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Beach ridges, breakers and bones: late Holocene geology and archaeology of the Fyffe site, S49/46, Kaikoura Peninsula, New Zealand

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Beach ridges, breakers and bones: late Holocene geology and archaeology of the Fyffe site, S49/46, Kaikoura Peninsula, New Zealand

B. G. McFadgen*

Four stranded beach ridge deposits are recognised at Avoca Point, Kaikoura and are considered to have been uplifted by earthquakes. An uplift rate of 1.5 mm/year is derived from beach ridge heights and radiocarbon dates. Earthquake uplifts are dated at 1900 years ago (amount unknown), 1400 years ago (1.1 m), 400 years ago (0.8 m), and 200 years ago (1.1 m).

Intermittent human occupation, probably for fishing, fowling and scavenging, was located on the actively-growing Beach Ridge C, between the sea and a lagoon. Cultural remains have very probably been mixed with the beach ridge deposits, with naturally stranded shells, and with bones from carcasses stranded by wave action.

Keywords: earthquake, uplifted beach ridges, uplift rate, prehistoric environment, moa, natural faunal deposit, Maori, East Polynesian, shoreline, extinct species, artifact.

INTRODUCTION

In 1982 the "Fyffe" site (S49/46) (N.Z. Archaeological Association site number, grid reference NZMS1, S49/98400: Metric site number 031/30, grid ref. 679657) at Kaikoura came under threat from land development. The site is believed by McCulloch (1983) to be where, in the late 1850's, the first intact moa's egg was found with a human burial (Dell and Falla, 1972). Excavations on the western side of the site in 1973 (Trotter, 1980) found artifacts in stratigraphic association with the bones of moa and many other animals, including the extinct swan and goose, nearly 1000 years old. Further excavations in 1982, this time on the eastern side of the site (McCulloch, 1982), found more bones and artifacts in two stone ridges. The main ridge, roughly parallel to the present shoreline, and the minor ridge perpendicular to the first, were interpreted as man-made walls enclosing a kumara garden dating from Polynesian times (McCulloch, 1982, 1983). One of the artifacts from the main ridge was a bone harpoon point claimed to be similar to early Marquesan points (McCulloch, 1983). On the basis of these finds, and what was already known about it, the site was considered by the Canterbury Museum Trust Board to be of outstanding importance. In the *Christchurch Press* of 28 October 1983, for example, it was reported that the site may be that of the first Polynesian settlement at Kaikoura, and possibly of the first big Polynesian settlement in New Zealand.

In 1983 the Canterbury Museum asked the NZ Historic Places Trust to help finance a major investigation of the site. Before committing itself, the Trust decided to make an independent assessment. I carried out the assessment between June and October 1983, with the co-operation of Mrs B. McCulloch and Mr M. M. Trotter of the Canterbury Museum.

The "Fyffe site" (Fig. 1) is one of two areas in the vicinity of Avoca Street, Kaikoura, where prehistoric cultural remains have been found. The other area, called for convenience the "Ward Street site" (Fig. 1) is located on the seaward side of Avoca Street about 300 m northwest of the Fyffe site.

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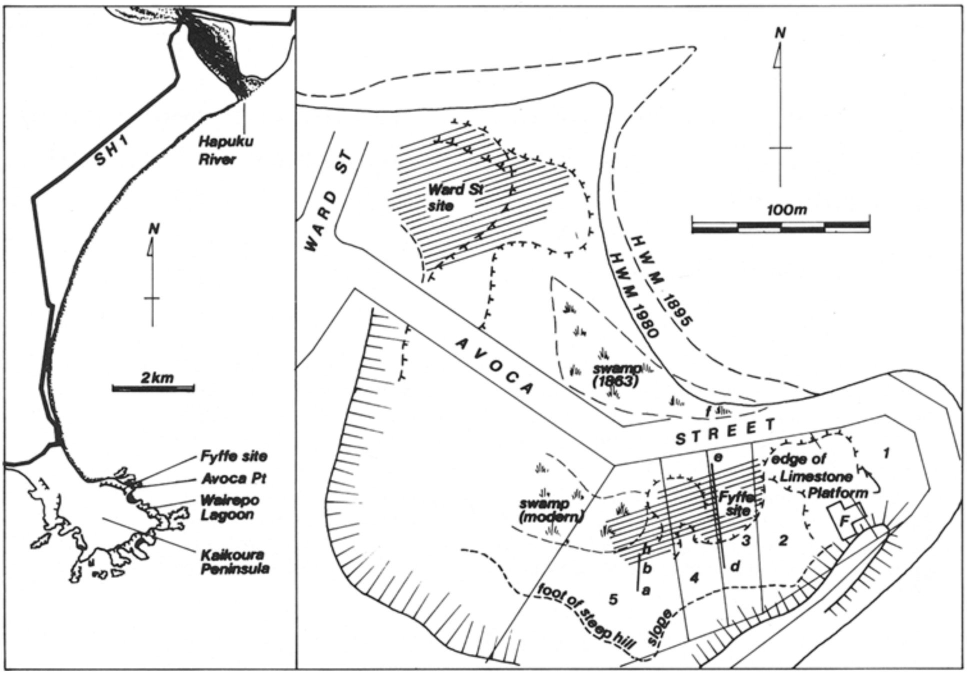

Fig. 1 — Locality map for the "Fyffe" site, S49/46, on Kaikoura Peninsula. Remains of prehistoric Maori occupation are shown cross-hatched. F = Fyffe house; a, b, h and d, e, f = cross-sections shown in Fig. 3. 1-5 = Lots on DP 826. Swamp (1863) from field notes of J. Ward (1866) and high water mark (1895) from DP 283. Note that the edges of Avoca Street are the legal road boundaries, not the edge of the road formation. 1980 shoreline from aerial photographs.

The Ward Street site has been badly disturbed by residential development in the last few decades, during which some 15 burials, moahunter adzes, a greenstone chisel and barbed fishhooks have been found (see Appendix 1). Compared with this, the Fyffe site is rich in faunal remains, but pre-European artifacts are principally stone flakes, with a few bone artifacts that are mostly connected with fishing (McCulloch, 1982). The stone ridges were particularly rich in faunal remains and artifacts.

The investigation described in this paper focusses on the prehistoric environment of the Fyffe site, in order to determine the circumstances under which the cultural and faunal remains were deposited.

GEOLOGY

Fyffe site is on the Holocene coastal platform on the south side of a small bay which faces northeast (Fig. 1). It is on the west side of Avoca Point, and is sheltered from the south by a steep hillside. The underlying rock is limestone which, from Avoca Point west, is exposed along the foreshore below high water mark, and as stacks on the coastal platform above high water mark. East of Avoca Point the foreshore is mudstone (Kirk, 1977).

Just above high water mark is the present storm beach ridge. It is composed of stones and gravel derived from the local limestone and from greywacke washed around the coast from the Hapuku River (Fig. 1).

On the south side of the bay, inland of Avoca Street, the limestone forms a rock platform roughly a metre above the storm beach, and further inland the ground rises to the edge of a second platform roughly 4 m above the storm beach (Fig. 2). The outer edge of the limestone platform is indented by two small embayments. The western embayment contains very swampy ground, the eastern embayment has a prominent ridge of stones and gravel across it.

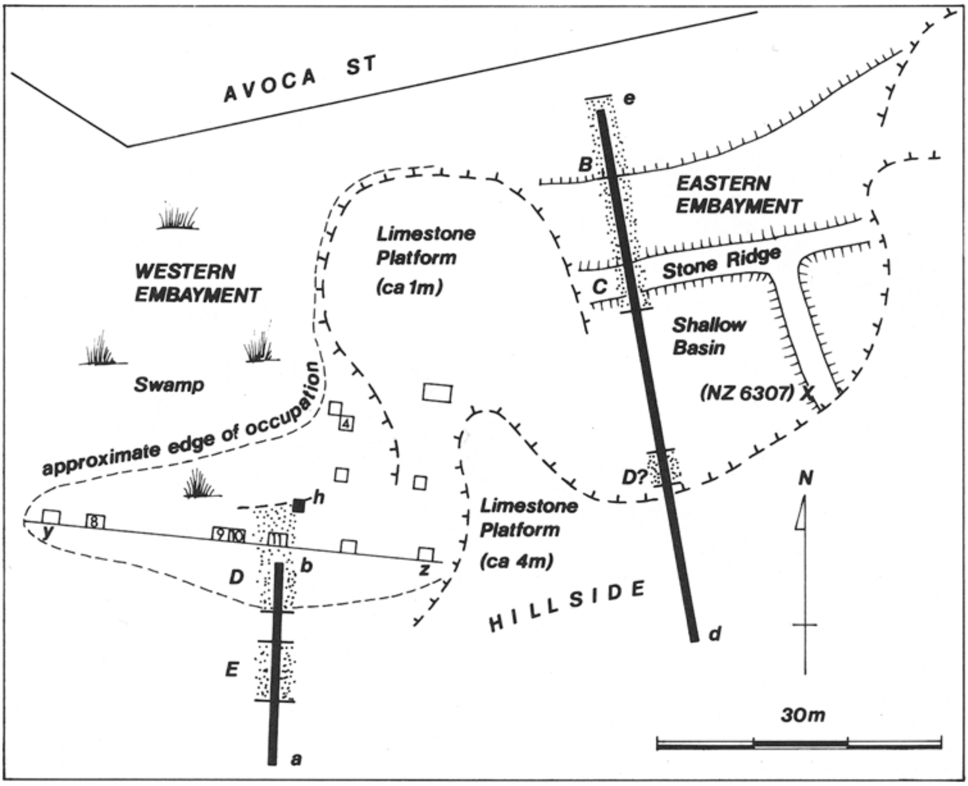

Fig. 2 — Shoreline features and archaeological excavations in the vicinity of site S49/46. a-b and d-e = machine-cut trenches, h = hole dug by hand. x = position of radiocarbon sample NZ6307. Y-Z = approximate position of the baseline of Trotter's 1972 excavation (Trotter, 1980). The approximate positions of his excavation squares are shown as unfilled rectangles. Numbered squares according to Trotter (1972). Stippled areas indicate position of uplifted beach ridge deposits. Heights of limestone platforms above the present storm beach are given in brackets. Note that Beach Ridge C coincides with "stone ridge" running east-west. Note the swamp in the western embayment and the shallow basin behind the stone ridge in the eastern embayment.

The crest of the stone and gravel ridge is about 1.9 m higher than the crest of the storm beach. The ground surface of the shallow basin behind it is remarkably level for about 6 m inland and is about 1.6 m higher than the storm beach. A second stone and gravel ridge 1 to 2 m wide and roughly perpendicular to the first runs inland along the eastern side of the embayment. It rises to the south with a slope of about 1 in 8 and has the appearance of a narrow causeway.

The stratigraphy was examined by cutting a trench with a mechanical excavator down each of the embayments (Fig. 2). The trench in the western embayment (a-b, Fig. 2) stopped at the edge of the swamp because the groundwater table was high, but the trench in the eastern embayment (d-e, Fig. 2) was dug nearly to Avoca Street.

BEACH RIDGE DEPOSITS

The trenches showed four stranded beach ridge deposits of stones and gravel, each overlapping shell sand resting on limestone bedrock (Fig. 3). The beach ridges increase in height with distance inland, the highest being the furthest inland. The present storm beach is labelled A, and the stranded beach ridges, in order of increasing height, B, C, D and E (Fig. 3). The eastern trench (d-e) cuts through beach ridges B and C, the western trench (a-b) through beach ridges D and E. Emergence heights of the beach ridges (i.e.

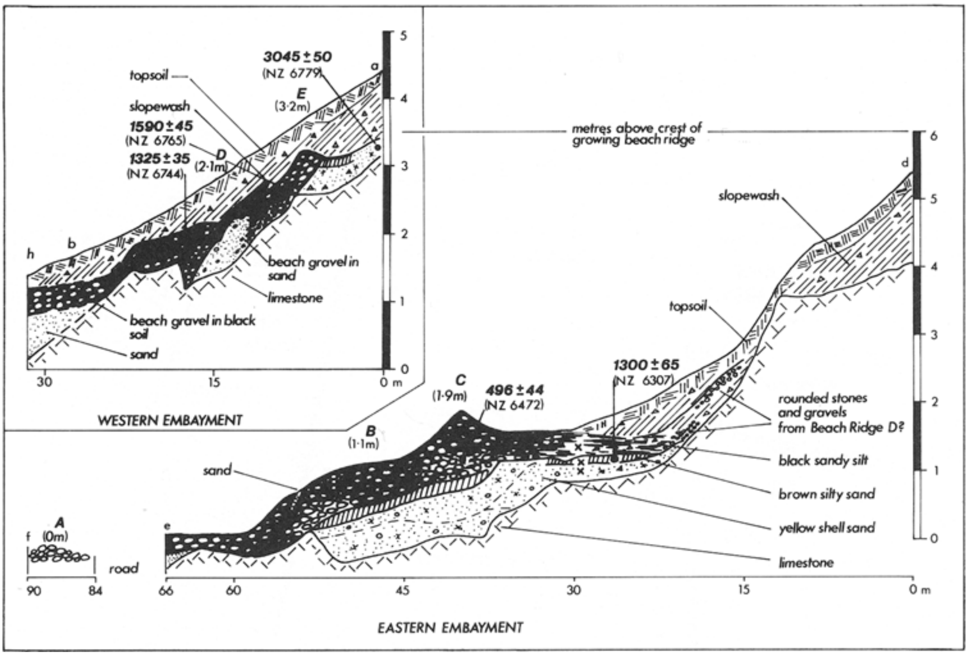

Fig. 3—Stratigraphic cross-section of eastern and western embayments along lines a-b-h and d-e-f (Figs 1 and 2). Vertical exaggeration approximately 6x. Positions of radiocarbon dated samples shown by infilled circles. Position of sample NZ6307, collected by B. McCulloch from the brown silty sand at point X in Fig. 2, is diagrammatic. Beach ridge crests labelled A to E, emergence heights in brackets. x = source of samples for particle-size analysis (Fig. 5).

height above a similar feature forming today—Wellman, 1971) are: B(1.1 m), C(1.9 m), D(2.1 m) and E(3.2 m).

Beach Ridge C, a prominent feature, can be traced on the ground surface as the stone ridge across the eastern embayment. It is the main ridge excavated by McCulloch (1982, 1983). A similar feature, also interpreted as an uplifted beach ridge, has been noted at about the same elevation elsewhere on the northeast Kaikoura Peninsula (Duckmanton, 1974). Beach Ridge B is a slight hump seaward of C (Fig. 2). Beach ridges D and E are buried by slopewash (Fig. 3).

There is no well-defined beach ridge at the head of the eastern embayment. Possibly the nature of the embayment prevented a beach ridge from forming there, except that two small lenses of rounded and sub-rounded stones and gravel were present in the eastern trench (Fig. 3). The stone ridge roughly perpendicular to Beach Ridge C, the minor ridge excavated by McCulloch (1982, 1983), is composed of stones and gravel, but, if it was formed by wave action, seems to be strangely orientated. Most of the ridge, however, is buried and its orientation may be explained when the subsurface distribution of stones and gravel is known. It was not examined.

The beach ridges are composed of rounded to angular limestone gravel and stones and rounded greywacke gravel. In Beach Ridge A the limestone is mostly angular to sub-angular, and greywacke gravel is common (up to 60% in small pockets). In beach ridges B and C the limestone is mostly angular to subangular and the amount of greywacke gravel is small. In beach ridges D and E the limestone is rounded and subrounded and the amount of greywacke gravel here, too, is small (about 2%).

The more rounded shape of the stones and gravel in beach ridges D and E compared with beach ridges A, B and C suggests that beach ridges D and E formed over a longer period than either the present storm beach or beach ridges B and C.

There is no definite date for the time when Beach Ridge A at the Fyffe site began to form, but at the Wairepo lagoon (Fig. 1) about 1 km southeast of the Fyffe site, the present storm beach ridge rests on peat radiocarbon-dated to between 200 and 300 years old (Duckmanton, 1974). This is taken to be a maximum date for Beach Ridge A.

Shells from beach ridges C, D and E, and from the sand overlapped by beach ridges C and E, were submitted for radiocarbon dating. The shells from the sand overlapped by Beach Ridge C were collected from an archaeological excavation (Fig. 2) by B. McCulloch of Canterbury Museum. The other shells were taken from the trench sections at positions shown in Fig. 3. Dates for all shell samples are given in Table 1.

Shells from sand overlapped by the highest beach ridge (E) are some 3000 years old (NZ6779, Table 1). Since that time there have been no eustatic sealevel changes, of sufficient magnitude to account for the stranded beach ridges, and sealevel appears to have remained within about ±0.5 m of its present position (Gibb, 1985). The beach ridges are therefore assumed to have been uplifted to their present heights by earthquakes.

Table 1 — Radiocarbon Dates. Dates with NZ numbers suffixed with "A" are in terms of old half-life (T1/2 = 5568 years). Dates with NZ numbers suffixed with "B" are in terms of new half-life (T1/2 = 5730). Dates with NZ numbers suffixed with "D" have a shell standard correction of −55 years applied (McFadgen, 1978).

NZ No.	Age (years BP)	Material Dated	Significance
6307A	1315 ± 65	Shells	Dates deposition of yellow
6307B	1355 ± 65	(*Protothaca* sp.)	shell sand overlain by Beach
6307D	1300 ± 65		Ridge C
6472A	535 ± 43	Shells	Dates formation of Beach
6472B	551 ± 44	(*Haliotis iris*)	Ridge C.
6472D	496 ± 44	(some pieces over 10 cm long)	
6744A	1340 ± 35	Shells	Dates formation of Beach
6744B	1380 ± 35	(*Protothaca* sp., *Turbo smaragda*)	Ridge D
6744D	1325 ± 35		
6765A	1595 ± 40	Shells	Dates formation of Beach
6765B	1645 ± 45	(*Protothaca* sp.)	Ridge E
6765D	1590 ± 45		
6779A	3020 ± 40	Shells	Dates an old foreshore inland
6779B	3100 ± 50	(*Turbo smaragda*)	of Beach Ridge E
6779D	3045 ± 50		

Beach ridges C and D have almost the same emergence height and are therefore considered to have formed between the same two earthquakes. Beach Ridge C however began forming considerably later than Beach Ridge D. Paua shells (*Haliotis iris*) from deep within Beach Ridge C have a date of only 500 years BP (NZ 6472, Table 1) compared with 1325 years BP (NZ 6744, Table 1) for Beach Ridge D. The paua shells included pieces more than 10 cm long and are unlikely to have moved through the stones.

Beach Ridge C also appears to have formed over a shorter time than Beach Ridge D, since its stones and gravel are much less rounded than those in Beach Ridge D. Comparison with the stones and gravel of Beach Ridge A suggests a formation time of less than 200 to 300 years.

There is no beach ridge equivalent to Beach Ridge C in the western embayment and Beach Ridge D appears to have continued forming there until it was uplifted.

Inferred dates for the earthquakes are based on the radiocarbon dates and an assumed average uniform uplift rate (Fig. 4). The uplift rate indicated by Fig. 4 is about 1.5 mm per year. It is in reasonable agreement with that of 2mm/year for the last 1000 years inferred by Duckmanton (1974) from uplifted shoreline deposits on northeast Kaikoura Peninsula. It is also close to the rate of 1.46 mm/year for vertical erosion of the intertidal platform at Avoca Point measured by Kirk (1977). The earthquake uplifts are dated at about 1900 years ago (amount unknown), 1400 years ago (1.1 m), 400 years ago (0.8 m), and 200 years ago (1.1 m).

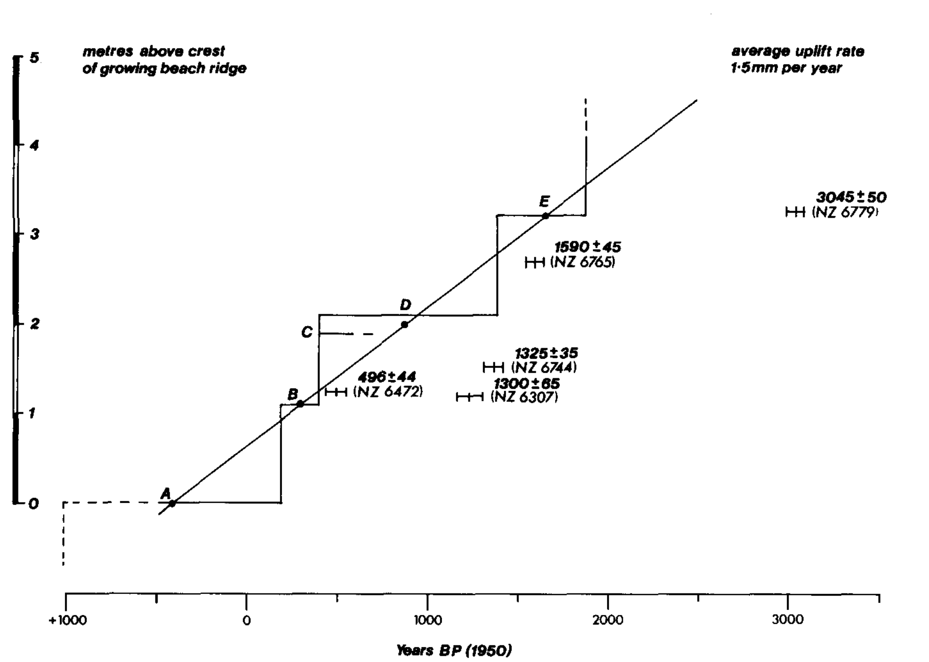

Fig. 4—Diagram showing emergence heights and times of formation of beach ridges A to E. Duration of beach ridge formation indicated by horizontal lines. Error bars indicate radiocarbon dates (±1sd). Maximum date for Beach Ridge A from Duckmanton (1974). Other dates from Table 1. Inferred times and approximate magnitude of each uplift shown by vertical lines. Note absence of uplift between beach ridges C and D. Horizontal lines arranged so that mid-points lie on a straight line representing average rate of uplift (1.5 mm/year). Inferred date of next uplift is some 1000 years hence.

EASTERN EMBAYMENT: STRATIGRAPHY AND PREHISTORIC ENVIRONMENT

Geological deposits behind Beach Ridge C comprise, from bottom to top, three layers with increasing mud content: yellow shell sand, brown silty shell sand, and black sandy silt (Fig. 3). Their mud contents (silt-sized particles and smaller) are 1%, 31% and 69% respectively (Fig. 5).

The sand content of each layer is composed of comminuted shell (including some microscopic shells), rock fragments, quartz and felspar (Table 2). The shell fragments are generally coarser than the rock fragments, the quartz and the felspar and are all fairly well rounded. The rock fragments are compound grains and are less well rounded; the quartz and felspar are free angular grains. The shell content is highest in the yellow shell sand and lowest in the black sandy silt (Table 2.)

The yellow shell sand forms a layer up to 30 cm thick behind Beach Ridge C, and up to 80 cm thick beneath Beach Ridge C. It contains large, broken and whole, marine shells (limpets, mussels, cockles etc), and up to 20% stones and gravel which tend to be most numerous beneath Beach Ridge C. There is no layering or bedding of the stones and gravel, and they are found more or less throughout the sand.

The virtual absence of mud in the shell sand rules out the possibility that the sand is an old lagoon deposit. The sand is well-sorted (Fig. 5), but from its content of stones, gravel and large shells, and the absence of any layering or bedding, it is unlikely to be an old dune sand. Its size-frequency distribution is similar to the sand just below present high-water mark (Fig. 5). If it were an old intertidal deposit, the virtual absence of mud, and the presence of stones, gravel and large shells, embedded in the sand by wave action,

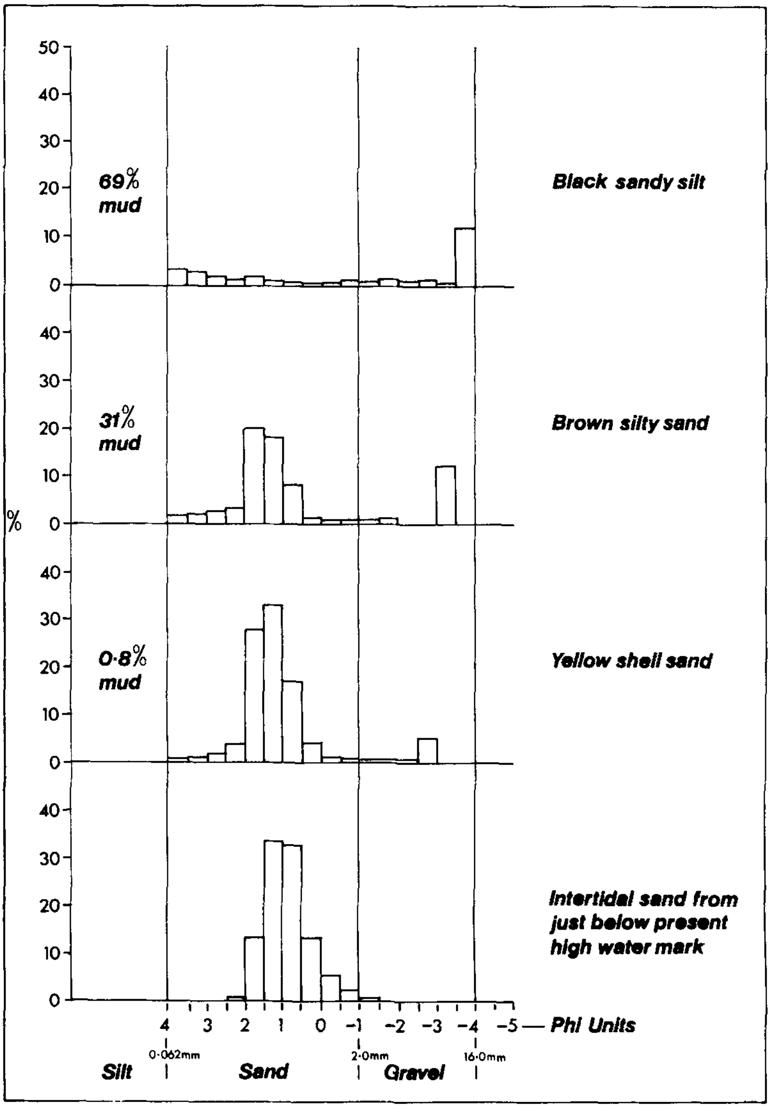

Fig. 5 — Particle size-frequency distributions of deposits immediately inland of Beach Ridge C (eastern trench) compared with sand from just below high water mark.

would be expected. The shell sand is therefore interpreted as an intertidal deposit which, from its height and position, was probably laid down during the formation of Beach Ridge D.

The brown silty sand is up to 10 cm thick behind Beach Ridge C and up to 20 cm thick beneath Beach Ridge C. Like the shell sand it contains stones and gravel (*c.* 12%) and large marine shells. The sand component is well-sorted, and its grain size is similar to the yellow shell sand (Fig. 5).

At one place in the eastern trench the brown silty sand was separated from the black sandy silt by a lens of yellow shell sand about 1 m long and 5 cm thick, indicating that the brown colour and silt content are not due to leaching from the black sandy silt but were present before the black sandy silt was deposited.

The mud content of the brown silty sand indicates a change from an intertidal to a lagoon environment. Shells from the brown silty sand are about 1300 years old (NZ 6307, Table 1), but the date of the change depends on how the brown silty sand was deposited. If the sand and silt were deposited at the same time, then the brown silty sand is a layer, which dates the change to within about 200 years of the start of Beach Ridge D.

The lower boundary of the brown silty sand however is gradational, and the sand grain size similar to the yellow shell sand, which suggests that the brown silty sand is the top of the yellow sand modified by the infiltration of mud and fine sand. In this case the shell date of 1300 years relates to the deposition of the yellow shell sand and is only an older age limit for the mud. The yellow shell sand is interpreted above as an intertidal deposit when Beach Ridge D was forming, and the date is in good agreement with the inferred period of formation of Beach Ridge D.

The brown silty sand is overlain by Beach Ridge C which contains shells dated at 500 years old (NZ 6472, Table 1) and the change to a lagoon could therefore have taken place any time between about 1300 and 500 years ago.

The brown silty sand passes beneath Beach Ridge C, and the shoreline when the lagoon was formed was thus seaward of the present position of Beach Ridge C. How far seaward is not known, but judging from the present shoreline, which has moved inland some 25 to 30 m since 1895 (Fig. 1), a position 15 m seaward across the entrance of the embayment is not unlikely.

Beach Ridge C rests directly on the brown silty sand, and the lowest cultural remains are beneath it. The beach ridge thus moved inland, reaching its present position sometime after human settlement.

The black sandy silt is between 30 and 50 cm thick. Compared with the shell sand and brown silty sand, the black sandy silt contains a significant amount of organic matter (the loss after hydrogen peroxide treatment is about 3%). It merges inland with slopewash, and seaward with Beach Ridge C. It contains both landsnails and marine molluscs.

The sand component of the black sandy silt, in contrast to the yellow shell sand and brown silty sand, is poorly sorted and finer. There is little shell (<5%) and the sand is largely fine-grained rock fragments, and quartz and felspar grains. The poor sorting suggests that it has been eroded from the hillside behind the site, and this origin is confirmed by its similarity with a sample of soil from the hillside (Table 2). The sand fraction of the hillside soil is rock fragments with about 10% quartz and felspar grains. Visually their grain size distribution is also similar. There are no shell fragments in the hillside soil but shell fragments are found in the present day intertidal sand. The shell fragments in the black sandy silt are probably from this source. The black sandy silt is therefore interpreted principally as a deposit derived from the hillside by slope wash and wind, with a small component of wind-blown sand from the shore.

Table 2—Percentage of shell, rock fragments, quartz and felspar in the sand component of the deposits behind Beach Ridge C, compared with soil from the steep hillside behind Fyffe site and with intertidal sand from just below present high water mark. Percentages estimated visually.

	Yellow Shell Sand	Brown Silty Sand	Black Sandy Silt	Hillside behind Site	Intertidal Sand
Shell %	>90	60-70	<5	absent	*c.* 10
Rock fragments %	<10	30-40	>75	>90	*c.* 90
Quartz and Felspar %	Present	Present	*c.* 20	*c.* 10	Present

The higher proportion of mud to sand, the darker colour, and the higher organic content of the black sandy silt, indicate a change in the lagoon conditions that prevailed when the brown silty sand was deposited: possibly there was an increase in the rate of deposition and a change in the type of vegetation. It is likely that as the basin silted up the lagoon became a swamp, which finally dried up when Beach Ridge C was uplifted some 400 years ago.

Samples of the black sandy silt and brown silty sand were examined for freshwater molluscs and ostracods in an attempt to confirm a lagoon, but none were found in either deposit. The lagoon may have been too brackish for freshwater molluscs, but would not have been so for all ostracods (S. Eager, *pers. comm.*, 1986). Both deposits, however, contained forams and other micromolluscs. Those from the brown silty sand showed signs of leaching, and those from the black sandy silt, signs of humic acid staining. Ostracod shells are very delicate, and conditions in the two layers may have been unfavourable for their preservation.

The boundary between the black sandy silt and underlying layers is distinct to sharp, indicating that conditions in the lagoon changed quite quickly. The brown silty sand contains stone artifacts (obsidian and chert flakes) in places, and the change to the black sandy silt, which therefore must have happened after human settlement, is possibly due to increased slope wash since the clearance of vegetation.

The black sandy silt contains beach ridge stones and gravel, probably thrown over Beach Ridge C by wave action. The proportion of stones and gravel gradually decreases inland from the beach ridge to about 15%. The two deposits thus appear to have accumulated for a time together.

The black sandy silt is also around the stones and gravel that form Beach Ridge C. Wave action would tend to wash silt out of a growing beach ridge, at least on its seaward side, and the silt in the ridge would therefore appear to have accumulated after the ridge was uplifted, probably as wind borne silt.

Implications for interpreting cultural activity

The three layers behind Beach Ridge C were deposited under conditions which would appear to preclude actual occupation while they were being deposited. This is despite the presence of shells, bones and/or artifacts within them. Some other explanation for their faunal and cultural content is needed.

Cultural remains (principally stone flakes and bone artifacts) have been found within Beach Ridge C and in the brown silty sand beneath. It is reasonable to assume therefore, that the beach ridge was occupied while it was growing. A modern analogy is at Wairepo lagoon (Fig. 6) where the present storm beach ridge, a few metres wide, separates the sea from the lagoon. People today drop rubbish on the beach ridge, and during the next storm the sea washes over it and may eventually incorporate it into the beach ridge.

Because of the exposed nature of the beach ridge and its proximity to the sea, any occupation is necessarily short and anything left behind rarely survives undisturbed beyond the next storm. Occupation of Beach Ridge C before it was uplifted would have been equally short, and cultural remains left behind equally susceptible to disturbance.

The most common artifact type present in the beach ridge deposits are stone flakes, which also appear to be the most numerous artifact type in the mud layers behind Beach Ridge C (Department of Internal Affairs Z 3460). Their distribution in the muds is perhaps not surprising since stone flakes would occasionally fly off and land some distance away from where they were struck, and others could have been washed in by waves during storms. Wave action probably also accounts for other artifacts in the lagoon muds. Disturbance of the lagoon bottom by animals, *e.g.* wading birds, feeding ducks, or children playing in the water, would soon incorporate the artifacts into the bottom deposits.

It may be suggested that, if artifacts could be incorporated into the brown silty sand by animal disturbance, then so could the 1300 year old shells. If such were the case then the shells would have been reworked and their date should therefore be disregarded, except as a maximum age for the black sandy silt. By disregarding the date the model presented in this paper would not be altered.

The Wairepo beach ridge is also strewn with wave-tossed shells and a variety of other wave-tossed debris. In October 1983 the carcasses of a seal and a seagull were lying on the beach ridge. Both carcasses had partly disintegrated and the scattered bones were already being incorporated into the beach ridge. Carcasses of animals that died at sea or were washed down rivers must have been thrown up onto the shore many times in

Fig. 6—Wairepo Lagoon. A narrow storm beach ridge separates Wairepo lagoon on the left from the sea on the right. The Wairepo lagoon and beach ridge are an analogous example of the situation which is thought to have existed at the Fyffe site during formation of Beach Ridge C.

the past. The high lime content of the beach ridges at the Fyffe site would favour preservation of their bones and it is not surprising that many bones have been found in Beach Ridge C. Significantly, none appear to have been found in position of articulation.

Although most bones would end up in the beach ridge, wave action, especially during storms, would have thrown some bones over the ridge and into the lagoon behind in the same way that stones and gravel are thrown.

Some of the bones in Beach Ridge C will presumably be from meals eaten by prehistoric Maoris, but the greater number will probably have been naturally deposited, and it will be difficult to tell which is which. Notwithstanding this difficulty, the bone assemblage is valuable as a dated sample of the fauna of the Kaikoura district and the older beach ridges should provide similar samples dating from the times of their formation.

Beach Ridge C is interpreted by me as a natural feature. To decide whether or not the stone ridge perpendicular to Beach Ridge C is a natural feature will require a detailed stratigraphic analysis and I did not examine it. Nevertheless, some conclusions can be drawn about the possibility of it being built as a wall around a kumara garden (McCulloch, 1982, 1983). If its stratigraphic position indicates an age older than the uplift of Beach Ridge C, then the possibility can be ruled out because the ridge would have been located either in an intertidal environment, or else in the lagoon or swamp immediately behind the growing beach ridge. If the ridge is younger than the uplift of Beach Ridge C, then its function as a garden wall is possible because the ground would have been drier, even though no evidence for prehistoric gardening was seen in the black sandy silt.

Soils may be blackened by the vegetation growing on them and the colour of the black sandy silt is not therefore considered significant. Prehistoric Maori gardens commonly contain sand and gravel added to them by man (McFadgen, 1980), but the sand and gravel content of the black sandy silt is adequately explained by natural processes. Although some garden soils may contain shells and bones, the shells, bones and the black sandy silt at the Fyffe site appear to have accumulated concurrently.

The possibility that the ridge may be a modified natural feature should be considered, and its likeness to a narrow causeway suggests an alternative purpose.

Western Embayment: Reinterpretation of Trotter (1980)

My recognition of beach ridges D and E agrees with Trotter (1980) who excavated the part of the site in the western embayment in 1973. The approximate positions of Trotter's excavation squares are shown in Fig. 2.

Moa bones, shells and charcoal were recovered from squares 9 and 10 (Fig. 2), from the top of limestone rubble which Trotter (1980) describes as sea-deposited. Although their exact positions with respect to Beach Ridge D are uncertain, squares 9 and 10 appear, from Figs. 2 and 3, to be on the seaward slope of Beach Ridge D. However, the configuration of Beach Ridge D near squares 9 and 10 is not known, and it is possible that the squares may have been situated towards the top or rear of the ridge. In the western trench (a-b, Fig. 3) the top of Beach Ridge D contained bones, charcoal and burnt stones, and the rear of the ridge, a fireplace. Radiocarbon dates reported by Trotter (1980), for the moa bones, shells and charcoal, are between 740 and 1010 years old, which is within the period that Beach Ridge D was forming.

Beneath the beach deposits, in squares 4 and 8 (Fig. 2), Trotter (1980) found a layer of peat which he considers probably formed behind a beach ridge and was later buried by further sea-deposited material in a manner similar to that proposed earlier in this paper for the lagoon deposits behind Beach Ridge C.

Shells, and the bones of a variety of birds, fish, mammals and reptiles, were found throughout the deposits (Trotter, 1980). Cultural remains were invariably recorded in "black soil", which was present in the upper part of the deposits, and faunal remains appear to have been classed as cultural by virtue of their (stratigraphic?) association with artifacts (principally stone flakes) in the black soil. The bones, charcoal and burnt stones in the western trench (Fig. 3) were also in a black deposit, similar to the black sandy silt in Beach Ridge C. The origin of the black soil is not explained by Trotter (1980), but if it is the same as the black sandy silt in Beach Ridge C, then the "black soil" may have percolated down into Beach Ridge D after the beach ridge was uplifted beyond the reach of the waves.

Differences between the species in the faunal assemblage classed as cultural and those in the assemblage classed as natural were explained largely as a result of selective hunting and gathering. Trotter, however, did not know the process by which the natural faunal remains came to be deposited (1980:281). If their possible origin as wave-tossed carcasses is acknowledged, then his evaluation of the significance of the site is open to reinterpretation. The stranding of carcasses is unlikely to have stopped just at the time when man began to use the beach ridge, and a stratigraphic association of animal bones and artifacts is therefore to be expected. There need not, however, be a cultural relationship, and to infer economic activities or diet without clearly separating naturally from culturally deposited bones would be misleading.

Yet the carcass of a large animal washed ashore might still attract human scavengers, if not for its meat then for its bones to make artifacts. The observed association between stone flakes and the bones of large animals need not, therefore, be entirely fortuitous. But the type of site represented would be considerably different from the small settlement inferred by Trotter, where the carcasses of hunted animals were taken to be consumed.

Trotter (1980) placed special significance on the presence of five comparatively large extinct bird species in the "cultural" deposits, as presumably important sources of meat. None of the five species, which included moas and the extinct goose and swan, were found in the natural deposits. Moas, however, were flightless birds which lived in, or on the edge of, forest, and they would have been susceptible to forest fires. Fires after human settlement were probably quite common and the moa bones in the site, and possibly the bones of the flightless goose, may perhaps represent the remains of birds which died while attempting to escape from forest fires by running into water courses or the sea.

Longshore drift, indicated by the distribution of greywacke gravel on the Kaikoura beaches, is south from the Hapuku River mouth (Fig. 1), counter to the nett northwards drift along the coastline (Gibb, 1979), and in the right direction to wash any bird carcasses from the Hapuku River onto Kaikoura beaches.

Trotter (1980) notes that bones in his "natural" assemblage are slightly more broken and worn than those in his "cultural" assemblage, but in a loose, stony beach ridge this might reasonably be expected of older bones. He draws attention to the different species composition between his natural and cultural bird bone assemblages. If, however, the flightless species are disregarded, then the species composition is remarkably similar (Trotter 1980, table 1). The most striking difference is the extremely high number of bones or bone fragments of spotted shag in his cultural assemblage (768 out of 1050: Trotter 1980, table 1). There is no discussion of this high number, and without some indication of how many individuals are represented it is not possible to judge what it means. Apart from the shag bones, which are equivocal, the differences between his "natural" and "cultural" assemblages could all result from natural processes. Some other way of distinguishing natural and cultural remains at this site is therefore needed if the economic activities and diet of the occupants are to be inferred with any degree of confidence.

The need to distinguish naturally from culturally deposited remains also applies to radiocarbon dates. Dates from "stratigraphically" contemporary samples could vary by several hundred years as a result of reworking of deposits by wave action. If bones have worked up in the deposits as Trotter (1980: 281) suggests, then artifacts could have worked down, and the question must be raised as to whether the Fyffe site dates are contemporary with human occupation. At best, the age of 860 years BP for occupation of the Fyffe site, which Trotter (1980) estimates from dates that range between 740 and 1010 BP, may only be a maximum date.

FYFFE SITE AND ITS RELATIONSHIP WITH WARD STREET SITE

On an earthquake-uplifted coastline like Kaikoura Peninsula, lagoons and swamps behind beach ridges were probably a common coastal feature in the past and are likely to have been attractive to the prehistoric Maori as a source of food. With the sea on one side and lagoon or swamp on the other, a beach ridge would have been an obvious stopping place, a precarious one unsuitable for a settlement, but in good weather ideal for a day's fishing, fowling, or scavenging. Fyffe site is considered here to have been such site.

If a settlement contemporary with the Fyffe site ever existed in the same bay, then its most likely location is the Ward Street site some 300 m northwest of the Fyffe site, where burials, finished artifacts, and structures have been found. The Fyffe site would then have been little more than an infrequently-occupied satellite of the Ward Street site.

CONCLUSIONS

1. Kaikoura Peninsula in the vicinity of the Fyffe site, S49/46, has been uplifted tectonically at an average rate of 1.5 mm per year for the last 3000 years.
2. Uplift appears to have been sudden and intermittent and old shorelines are marked by stranded beach ridges of stones and gravel.
3. At the Fyffe site the stone ridge roughly parallel to the shoreline, interpreted by McCulloch (1982) as a stone wall, is an old uplifted storm beach ridge, a conclusion broadly in agreement with Trotter (1980) who considered the feature to be basically a natural formation.
4. The prehistoric Maori apparently occupied the Fyffe site while the beach ridge was actively growing. Consequently, occupation remains are likely to have been mixed with beach ridge deposits, with naturally-stranded shells, and with bones from naturally-stranded animal carcasses by wave action.
5. The ground behind the beach ridge could only have been used for kumara growing since less than 400 years ago, which is when the beach ridge was uplifted beyond the reach of wave action and the lagoon behind it dried up. However, no evidence of gardening in the lagoon deposit was seen.

6. The Fyffe site is interpreted as a repeatedly-visited beach ridge, used on a day to day basis as weather permitted, for fishing, fowling or scavenging.

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Radiocarbon dates were determined by the Institute of Nuclear Sciences, DSIR, Gracefield.

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APPENDIX 1

SUMMARY OF ARCHAEOLOGICAL REMAINS (UNPUBLISHED) FROM WARD STREET SITE (compiled from information supplied by local residents)

33 Avoca Street:	Part of a fishhook, back left of allotment.
35 Avoca Street:	3 burials, one with dentalium shell anklets; fishing sinker; 3 fishhooks (2 barbed); adze flakes; bird and fishbones; chert. Deposits down to about 1 m depth, some probably still intact.
43 Avoca Street:	1 blackstone adze.
7 Whakatu Quay:	3 burials under house; remains of small whare at entrance to driveway, with charcoal-stained sand to depth of 60 cm; 2 large 1A adzes from under garage. Remains damaged by bulldozing.
11 Whakatu Quay:	2 small rectangular cross-sectioned adzes, one tanged, one untanged; small greenstone chisel.
9(?) Whakatu Quay:	6 + burials found when septic tank put in, and 3 burials when sewerline dug. Some remains probably still intact.