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Shell Points of Maori Two-piece Fishhooks from Northern New Zealand

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ABSTRACT

Prehistoric points of two-piece fishhooks made of *Cookia sulcata* are known from a few archaeological sites in northern New Zealand. A study of these and museum specimens shows them to have some diversity of form sufficient to allow classification of their attachment details, and of their shapes. A possible history of the various types is provided and some regional differences are apparent. The abundance of shell hooks in relation to other hook forms is related to abundance of *C. sulcata* and availability of bone.
Keywords: NEW ZEALAND, MAORI, ARCHAEOLOGY, MULTIVARIATE STATISTICS, CLUSTER ANALYSIS, TWO-PIECE FISHHOOKS, BOLLONS COLLECTION.

INTRODUCTION

Two-piece fishhooks became a dominant form of hook late in New Zealand prehistory. Bone examples of the point legs of these are well known from the length of the country. Shanks of bone also occur but less frequently than points and it would seem that the wooden shanks known ethnographically were more common.

Points and shanks in shell also occur and appear more common in the northern North Island. As with bone, shanks are less common than points and wood may be considered as the material most commonly used for the shanks of hooks with shell points.

Shell points are much less frequent in museum collections than bone points and examples from excavations are very few indeed. They differ from bone points in a number of ways. They are never as large as the largest bone or ivory points, no doubt because of the limitations of the material. Also, they lack barbs almost entirely, decorative notching is absent, straight points are rare and the attachment details at the base of the points avoid the deep notches and prominent knobs often found on bone points. Compared with bone points they are relatively homogeneous.

The most common material for their manufacture is the mollusc *Cookia sulcata*, a shell physically rather similar to the *Turbo* shells often used for shell tools in tropical Polynesia. One-piece hooks are also known in this material but whole examples are quite rare. Other shellfish have also been used for points but less frequently.

Cookia sulcata occurs throughout New Zealand on rocky shores but as it is a relatively large animal, large specimens are not found on shores with substantial surge. The distribution of the points suggests that they are uncommon or absent in places where *sulcata* is naturally absent, but that the reverse is not true. In some places where *C. sulcata* is available, it does not appear to have been used for two-piece points.

One-piece hooks of shell have a wider distribution than two-piece hooks, though these too do not extend to the far south. They are an early form in the Wairarapa where they are dated from the twelfth to fourteenth centuries A.D. (Leach 1979:109).

They also occur in the Pig Bay site (N38/21) and there is a single example from Hot Water Beach (N44/69) dating from about the sixteenth century A.D. (Leahy 1974:37).

A later assemblage from Kauri Point Pa (N53-4/5) is illustrated by Green (1978). Use of shell for one-piece hooks is absent from many early sites where hooks of moa bone occur. A deterministic model which would explain much of the spatial and temporal variety in the use of shell for one-piece hooks is that they were used where the shell was available when suitable bone was rare, that is, in localities where *C. sulcata* grows and where and when moa bone was of limited availability.

Some trolling hook points of shell are known. One from Harataonga Bay Western Midden (N30/5) is an early example, probably dating from the thirteenth century A.D. (Law 1972:100).

Archaeological specimens of shell hook points will be discussed in detail below. The distributional information, considered with other information on New Zealand fishhooks, is suggestive. As parts of two-piece hooks, the shell points belong to Crosby's (1966) secondary adaptation of Eastern Polynesians to New Zealand. The use of local shells as raw material for hooks seems to be a primary adaptation to New Zealand, if not a dominant one. The combination of shell and the two-piece form was an adaptation which was only locally adopted.

This study was undertaken to attempt to elucidate the role of shell hook points in the prehistory of the northern North Island. The archaeological specimens are not common, and alone are not of great use in demonstrating their forms, frequency and history empirically, so recourse was made to museum collections in the belief that these would define more closely the variety of forms. Regional differences, if present, might be of value in suggesting functional adaptation to different fishing environments or phylogenic relationships. The first aim in the study was to develop a typology which parsimoniously covered the variety apparent and a numerical taxonomic approach was chosen.

THE POPULATION

From the collections of the Auckland Institute and Museum and the National Museum, Wellington, 134 hook points of *Cookia sulcata* were studied. A number of hook points were rejected for study, because they were made of shell other than *Cookia sulcata*, although some of these were quite similar to the *Cookia* points. One non-*Cookia* specimen was admitted, being of unusual interest as it was from the Pig Bay archaeological site (N38/21). It appears to be made from the lip of an ostrich foot shell (*Struthiolaria* sp.). *Struthiolaria* appeared to be the material from which many of the rejected points were made, but there were others of *Haliotis* and mussel.

In addition to these 135 points, a point in a private collection was included for some purposes, though it was not fully recorded. The total studied, therefore, was 136 points. One whole *Cookia* point was rejected, as it was not clear which end was the tip. This is not included in the total. Not all of the points recorded were whole. The bases of 14 broken points were recorded as details of bases formed part of the study. It is possible that some of these were from the shanks of two-piece hooks, particularly those with the Bb forms of base, as these also occur on shanks. No tips of broken points were included in the study.

No unfinished points were identified in the study. It is possible some or all of the 15 points which lacked either inside or outside notching were in this category, but this cannot be objectively determined.

The population was studied by recording a variety of data. From the 115 points which could be measured, various measurements were taken for use in a multivariant clustering study of the shapes and sizes of the points. The bases of the points were recorded and identified against a base classification developed from observation.

The outside of the shellfish is always clear on points made of *Cookia sulcata*. When the point is placed on a surface with the outside uppermost it is possible to record if the direction of the tip is clockwise or anti-clockwise with respect to the curvature of the point. This was recorded for most points, though overlooked on several broken points.

There are six categories of data to present: the outcome of the multivariant classification, the base form classification, the locality records, the collection of origin, the clockwise/anti-clockwise data and whether the points were whole or broken. The fifteen cross category tables resulting from these six categories are brought together in Table 1.

TABLE 1
A CROSS CLASSIFICATION TABLE FOR THE ASSEMBLAGE OF POINTS

		a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v
Shape Type																							
1	a	40																					
2	b	–	19																				
3	c	–	–	29																			
4	d	–	–	–	27																		
Incomplete/not measured	e	–	–	–	–	21																	
Base Type																							
A	f	0	0	4	5	6	15																
Ba	g	3	6	4	0	2	–	15															
BbA	h	37	13	19	20	4	–	–	93														
BbB	i	0	0	2	2	3	–	–	–	7													
Not classified	j	–	–	–	–	6	–	–	–	–	6												
Locality																							
Northern group	k	27	10	11	12	5	0	9	56	0	0	65											
Southern group	l	3	3	6	8	12	15	4	4	7	2	–	32										
Elsewhere	m	0	0	1	0	1	0	0	1	0	1	–	–	2									
No record	n	10	6	11	7	3	0	2	32	0	3	–	–	–	37								
Collection																							
Auck. museum	o	10	4	9	10	7	12	5	16	7	0	12	27	0	1	40							
Nat. museum	p	30	15	20	17	13	2	10	77	0	6	53	4	2	36	–	95						
Private	q	0	0	0	0	1	1	0	0	0	0	0	1	0	0	–	–	1					
Handedness																							
Clockwise	r	39	19	28	24	12	13	14	89	5	1	61	26	1	34	27	95	0	122				
Anti-clockwise	s	0	0	0	2	6	0	1	2	0	5	4	0	1	3	8	0	0	–	8			
Not recorded/ recordable	t	1	0	1	1	3	2	0	2	2	0	0	6	0	0	5	0	1	–	–	6		
Completeness																							
Whole	u	40	19	29	27	7	10	14	88	4	6	60	24	2	36	33	88	1	110	8	4	122	
Broken	v	–	–	–	–	14	5	1	5	3	0	5	8	0	1	7	7	0	12	0	2	–	14

Note: In each box 136 hook points are allocated

The large National Museum collection is of special interest. The great bulk of it is from the Bollons collection. John Bollons was born in 1862 and came to New Zealand in 1881. He went to sea at age 14 (Anon. 1897:795) and his career lasted until 1929 (Kirk 1964:70). He joined the Government ship "Hinemoa" in 1893. "Hinemoa" was by this time employed as a lighthouse tender and Bollons subsequently became Captain of her and later of "Tutanekai" when the latter became the lighthouse tender. In the period in which he was servicing lights he would have made many visits to Cape Maria van Diemen, where a light was established in 1879. Although lights were not established at Cape Reinga until 1941 and at North Cape until 1929, surveys for the siting of the first-mentioned were carried out by Bollons (Ross 1975:134). The opportunity to make the collections localised to Tom Bowling Bay, North Cape and Cape Maria van Diemen must have arisen on these visits.

The National Museum collection of fishhook points from the far north has a lower proportion of broken points than the Auckland Museum collection. While this can be a characteristic of collections including fakes, it may only reflect collector selection at discovery. The forms of the hooks in the Bollons collection can be matched in the smaller Auckland Museum collection, which strongly supports accepting them as authentic.

Some of the Auckland Museum collection is localised to "North Cape". In popular usage this term is often applied to the whole of the northern-most extremity of the North Island. While such localisations have been accepted here as applying strictly to North Cape, it is not unlikely that the points are from elsewhere in that northern area. Given Bollons' familiarity with the area, his localisations to North Cape can be accepted more readily.

TERMINOLOGY

The following terms are used in discussing the fishhooks:

Point: The whole of the point part of the two-piece bait hook.

Tip: The sharper end of the point intended to penetrate a fish's mouth.

Base: The opposite end of the point from the tip.

Bait Notch: A notch in the point which appears to have the function of facilitating the attachment of bait using light cord.

Base Notch(es): Notches on the base of the point appearing to be positioned for securing the point to the second part of the hook with light cord.

Probably significant: A significance level in a statistical test where the hypothesis tested has a probability in the range of 0.05 to 0.01.

Significant: A significance level in a statistical test where the hypothesis tested has a probability of less than 0.01.

FORMAL STUDY

The formal study was directed at the variety of base forms apparent in the sample. The methods employed were those of inspection with an aim of subdividing the assemblage on a rational and repeatable basis into types which in the opinion of the researcher have some functional difference as methods of attaching the points to the shanks.

The most obvious division in the sample was into points which appeared to be fashioned for butted attachment (A) and those for lapped attachment (B) (Fig. 1). The first have a flanged base which is filed flat on the end surface which is intended for butting on to a shank. A plane projected upwards from this surface passes near the tip of the hook. In addition, these bases have notching which allows the use of lashing tangential to the curve of the point to hold the butted surfaces together. The B form bases lack any surface designed for abutting, and frequently show a rounded form which can only allow some form of lapped joint. These non-abutted joints can be further subdivided. Type Ba has the base squarely cut transversely to the curve of the point but lacks the flanging. The plane of the cut off base does not pass near the tip of the point. It is conceivable that some of these points fitted into slotted shanks, the slot of which enveloped part of this base. In Type Bb, the base of the point comes to a rounded end which is usually more curved in plan view than Type Ba. This form often has notching on the inside or outside of the point base which for the most part suggests that the two halves of the hook were lashed together with binding radial to the inside curve of the hook. This type is further subdivided to distinguish a particular form. This form, Type BbB, has the rounded end, radial notches only on the outside of the point and, most importantly, has a single notch for a tangential binding in addition to the radial binding. This form of base also occurs on shell shanks from the same area as the points and it would appear that points and shanks with identical base forms were lapped together. The bases BbA are those Bb bases which do not fall into the BbB Type. The four types of base, A, Ba, BbA, and BbB are shown in Figure 1.

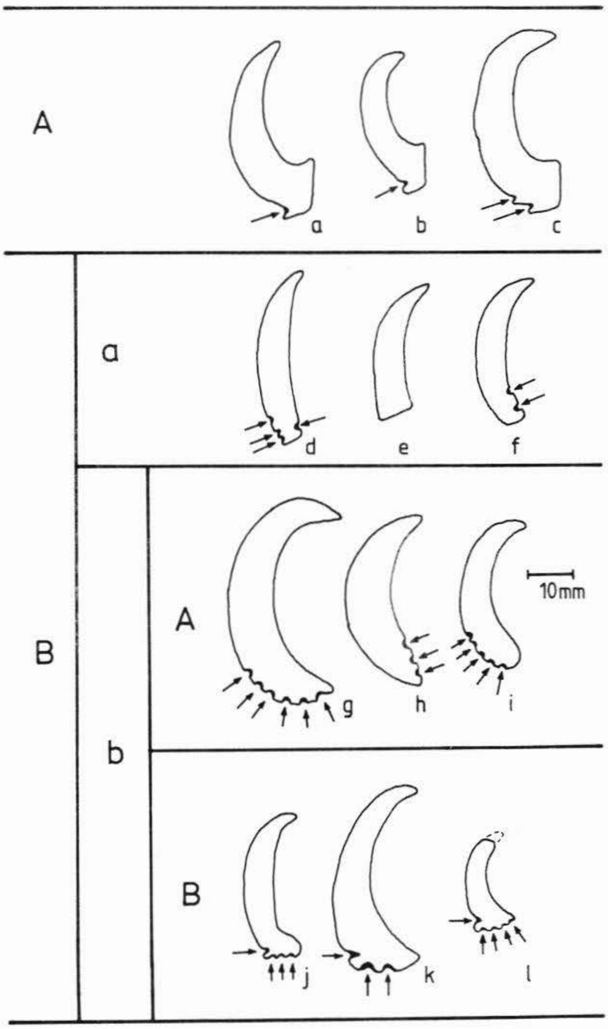

Figure 1: Base types, three of each illustrated, from the top A, Ba, BbA, BbB. Arrows indicate notches. a) Waihi, Auckland Museum (AM) 34812.4, b) Whitipirorua, AM/AR5478, c) Opito, NM9123, note bait notch, d) North Cape, NM9039, e) Unlocalised, NM1226.2, f) Waihi AM34812.1, g) Taputaputa, AM16194.2, h) Spirits Bay AU 6496.10, i) Tom Bowling Bay, NM9061, j) Whitipirorua AM/AR5474, k) Opito, AM/AR90, l) Whitipirorua AM/AR5463. Type allocations: 1: d, f, h 2: e 3: b, i, j 4: a, c, g, k.

These types have some similarity to forms used in two-piece bone hooks. The Type Ba bases can be compared with those on Hjarno's Type C5a bone points from Otago (1967:30). Both also lack barbs. The status of Type BbB is confirmed by its replicate in bone. Eyles (1975:136) illustrates a point and shank of this form from a Kaikoura site (S49/3). The point in this specimen is unbarbed.

The spatial and temporal relationships of these types will be considered with those of the point shape types found in the multivariant study.

HANDEDNESS

It is a remarkable feature that there is a strong bias in the handedness of the points towards clockwise-tipped points (Table 1). This is not explicable through any mechanical character of the shell from which they are made. Equally, successful points should be able to be made in either hand. A possible explanation is as follows: The idea of using two pieces for a hook is to minimise the damage caused by breakage. As the point is the weaker part and that most at risk, it would break and be replaced most often. To aid penetration into a fish's jaw, it is important to have the tip of the point correctly angled in relation to the body of the hook. The shape of *Cookia* shells means that points made from them are curved in two planes. All points of the same hand will curve in the same way. If a point on a lapped hook breaks and needs replacement, one with the same curvature will be required to restore the hook tip to the same position as formerly. Thus standardising handedness of points aids such repairs, perhaps allowing a stock of spare points to be kept.

This explanation, however, must hold over the entire time scale and geographical range seen here. This implies a common tradition of point manufacture over the identified range of these points.

ABERRANT POINTS

A few points were encountered which could not be included in the study (Fig. 2). Some of these (a, b, c, on Fig. 2) could not be measured, while a few others (e.g. Fig. 2d) were believed to be trolling hook points. Interestingly, there was a high frequency of anticlockwise points in this aberrant group.

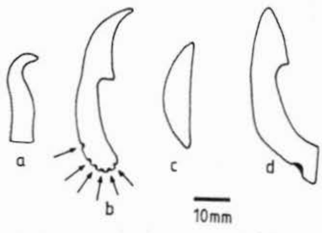

Figure 2: Aberrant points of shell, not included in study. a) Cape Maria van Diemen, NM9117, b) Cape Maria van Diemen, NM9111, c) Kawau AM25415, d) Gable End Foreland NM9120. Both a) and d) are anticlockwise. On c) it is not clear which end is the tip. d) is comparable to lure points of bone.

MULTIVARIANT STUDY

A cluster analysis study was made of the population on dimensional data. Eight dimensions were taken from each point (see Fig. 3). They were selected with the concept of being sufficient to so constrain a draughtsman, given only the values, that he or she could produce a reasonable illustration of the item.

To take the measurements, the item was placed on a flat surface with the inside of the shell downwards. The length was then the greatest length and the half and quarter points were fixed in relation to this length and marked in soft pencil on the inside curve of the point. The second and third dimensions were taken with the tip and base of the point touching the surface perpendicular to the plane on which the point rested. The dimensions were then taken from this second plane to the marked quarter and half marks.

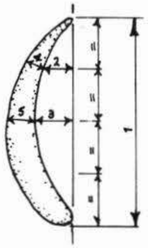

Figure 3: Dimensions taken on points. Dimension No. 6 is thickness at half length, No. 7: number of inside notches, No. 8: number of outside notches.

Because of the nature of the shell, the plane of the body of the point is rarely parallel to the first plane. The third and fourth dimensions were taken in the plane of the body of the point. In taking these, the calliper used were adjusted in a vertical plane to maximise the distance measured and adjusted in a horizontal plane to minimise the distance measured, working in each case from the marked quarter and half marks.

The sixth dimension, thickness, was taken as close to the half length mark as possible but was shifted to the nearest hollow left by the ribbed exterior of a *Cookia sulcata* shell.

Because of the usually curved cross section of the centre of the point, the thickness is not a true thickness but the distance between the parallel calliper jaws, which would not usually touch the hook at adjacent points. Dimensions were read with vernier callipers to the nearest 0.1 mm.

The numbers of notches on the inside and outside of the curve provide the seventh and eighth dimensions. These clearly form a discrete rather than a continuous variable. Outside notches range in number up to seven and average 1.9 per point in the population studied metrically. Inside notches range to 5 and average 1.1 per point. Given that both vary over a considerable range, they were accepted as being equivalent to continuous variables.

CLUSTER ANALYSIS

The clustering procedure used is known as a "K-Means" procedure described by Hodson (1971), Kendall (1975) and Hartigan (1975).

Before clustering was undertaken, the variables were replaced by their logarithms if this reduced skewness, then transformed to a correlation-free form by a process analogous to principal components analysis which excludes usual rotation of the data to the principal component axes as an unnecessary step for this purpose, and lastly the correlation-free transformed variables were standardised to unity variance.

The clustering programme (SUPERK, written in ALGOL by the author) groups units together using Euclidean distances into the selected number of clusters (K). Re-assignment passes are made as the units are progressively added. When complete, the within groups variance/covariance matrix is used to calculate Mahalanobis distances between units and cluster centres and units are re-assigned if appropriate. Repeated passes are made if re-assignment occurs with re-calculation of the variance/covariance matrix and cluster centres at each pass. The programme finally reports unit assignments to clusters, inter-cluster distances, both Euclidean and Mahalanobis, together with the Sum of the Squared Errors (Euclidean distances), SSE, and the determinant of the within cluster variance/covariance matrix. The latter two are indicative of the tightness of the clusters.

For each value of K, multiple trials were made to find the tightest clusters (measured by the smallest value of the determinant of the within cluster variance/covariance matrix) and the tightest adopted for presentation.

Explanations of this procedure of more value to the general reader can be found elsewhere (Law 1980).

APPLICATION

Of the eight data dimensions, Nos. 4 to 8 were logarithmically transformed, as they had lesser skew in this form. Table 2 shows the correlation matrix for the eight dimensions after this transformation. As might be expected, the two dimensions defining the shape of the curve, Nos. 2 and 3, are highly correlated, as are the two dimensions taken on the width, Nos. 4 and 5. For a population of this size a correlation higher than 0.18 (or less than -0.18) suggests the correlation is statistically significant at a level of "probably significant" for null hypothesis of zero correlation (n=115). The majority of the correlations tabulated fall into this class. Interestingly, the notches on the outside and inside are negatively correlated, that is, points tend to have either outside or inside notches. There are a few points with both inside and outside notches.

TABLE 2
CORRELATION MATRIX OF DIMENSIONS

		Dimension							
		1	2	3	4	5	6	7	8
Dimension	1	1.00							
	2	0.50	1.00						
	3	0.48	0.95	1.00					
	4	0.79	0.34	0.33	1.00				
	5	0.81	0.33	0.31	0.96	1.00			
	6	0.57	0.30	0.23	0.60	0.62	1.00		
	7	−0.10	0.27	0.31	−0.14	−0.12	−0.05	1.00	
	8	0.16	−0.15	−0.23	0.08	0.12	0.23	−0.31	1.00

Lower half only shown. Dimension numbers as in Figure 2. Dimensions 5 to 8 inclusive after log transformation.

Following removal of the correlation, the transformed data were used to cluster the units, using from two to six clusters. Figure 4 shows values for some statistics related to different numbers of clusters. For each number of clusters, a number of attempts were made to find better ways of partitioning the units. Those presented are the best found.

The reduction of SSE with an increasing number of clusters (Fig. 4, upper) does not show any marked shoulders, but this is not the case with the cluster volume statistic (Fig. 4, middle), which shows a massive reduction when two clusters are selected, but only small reductions thereafter. This massive reduction is reflected in the large Mahalanobis distance between the two clusters (Fig. 4, lower). Given the large number of localised artefacts in this assemblage and the variety apparent in the study of the base forms, it seemed appropriate to attempt to see more detail in the spatial distribution and time history than two types would allow. In consequence, using the information on Figure 4, clustering with four types was selected as having the best separation between the closest clusters, whether measured by Mahalanobis or Euclidean Distance. Hence clustering at this level was adopted for the regional study. It must be emphasised that the success or otherwise in finding regional differences did not enter into the decision on the number of types to adopt other than as noted above.

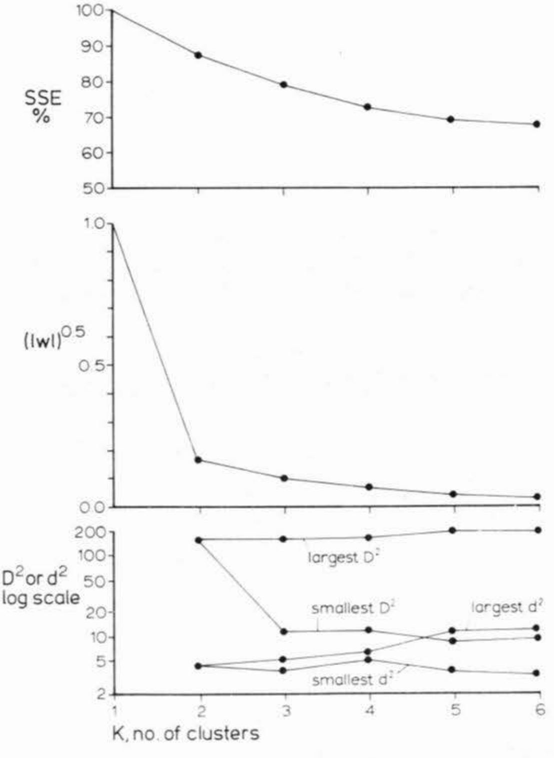

Figure 4: Clustering statistics: Upper, reduction of SSE with increasing number of clusters (K); Middle, reduction of the volume of clusters with increasing number of clusters; Bottom, changes in inter-cluster distances with increasing number of clusters.

The most typical points of the four clusters are illustrated in Figure 5. These were selected as the units which were the closest to their respective cluster centres measured by Euclidean Distance. Table 3 shows the character of the four types in subjective terms. It should be noted that attempts to classify the population into types using this sort of list does not yield a very high rate of success. A mathematical discrimination is required.

Table 4 shows the Mahalanobis distances between the clusters while Tables 5 and 6 show the way in which the units are redistributed as the number of clusters is increased from two up to four. As can be seen, the first cluster, or Type 1, is established in the partition into two clusters and persists through the creation of three and four clusters without alteration. In the distance table, Table 4, cluster 1 is again clearly removed

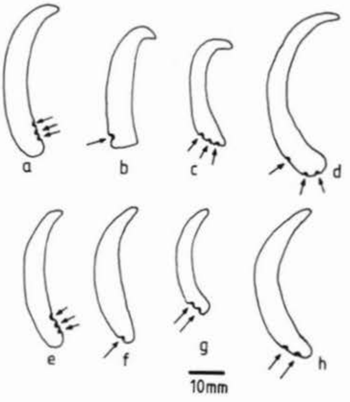

Figure 5: Points most typical of the four clusters; Above, actual points, a) Type 1 North Cape NM9043, b) Type 2 North Cape AM23262.6, c) Type 3 Unlocalised NM9098, d) Type 4 North Cape NM9038; Below, points generated from the cluster average scores, e) Type 1, f) Type 2, g) Type 3, h) Type 4.

TABLE 3
CHARACTERISTICS OF THE SHAPE TYPES

<table>
<tr><th rowspan="2">Character</th><th colspan="4">Type</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Inside notches</td><td>present</td><td colspan="3">absent or few</td></tr>
<tr><td>Shape</td><td>crescent</td><td>point incurved</td><td colspan="2">crescent</td></tr>
<tr><td>Length</td><td colspan="2">average</td><td>short</td><td>long</td></tr>
<tr><td>Width</td><td>average</td><td>wide</td><td>narrow</td><td>wide</td></tr>
</table>

The characters are listed in order of significance.

TABLE 4
INTER-CLUSTER MAHALANOBIS D-SQUARED VALUES

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
1	–			
2	163.5	–		
3	158.3	11.5	–	
4	160.8	13.8	15.4	–

TABLE 5
POINTS TRANSFERRED BETWEEN CLUSTERS FOR K=2 AND K=3

		K=3 Cluster 1	K=3 Cluster 2	K=3 Cluster 3	Total
K=2	Cluster 1	40	–	–	40
K=2	Cluster 2	–	38	37	75
Total		40	38	37	115

TABLE 6
POINTS TRANSFERRED BETWEEN CLUSTERS FOR K=3 AND K=4

		K=4				
		Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
	Cluster 1	40	–	–	–	40
K=3	Cluster 2	–	19	19	–	38
	Cluster 3	–	–	10	27	37
Total		40	19	29	27	115

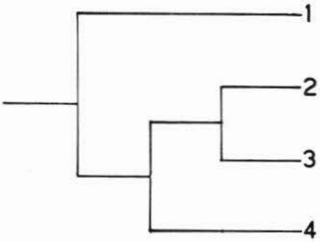

Figure 6: Hierarchy of type clusters.

from the other three clusters which are much closer to each other than to cluster 1. In increasing from three to four clusters, the added cluster attracts units from two k=3 clusters rather than being formed by fission of one of those clusters. Figure 6 shows the cluster hierarchy based on the transfers and the inter-cluster distances.

Table 1 shows the relationship between the base types determined in the formal study and the types determined in the clustering study. Base types A and BbB are absent from Type 1, as might be expected given that Type 1 is essentially defined by presence of inside notching. The low numbers of points, apart from those with BbA bases, makes precise links between the two systems unclear, but a preliminary hypothesis could be to link Ba bases to shape Type 2 and A and BbB bases collectively to Types 3 and 4.

REGIONAL VARIATIONS

The points available for study have two very marked peaks of distribution, the far north of the North Island and the region encompassing the eastern Coromandel and Hauraki Gulf (Fig. 7). Because of the separation in the distribution, an obvious procedure is to test the frequency of types in the two areas.

Table 1 shows the division of the base styles between the areas. The difference in frequency between the areas is highly significant. The A and BbB forms show clearly as southern forms, while the BbA form is predominantly but not exclusively northern. The unlocalised group is very close to the northern area group, which is not surprising, as this group is predominantly from the Bollons collection. Given that there is an overlap between the base types and the cluster analysis types, a difference between the areas would also be expected for the latter. Table 1 shows the regional breakdown, but the difference between the two area groups fails to reach a significant level when tested across four types. If, however, the level of discrimination is lowered to the

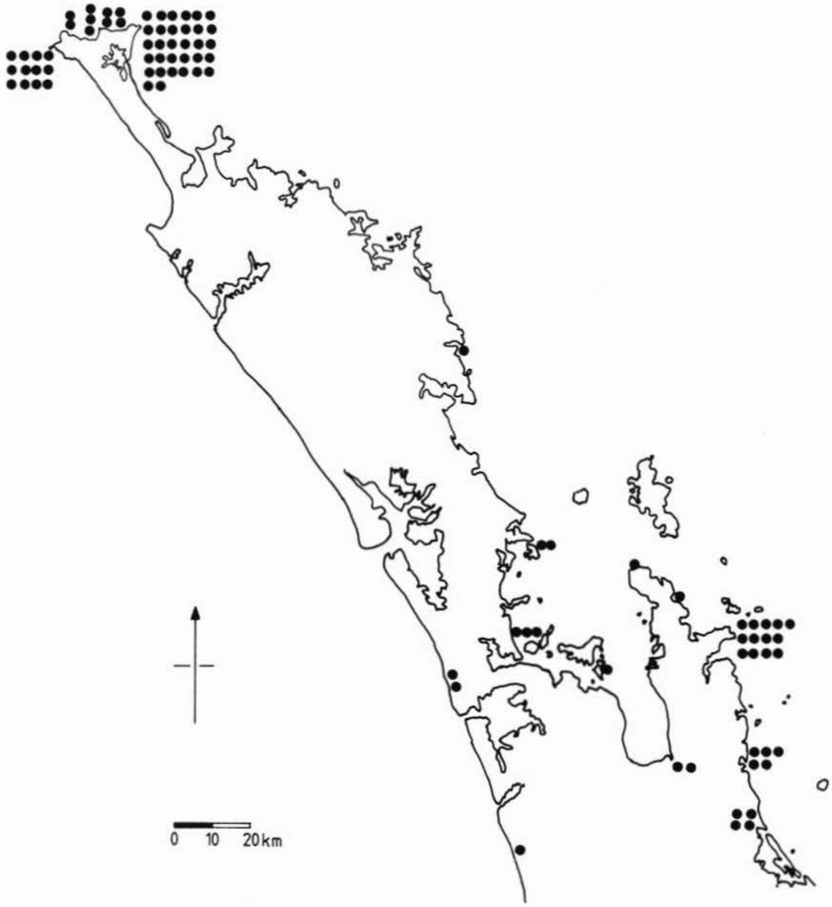

Figure 7: Distribution map for localised hooks. Not shown is one in the Bollons collection attributed to Kaikai's Beach in Otago.

difference between Type 1 and the remainder, then the difference of frequency is probably significant, with Type 1 being under-represented in the south. As fewer points are classified to shape type than to base type, the difference in significance between the two type classifications could be an artefact of sample size, as larger samples aid determination of significance.

At a more detailed level, the more precisely localised collections can be examined for differences in frequency. The data in Figures 8 and 9 can be so used. In the northern area, none of the collections differ significantly when the proportion of base styles is looked at. However, the type frequencies show the following differences. The largest collection, that from North Cape, differs from the rest of the northern group at a probably significant level. The variation in the frequency of Type 3 contributed most to this finding and that of Type 4 the least. Looking at Type 4 alone, the variation of frequency of Type 4 versus the other types as a group reaches a probably significant level between the Taputaputa collection and both the Tom Bowling Bay and North Cape collections (Fisher exact test, probability of no difference).

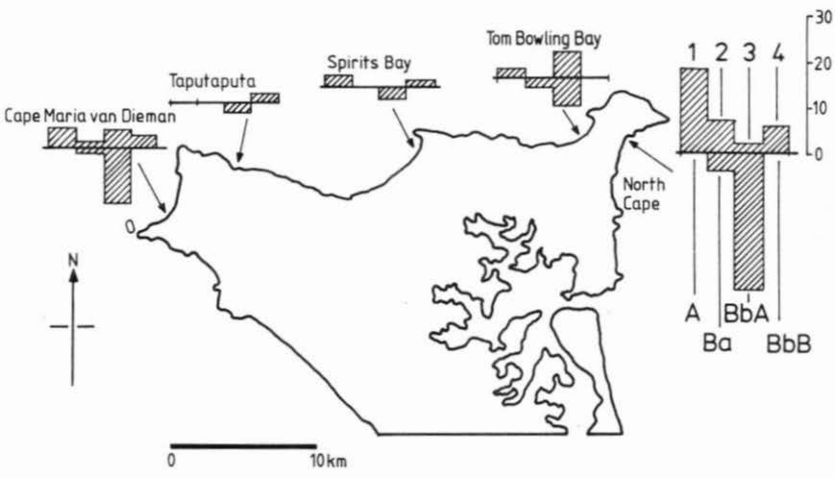

Figure 8: Type frequency histograms for the far north of the North Island.

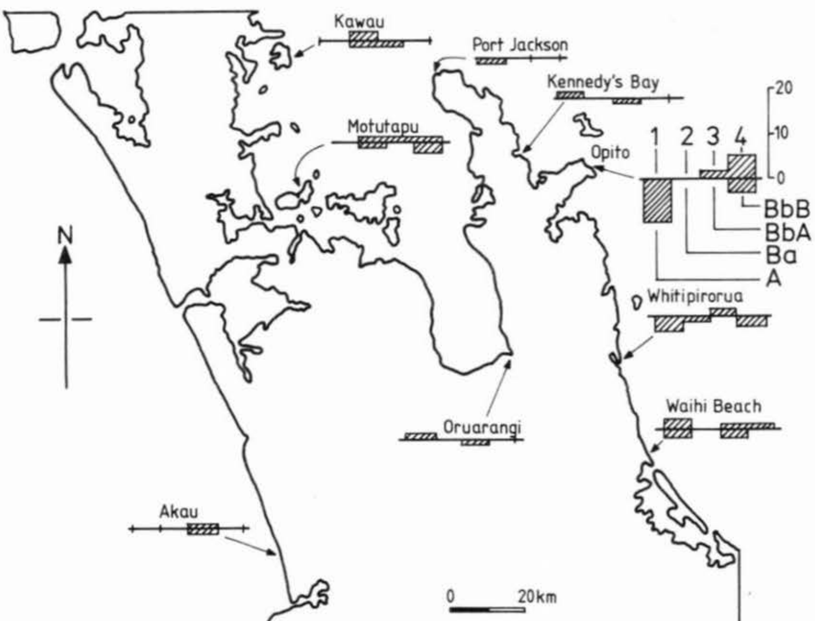

Figure 9: Type frequency histograms for the Auckland/Coromandel area of the North Island.

Turning to the southern collection's base styles, the total number of localised bases at 30 is very small for establishing significant differences when subdivided. The largest assemblage, that from Opito, differs from the aggregate of the other collections when type A bases are compared with non-type A bases at a probably significant level (Fisher exact test, probability of no difference). The Opito assemblage is different from the Motutapu collection on the same basis, at the same level. Looking at type BbA bases, the Waihi collection differs from Opito, again at the same level on the same test. The frequency of base style A in the five Coromandel collections stands out as significant (Fisher exact test, probability of no difference).

Turning to the clustering types, the small numbers make tests unpromising and no significant patterns can be seen.

ARCHAEOLOGY

None of the specimens from the far north are from archaeological excavations. One temporal indicator is the absence of these hooks from the Mt Camel Site (N6/4, Roe 1969, Shawcross 1972) where abundant hooks of moa bone reflect an abundance of moa bone from moa consumed at the site. This site is likely to be fourteenth century A.D.

The far north area is the source of some substantial collections of artefacts as well as the hooks reported here. Some of these sites still exist. Davidson (pers. comm. 1979) suggests some sites which could have been the source of the far north hooks: at North Cape N1-2/85, Tom Bowling Bay N1-2/86, Cape Maria van Diemen N1-2/227 and Taputaputa N1-2/194. Archaic artefacts are known from these areas and this conjunction suggests that some at least of the far north points have association with Archaic artefact assemblages.

In the south, more of the points are from excavated sites. One point (Type 1, BbA base) is from Oruarangi (N49/28, Fisher 1935). Best's recent work suggests this would date later than the sixteenth century A.D. (Best 1980:73). As an almost solitary specimen of a shell point in a site with many other points of bone of rather different shape, it could be seen as an import, possibly from Northland. Shawcross and Terrell (1966:414) show a second nondescript shell point from this site but do not identify the species from which it is made.

At the Sunde Site on Motutapu (N38/24), a point was found beneath the Rangitoto eruption ash layer (Type 4, BbB base) which would date to the fourteenth century A.D. (Law 1975). From above the same ash layer at Pig Bay (N38/21), two points are known (Type 2, Ba base and Type 3 BbB base). This latter point is the only specimen made from *Struthiolaria* included in the study and is illustrated by Golson (1959:42). From their position in the site, they are associated with Archaic artefacts in a deposit which is post-fourteenth century A.D.

In the Coromandel region, the site associations of the points from Whitipirorua (N49/16, Jolly 1978) suggest the points are Archaic. Only two are complete (Type 3, A, Type 3, BbB), but in addition there are three base sections, two of A and one of BbB. There is also a complete shank with a BbB base. At Opito, N40/2 (Jolly and Murdoch 1974) has similar Archaic associations. There are four complete points (Type 4, A, Type 4, BbB, Type 4, A, and Type 3, A) and two base pieces, A and Ba. As in the far north, what is arguably the earliest occupation—the lowest layers in the Opito site of N40/3—lacks shell hooks but has bone hooks. A likely age for this occupation is thirteenth century A.D. or earlier. Lastly, from the eighteenth century A.D. site of N40/16 at Opito, there are two complete points (Type 4, A base, Type 3, A base) and a base piece with an A base.

One point from the remarkable Jolly cache of fishhook points from Opito is made of shell (Jolly 1981). This point is not of *Cookia* but rather of the lip of some other species of gastropod. It has a type BbA base with outside notching. Its association with four other points made of ivory displaying the barb and notch features of bone hooks confirms that their absence from shell hooks was one of choice.

A final point worthy of note is a *Struthiolaria* specimen excavated at Galatea Bay (N43/33) on Ponui Island (Terrell 1967:61) which is of about eighteenth century A.D. age. It is not simply comparable to the points studied here, indicating only that the idea of using shell points was current at that time.

ETHNOGRAPHY

Shell points connected to shanks to form complete hooks are surprisingly rare. The Gisborne Museum holds a made-up specimen with a *Cookia* point in a wooden shank, while the hooks found by Fairfield (1933) at Manukau Heads include three with *Struthiolaria* points on wooden shanks. These take the form of Oceanic *Ruvettus* hooks and it is not clear how they were used by Maori fishermen.

Early European visitors to New Zealand mention hooks of shell (Savage 1807:58, Banks 1962:26) but it would seem less utilitarian objects were collected as curiosities, and no other two-piece hooks with shell points are known to the author.

DISCUSSION AND CONCLUSIONS

Shell fishhooks span the full range of New Zealand prehistory. The shell points of two-piece hooks were only locally popular. They appear to stem from a single historical origin, but if they were used in the first settlements, they were greatly outnumbered by one-piece hooks, usually of bone. This, however, is true of two-piece hook points of all materials which, though known from undoubted Archaic contexts, are always less common than one-piece hooks (Leach 1979:102, Davidson 1978:219, Hamel 1979:120). Undoubtedly shell artefacts are often missed in excavations among shellfish food waste and it is unwise to base conclusions on apparent absence. Shell points were certainly in use from Archaic contexts in the fourteenth century through to European contact.

The formal and metrical study carried out here showed that the observed variation in form was not random. In the far north, there are suggestive variations between localities which may relate to different fishing opportunities or to small scale differences in fisherman's preferences. There is some scope there for fieldwork on fishing opportunities and their realisation (cf. Coutts 1975). The Auckland and Coromandel collection of hooks appears to stem from the same origin but has in addition some base forms of its own (A and Ba) and shows the Type 3 and 4 forms more frequently. A time history of the types is hinted at by the archaeological material from the south. An early diversity of bases, A, Ba and BbB, seems to have narrowed to A type bases. Of the shape Types 2, 3 and 4, the first dropped from popularity. Such conclusions are tentative and need further archaeological specimens for confirmation.

The use of a metrical study here in addition to the more traditional formal study of the base forms does yield additional information even though the two analyses are not strictly independent. A metrical analysis yields a clustering hierarchy diagram, and it is of some interest that the fundamental division between Type 1 and Types 2, 3 and 4 can be paralleled in the distributional data, where Type 1 is a predominantly far north form of point. The hierarchy of the clusters has been interpreted in some cases of archaeological metrical analysis as representing an historical relationship between varieties. In this case, the archaeological information would allow such an explanation for the difference between Type 1 and the other forms, with the local traditions being established early in the prehistory of New Zealand.

Only small progress has been made in artefact studies in recent New Zealand archaeological research. The small number of diagnostic specimens from many excavations is an explanation often invoked. This paper and an earlier paper on pendants (Law 1980), where similar methods were used, suggest that unpromising excavated material, studied in conjunction with museum specimens, will yield to analysis, and that there is fine detail in the history of Maori material culture to be discovered in such analyses.

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