is classified here as restricted function.

A4.2.12 TAURIKO, TAURANGA, U14/2402 (TAU-2402)

Located on a hill immediately west of the Kopurererua Stream, and midway between State Highways 29 and 36 at Tauriko, the temporary camp site U14/2402 was originally recorded as an obsidian flake 'findspot'. However investigations of three areas in 2008 prior to earthworks associated with the development of the Tauriko Business Estate identified a small terrace, ovenscoops, postholes, stakeholes, pits and midden. One shell sample from 'Area B Feature 123' was submitted for radiocarbon dating, and produced a calibrated age that falls in the 'middle' period. A midden sample from the same feature is used for the faunal assemblage here, and gives a total MNI of 1827. This site is classified here as restricted function.

A4.2.13 OROPI DOWNS, TAURANGA, U14/1941 (ORO-1941)

The pit complex and temporary camp site, U14/941, is located on the edge of a wide flat terrace on the eastern side of the Waiorahi stream, adjacent to flat pastoral land in the Oropi Valley, Tauranga (Campbell and Hudson 2008b). The site was investigated in 2007 prior to

earthworks associated with the Oropi Downs Stages III and IV development; eight pits, eight ovenscoops, several postholes and one midden were identified. One shell sample was submitted for radiocarbon dating and provided a calibrated date range that falls in the 'middle' period. Data from two midden samples ('F18' and 'F32') have been combined here to form one assemblage, with a total MNI of 929. This site is classified as restricted function.

A4.2.14 Oropi Downs, Tauranga, U14/3216 (ORO-3216)

The pit complex and temporary camp site U14/3216 was recorded during 2005 as "a midden on the lip of the wide, flat terrace" (Campbell and Hudson 2008a:9), during an archaeological assessment in the Oropi Valley, Tauranga (Campbell 2005b). The site was investigated in 2005 prior to residential development; two areas were exposed, revealing eight pits (all in Area A), ovenscoops and postholes (in both areas). One shell sample from feature 17 was submitted for radiocarbon dating, providing a calibrated age range that falls in the 'middle' period. Faunal data from features 9, 17, 41, 47, 103 and 111 were combined to form one assemblage with a total MNI of 715. This site is classified as restricted function.

A4.2.15 Oropi Downs, Tauranga, U14/3056 (ORO-3056)

The temporary camp site, U14/3056, is located on a slope on the edge of a wide flat terrace in the Oropi Valley, Tauranga (Campbell and Hudson 2008b). The site was investigated in 2005 prior to earthworks associated with the Oropi Downs Stages III and IV development; one midden (8x5m), seventy-five postholes, seventeen ovenscoops and two small pits were identified. A shell sample was submitted for radiocarbon dating (Wk18304) and yielded a calibrated range that falls in the 'middle' period. Faunal data from features 61, 62, 63 and 'midden trench' are combined here to form one assemblage, totalling 893 (MNI). This site is classified as restricted function.

A4.2.16 Oropi Downs, Tauranga, U14/1945 (ORO-1945)

The temporary camp site, U14/1945, is situated on a ridge west of Oropi Road, Tauranga (Campbell 2003). In 2003 the site was investigated during initial earthworks at the Oropi Downs residential development; evidence for kumara storage, shellfish processing and charcoal burning was identified (Campbell and Piahana 2003). A shell sample (from sample 3) and a charcoal sample (from sample 4, the base of the hangi feature in trench 1) were submitted for radiocarbon dating (Wk13116 and Wk13117 respectively). These dates were statistically different at the 95% confidence level. The faunal data used here is from 'Area B

kumara pit Sample 3' and matches the sample for Wk13116. The assemblage has a total MNI of 1529. This site is classified as restricted function.

A4.2.17 Cheyne Road, Tauranga, U14/1920 (CHE-1920)

The pit complex and temporary camp site U14/1920 is one of two sites situated on a ridge at Cheyne Road, south-west of the Waimapu Estuary, Tauranga (Furey 2004b). It was investigated in 2004 prior to recontouring for residential development, and is described as "typical of the short term occupation sites dotted around the landscape of the Tauranga area" (Furey 2004b:34). Although the site was divided into two areas (A and B) because the distance between the two sets of features measured 70m, the shell samples submitted for radiocarbon dating from Area A Pit 3 (Wk14113) and Area B Firescoop T4 (Wk14114) were statistically identical at the 95% confidence level; the mean pooled radiocarbon age produced a calibrated range that overlaps the 'early' and 'middle' period boundary. The faunal data used here are the combined assemblages of Fill of Pit 4, Area A and Trench 4, Area B. The combined MNI total comes to 472. This site is classified as restricted function.

A4.2.18 Cheyne Road, Tauranga, U14/3193 (CHE-3193)

Identified by test trenching in 2003, the pit complex and temporary camp site U14/3193 is one of two sites situated on a ridge at Cheyne Road, south-west of the Waimapu Estuary, Tauranga (Furey 2004b). It was investigated in 2004 prior to recontouring for residential development; kumara pits, middens postholes and ovenscoops were revealed. Shell samples from 'Trench 1 Pit 4' and 'Trench 2 midden scoop' were submitted for radiocarbon dating, and provided calibrated ages that were identical at the 95% confidence level. The mean pooled radiocarbon age yielded a calibrated date range that falls into the 'middle' period. The faunal data from three samples, 'Base of Slope, Trench 14', 'Trench 1: Pit 1.4 fill' and 'Trench 2: Shell Scoop, 17m T2w' are combined in this analysis. The total MNI value is 1919. This site is classified as restricted function.

A4.2.19 Oropi Park, Tauranga, U14/3197 (ORO-3197)

In November 2003, a shell midden was exposed and damaged by earthmoving machinery at 298 Poike Road, Tauranga, associated with development of an industrial subdivision (Campbell 2004). After a damage assessment was undertaken by Ken Phillips (Phillips 2003a), monitoring of earthworks was conducted by Matthew Campbell in 2004. Two patches of shell midden and a raked out oven scoop were identified in the undamaged remnant of the site. One shell sample was radiocarbon dated (Wk15814) and yielded a calibrated date range

that falls in the 'middle' period. The faunal data from all three midden samples were combined here to form one assemblage, with a total MNI of 2019. This temporary camp site is classified here as restricted function.

A4.2.20 ROWESDALE, TAURANGA, U14/3218 (ROW-3218)

The defended settlement site, U14/3218, is situated on a ridge top in Ohauiti, Tauranga. The site is described as palisaded with "sixty-eight pits, two definite house outlines, hints of several other houses, nine earth ovens and 567 postholes" (Campbell 2005a:1) In 2005 it was investigated prior to works associated with Rowesdale Development Stage 6, a residential subdivision (Campbell 2005a). Four shell samples were submitted for radiocarbon dating from feature 1 (Wk16950), feature 21 (Wk16947), feature 25 (Wk16948), and feature 38 (Wk16949); these proved to statistically identical at the 95% confidence level, and yielded a calibrated age range that falls in the 'middle' period. A charcoal sample of *mahoe* and five-finger from feature 32 was also radiocarbon dated and provided a calibrated age range that lies in the middle period. Faunal data from samples 1, 21, 25 and 38 were combined as one assemblage here, with a total MNI of 715. This site is classified as multi-function.

A4.2.21 ROWESDALE, TAURANGA, U14/1972 (ROW-1972)

The temporary camp site U14/1972 is described as an eroding shell midden, situated on a steep bank in Ohauiti, Tauranga. In 2005 it was investigated prior to works associated with Rowesdale Development Stage 6, a residential subdivision (Campbell 2005a). Two main concentrations of midden were visible over 100m. One shell sample was radiocarbon dated and provided a calibrated date range that falls in the 'middle' period. One midden sample was analysed for faunal data and the assemblage has a total MNI value of 640. This site is classified as single function.

A4.2.22 KAITEMAKO SUBSTATION, WELCOME BAY, TAURANGA, U14/? (KAI)

At the time of writing, no NZAA site record number is available for the Kaitemako Substation site, a temporary camp site on Kaitemako Road, Welcome Bay, Tauranga. Prehistoric Maori archaeological features were identified during earthworks monitoring for the installation of an electrical substation (Gumbley and Farley 2008). Features included damaged shell middens, ovenscoops, a posthole and a cluster of rocks. One shell sample was submitted for radiocarbon dating and provided a calibrated date range that falls in the 'middle' period. Two midden samples, from 'Sediment Pond' and 'Trench 2, F6' were combined to form one assemblage with a total MNI of 1755. This site is classified as single function.

A4.2.23 Fergusson Park Car Park, Tauranga, U14/3305 (FPC 3305)

Fergusson Park is located near the northern end of Tilby Drive, in the suburb of Matua, Tauranga, and overlooks the estuary mudflats of Tauranga Harbour. The temporary camp site U14/3305 was identified during monitoring of earthworks for the extension of the carpark at Fergusson Park in 2008; a disturbed shell scatter and an intact shell concentration were exposed (Mintmier 2008). Two shell samples from the primary shell midden deposit (layer IV) were submitted for radiocarbon dating (Wk24203 and Wk24204); these dates are statistically identical at the 95% confidence level, and a mean pooled radiocarbon age provided a calibrated age range that falls in the 'middle' period. The exact context of the midden sample used for faunal analysis is not obvious, but it here it is assumed that, like the radiocarbon dating samples, it is from the 'primary shell midden deposit'. The assemblage has a total MNI of 380. This site is classified as restricted function.

A4.2.24 Highgrove, Welcome Bay, Tauranga, U14/2039 (HIG-2039)

Situated on a short, level spur ridge, south of Waitaha Road and east of Kaitemako Road, Welcome Bay, the pit complex and temporary camp site U14/2039 is described as a pit/terrace site. During earthworks for the Highgrove residential subdivision in 2002, shell, ovenscoops and probable storage pits were exposed below the terraces and pit (Hooker 2005a). Subsequently the site was investigated, and six pits and two hearths were identified. Two shell samples from 'Hearth 1' and 'Hearth 2' (Wk17778 and Wk17779 respectively) were radiocarbon dated and proved to be statistically identical at the 95% confidence level; a mean pooled radiocarbon age gave a calibrated date range that falls in the 'late' period. Midden faunal data from 'Hearth 1' and 'Hearth 2' was combined here to form one assemblage with a total MNI of 195. This site is classified as restricted function.

A4.2.25 Balintoy Park, Welcome Bay, Tauranga, U14/3269 (BAP-3269 T1, F6)

This pit complex and temporary camp site was one of two identified during earthworks for a residential subdivision (Harris and Campbell 2009); U14/3269 is recorded as a midden. Excavation during 2006 revealed more midden and some isolated ovens and pits. Further investigation in 2007 opened up three areas, where a further 25 features were identified, including one small patch of midden and two small groups of storage pits. A charcoal sample of *Hebe sp*., *Coprosma sp.*, and *Melicytus sp*. from feature 6 was submitted for radiocarbon dating (Wk24221) and yielded a calibrated range that falls in the middle period. A shell sample from Trench 1 was also radiocarbon dated; this date is not statistically identical to the

charcoal date at the 95% level, but its calibrated range also falls in the 'middle' period. Faunal data from midden samples 'Trench 1 #1' and 'Trench 1 #2' were combined to form one assemblage (BAP-3269 T1), and data from 'Feature 6' is used for another assemblage (BAP-3269 F6). The Trench 1 assemblage has a total MNI of 1919, and the Feature 6 assemblage 43. This site is classified as restricted function.

A4.2.26 Asher Block, Omanu-Papamoa, U14/2912 (ASH-2912)

The pit complex and temporary camp site U14/2912 was one of three sites investigated in early 2008 at the Asher Block, situated on the Papamoa dune plain between Omanu-Papamoa Beach and Rangataua Bay, Tauranga Harbour (Gumbley 2010). The eastern half of the site was excavated in seven areas, A-G; the remainder of the site was outside the development area. Features identified included postholes, pits, stone/rock caches, ovens (umu) and fireplaces (hearths). Unusually for the Papamoa dune plain, five stratigraphic layers were identified. Three of these were interpreted as the 'principle' layers; a large number of pits were found in all layers, as well as numerous postholes and a large number of artefacts. Three shell samples from Layers 1 and 2 (Wk22622, Wk23092 and Wk23093), one sample from Layer 3 (Wk23095) and one sample from Layer 4 (Wk23094) were submitted for radiocarbon dating. Although Gumbley pools the dates from Layers 1 and 2, he keeps the dates from Layers 3 and 4 separate. Here, all five dates were tested for significance using Calib601, and are statistically identical at the 95% confidence level. Although three phases of occupation occurred, they took place within a rapid period of time. The mean pooled radiocarbon age yields a calibrated age range that falls in the 'middle' period. The faunal data from samples 'a', 'F19', 'F96', 'F108' and 'F140' have been combined here to form one assemblage, with a total MNI of 9602. This site is classified as restricted function.

A4.2.27 Tuihana Subdivision, Papamoa Beach Road, U14/2897 (TUI -2897-1, -2, -3)

The Tuihana Subdivision is located on the Papamoa Dune Plain, inland of Papamoa Beach Road, Papamoa (Felgate 2006a). The temporary camp site U14/2897 was investigated in 2004 to mitigate the effects of earthworks for a residential subdivision. Nine areas and eleven trenches were investigated; middens, scoops and postholes were identified. Three samples were submitted for radiocarbon dating from Trench 11; samples 1 (Wk17613) and 3 (Wk17615) were from an upper (younger) stratigraphic layer, sample 2 (Wk17614) was from a lower (earlier) cooking event. Samples 1 and 3 are not able to be tested for statistically significant similarity, as sample 1 is from manuka twig (where carbon is sourced from the

terrestrial carbon pool) and sample 3 is from the shellfish species *Paphies subtriangulata* (where carbon is sourced from the marine carbon pool). Sample 2, also from *P. subtriangulata*, is significantly differently different from sample 3 at the 95% confidence level. Therefore, data from midden samples 1, 2 and 3 were not combined, and each is treated as a separate assemblage here. Sample 1 has a total MNI of 102, sample 2 a total of 334 and sample 3 a total of 245. Assemblage TUI-2897-2 falls in the 'middle' period, while assemblages TUI-2897-3 and TUI-2897-1 fall in the 'late' period. This site is classified as restricted function.

A4.2.28 Evans Road, Papamoa, U14/3256 (EVA-3256)

The temporary camp site at 46 Evans Road, Papamoa, lies directly south-east of the previous site, U14/2894, on a levelled former ridge of a dune plain (Felgate 2006b). Despite part of the site having been destroyed, fifteen features were recorded, including postholes, hangi stones and ovenscoops. Two shell samples, from features 11 and 12, were radiocarbon dated and are statistically identical at the 95% confidence level; a mean pooled radiocarbon age yielded a calibrated date range that falls in the 'middle' period. Faunal data from samples of 'Feature 11', 'Feature 11 Charcoal from base', 'Feature 11 Sample 2', 'Feature 12 Sample 2' and 'Feature 12 Shell Sample' have been combined here to form one assemblage with a total MNI of 1150. This site is classified as restricted function.

A4.2.29 Supacenta Development, Papamoa, U14/2891 (SUP-2891)

The temporary camp site U14/2891 is one of five sites investigated in 2004 prior to earthworks for commercial development (Felgate 2005). The site is north-west of U14/2888, and west of Domain Road, Papamoa, on the Papamoa dune plain. Four other sites were also investigated and reported with U14/2891; Felgate notes

> "Areas where archaeological remains were discovered were extensive, and were investigated by a continuation of stripping by hydraulic digger under the direction of an archaeologist, and further by hand excavation at varying levels of detail. Accordingly, the terminology used to describe localities investigated departs from the NZAA site designations in the NZAA site recording scheme, and follows instead an alphabetical denomination of excavation areas A, B, C, D, E, F, G, H, I and J" (2005:4).

This makes assigning radiocarbon samples and midden samples to specific sites a complex and potentially error-prone task. Here the shell samples submitted as Wk17606 and Wk17610

are interpreted as being associated with U14/2891, and also midden samples 'Area F F1B' and 'Area F F1E'. The radiocarbon ages are statistically identical at the 95% confidence level; the mean pooled radiocarbon age produces a calibrated date range that falls in the 'late' period. The two midden samples are combined here to give a total MNI of 501. This site is classified as restricted function.

A4.2.30 SUPACENTA DEVELOPMENT, PAPAMOA, U14/2889 (SUP-2889)

The undefended settlement site U14/2889 is one of five sites (see above) investigated in 2004 prior to earthworks for commercial development (Felgate 2005). The site is adjacent to previously mentioned U14/2891 and north-west of U14/2888; south of Gravatt Road and west of Domain Road, Papamoa, on the Papamoa dune plain. As described previously, because of Felgate's reporting methods it is difficult to associate results with the correct site record number; here the shell samples submitted as 'Area H, Feature 1006, (pit) Spit 6' (Wk17605), 'Area H, Feature 1006, (pit) Spit 5' (Wk17607) and 'Area H, Feature 1006, (pit) Spit 1' (Wk17608) are interpreted as originating from U14/2889. The calibrated dates proved to be identical at the 95% confidence level; the mean pooled radiocarbon age gives a calibrated date range that falls in the 'late' period. Faunal data from samples 'Area H, Feature 1006, (pit) Spit 6', 'Area H, Feature 1006, (pit) Spit 5' and 'Area H, Feature 1006, (pit) Spit 1' are combined here to form one assemblage. This site is classified as restricted function.

A4.2.31 SUPACENTA DEVELOPMENT, PAPAMOA, U14/2888 (SUP-2888)

Located west of Domain Road, Papamoa, on the Papamoa dune plain, this temporary camp site was investigated in 2004 prior to earthworks for commercial development (Felgate 2005). Midden sample 'Area G F33 deep U-shaped hangi' has here been interpreted to originate from site U14/2888; a shell sample from the same feature was submitted for radiocarbon dating (Wk17609) and yielded a calibrated date range that falls into the 'middle' period. The sample has an MNI total of 21; the site is classified as restricted function.

A4.2.32 TARA ROAD, PAPAMOA, U14/3230 (TAR-3230 H, TAR-3230 G)

The site U14/3230 is situated on a low dune directly south of the Wairakei River channel, north of Tara and Parton Roads and east of Longview Drive, Papamoa; it is part of an extensive distribution of archaeological features recorded under U14/2880 on a separate land title (Campbell et al. 2009). The site was investigated in 2007 prior to three development projects (residential subdivision, sporting facilities and educational facilities). Eight areas were opened up but the main focus of the excavation were Areas A, C, G and H. Areas A-F

had been disturbed by ploughing, while remains in Areas G and H were more dense and complex. In Area G earth ovens, postholes, middens, pits, a stone cache and a trench were identified; Area H revealed earth ovens, postholes, a large dense midden, a stone cache and pits were recorded. Seven shell samples were submitted for radiocarbon dating – one from Area C, three from Area G and three from Area H. The samples from 'Area H #191 F359 Layer A', 'Area H #192 F359 Layer B' and 'Area H #193 F359 Layer B1' proved to be statistically identical at the 95% confidence level, and yielded a calibrated date range that falls in the 'middle' period. The samples from 'Area G #113 F240 upper', 'Area G #166 F187' and 'Area G #110 F240 Sp4' were also statistically indistinguishable at the 95% confidence level, and the mean pooled radiocarbon age provided a calibrated date range which lies in the 'late' period. For Area H faunal data, the MNI values of samples 'F359 S361 S1', 'F359 S361 S2, 'F359 S361 S3', 'F359 S361 S4', 'F359 S361 S5', 'F359 S372 S1', 'F359 S372 S4', 'F359 S372 S5' and 'F359 S372 S6' are combined to form one assemblage with a total MNI of 6651. The Area G faunal data is a combination of samples 'F270 Sp1', 'F270 Sp2', 'F270 Sp3', and 'F270 Sp4'which give a combined MNI total of 247. Both Area G and Area H are temporary camps, and are classified as restricted function.

A4.2.33 TARA ROAD, PAPAMOA, U14/3231 (TAR-3231)

Situated to the west of U14/534 and Gordon Spratt Reserve, the temporary camp site, U14/3231, lies on a high dune ridge, immediately adjacent to an old inter-dune swamp and north of Tara Road, Papamoa (Campbell et al. 2009). The site was investigated in 2007 prior to three development projects (residential subdivision, sporting facilities and educational facilities). Excavation revealed that the site had been extensively damaged by rabbit burrowing, but some midden was observed intact. A shell sample submitted for radiocarbon dating yielded a calibrated age range that lies in the 'late' period. Faunal data from feature 600 is used here, which has an MNI total of 227. This site is classified here as single function.

A4.2.34 GOLDEN SANDS, PAPAMOA, U14/3113 (GSP-3113)

The temporary camp and horticultural soils site, U14/3113, is situated in the "eastern half of the Papamoa dune plain between the coastal fore dunes and the palaeochannel of the Wairakei River" (Gumbley and Phillips 2004:1) and to the south of Short Place. The site was investigated in 2003 as part of earthworks for residential subdivision. Six areas, A-F, were investigated by hand; features included middens and hearths. Two shell samples from 'Area C1 midden' and 'firescoop F1b' were submitted for radiocarbon dating (Wk13790 and Wk13791 respectively); these were indistinguishable at the 95% confidence level, and mean

pooled radiocarbon age yielded a calibrated age range that falls in the 'middle' period. Data from midden samples 'Area C1 SB' and 'F1b' were combined here to create one assemblage with a total MNI of 510. This site is classified here as restricted function.

A4.2.35 Golden Sands, Papamoa, U14/3116 (GSP-3116)

The temporary camp and horticultural soils site U14/3116 is one of two sites (see above) that was investigated in 2003 as part of earthworks for residential subdivision. It is located in the "eastern half of the Papamoa dune plain between the coastal fore dunes and the palaeochannel of the Wairakei River" (Gumbley and Phillips 2004:1) and to the south of Short Place. Two areas (A and B) and three trenches were investigated, revealing ovenscoops, shell lenses, postholes and a terrace. Shell samples from ovenscoops B1 and B18b were radiocarbon dated, and proved to be identical at the 95% confidence level. A mean pooled radiocarbon age gave a calibrated date range that lies in the late period. Faunal data from midden sampled from ovenscoops B1 and B18b is combined here to form one assemblage with a total MNI of 980. This site is classified here as restricted function. This site is classified here as restricted function.

A4.2.36 Maketu South, Maketu, V14/187 (MAS-187)

MAS-187 (V14/187) is one of two sites uncovered when a new water main was laid along Beach Road, which boarders the Maketu estuary where it enters the sea, at Maketu in March and April 2008 (Moore, P.R. 2008c; Moore, P.R., Taylor et al. 2009). A temporary camp, the extent of the site is estimated at approximately 50 x 30 m; the water main trenching is estimated to affect approximately 10-12 m². The archaeological evidence comprises a distinctive cultural layer of black, charcoal-rich sand, with stone flakes, bone material and fire-cracked rocks. The southern extent of the site lies directly above the Kaharoa Tephra; the cultural layer is approximately 10-15 cm thick at this point, and grades to clean white sand. Structures or features which had been excavated into the tephra included postholes, two firescoops and a small pit containing large moa bones and fire-cracked rock. Moa bone from M22 was submitted for radiocarbon dating (Wk23623) and yielded a calibrated date which lies in the early period. The faunal assemblage did not contain any shell, and only very little fish, resulting in a total MNI of 10.

A4.2.37 MAKETU NORTH, MAKETU, V14/188 (MAN-188)

MAN-187 (V14/188) is the second of two sites uncovered when a new water main was laid along Beach Road, Maketu in March and April 2008 (Moore, P.R. 2008c; Moore, P.R., Taylor et al. 2009). The site extends along the northern part of Beach Road for approximately 140 – 200 m, and is estimated to be 10 m wide. The archaeological remains, a temporary camp, consist of a single continuous midden layer 70 cm thick including shell, fish bones, fire-cracked rock, charcoal and mammal bones, overlain with clean dune sand. Nineteen samples were combined to calculate an MNI total of 1364. Two samples of *Paphies australis* were submitted for radiocarbon dating (Wk23634 and 23635), and a mean pooled radiocarbon age gave a calibrated date range that lies in the middle period.

A4.2.38 HAMURANA ROAD, ROTORUA, U15/9 (HAM-9)

Situated on the north shore of Lake Rotorua, directly adjacent Hamurana Road and east of Te Waerenga Road, the temporary camp site U15/9 was originally recorded in the early 1960s as probably the largest midden of kakahi (freshwater mussel, *Hyridella menziesii*) in the Rotorua district, and also contained two bell-shaped rua pits (Campbell and Phillips 2005). Although much impacted by roading, two intact areas were able to be investigated in early 2005 – Paketuri, described by Stafford (1994:73, Map 17), and a large kakahi midden described as 'Midden C' by Phillips (2003b). Paketuri was excavated in six areas, A-F, which included features such as ovenscoops, rectangular pits, rua pits, a terrace and postholes. 'Midden C' contained evidence for four phases of use: gardening, midden deposition, fill dumping from the terrace above, and further midden deposition. Four samples of charcoal from unspecified but 'short-lived' plant species from 'Trench 1 Sample 1', 'Trench 1 Sample 2', 'Area A Feature 5' and 'Feature D4' were submitted for radiocarbon dating; they proved to be statistically identical at the 95% confidence level. A mean pooled radiocarbon age gave a calibrated date range that falls in the 'late' period. Faunal data from 'Trench 1 Sample 1', 'Trench 1 Sample 2' and 'Sample 6' are combined here to form one assemblage with a total MNI of 668. This site is classified here as multi-function.

A4.2.39 THE STRAND, WHAKATANE, W15/780 (STR-780)

The remains of a undefended settlement site situated between George St and Clifton Road, behind the Whakatane Hotel, were identified during road works in 1988. In mid-2006 monitoring of waste-water reticulation pipeline upgrade along The Strand, conducted by Nicholas Cable, identified intact cultural layers, postholes and middens associated with prehistoric Maori fishing site W15/780. Shell samples 303 and 324 were submitted for

radiocarbon dating (Wk21013 and Wk21014 respectively) and proved to be statistically identical at the 95% confidence level; the mean pooled radiocarbon age yielded a date range that overlaps the boundary of the 'middle' and the 'late' periods. Data from midden samples '304 Trench 1' and '324 Trench 2' were combined to form one faunal assemblage with a total MNI value of 353. This site is classified as restricted function.

A4.2.40 Te Horo Drive, Ohope Beach, W15/584 (TEH-584)

The temporary camp site W15/584 is situated at Te Horo drive, on an east-west oriented dune ridge at the western end of the Ohope Spit; it lies north-east of Tauwhare Pa. The site was investigated in 1997 prior to residential subdivision development (Bowers and Phillips 1997); pits, hangi and midden were identified. Shell samples taken from sample 4 (a concentrated shell midden lens in the south baulk of the east-west trench; Wk5480), and sample 19 (taken from a concentrated lens in in the eastern baulk of the north-south trench; Wk5481) submitted for radiocarbon dating proved to be statistically identical at the 95% confidence level. The mean pooled radiocarbon age provided a calibrated date range that falls across the boundary of the 'early' and 'middle' periods. The faunal data from samples 1, 16, 17, 18, 19, 20, 21, 24 and 25 have been combined to form one assemblage with a total MNI value of 4800. This site is classified here as restricted function.

A5 RADIOCARBON DATE INPUTS

The following tables present the radiocarbon data inputs associated with the assemblages listed in section A.4.

Table A.23 Data inputs from Coromandel assemblages used in OxCalib601

Lab code	14C BP (CRA)	14C Age SD (years)	Delta R (years)	Delta R SD (years)	Marine Carbon %	Description	Material	CalCurve Number
Wk5444	1000	50	-7	45	100	TRN Lower L2	Shell - *A. stutchburyi*	3
Wk5445	1090	50	-7	45	100	TRN Lower L2	Shell - *L. smaragda*	3
MPRA	1045	48	-7	45	100	TRN Lower L2	Shell	3
NZ0594	885	52	REJECT	REJECT	REJECT	TRN Lower L2, oven	charcoal - no ID	
NZ0595	449	44	REJECT	REJECT	REJECT	TRN Lower L2, oven	charcoal - no ID	
NZA0558	460	55	REJECT	REJECT	REJECT	TRN Lower L2, oven	bone – *D. struthoides* collagen - potential contamination (Petchey 1999:113)	
NZ1875	885	58	REJECT	REJECT	REJECT	TRN Lower L2	shell – *C. denticulata, L smaragdus* - unreliable species	
Wk21355	1092	34	-7	45	100	CCK L9	fish bone - *P. auratus*	3
Wk21363	1007	34	-7	45	100	CCK L9	fish bone - *P. auratus*	3
MPRA	1050	40	-7	45	100	CCK L9	fish bone - *P. auratus*	3
NZA0576	751	58				CCK L9	bone - moa ?sp.	3
Wk21642	744	33	-7	45	100	CCK L9	bone - *Nestor meridionalis*	3
MPRA	746	29	-7	45	100	CCK L9	terrestrial birds	
NZ6800	1035	28	-7	45	100	CCK L7	shell - *P. subtriangulata*	3
NZ6642	932	64	-7	45	100	HHB upper	shell - *P. subtriangulata*	3
Wk21693	1025	33	-7	45	100	CL T12/3 Area F L2 Nth Baulk	shell - *P. australis*	3
Wk21694	931	32	-7	45	100	CL T12/3 Area F L2 F22	shell - *P. australis*	3
MPRA	978	39	-7	45	100	T12/3 L2	shell - *P. australis*	3
inclusion						HHB middle		
NZ6646	952	51	-7	45	100	HHB lower	shell - *P. subtriangulata*	3
NZ4883	606	56			0	PJK	bone - moa: *A. didiformis*, *P. mappini*, *D. struthoides*, *collagen*	
Wk1169	870	45	-7	45	100	WHT upper	shell - *A. stutchburyi*	3
Wk1515	990	50	-7	45	100	WHT earliest occ	shell - *P. australis*	3
MPRA	927	46	-7	45	100	WHT-16	shell	3
NZ6825	881	51	-7	45	100	CCK L5	shell - *P. subtriangulata*	3
Wk14285	898	37	-7	45	100	KTR-78 MM1	shell - *A. stutchburyi*	3
Wk14413	886	37	-7	45	100	BWT-875 base of occupation	shell - *A. stutchburyi*	3
Wk14471	886	31	-7	45	100	WHA-1044 lower T4 LM	shell - *P. australis*	3
NZ6798	851	33	-7	45	100	CCK L3	shell - *P. subtriangulata*	3
inclusion						HWB lower		
NZ1169	437	44	REJECT	REJECT	REJECT	HWB middle SqM12 L4	charcoal - no ID	
NZ1170	492	87	REJECT	REJECT	REJECT	HWB middle SqM11 L4	charcoal - no ID	
NZ1297	832	44	-7	45	100	HWB middle M11/12 baulk L4	shell - *P. australis*	3

Table A.23 Data inputs from Coromandel assemblages used in OxCalib601, *continued*

Lab code	14C BP (CRA)	14C Age SD (years)	Delta R (years)	Delta R SD (years)	Marine Carbon %	Description	Material	CalCurve Number
NZ1298	-100	104	REJECT	REJECT	REJECT	HWB middle SqM11, 11/12 baulk L4	fish bone carbonate	
NZ1299	647	92	REJECT	REJECT	REJECT	HWB middle SqM11, 11/12 baulk L4	fish bone collagen, no ID	
NZA0583	549	74	REJECT	REJECT	REJECT	HWB other L6	bone - moa ?sp. collagen	
Wk8065	790	50	-7	45	100	MTR-990	shell - *A. stutchburyi*	3
Wk25355	807	30	-7	45	100	AHU-944 M3	shell - *P. subtriangulata*	3
Wk4660	780	50	-7	45	100	ANA Lower A4a L12 firescoop	shell - *P. australis*	3
Wk4662	710	50	-7	45	100	ANA Lower Trench 4 L22	shell - *P. subtriangulata*	3
NZ5184	827	56	-7	45	100	ANA Lower scarp of terrace 7	shell - *P. australis*	3
MPRA	770	40	-7	45	100	ANA Lower	shell - Paphies	3
Wk14234	760	27	-7	45	100	WHI-927 B F44	shell - estuarine	3
Wk21753	747	34	-7	45	100	WHB 1275	shell - *P. subtriangulata*	3
Wk12109	728	41	-7	45	100	PAU swe	shell - *P. australis*	3
Wk12110	734	42	-7	45	100	PAU lot 3	shell - *P. australis*	3
MPRA	731	43	-7	45	100	PAU	shell - *P. australis*	3
Wk13650	731	38	-7	45	100	WHI-926	shell - *P. australis*	3
Wk25357	839	37	-7	45	100	WHA-1035 M3	shell - *P. australis*	3
Wk25356	610	31	-7	45	100	WHA-1035 M2	shell - *P. australis*	3
MPRA	729	38	-7	45	100	WHA 1035	shell - *P. australis*	3
Wk13352	730	35	-7	45	100	WHI-624	shell - *P. australis*	3
Wk11407	720	51	-7	45	100	ANA Upper outer ditch	shell - *P. australis*	3
Wk4659	670	50	-7	45	100	ANA Upper T4 L9	shell - *P. australis*	3
Wk4661	700	50	-7	45	100	ANA Upper A4a L7	shell - *P. australis*	3
Wk3751	660	51	-7	45	100	ANA Upper palisade posthole	shell - *P. australis*	3
Wk3755	720	50	-7	45	100	ANA Upper palisade posthole	shell - *P. australis*	3
MPRA	722	26	-7	45	100	ANA Upper	shell - *P. australis*	3
Wk14472	694	30	-7	45	100	WHA-1044 upper AC F9	shell - *P. australis*	3
Wk8066	690	50	-7	45	100	MTR-983 A1 MS4	shell	3
Wk8067	620	50	-7	45	100	MTR-983 A1 MS35	shell	3
Average	665	48	-7	45	100	MTR-983	shell	3
Wk15677	629	33	-7	45	100	WHP-751 Area D/E Midden	shell - *P. australis*	3
Wk15678	711	35	-7	45	100	WHP-751 Area A Midden 1a	shell - *P. australis*	3
Wk15679	653	34	-7	45	100	WHP-751 Area C Midden over pit3/F23	shell - *P. australis*	3
MPRA	664	33	-7	45	100	WHP-751	shell - *Paphies australis*	3

Table A.23 Data inputs from Coromandel assemblages used in OxCalib601, *continued*

Lab code	14C BP (CRA)	14C Age SD (years)	Delta R (years)	Delta R SD (years)	Marine Carbon %	Description	Material	CalCurve Number
Wk6377	670	40	-7	45	100	MTR-993 25cm bs	shell - *P. subtriangulata*	3
Wk6378	680	50	-7	45	100	MTR-993 35cm bs	shell - *P. subtriangulata*	3
Wk6379	580	50	-7	45	100	MTR-993 F4	shell - *P. subtriangulata*	3
MPRA	645	37	-7	45	100	MTR-993	shell - *P. subtriangulata*	3
Wk14412	630	36	-7	45	100	BWT-876 fill of pit 3	shell - *P. australis*	3
Wk5650	610	45	-7	45	100	WHA-959 AF SA hangi scoop	shell - *A. stutchburyi*	3
Wk5651	612	45	-7	45	100	WHA-959 AF SA hangi scoop	shell - *A. stutchburyi*	3
MPRA	611	45	-7	45	100	WHA-959	shell - *A. stutchburyi*	3
Wk24975	618	33	-7	45	100	WHA-106 WRM A3	shell - *A. stutchburyi*	3
Wk24976	671	35	-7	45	100	WHA-106 WRM B1	shell - *A. stutchburyi*	3
Wk24977	569	35	-7	45	100	WHA-106 WRM C6	shell - *A. stutchburyi*	3
MPRA	618	33	-7	45	100	WHA-106	shell - *A. stutchburyi*	3
Wk14414	616	34	-7	45	100	BWT-874 base of M2	shell - *P. australis*	3
Wk19035	602	36	-7	45	100	WHB-1246 F5	shell - *P. subtriangulata*	3
Wk21803	572	35	-7	45	100	NH-173 Area A Pit 9	shell – *P. australis*	3
Wk21804	574	38	-7	45	100	NH-173 Area B Sq1	shell – *P. australis*	3
Wk21805	589	35	-7	45	100	NH-173 Area D midden	shell – *P. australis*	3
MPRA	578	33	-7	45	100	NH-173 Average	shell – *P. australis*	3
NZ1876	566	57	REJECT	REJECT	REJECT	TRN Upper L6	shell - *C. denticulata, L. smaragdus* - unreliable species	
Wk5446	570	40	-7	45	100	TRN Upper L6	shell - *A. stutchburyi*	3
Wk11074	581	47	-7	45	100	WHI-858 FA	shell - *A. stutchburyi*	3
Wk11075	596	48	-7	45	100	WHI-858 FC	shell - *A. stutchburyi*	3
Wk11076	510	47	-7	45	100	WHI-858 FD	shell - *A. stutchburyi*	3
MPRA	562	38	-7	45	100	WHI-858 Average	shell - *A. stutchburyi*	3
Wk26143	499	35	-7	45	100	WHA 240 Area A F3	shell - *A. stutchburyi*	3
Wk26144	599	35	-7	45	100	WHA 240 Area B F6	shell - *A. stutchburyi*	3
MPRA	549	40	-7	45	100	WHA 240	shell - *A. stutchburyi*	3
Wk14233	544	33	-7	45	100	WHI-927 A F8	shell - estuarine	3

Table A.24 Data inputs from Western Bay of Plenty assemblages used in OxCalib601

Lab code	14C BP (CRA)	14C Age SD (years)	Delta R (years)	Delta R SD (years)	Marine Carbon %	Description	Material	CalCurve Number
Wk14113	865	35	-7	45	100	CHE 1920 Pit 3	shell - *P. australis*	3
Wk14114	823	30	-7	45	100	CHE 1920 Trench 4	shell - *P. australis*	3
MPRA	843	39	-7	45	100	CHE 1920	shell - *P. australis*	3
Wk5480	800	40	-7	45	100	TEH 584 Sample 4	shell - *P. subtriangulata*	3
Wk5481	870	40	-7	45	100	TEH 584 Sample 19	shell - *P. subtriangulata*	3
MPRA	835	43	-7	45	100	TEH 584	shell - *P. subtriangulata*	3
Wk16946	818	31	-7	45	100	ROW 1972	shell - *P. australis*	3
Wk17613	138	39				TUI 2897-1	twig - manuka predominantly	5
Wk17614	800	35	-7	45	100	TUI 2897-2	shell - *P. subtriangulata*	3
Wk17615	545	34	-7	45	100	TUI 2897-3	shell - *P. subtriangulata*	3
STATISTICALLY	DIFFERENT	AT	95%	LEVEL				
Wk16952	447	32	-7	45	0	ROW 3218 F32	wood - young lived species	5
Wk18306	798	32	-7	45	100	ORO 3216 F17	shell - *P. australis*	3
Wk24223	762	35	-7	45	100	MAT 2351 F11	shell - *P. australis*	3
Wk24224	979	35	-7	45	100	MAT 2351 F248	shell - *P. australis*	3
MPRA	780	40	-7	45	100	MAT-3251	*shell – P. australis*	3
Wk14115	807	30	-7	45	100	CHE 3193 trench 1 Pit 4	shell - *P. australis*	3
Wk14116	755	27	-7	45	100	CHE 3193 Trench 2, midden scoop	shell - *P. australis*	3
MPRA	780	38	-7	45	100	CHE 3193	shell - *P. australis*	3
Wk16947	783	31	-7	45	100	ROW 3218 F21	shell - *P. australis*	3
Wk16948	802	32	-7	45	100	ROW 3218 F25	shell - *P. australis*	3
Wk16949	763	31	-7	45	100	ROW 3218 F38 sp 2	shell - *P. australis*	3
Wk16950	799	31	-7	45	100	ROW 3218 F1	shell - *P. australis*	3
MPRA	787	27	-7	45	100	ROW 3218	shell - *P. australis*	3
Wk13116	780	35	-7	45	100	ORO 1945 S3	shell - *P. australis*	3
Wk13117	355	35	-7	45	100	ORO 1945 S4	charcoal - *Melicytus* sp.	5
STATISTICALLY	DIFFERENT	AT	95%	LEVEL				
Wk18304	778	35	-7	45	100	ORO 3056	shell - *P. australis*	3
Wk24203	716	35	-7	45	100	FPC 3305 D3-1	shell - *P. australis*	3
Wk24204	817	35	-7	45	100	FPC 3305 D3-2	shell - *A. stutchburyi*	3
MPRA	766	40	-7	45	100	FPC 3305	shell	3
Wk20104	768	35	-7	45	100	TEP 3221	shell - *P. australis*	3

Table A.24 Data inputs from Western Bay of Plenty assemblages used in OxCalib601, *continued*

Lab code	14C BP (CRA)	14C Age SD (years)	Delta R (years)	Delta R SD (years)	Marine Carbon %	Description	Material	CalCurve Number
Wk24220	770	35	-7	45	100	BAP 3269 T1	shell - *P. australis*	3
Wk24221	368	35				BAP 3269 F6	charcoal - *Melicytus* sp. & *Coprosma* sp.	5
STATISTICALLY	DIFFERENT	AT	95%	LEVEL				
Wk16951	745	31	-7	45	100	ROW 3235 F61	shell - *A. stutchburyi*	3
Wk13790	755	34	-7	45	100	GSP 3113 Sample B Area C1	shell - *P. subtriangulata*	3
Wk13791	705	37	-7	45	100	GSP 3113 F1b	shell - *P. subtriangulata*	3
MPRA	731	41	-7	45	100	GSP 3113	shell - *P. subtriangulata*	3
Wk22574	741	29	-7	45	100	ORO 1941	shell - *P. australis*	3
Wk15814	736	33	-7	45	100	ORO 3197	shell - *P. australis*	3
Wk20987	714	44	-7	45	100	FTP 1465A F13	shell - *A. stutchburyi*	3
Wk20988	675	41	-7	45	100	FTP 1465B F74	shell - *A. stutchburyi*	3
MPRA	694	44	-7	45	100	FTP 1465	shell - *A. stutchburyi*	3
Wk21373	779	32	-7	45	100	TAR 3230 H #191 F359 LA	shell - *P. subtriangulata*	3
Wk21374	709	31	-7	45	100	TAR 3230 H #192 F359 LB	shell - *P. subtriangulata*	3
Wk21375	713	36	-7	45	100	TAR 3230 H #193 F359 LB1	shell - *P. subtriangulata*	3
MPRA	734	32	-7	45	100	TAR 3230 H	shell - *P. subtriangulata*	3
Wk6830	700	40	-7	45	100	TKP 2894	shell species unknown	3
Wk17618	736	34	-7	45	100	EVA 3256 1	shell - *P. subtriangulata*	3
Wk17619	656	33	-7	45	100	EVA 3256 2	shell - *P. subtriangulata*	3
MPRA	696	40	-7	45	100	EVA 3256	shell - *P. subtriangulata*	3
Wk23492	702	33	-7	45	100	WHA 1229	shell - *P. australis*	3
Wk22622	675	30	-7	45	100	ASH 2912a	shell - *P. subtriangulata*	3
Wk23092	713	33	-7	45	100	ASH 2912 F19	shell - *P. subtriangulata*	3
Wk23093	678	34	-7	45	100	ASH 2912 F96 S#266	shell - *P. subtriangulata*	3
Wk23094	740	34	-7	45	100	ASH 2912 F108	shell - *P. subtriangulata*	3
Wk23095	740	34	-7	45	100	ASH 2912 F140	shell - *P. subtriangulata*	3
MPRA	709	25	-7	45	100	ASH 2912	shell - *P. subtriangulata*	3
Wk22575	702	25	-7	45	100	KAI	shell - *A. stutchburyi*	3
Wk24224	656	35	-7	45	100	TAU 2402	shell - *P. australis*	3
Wk21013	646	35	-7	45	100	STR 780 WHK001	shell - *P. australis*	3
Wk21014	663	35	-7	45	100	STR 780 WHK002	shell - *P. australis*	3
MPRA	654	40	-7	45	100	STR 780	shell - *P. australis*	3

Table A.24 Data inputs from Western Bay of Plenty assemblages used in OxCalib601, *continued*

Lab code	14C BP (CRA)	14C Age SD (years)	Delta R (years)	Delta R SD (years)	Marine Carbon %	Description	Material	CalCurve Number
Wk17606	313	34				SUP 2891	charcoal - species not specified	5
Wk17610	227	40				SUP 2891	charcoal - species not specified	5
MPRA	277	26				SUP 2891	charcoal - species not specified	5
Wk9031	620	50	-7	45	100	GVE 2032	shell - *A. stutchburyi*	3
Wk17778	616	35	-7	45	100	HIG 2039 H1	shell - *A. stutchburyi*	3
Wk17779	639	35	-7	45	100	HIG 2039 H2	shell - *A. stutchburyi*	3
MPRA	628	40	-7	45	100	HIG 2039	shell - *A. stutchburyi*	3
Wk6572	660	50	-7	45	100	GSR 534 sample 1a	shell unknown species	3
Wk6573	570	50	-7	45	100	GSR 534 sample 3b	shell unknown species	3
MPRA	615	48	-7	45	100	GSR 534	shell unknown species	3
Wk17781	613	33	-7	45	100	WEL 2031	not specified	3
Wk22576	599	30	-7	45	100	TAR 3231	shell - *P. subtriangulata*	3
Wk22580	592	35	-7	45	100	LDP 524	shell - *P. subtriangulata*	3
Wk13792	598	36	-7	45	100	GSP 3116 B1 fill	shell - *P. subtriangulata*	3
Wk13793	569	35	-7	45	100	GSP 3116 B18/B firescoop	shell - *P. subtriangulata*	3
MPRA	583	41	-7	45	100	GSP 3116	shell - *P. subtriangulata*	3
Wk22579	584	33	-7	45	100	LDP 521	shell - *P. subtriangulata*	3
Wk6828	580	40	-7	45	100	TKP 1712	shell - species not specified	3
Wk16046	160	46				HAM 9 Trench 1 Sample 1	charcoal - short lived species (not specified)	5
Wk16047	266	49				HAM 9 Trench 1 Sample 2	charcoal - short lived species (not specified)	5
Wk16048	228	35				HAM 9 Area A F5	charcoal - short lived species (not specified)	5
Wk16049	242	34				HAM 9 Area D F4	charcoal - short lived species (not specified)	5
MPRA	226	20				HAM 9	charcoal - short lived species (not specified)	5
Wk17605	306	31				SUP 2889 Area H F1006 Sp 6	charcoal - species not specified	5
Wk17607	210	31				SUP 2889 Area H F1006 (pit) Sp 5	charcoal - species not specified	5
Wk17608	204	35				SUP 2889 Area H F1006 (pit) Sp 1	charcoal - species not specified	5
MPRA	207	23				SUP 2889 Area H F1006 (pit) Sp1&5	charcoal - species not specified	5
Wk21371	536	32	-7	45	100	TAR 3230 G #113 F240 upper	shell - *P. subtriangulata*	3
Wk21372	584	34	-7	45	100	TAR 3230 G #166 F187	shell - *P. subtriangulata*	3
Wk21376	599	31	-7	45	100	TAR 3230 G #110 F240 Sp4	shell - *P. subtriangulata*	3
MPRA	573	32	-7	45	100	TAR 3230 G	shell - *P. subtriangulata*	3
Wk17780	534	34	-7	45	100	WEL 2029	not specified	3

A6 Assemblage Raw Energy Values by Study Area, Period and Faunal Class

Table A.25 Early period Coromandel assemblage energy yields by faunal class

	CCK-339 -L9	TRN-62 -Lower	CCK-339 -L7	PJK-53	CL-3	HHB-242-Lower	HHB-242-Middle	Average
Shellfish kCal	208	1228	5426	6356	8008	1998	2247	3639
Fish kCal	7445	110402	98246	41600	315159	20408	82848	96587
Marine & Wetland Bird kCal	11730	64414	3720	33831	7325	3146	3876	18292
Terrestrial Bird kCal	3929	11150	3031	24835	2327	-	123	6485
Moa kCal	-	51562	-	-	-	-	-	7366
Marine Mammal kCal	173916	1530073	456913	2445532	480141	-	-	726654
Terrestrial Mam kCal	252	7686	23058	30366	204112	7686	15372	41219
Total kCal	**197480**	**1776515**	**590394**	**2582520**	**1017072**	**33238**	**104466**	**900241**

Table A.26 Early-middle period Coromandel assemblage energy yields by faunal class

	HHB-242-Upper	WHT-16	CCK-399 -L5	CCK-399 -L3	HWB-115-Lower	HWB-115-Middle	AHU-944	Average
Shellfish kCal	2992	1260	2057	44480	4823	1657	2690	8566
Fish kCal	71879	12287	88237	109499	118435	49311	28743	68342
Marine & Wetland Bird kCal	3146	7190	13839	9778	50311	27638	-	15986
Terrestrial Bird kCal	-	-	-	222	26880	119655	-	20965
Moa kCal	-	-	-	-	-	24360	-	3480
Marine Mammal kCal	-	217722	409204	147163	347805	231870	319704	239067
Terrestrial Mam kCal	126	15120	15372	15498	39060	15372	7560	15444
Total kCal	**78143**	**253579**	**528709**	**326640**	**587314**	**469863**	**358697**	**371849**

Table A.27 Middle period Coromandel assemblage energy yields by faunal class

	MTR-990	WHI-927-B	PAU-1028	WHI-926	WHA-1035	WHI-624	Average
Shellfish kCal	133	4325	56	542	422	889	1061
Fish kCal	-	-	2768	-	-	-	461
Marine & Wetland Bird kCal	-	-	-	-	-	-	-
Terrestrial Bird kCal	-	-	-	-	-	-	-
Moa kCal	-	-	-	-	-	-	-
Marine Mammal kCal	-	-	-	-	-	-	-
Terrestrial Mam kCal	-	-	-	-	-	-	-
Total kCal	**133**	**4325**	**2824**	**542**	**422**	**889**	**1523**

Table A.28 Middle-late period Coromandel assemblage energy yields by faunal class

	WHP-751	MTR-993	WHA-106	WHA-959	NH-173	Average
Shellfish kCal	1342	4471	1033	550	801	1639
Fish kCal	-	2271	-	-	1808	816
Marine & Wetland Bird kCal	-	-	-	-	-	-
Terrestrial Bird kCal	-	-	-	-	-	-
Moa kCal	-	-	-	-	-	-
Marine Mammal kCal	-	-	-	-	-	-
Terrestrial Mam kCal	-	-	-	-	-	-
Total kCal	**1342**	**6742**	**1033**	**550**	**2609**	**2455**

Table A.29 Late period Coromandel assemblage energy yields by faunal class

	TRN-62 Upper	WHI-858	WHA-240	WHI-927-A	Average
Shellfish kCal	730	1676	1192	443	1010
Fish kCal	1808	-	2303	0	1028
Marine & Wetland Bird kCal	494	-	-	-	124
Terrestrial Bird kCal	986	-	-	-	247
Moa kCal	-	-	-	-	-
Marine Mammal kCal	-	-	-	-	-
Terrestrial Mam kCal	-	-	-	-	-
Total kCal	**4018**	**1676**	**3495**	**443**	**2408**

Table A.30 Early period Western Bay of Plenty assemblage raw energy yields by faunal class

	MAS-187
Shellfish kCal	-
Fish kCal	1808
Marine Bird kCal	14483
Terrestrial Bird kCal	1265
Moa kCal	89320
Marine Mammal kCal	147163
Terrestrial Mam kCal	15120
Total kCal	**269159**

Table A.31 Early-middle period Western Bay of Plenty assemblage raw energy yields by faunal class

	KTR-78	BWT-875	CHE-1920	TEH-584	ROW-1972	TUI-2897-2	Average
Shellfish kCal	583	58	292	5801	453	727	1319
Fish kCal	-	3616	1808	6911	1033	-	2228
Marine & Wetland Bird kCal	-	1266	-	-	-	-	211
Terrestrial Bird kCal	-	-	-	-	-	-	-
Moa kCal	-	-	-	-	-	-	-
Marine Mammal kCal	-	-	-	-	-	-	-
Terrestrial Mam kCal	-	-	-	-	-	-	-
Total kCal	**583**	**4940**	**2100**	**12712**	**1486**	**727**	**3758**

Table A.32 Middle period Western Bay of Plenty assemblage raw energy yields by faunal class

kcal	ORO-3216	ROW-3218	CHE-3193	ORO-1945	ORO-3056	ANA-78-Lower	MAT-2351	MAN-188	BAP-3269-T1	TEP-3221	FPC-3305	WHB-1275	BAP-3269-F6	SUP-2888	ORO-1941	ORO-3197	GSP-3113	TAR-3230-H	ASH-2912	Ave
Shellfish	311	1181	1534	1021	392	145	1553	1230	1458	442	249	438	35	35	689	847	915	13360	19156	2431
Fish	-	1033	-	1237	-	-	-	38441	-	-	-	-	-	-	-	1033	-	6911	272652	15715
M/W Bird	-	3248	-	-	-	-	-	20160	-	-	-	-	-	-	-	-	-	5493	2314	614
T Bird	-	7560	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1971	-	530
Moa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M Mam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T Mam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7560	7560	840
Total kCal	**311**	**13022**	**1534**	**2258**	**392**	**145**	**1553**	**59831**	**1458**	**442**	**249**	**438**	**35**	**35**	**689**	**1880**	**915**	**35295**	**301682**	**20130**

Table A.33 Middle-late period Western Bay of Plenty assemblage raw energy yields by faunal class

	FTP-1465	WHA-1229	EVA-3256	ANA-46-Upper	KAI	STR-780	TAU-2402	BWT-876	BWT-874	SUP-2891	WHB-1246	Average
Shellfish kCal	2495	107	492	644	1610	567	1234	106	152	1092	598	827
Fish kCal	-	-	15354	35975	-	5907	-	-	1237	3098	-	5597
Marine & Wetland Bird kCal	-	-	-	-	-	-	-	-	-	-	-	-
Terrestrial Bird kCal	-	-	-	-	-	-	-	-	-	-	-	-
Moa kCal	-	-	-	-	-	-	-	-	-	-	-	-
Marine Mammal kCal	-	-	-	-	-	-	-	-	-	-	-	-
Terrestrial Mam kCal	-	-	-	-	-	-	-	-	-	-	-	-
Total kCal	**2495**	**107**	**15846**	**36619**	**1610**	**6474**	**1234**	**106**	**1389**	**4190**	**598**	**6424**

Table A.34 Late period Western Bay of Plenty assemblage raw energy yields by faunal class

	TAR-3231	GSP-3116	HAM-9	TAR-3230-G	TUI-2897-3	TUI-2897-1	SUP-2889	Average
Shellfish kCal	603	2146	532	1809	538	222	689	758
Fish kCal	0	993	1310	1808	0	0	20321	4688
Marine & Wetland Bird kCal	-	-	-	-	-	-	-	-
Terrestrial Bird kCal	-	-	-	-	-	-	-	-
Moa kCal	-	-	-	-	-	-	-	-
Marine Mammal kCal	-	-	-	-	-	-	-	-
Terrestrial Mam kCal	-	-	-	-	-	-	-	-
Total kCal	**603**	**3139**	**1842**	**3617**	**538**	**222**	**21010**	**5446**