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Pre-European Māori Fishing at Foxton, Manawatu, New Zealand

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ABSTRACT

Fish remains from excavations in four areas of the Foxton archaeological site (S24/3) were analysed. The 4109 identified bones produced a Minimum Number of Individuals of 1040 fish from 8 families. The assemblage was dominated by New Zealand snapper (*Pagrus auratus*, Family Sparidae), which comprised 80% of the total MNI. Kahawai (*Arripis trutta*, Family Arripidae) contributed 15% and other families only minor amounts. Snapper decreased in abundance and kahawai increased from the lower to the upper layers. The Foxton catch at all periods is different from other assemblages studied from central New Zealand. This partly reflects the local marine environment, which lacks rocky shores and reefs, but we also hypothesise that it is related to warmer surface sea water conditions in Cook Strait in the early phase of the New Zealand prehistoric period. Size frequency diagrams were constructed for snapper and kahawai. It was found that the mean fork length and mean ungutted weight of snapper increased over time. Similar changes have been observed for other species in archaeological sites in New Zealand.

Keywords: NEW ZEALAND, FOXTON, MAORI, ARCHAEOZOOLOGY, FISHING, SIZE FREQUENCY DISTRIBUTION.

INTRODUCTION

The Foxton site (S24/3) is one of relatively few archaeological sites in the Cook Strait region with numerous bones of moa and other extinct birds. Like other early coastal sites in New Zealand, it also contained abundant fish bones and shells. This paper reports the results of a study of the fish remains. The site is the northern-most we have studied in the greater Cook Strait area and one of the oldest. It extends our understanding of the diversity of pre-European Māori fish catches in central New Zealand.

THE FOXTON ARCHAEOLOGICAL SITE

The Foxton site is situated in the Manawatu sand plain on the west coast of the North Island. This plain is part of a dune belt that extends from Paekakariki in the south to Patea in the north (Cowie 1963). The dune belt is traversed by three major rivers (Manawatu, Rangitikei and Wanganui) and many smaller ones. Foxton is the only known archaeological site between Paekakariki and Wanganui containing definite evidence of moahunting (Anderson 1989: 111, 115). The closest site likely to be of similar age is almost 90 km to the south at Paremata (Davidson 1978).

Today the site is about 2.4 km north of the Manawatu River and 2.8 km inland. It lies on the inland side of the southernmost of a line of lagoons extending northwards from the

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Manawatu to the Rangitikei River. This line of lagoons marks the boundary between two phases of dune building: the Motuiti Dune-building phase (Cowie 1963) on the inland side, and the more recent Older Waitarere Dune-building Episode (McFadgen 1985) on the seaward side (McFadgen 1985: Fig. 14). The site is a low mound of the Motuiti dune surface, bordered to the west by the lagoon and on the other three sides by swamp.

McFadgen (1972: 27–28) reviewed historical evidence for the environmental setting of the site. An 1859 survey described the area between the lagoons and the coast as 'barren sandhills'. During the nineteenth and early twentieth centuries, the lagoons had no defined outlet and were more extensive than today. Using terrestrial and freshwater molluscs from the excavations, McFadgen (1972: 71–79) reconstructed the setting of the site as a clearing on the edge of the lagoon, surrounded by podocarp-dominated forest (McFadgen 1985). There may have been relatively open sand dunes between the lagoon and the sea. It is not clear how far away the coast and river were at the time, or whether there was canoe access to the lagoons from the river. Adkin (1948: 37–38, 414–15) described a canoe-landing place, Te Waka-puni, on the north bank of the river at its confluence with the Mikihi stream, which drained the nearest lagoon. He considered this landing place, recorded by Brees in 1842, to be the recognised starting point for parties proceeding to the lagoons.

The shore of the dune belt in this south-west part of the North Island is an exposed ocean beach stretching for many miles and broken only by river and stream mouths. There are no rocky outcrops or reefs to attract fish species that prefer such habitats. The intertidal and subtidal zones are a major source of sand-dwelling bivalves. Some of the waterways flow straight to the sea, but others have estuaries supporting shellfish such as mudsnails and cockles.

The Foxton site was accidentally discovered by the landowner in 1963, and excavated over about ten years by members of the Wellington Archaeological Society with assistance from the then Dominion Museum and, in the later seasons, from the Anthropology Department of Otago University and the Geology Department of Victoria University of Wellington. The excavations, directed by McFadgen (1972), showed two distinct parts to the site: three well-defined and stratified shell dumps on the eastern side (Areas I to III) and a western area (IV) where shell midden was more extensive but diffuse and scattered. A ten foot (3 m) grid was laid out, within which mostly 8 foot (2.4 m) squares were excavated. All four areas were tested in the first season; in subsequent seasons first Area IV and then Area III were investigated in greater detail. Excavation was by hand trowel. Recovery methods varied. Particularly during the earlier seasons, sieves were not used and items were hand picked by excavators. During much of the excavation of Area III, one-quarter inch (6 mm) and one-eighth inch (3 mm) sieves were used (McFadgen pers. comm. 2000).

The deposits contained bones of moa and other birds (notably forest species), shells and fish bones. Moa bones were concentrated in the basal layers. Artefacts were predominantly of Archaic or Eastern Polynesian types.

In the northern part of Area III, a lower deposit containing moa bones was separated by a buried soil from an upper and more extensive occupation consisting of a stratified shell midden dump and associated house, cooking shelter and flaking floor. In this study, the fish bone assemblage from below the buried soil in this part of the site has been designated as Early and that above the buried soil as Late. The Late occupation comprised three distinct layers separated by sand lenses. However, these sand lenses probably represent only brief intervals of abandonment by people using the same structures and midden dump throughout. Although the overall sequence in this part of the site was clear, the complexity of recovery of faunal remains from individual squares made it impractical to compare the fish remains from different layers of the Late assemblage.

Area IV could not be linked stratigraphically to Area III, but because it contained moa bones, it is thought to be early and of broadly similar age to the Early deposit in Area III. It is designated here as 'Early ?'. The relationship of Areas I and II to Areas III and IV is unknown, but they also contained some moa bones.

Ten radiocarbon dates from the site (McFadgen 1997: Table 1) are listed in Table 1. The dates on cockle shell are inverted with respect to the stratigraphy and the dates of tuatua shells (McFadgen 1978) and do not assist in determining the duration of the interval between the Early and Late occupations in Area III. McFadgen (1978) estimates that the buried soil between the two occupations took between 100 and 200 years to form. He suggests that "the Early occupation is from the early part of the prehistoric period and the Late occupation from the middle part of the prehistoric period" (McFadgen pers. comm. 2000).

TABLE 1

Radiocarbon dates from Foxton

Lab no.	**Area**	**Layer**	**Period**	**Material**	**$\delta^{13}C$**	**CRA**
NZ682	IV	-	Early ?	charcoal	-25	736 ± 48
NZ683	III	lens 2	Late	cockle	-0.54	1095 ± 60
NZ684	III	oven	Late	charcoal	-25	523 ± 63
NZ685	III	above oven	Late	charcoal	-25	177 ± 113
NZ1250	III	lens 3	Late	tuatua	+0.15	671 ± 68
NZ1251	III	lens 4	Late	cockle	-0.73	1147 ± 84
NZ1347	III	lens 4	Late	cockle	-0.24	1139 ± 47
NZ1349	III	lens 1	Early	cockle	-0.44	1075 ± 45
NZ1479	III	lens 3	Late	cockle	-0.44	965 ± 58
NZ1480	III	lens 1	Early	tuatua	+1.02	936 ± 58

ANALYSIS OF FISH REMAINS

The methods used for analysis followed the techniques developed in New Zealand for the treatment of archaeological fish bone assemblages from Pacific islands generally. This has been described in detail elsewhere (Leach 1986; Leach *et al.* 1997a). All identifications are made to the lowest taxonomic level possible. Taxonomy and nomenclature follow Paulin and Stewart (1985) and Paulin *et al.* (1989). Wherever possible, common names are used in this paper.

The calculation of minimum numbers followed the general technique of Chaplin (1971) as discussed by Leach (1986; see also Leach *et al.* 1997a). No attempt was made to increase MNI by taking into account observed size mis-matches. A total of 4109 fish bones were able to be identified in the Foxton assemblage. These yielded a minimum number of 1040 fish. The distribution of bones by anatomy from the site is given in Table 2.

Following the identification and quantification of fish remains according to taxa, sizes of the predominant fish in the catch, New Zealand snapper (*Pagrus auratus*) and kahawai (*Arripis trutta*), were estimated and size-frequency diagrams constructed for the various components of the overall catch.

TABLE 2

Numbers of Identified Fish Bones from Foxton According to Anatomy and Side (N=4109)

Anatomy	Left	No-Side	Right
Dentary	534	-	562
Articular	274	-	296
Quadrate	288	-	306
Premaxilla	582	-	496
Maxilla	380	-	359
Vomer	-	19	-
Operculum	-	12	-
Dorsal/Erectile Spin	-	1	-
Number of Bones	**2058**	**32**	**2019**

The methods by which a prehistoric catch size-frequency diagram is reconstructed have been described in a series of papers in which we focused on one species at a time. The work relating to snapper is to be found in Leach and Boocock (1995), in which it was shown that regression equations allow the estimation of fork length from bone measurements with a standard error of the estimate ranging from 9 to 18 mm, and of live ungutted weight ranging from 120 to 344 g, depending on the bone used. With this method, we reconstructed snapper catches from five archaeological sites in the northern North Island (Leach and Davidson 2000). The results of the kahawai study can be found in Leach *et al.* (1996), in which it was shown that fork length could be estimated with a standard error of less than ±29 mm and weight to less than ±290 g.

CHARACTER OF THE ARCHAEOLOGICAL FISH CATCH

The relative abundance of fish families in the overall Foxton catch is given in Table 3. Only eight families are represented. The catch consisted largely of snapper, with a minor but significant component of kahawai. Six other families contributed less than 5% of the total. This catch reflects the lack of rocky shores or reefs in the area. Snapper and gurnard are to be expected in this sandy environment, while the pelagic species, kahawai, trevally and barracouta, are known to move through these waters.

We have previously reviewed assemblages from 13 archaeological sites in central New Zealand (Leach *et al.* 1997a: 64–67; Horwood *et al.* 1998: 17–19). Compared with these assemblages, Foxton has the second largest MNI, but one of the lowest numbers of fish families. It has a higher proportion of snapper than any site except The Glen in Tasman Bay, and a higher proportion of kahawai than any other site. Although seven of the 13 sites contained kahawai, these fish contributed more than 10% of the catch only at Paremata.

The variability of pre-European fish catches in central New Zealand has been further illustrated by recent studies of an assemblage from Raumati Beach and two adjacent sites at Orongorongo between Wellington and Palliser Bay.

TABLE 3

Relative Abundance of Fish Families at Foxton (all provenances combined)

Family Name	**NISP**	**MNI**	**% MNI**
Sparidae (snapper)	3470	836	80.4 ± 2.5
Arripidae (kahawai)	542	158	15.2 ± 2.2
Anguillidae (eel)	66	27	2.6 ± 1.0
Triglidae (gurnard)	20	9	0.9 ± 0.6
Carangidae (trevally)	6	6	0.6 ± 0.5
Gempylidae (barracouta)	3	2	0.2 ± 0.3
Mugilidae (mullet)	1	1	0.1 ± 0.2
Squalidae (dogfish)	1	1	0.1 ± 0.2
Totals	**4109**	**1040**	**100.0**

Note: In this and subsequent tables ± % value is the SE of % (Snedecor and Cochran 1967: 210 ff.; Leach and de Souza 1979: 32).

The Raumati Beach site yielded a relatively small assemblage of fish (NISP 312, MNI 86). This site is about 80 km south of Foxton, but is still on the shore of the sand dune belt (Leach *et al.* 2000a). Kahawai were the most numerous fish, contributing 28% of the catch, closely followed by red cod (Moridae family) at 23%. Twelve other families contributed between 1% and 7%, including snapper at just under 5%. Although the Raumati site is situated in the dunes immediately behind a sandy beach, it is within easy reach by canoe of Kapiti Island, which lies about 8 km off-shore and provides a rocky inshore marine environment inhabited by a much greater range of fish species (Horwood *et al.* 1998).

The Orongorongo assemblages are larger (MNI 162 and 668). Kahawai contributed 25% of the catch in the smaller assemblage but only 1.5% of the larger; snapper were absent from the smaller assemblage and contributed less than 1% to the later one. This study is still in progress.

The Foxton catch, with its dominance of snapper, adds to the growing evidence about the availability of snapper in central New Zealand waters. Snapper are the most abundant fish at the two sites studied in Tasman Bay (The Glen and Rotokura) and at Paremata, and the second most important species at Mana Island, although they constitute more than 50% of the catch only at The Glen. Elsewhere in the region they are represented by small numbers in all except two of the smaller assemblages.

Kahawai feature prominently in modern perceptions of pre-European Māori fishing, perhaps because of the large numbers of trolling lures described as kahawai lures in museums in New Zealand and around the world. However, kahawai have been identified in relatively few archaeological sites. The Kupenga data base in the Archaeozoology Laboratory at the Museum of New Zealand contains information from 126 archaeological sites in New Zealand. Only 13 sites among those with an MNI of 100 or more contain more than 2% kahawai. Eight of these, including Foxton, are in central New Zealand, while the other five are in the northern part of the North Island.

Eels have been identified in only five other sites in central New Zealand: the Washpool Midden (27/363), Rotokura (1/583), Orongorongo (1/162 and 1/668) and (Mana Island (2/1802). At Mana they were present only in the historic (nineteenth century) deposit. Although systematic size reconstruction of archaeological eels has yet to be undertaken, it is our impression that all the eel bones so far identified from archaeological sites in central New Zealand are from small fish. The Manawatu sand plain is an area in which the mass capture of mature eels during their migration to the sea was important in the historic period (Adkin 1948: 19–30). However, the relatively few and small eel bones from Foxton do not appear to reflect this activity.

SPATIAL AND TEMPORAL VARIATION IN THE FOXTON FISH CATCH

The material studied came from four different areas of the site, whose stratigraphic and chronological relationships are unclear. As noted above, a secure chronology based on stratigraphy was established only within Area III, where most of the deposits could be categorised by the excavator as either Early or Late. The assemblage from the site has therefore been examined for both spatial and chronological variation.

Table 4 shows the relative abundance of fish families in the four areas. It can readily be seen that snapper is the dominant fish in all areas. Kahawai is next except in Area I, where it is partly replaced by another pelagic family, Carangidae, represented by trevally.

TABLE 4

Relative Abundance of Fish at Foxton by Area (see Table 3 for common names)

Family	**Area I**	**Area II**	**Area III**	**Area IV**
Sparidae	95.2 ± 6.1	82.1 ±13.7	77.1 ±2.9	95.1 ±4.7
Arripidae	1.6 ± 3.9	17.9 ±13.7	17.5 ±2.7	4.9 ±4.7
Anguillidae	- - -	- - -	3.3 ±1.3	- - -
Triglidae	- - -	- - -	1.1 ±0.8	- - -
Carangidae	3.2 ± 5.2	- - -	0.5 ±0.5	- - -
Gempylidae	- - -	- - -	0.2 ±0.4	- - -
Mugilidae	- - -	- - -	0.1 ±0.3	- - -
Squalidae	- - -	- - -	0.1 ±0.3	- - -
MNI Totals	63	39	821	102
Total = 1025				

Areas I and IV appear very similar to each other, with snapper comprising 95% of the catch and the remaining 5% composed of either trevally or kahawai. Trevally were significant only in Area I; this may be the result of a brief period when these fish happened to be running in the fishing grounds frequented by the Foxton fishermen.

Areas II and III also appear very similar to each other in their proportions of snapper and kahawai, although the small sample from Area II renders this apparent similarity statistically unreliable. The minor marine species apart from trevally are, as might be expected, found only in the large sample from Area III. However, the presence of eels only in Area III when (at least on the basis of sample size) they might have been expected in Area IV may also represent a difference in practice between areas, although this is statistically difficult to verify.

In summary, all areas reflect a high abundance of snapper, with a minor component of pelagic species, usually kahawai but sometimes also trevally. This concentration on snapper is highest in Areas I and IV. The only possible spatial indication of variation in fishing practice is the presence of eels in Area III only.

Chronological variation was explored by comparing the Early and Late assemblages from Area III and the Early ? assemblage from Area IV. Areas I and II were excluded from chronological analysis.

The relative abundance of fish families in the three chronological assemblages is given in Table 5 and the proportion of snapper in them is illustrated in Figure 1. The Early ? assemblage (which is the same as the Area IV assemblage) stands out as having a very high proportion of snapper and a low proportion of kahawai. In this respect, the Early assemblage is closer to the Early ? assemblage than it is to the Late assemblage.

TABLE 5

Changes in Relative Abundance of Fish at Foxton Over Time
(see Table 3 for common names)

Family	**Early**	**Early ?**	**Late**
Sparidae	87.7 ±4.5	96.0 ± 4.4	72.5 ±3.7
Arripidae	8.4 ±3.8	4.0 ± 4.4	21.5 ±3.4
Anguillidae	2.2 ±2.1	- - -	3.8 ±1.6
Carangidae	0.4 ±1.1	- - -	0.5 ±0.7
Triglidae	0.4 ±1.1	- - -	1.4 ±1.0
Mugilidae	0.4 ±1.1	- - -	- - -
Squalidae	0.4 ±1.1	- - -	- - -
Gemphylidae	- - -	- - -	0.3 ±0.6
Total MNI	**227**	**99**	**578**

Several of the minor species, including eels and carangids, are present in both Early and Late assemblages but not in Early ? It is possible that there has been some mixing between the stratigraphically complex layers of Area III, which may have blurred some distinctions. However, it can reasonably be argued on the evidence of moa bones that the Early ? assemblage probably is indeed early, and that there was a decline in snapper and an increase in kahawai from early to late at Foxton. On this basis it can be suggested that Area I is also relatively early and Area II probably late. Area I was the place where moa bones were first discovered accidentally and was largely dug over before the archaeological investigation began. The abundant moa bones apparently recovered from this part of the site support the view that it is early. Area II is physically closest to Area III and may largely represent another aspect of the Late occupation that was well defined at Area III. The differences between Early and Late (not including Early ?) are illustrated in Figure 2.

The reasons for the apparent changes through time are not so clear. Both snapper and kahawai are likely to have been most abundant in late summer, so seasonality is probably not a factor. A change in fishing method to include greater use of trolling hooks could be the reason for an increase in kahawai. Variations in natural abundance might also be a factor.

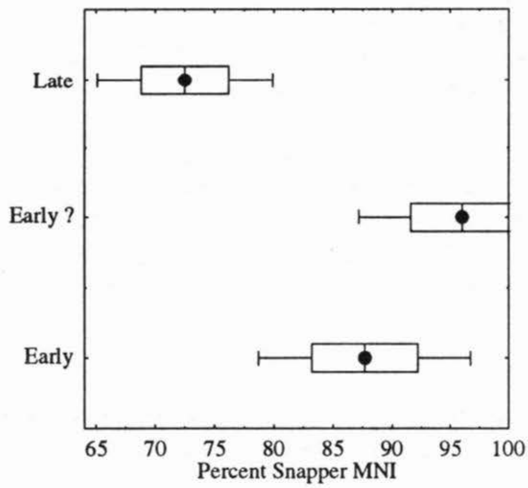

Figure 1: The changing proportions of snapper in three assemblages at Foxton.

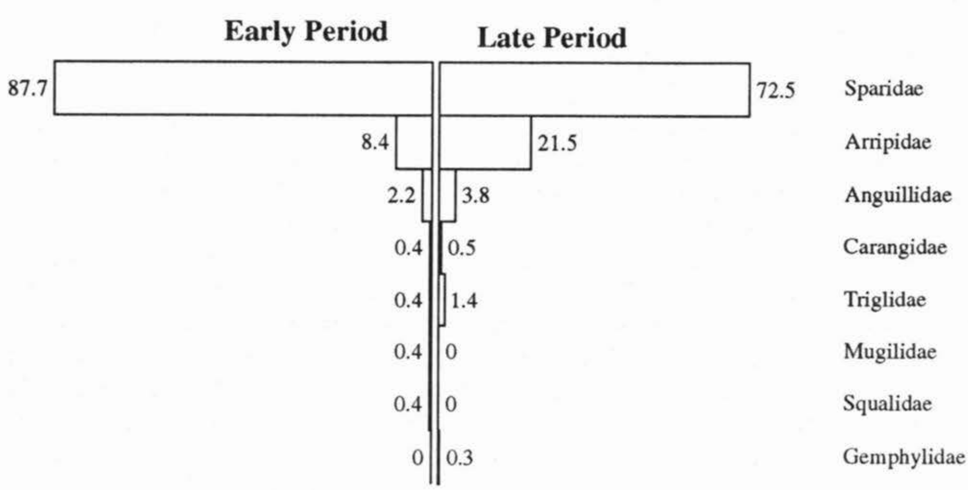

Figure 2: The relative abundance of fish families in the Early and Late assemblages at Foxton.

Variations in natural abundance may well be the reason for the high proportion of snapper in the site at all periods compared with other sites in the Cook Strait region. At least some of the occupation of this site appears to have been during what is known as the 'Little Climatic Optimum' (Leach and Leach 1979), when surface sea water temperatures were warmer than today. Since the recruitment rate of snapper is known to be exponentially related to water temperature, we can be sure that sea conditions favoured higher snapper abundance further south in New Zealand at this time. Our studies of snapper elsewhere have suggested a decline in relative abundance through time. At Mana Island, there was a decline between the fifteenth and nineteenth centuries (Horwood *et al.* 1998: 16–17). In Northland, although snapper dominated the catch at Kokohuia on the shore of the Hokianga Harbour, they were less abundant there than in two earlier northern sites at Mount Camel and Twilight Beach (Leach *et al.* 1997b: 112–13).

The argument for greater abundance of snapper in the region at a relatively early period is strengthened by research on mean annual surface sea water temperatures at different periods using $^{16}O/^{18}O$ ratios in shellfish from dated archaeological sites. Determinations on Foxton samples from Early?, Early and Late contexts are very similar and fall clearly in the warmer phase, suggesting that most of the occupation of the site may well have taken place in the period before the Little Ice Age (Leach *et al.* 2000a).

CHANGES IN FISH SIZE THROUGH TIME

The sample of snapper from Foxton is a large one, offering the opportunity to investigate changes in size frequency through time at this site. The size frequency distributions of fork lengths for the three assemblages, Early, Early ? and Late, are given in Figure 3 and the data for both fork length and ungutted weight in Tables 6 and 7. There is a clear increase in mean fork length and mean ungutted weight through time, which is depicted in Figure 4. The differences between the Early and Late assemblages in both mean fork length and mean ungutted weight are statistically significant.

TABLE 6

Analysis of Snapper Fork Length (mm) at Foxton

	Early			**Early ?**			**Late**		
N		436			162			644	
Range	254	to	836	297	to	703	239	to	953
Mean	456.5	±	4.6	469.6	±	6.7	481.6	±	3.9
SD	96.1	±	3.2	86.3	±	4.7	101.4	±	2.8
g1/w1	0.3	and	4.7	0.4	and	3.4	0.5	and	7.8
g2/w2	3.0	and	0.1	3.0	and	0.1	3.5	and	3.0

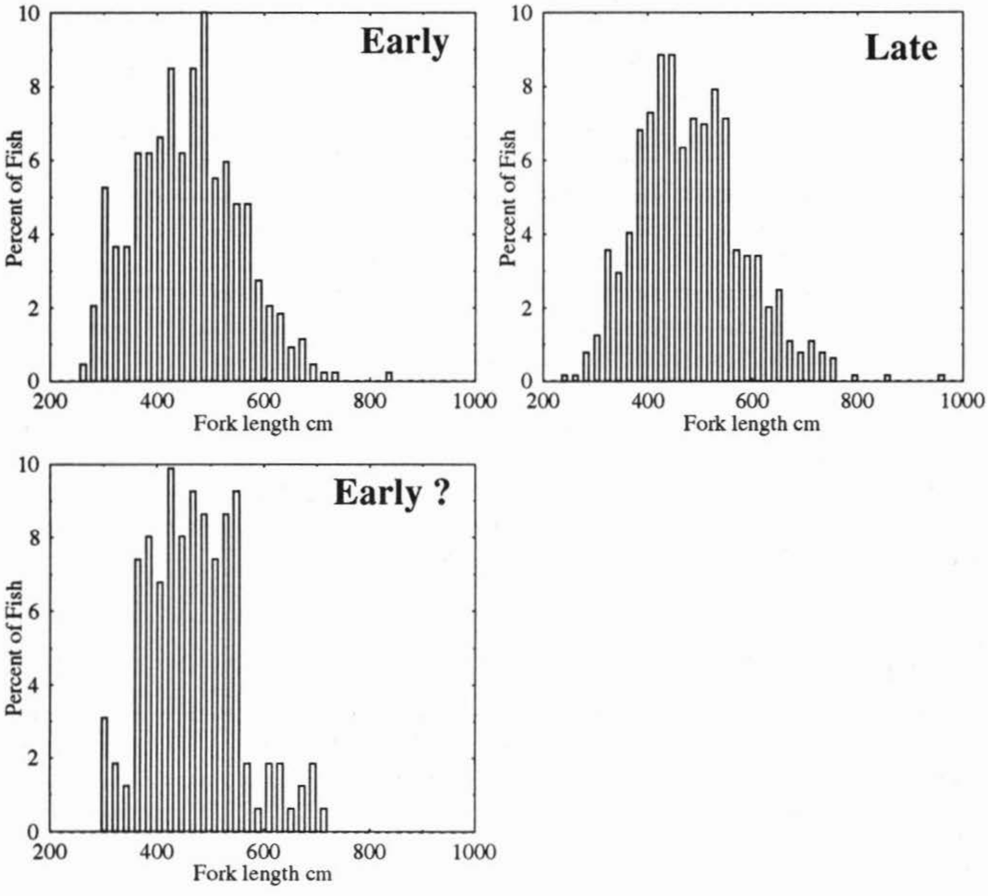

Figure 3: Size-frequency diagrams of the snapper catch in three assemblages from Foxton.

TABLE 7

Analysis of Snapper Ungutted Weight at Foxton

	Early	Early ?	Late
N	436	162	644
Total Wt kg	917	360	1591
Range g	323 to 11207	515 to 6702	269 to 16539
Mean g	2103.1 ± 64.0	2223.7 ± 98.8	2470.7 ± 65.5
SD g	1338.3 ± 45.3	1257.5 ± 69.8	1663.3 ± 46.3

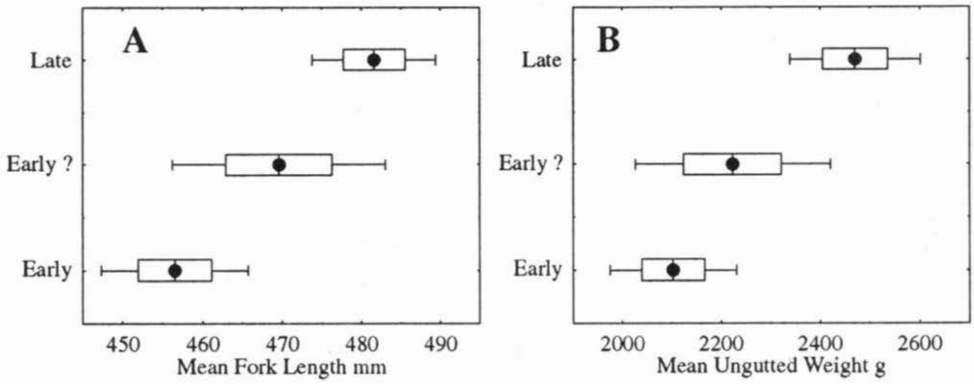

Figure 4: Changes in mean fork length and mean ungutted weight of snapper through time at Foxton.

We have previously reconstructed snapper sizes from one other archaeological site in the Cook Strait region and five sites in northern New Zealand. At Rotokura in Tasman Bay the archaeological snapper were not significantly larger than those from modern trawl data, but there was a significant increase in mean size through time (Leach and Boocock 1994: 78–82). In the five northern sites, archaeological specimens were significantly larger than modern ones; we attributed this to selective capturing methods which favoured larger specimens and massive stock depletion in recent times (Leach and Davidson 2000). However, the five northern sites did not have good internal chronology. Only at Cross Creek on the Coromandel Peninsula was there possible evidence of a slight decrease in mean size through time.

The mean size of the Foxton snapper is smaller than Rotokura but similar to those from northern New Zealand, especially Galatea Bay, Kokohuia and Mount Camel (Leach and Davidson 2000). Rotokura is in Tasman Bay at the northern tip of the South Island. This is close to the southern limit of the distribution of snapper in New Zealand, and is well known amongst fishermen and fisheries scientists as having an unusual population. For example, snapper tend to be rather larger in these waters than further north.

Because of the much smaller size of the kahawai sample from Foxton, only a single size-frequency diagram for all measurable kahawai bones is given in Figure 5. The data are presented in Table 8. The only other site for which comparable information is available is Raumati Beach, where the range of fork lengths was slightly greater (252.2 to 693 mm) and the mean considerably smaller (439.4 ± 7.5, SD 75.9 ± 5.0). The Raumati sample is too small (only about one third the size of the Foxton sample) for a reliable size frequency diagram to be constructed.

Chronological differences in mean fork length of kahawai at Foxton are presented in Figure 6. The category '? Age' in Figure 6 and Table 8 includes kahawai from Areas I and II. This diagram seems to illustrate an increase in mean size from Early to Late in Area III, but the samples from all provenances except Late are too small for any trends to be confirmed statistically.

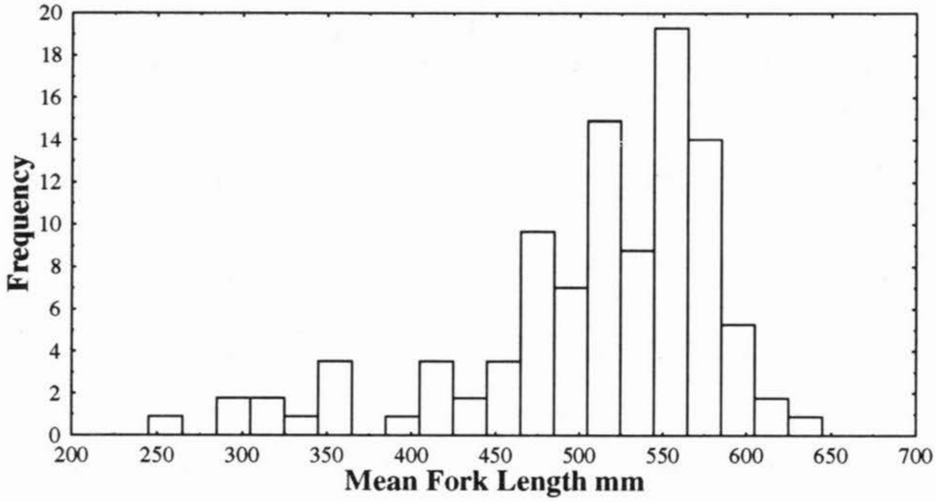

Figure 5: Size-frequency diagram of the kahawai catch at Foxton.

TABLE 8

Analysis of Kahawai Fork Length (mm) at Foxton

Age	**N**	**Range**	**Mean**	**SD**	**g1/w1**	**g2/w2**
? Age	8	488-610	549.6 ±12.0	34.0 ± 8.5	-0.0,0.3	3.3,1.4
Early ?	4	493-574	537.3 ±17.0	34.0 ±12.0	-0.3,1.0	1.9,0.2
Early	11	255-562	413.8 ±32.0	106.2 ±22.6	0.1,0.5	1.5,1.2
Late	91	289-635	515.3 ± 7.0	67.3 ± 4.9	-1.2,4.5	5.0,4.3
Total	114	255-635	508.7 ± 7.1	75.9 ± 5.0	-1.3,5.14.5,3.6here]	

Rotokura is the only site other than Foxton where an increase in mean size of snapper through time has been documented. This is because almost no other sites with long occupation sequences have produced large assemblages which can be examined carefully. Similarly, there are as yet no reliable data on changes in kahawai size through time. However, studies of labrids and blue cod have also revealed a pattern of increasing mean size through time (Leach *et al.* 1999; 2000b). The reasons for such changes have been shown to be complex and to include factors such as variations in natural populations and recruitment, and changes in fishing practice, as well as human impacts on some fish stocks (Leach and Davidson 2001). Each new study adds information which will contribute to a better understanding of these complex issues.

A major reason for undertaking size reconstructions is to calculate the amount of food represented by the archaeological bones. Table 7 gives the total ungutted weight of snapper represented by the excavated bones. It should be noted that one spectacular snapper weighed 16.5 kg. However, fish were only part of the meat component of the diet of the inhabitants

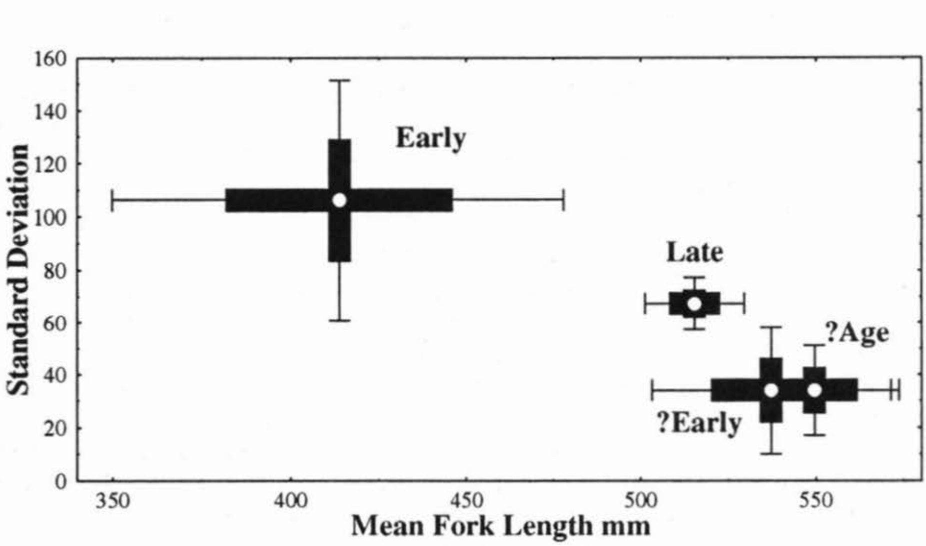

Figure 6: Variations in mean fork length of kahawai at Foxton through time.

of the Foxton site. Estimation of the relative contribution of fish to the diet at Foxton must await detailed studies of shellfish and bird remains.

DISCUSSION AND CONCLUSIONS

The Foxton catches appear to reflect fairly stable natural populations of fish in the vicinity during the occupations at the site and consistent methods of capture, apart from the possible increase in emphasis on trolling suggested above. The catch from the Raumati Beach site presents an interesting contrast. Although many of the minor species at Raumati reflect the more diverse marine environment there, the abundance of red cod and unimportance of snapper at Raumati are striking. However, surface sea water temperatures were cooler in the vicinity of the Raumati site when it was occupied. The much lower representation of snapper and the abundance of red cod may reflect differences in natural abundance.

Snapper are close to the southern limit of their distribution in central New Zealand. They constituted a significant part of the pre-European catch in two main areas in this region: Tasman Bay and the south-west coast of the North Island. The snapper population in Tasman Bay is an unusual one (Leach and Boocock 1994: 82). On the North Island west coast, snapper are more numerous in early sites than later ones — Mana Island Early, Paremata and Foxton. They decline in relative abundance through time at Mana and are most numerous at Foxton, which is both relatively early and further north. As noted above, there is a marked contrast between the relative abundance of snapper at Foxton and at the later Raumati Beach site. We may here be observing a natural decline related to changes in surface sea water temperatures during the pre-European period. It is unfortunate that at present we have no assemblages of fish remains from the North Island west coast between Foxton and

Kokohuia on the Hokianga Harbour. Such assemblages would contribute to a better understanding of the prehistoric snapper fishery in this part of New Zealand.

The small number of eels in the Foxton assemblages raises again the question of the role of the eel fishery in pre-European New Zealand. As noted above, Adkin described in considerable detail the importance of the eel fishery in the area from Horowhenua to Wanganui, and the three main methods of capture — weirs in running streams, another type of weir in lakes and lagoons, and the use of traps in artificial channels. Many of the eeling sites he documented were in use during the historic period, although some were constructed at a time of which his twentieth century informants had no knowledge. Systematic capture of large migratory eels does not seem to have been part of the subsistence economy of the Foxton fishermen. Other resources, particularly birds, attracted them to the shore of the lagoon on the edge of the forest. The major focus on eeling in this region appears to have developed later.

Size reconstructions of kahawai from Foxton and Raumati provide only a starting point for exploring possible changes in mean size of this species as there is as yet nothing else to compare them with. However, the size reconstructions of Foxton snapper are an important addition to our knowledge of this species. The apparent increase in mean size through time parallels that of snapper at Rotokura and the increases in mean size of blue cod and labrids in various parts of New Zealand.

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