

# Māori Cordage from Te Wao Nui a Tiriwa, Auckland, Aotearoa New Zealand

Lisa Mckendry<sup>1</sup>

## ABSTRACT

Tāmaki Paenga Hira (Auckland War Memorial Museum) holds a number of Māori archaeological textiles from cave and rockshelter sites in Aotearoa New Zealand. The textiles presented here are a cordage collection from Te Wao Nui a Tiriwa (Waitakere Ranges), Auckland. The cord fragments are manufactured with *whiri* (plaited) and *miro* (twisted) structures. The diversity of structural attributes reveals the use of a range of materials, strand forms and dimensions to manufacture cords. A range of local resources were used at all sites for plaited cords, however, the twisted cords are all made from the same plant species, *harakeke* (*Phormium tenax*, New Zealand Flax). The artefacts appear to be functional items such as lashing, binding and fishing lines. The exception is a plait made with human hair. In the main, the types of *whiri* and *miro* cords in the Te Wao Nui a Tiriwa collection are represented in other archaeological cordage assemblages in Aotearoa. This article provides comprehensive technical information which contributes to our understanding of Māori cordage technology and provides data important for future comparative textile studies.

Keywords: *Māori textiles, cordage, fibre plants*

## INTRODUCTION

Textile research on archaeological collections can be heavily constrained by taphonomic issues. Fibre remains are rarely found intact which can limit access to important details, such as the original size and shape of the artefact (Norton 1990). This, in turn, impacts the certainty of identifying the raw material, the structures, or the artefact itself (Norton 1990; Smith 2014). Despite these constraints, variations in the structural attributes of textiles tell us about raw material use, technological traditions and the types of activities at sites. This paper focuses on cordage, an essential component of material culture for past Māori communities within Aotearoa New Zealand. Cordage refers to strands, cords, lines and ropes (Bernick 1998: 16). These can be made using a wide range of manufacturing methods, including knotting, twisting or plaiting plant fibres or leaf strips. Two of the main cordage forms made by Māori were twisted cords (*miro*) and plaited cords (*whiri*). This paper describes a collection of cordage from Te Wao Nui a Tiriwa (Waitakere Ranges), Auckland, in terms of the range of materials used, the strand forms and dimensions, and the functions of identified specimens, adding important data to our knowledge of Māori cordage technology and its uses in the region.

## Māori Cordage

Twisted cords were used for making the fishing lines and leaders that were a fundamental part of survival for Māori communities (Paulin 2007). The first European explorers of Aotearoa commented on the superiority of Māori fishing lines (Best 1986). Further, narrow twisted cords were essential for composite fishhooks, used to bind the hook to the lure and to attach the line to the hook (Leach 2006). Plaited cords were also important components for the fishing industry, such as for net-making (Best 1986), however, they were essential for land based purposes. The versatility of the plaited cord was fully exploited, used for binding cords on tools (Aranui 2006), for sandals and *kawe* (carrying straps) (McAra 2004) and for *tu-maurea* (woman's belt) (Hiroa 1923). In addition, a plait was often used to finish woven objects such as *kete* (bag), *whāriki* (floor-mat) or *kākahu* (cloaks) (Pendergrast 1984; Aranui 2006). Plaited cords were made from a variety of plant species, including *harakeke* (*Phormium tenax*, New Zealand Flax), *tī kōuka* (*Cordyline australis*, cabbage tree), *kiekie* (*Freycinetia banksii*) and *karetu* (*Hierochloe redolens*) (Goulding 1971; McCallum & Carr 2012). Twisted cords were primarily made from processed inner *harakeke* fibres, known as *muka* (or *whitau*) (Best 1986; Pendergrast 2005).

## The Assemblage and Sites

The cordage assemblage presented here is part of a wider collection of textile fragments gathered from dry cave

<sup>1</sup> 649c Esdaile Road, RD8, Tauranga 3180  
Email: lisamckendry88@gmail.com  
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and rockshelter sites in Te Wao Nui a Tiriwa (Waitakere Ranges) Auckland (Figure 1). This mountain range runs north of the Manukau Harbour entrance and up the western coastline of the Auckland Region. The textiles are from six separate locations;

Anawhata Q11/178, Piha: Lion Rock Q11/213 and Takatu Point Q11/223, Karekare Q11/238, Whatipu Q11/41, Q11/6 and Paratutae Island Q11/294, 295 and 296 (see Figure 1). The site settings include sheltered cliffs alongside a river valley, exposed coastal sites on the rugged Western coastline, and two islands with pā sites. Many are only accessible by rope, and most are of a small size not suitable for long term permanent occupation (Lawrence 1989). This area was actively used by Māori over a long period, with the initial occupation peaceful, consisting of a small population living primarily on the coastline and along river valleys, enjoying the abundant terrestrial and marine resources (Taua 2009). During times of war in the 16th-18th centuries the caves and rockshelters were used as refuges and after Nga Puhī raids in the 1800s decimated the population, a few dispersed groups remained to maintain a presence on the land (Taua 2009).

The textiles were fossicked in the early 1900s by F. Mappin and A. Pycroft, G. Fairfield and J. Donald, W.E. Browne and E. Willis and deposited in various lots at the Auckland Museum between 1920 and 1950. In addition to cordage the complete textile assemblage is made up of fishing nets and lines, baskets, cloak fragments, belts, mats, discard fibres and human hair remains. These are outside the scope of this paper and will be discussed in a future article. Here analysis focusses on the forty specimens of cordage represented in the collection.

### Textile Analysis

The rarity of archaeological cordage finds and the small number of remains has resulted in only a few research papers on Polynesian cordage. These are primarily technical descriptions of cordage collections from locations in New Zealand such as: Lee Island (Anderson, Goulding & White 1991); Kohika (McAra 2004; Aranui 2006), Takaka (Davidson & Leach 2006); Puketoi Station, Southland and Kaitorete Spit (Smith 2014); and in wider Polynesia: Hawai'i (Summers 1990); and Rapa (Cameron 2012). A wide range

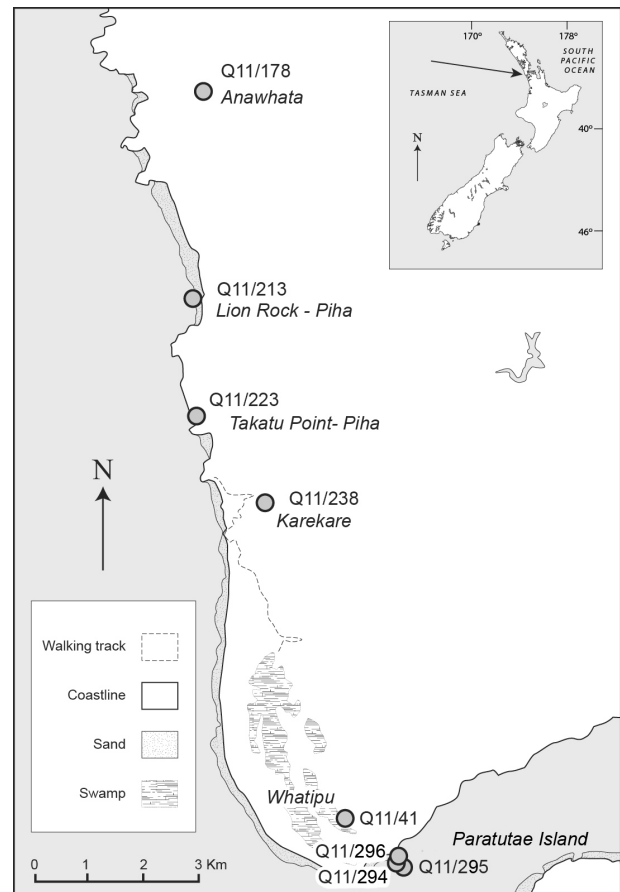


Figure 1. Map of Te Wao Nui A Tiriwa: Anawhata Q11/178, Piha: Lion Rock Q11/213 and Takatu Point Q11/223, Karekare Q11/238, Whatipu Q11/41, Q11/6 and Paratutae Island Q11/294, 295 and 296. Map by Briar Sefton.

of terminology is used in these reports which can hinder comparative research (Table 1).

The structure of a textile is the key component in textile classifications because it is an objective attribute that exists in nearly all archaeological textiles, whether fragmentary or complete (Emery 1966; Connor 1983; Wendrich 1991; Smith & Laing 2011). The single elements making up a cord are strands and the form of the strands can vary from shredded leaf strips, leaf strips or *muka* (see

Table 1. Terminology used in this paper, comparable terms and definitions.

<i>Miro</i> / Twisted	Hand-rolled, Plied	Twisting, spinning or hand-rolling a minimum of two strands (Emery 1966).
<i>Whiri</i> / Plaited	Braided	Interlacing of at least three individual strands (Emery 1966).
Stripped		Leaf split into two or more strips.
Shredded		Leaf separated into thin strips, retaining most of the epidermis (Summers 1990).
Retted		Leaf strips soaked in water before scraping off the epidermis to release the inner fibres (Summers 1990).
<i>Muka</i>	<i>Whitau</i>	Inner harakeke fibre aggregates (Carr <i>et al.</i> 2008).

Table 1). There are two cordage structures represented in the currently considered collection, *miro* and *whiri*, and these have distinct structures and qualities. *Miro* cordage is made by twisting or hand-rolling fibres (Figure 2), and *whiri* cords are made from interlacing at least three individual strands (Figure 3) (Emery 1966). The structural variables are the dimensions, the number and form of the single strands, the twist direction and tightness (Table 2). The term ply is used to notate the number of strands and the final twist direction is recorded as an ‘S’ or ‘Z’ twist (Summers 1990; Cameron 2012), or ‘I’ twist (Wendrich 1991) (see Figure 2). The twist tightness is the number of twists in a certain length, usually 100 mm. The other category, plaited cords, share many of the above variables.

**RESULTS**

The plant materials represented in the assemblage have been previously identified by Goulding (1971). Goulding undertook a meticulous and comprehensive investigation of the raw materials in the Waitakere Ranges archaeological textiles and left a resource that makes an important contribution to understanding and analysing this assemblage. Scientific fibre identification techniques have since improved with the use of DNA, micro-computed tomography, SEM and polarized light microscopy (Smith, Pater-

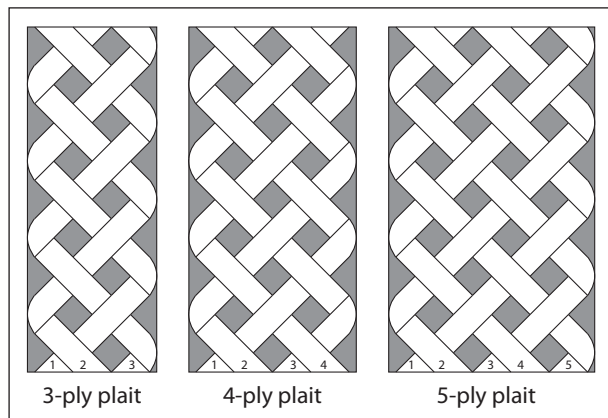


Figure 3. Three-ply, four-ply and five-ply plaits.

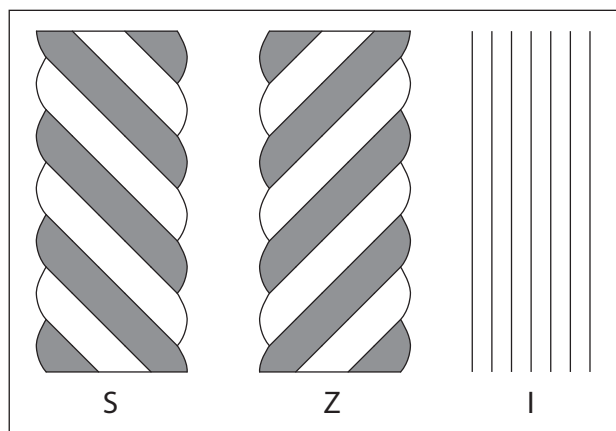


Figure 2. Twist direction S, Z, I.

son and Lowe 2016). However, due to lack of specialised resources they were not applied in this instance.

All forty artefacts were fragmented, except for the fishing line and human hair cord. The 19 *miro* structures were made from one plant species, *harakeke*. In contrast, within the 21 *whiri* structures, nine were made from *harakeke*, six from *tī kōuka*, five from *kiekie* and one from *makawe* (human hair). In addition, the *whiri* strand forms were diverse. The *harakeke* cords had a width range of 5–40 mm, with a mean of 15.9 mm and strands made of leaf strips, shredded leaf, and *muka*. The *tī kōuka* fragments had leaf strips and shredded strands with a width range of 12–25 mm and mean of 12.6 mm, and the *kiekie* strands were leaf strips, roots or unidentifiable, with a width range of 10–18 mm and mean of 17 mm.

**Miro Cordage**

The plying together of fibres provides cohesion, flexibility and length (Cameron 2012). The nineteen separate *miro* structures are connected to six catalogue numbers (Table 3). Apart from two complete fishing lines and an anchor rope, they are short lengths of a standard width and constructed in S and Z-twist directions with variable tightness (loose <10 degrees, medium 10–25 degrees, tight

Table 2. The structural variables of material, dimensions, the number and form of the single strands, the twist direction and tightness.

Structural Variable	Miro / Twisted	Whiri / Plaited
Dimensions	Length and width mm	Length and width mm
Material	Species	Species
Number of single strands	Two or more - ply	Three or more - ply
Form of single strands	Shredded, leaf strips or muka	Shredded, leaf strips or muka
Twist direction	Z, S, I	
Tightness	Number of twists/100 mm	Number of crossings/100 mm

Table 3. Miro ‘Twisted’ Cordage Structures: AM# (Auckland Museum number), CA# (Cave Assemblage Structure number), Material species, Dimensions, Number of Strands, Width of Single Strands, Final Twist Direction, Rank of Angle of Twist (L-loose, M-medium, T-tight) and Beads.

Miro Structures										
AM#	CA#	Material Species	Length (mm)	Width (mm)	No. of Strands	Width Single Strand (mm)	Final Twist	Rank of Angle of Twist	Bead	Notation
17107.3	PM200	European	860	6.0	2	4.0	Z	L		two-ply Z-twist
17107.3	PM253	Harakeke	400	2.0	2	1.5	Z	L		two-ply Z-twist
18072	KM207	Harakeke	114	1.0	2	1.0	S	M		two-ply S-twist
18072	KM212	Harakeke	130	5.0	2	2.0	S	M		two-ply S-twist
18072	KM209	Harakeke	68	3.0	6	2.0	Z	T	X	three-ply Z-twist (3xtwo-ply S-twist)
18072	KM210	Harakeke	94	3.0	6	2.0	Z	M	X	three-ply Z-twist (3xtwo-ply S-twist)
18072	KM211	Harakeke	56	5.0	6	3.0	Z	T	X	three-ply Z-twist (3xtwo-ply S-twist)
18072	KM215	Harakeke	1000	2.0	6	1.0	Z	T	X	three-ply Z-twist (3xtwo-ply S-twist)
18072	KM215a	Harakeke	1000	1.5	2	0.5	Z	M	X	three-ply Z-twist (3xtwo-ply S-twist)
31727	KM216	Harakeke	115	1.0	2	0.5	Z	T		two-ply Z-twist
31727	KM217	Harakeke	1000	2.0	6	1.4	Z	T	X	three-ply Z-twist (3xtwo-ply S-twist)
31727	KM217a	Harakeke	1000	1.5	6	0.5	Z	M	X	three-ply Z-twist (3xtwo-ply S-twist)
33011.4	KM206	Harakeke	335	36.0	2	36.0	Z	T		two-ply Z-twist
42138	WUM201	Harakeke	100	3.0	2	2.0	S	L		two-ply S-twist
42138	WUM202	Harakeke	525	3.0	2	2.0	Z	L		two-ply Z-twist
42138	WUM203	Harakeke	760	2.0	2	1.0	Z	M		two-ply Z-twist
42138	WUM204	Harakeke	160	2.0	2	1.0	Z	M		two-ply Z-twist
42138	WUM205	Harakeke	800	2.0	2	1.0	Z	M		two-ply Z-twist
46374	PM246	Harakeke	305	15.0	2	8.0	Z	L		two-ply Z-twist

>25 degrees: Emery 1966:11). The S-twist fragments are in the form of one-ply and two-ply with medium and loose twists. The sixteen cords with a Z-twist are two-ply and three-ply with loose, medium and tight tensions. The *miro* cord widths range from 0.5 mm to 36 mm, however, 90% are 6 mm or less. Two cords are made with shredded fibres and the remaining are from *muka*.

The complete or nearly complete *miro* artefacts include a leader and snood (AM#17107.3), an anchor rope (AM#33011.4) (Figure 4) and fishing lines (AM#18072 (Figure 5) and AM#31727). The leader is a tight two-ply Z-twist European rope with burnt ends and the snood is made with a repeated half-hitch from a loose two-ply Z-twist *muka* cord of 2 mm width. The anchor rope is a dense, large (36 mm wide) and tight two-ply Z-twist with a detached loop that appears to have been torn from the rope.

The two complete fishing lines are manufactured in a tight three-ply Z-twist from 3 x two-ply S-twist *muka* cords. This structure was identified based on the presence of beads (Hurley 1979). Both lines begin at approximately 1.5 mm wide before gradually widening to a 2.5–2.8 mm wide line. The length cannot be determined due to the way the line is bundled. In addition, AM#18072 has short lengths of two-ply Z-twist, three-ply Z-twist (3 x two-ply S-twist) and two-ply S-twist *muka* cords and two bound

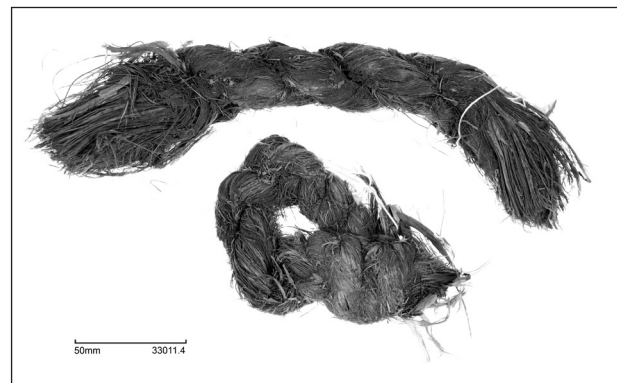


Figure 4: AM#33011.4 Anchor Rope from Karekare. Photograph by Tim Mackrell.

cord fragments associated with it. The line AM#31727 has a fish hook shank associated with it (but without provenience). This has a fine uneven medium two-ply Z-twist line and an even finer loose two-ply Z-twist cord, both from *muka*, to bind the shank to the line.

The cords within AM#42138 consist of various two-ply S and Z-twist *muka* fragments with widths of 1–2 mm. They are unevenly twisted in both medium and loose ten-

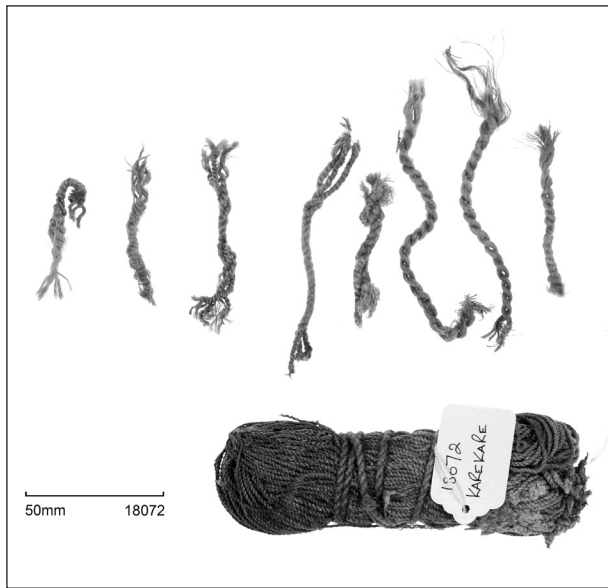


Figure 5: AM#18072 Complete fishing line (three-ply Z-twist (3 x two-ply S-twist) from Karekare. Photograph by Tim Mackrell.

sion. The browning at the tips suggest they were burnt, and they may be from a single cord. The final two-ply Z-twist fragment (AM#46374) is unusual as it has shredded *harakeke* strands and is 15 mm wide.

### Whiri Cordage

Leaf strips and fibres are plaited to produce lengths of cordage for binding or lashing purposes (Cameron 2012). The twenty-one *whiri* fragments are three-ply plaits of varying lengths, widths and levels of tightness (Table 4). The strand forms and materials used are diverse; *harakeke*, *tī kōuka kiekie* and *makawe*. The plait with the smallest width of 1 mm, AM#31729, is a rare cord made of *makawe* and stained with *kōkōwai* (red ochre) mixed with resin or oil. It is tightly plaited with each strand consisting of four strands of hair, and is a long length coiled similar to modern hand-fishing lines. The other narrow fragment, AM#47620, is loosely plaited and 5 mm wide. It is distinctive as the single strands are each made from one *harakeke* leaf that has been folded in half lengthways.

The majority of cord fragments have a width ranging between 8–15 mm and are medium to tightly plaited using shredded leaves. The two long fragments, AM#19775.2 and AM#17107.1, are made from *harakeke* and broken

Table 4. Whiri ‘Plaited’ Cord Structures: AM# (Auckland Museum number), CA# (Cave Assemblage Structure number), Material species, Dimensions, Number of Strands, Width of Single Strands, Strand Form and Rank of Crossing number/100 mm (L-loose, M-medium, T-tight).

Whiri Structure								
AM#	CA#	Material Species	Length (mm)	Width (mm)	No. of Strands	Width Single Strand (mm)	Strand Form	Crossing Rank
17107.1	PW302	Harakeke	2147	8	3	2.00	Shredded	M
17114	PW309	Tī kōuka	170	15	3	7.00	Shredded	M
17114	PW310	Kiekie	55	18	3	7.00	Leaf Strip	n/a
17114	PW312	Tī kōuka	160	12	3	6.00	Shredded	M
17114	PW313	Tī kōuka	110	17	3	6.00	Shredded	M
19775.2	PHW334	Harakeke	1490	15	3	6.00	Leaf Strip	M
23887.1	AW328	Kiekie	240	10	3	4.00	Unprepared	L
23887.1	AW329	Kiekie	330	10	3	4.00	Unprepared	L
23887.1	AW330	Kiekie	285	10	3	4.00	Unprepared	L
31729	HKW350	Human hair	500	1	3	0.25	Unprepared	T
33011.5.3	KW322	Tī kōuka	155	13	3	8.00	Leaf Strip	T
42138	WUW308	Harakeke	170	8	3	3.00	Shredded	M
47619.1	WUW317	Harakeke	660	18	3	13.00	Shredded	L
47619.2	WUW306	Harakeke	240	30	3	6.00	Shredded	L
47620	WUW307	Harakeke	120	5	3	18.00	Leaf Strip	n/a
47625	WUW305	Kiekie	140	15	3	7.00	Unidentifiable	M
47626	WUW304	Tī kōuka	170	20	3	11.00	Leaf Strip	L
47630	WUW314	Tī kōuka	960	25	3	0.50	Unknown	M
49213	PW301	Harakeke	260	10	3	2.00	Leaf Strip	L
49215	PW300	Harakeke	250	10	3	5.00	Leaf Strip	L
2012.x.219	WUW316	Harakeke	330	40	3	20.00	Shredded	L

into three and four pieces (Figures 6 & 7). They differ in that AM#19775.2 is nearly double the width of AM#17107.1 (15 mm and 8 mm), and are plaited using different techniques. AM#19775.2 is the typical flat three-ply plait, however, in AM#17107.1 each strand is twisted before being replaited, creating an irregular texture. A further three short, tightly plaited fragments, made with shredded strands are from *harakeke*, *tī kōuka* and *kiekie*. The three semi-circular fragments of plaited *kiekie* root, AM#23887.1, have a loose tension, the same cord and strand width, indicating they may be from the one object. The tips of all three are stained black from probable burning.

The cord fragments wider than 11 mm have a medium tension, regardless of the strand form and material species. The plaited cords in AM#17114 have a range of widths from 12–18 mm, three are made from shredded *tī kōuka* fibres and one (PW310) is made up of wide *kiekie* leaf strips. Cord AM#33011.8 consists of two plaits in a Y-shape (McAra 2004: 153), where two plaits are joined, or separated. The larger plait has been laid on top of the smaller three-ply plait and both are made from *tī kōuka*. The wider fragments, AM#19775.2 and AM#47625 (15 mm), AM#47619.1 (18 mm), AM#47626 (20 mm), AM#47619.2/WUW306 (30 mm) and AM#2012.X.219 (40 mm) are plaited with a medium tension from shredded *harakeke* fibres.

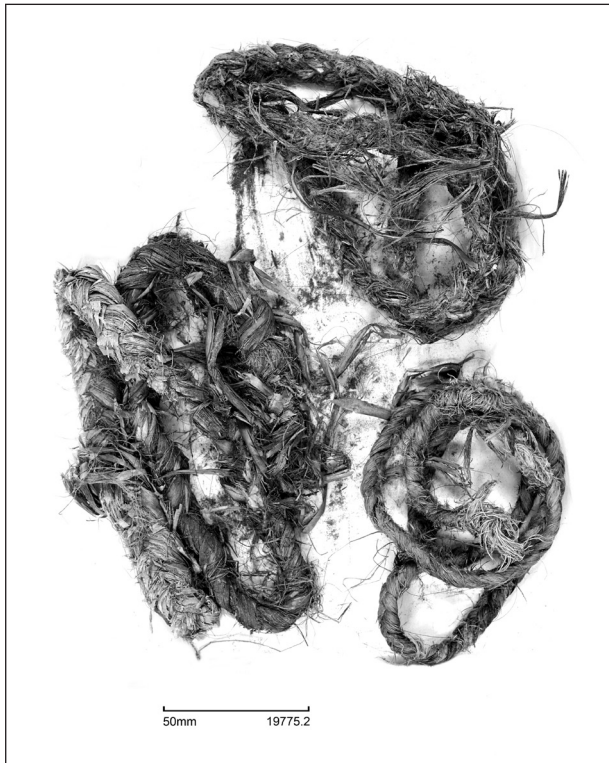


Figure 6: AM#19775.2 Three-ply plait, flat, from Piha: Takatua Point. Photograph by Tim Mackrell.

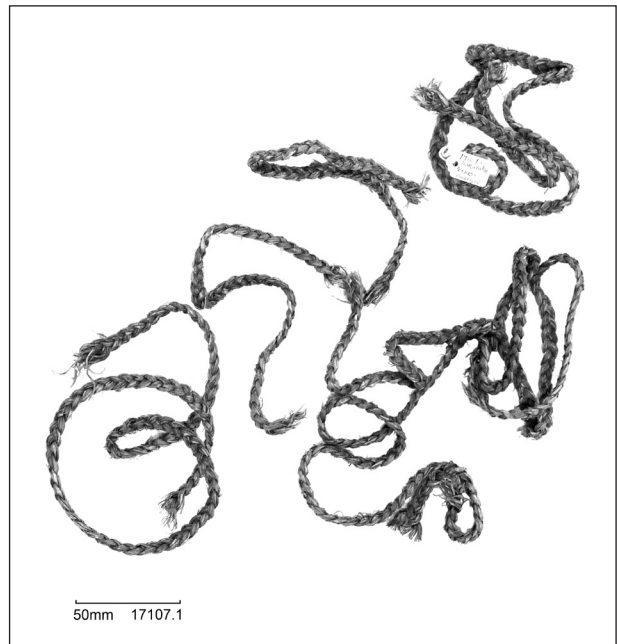


Figure 7: AM#17107.1 Three-ply plait, irregular, from Paratutae Island. Photograph by Tim Mackrell.

## DISCUSSION

### Materials

Cordage, in a variety of sizes and forms, was vital for pre-European Māori survival but is rarely found in archaeological contexts due to its organic nature (Anderson *et al.* 1991; McAra 2004; Smith 2014). The rare cordage assemblage described here confirms Māori used a range of available raw materials for plaited cords, including *harakeke*, *tī kōuka*, *kiekie*, and *makawe*. The leaves used for the plaits appear, in the main, to be prepared but unprocessed, and used either as leaf strips or shredded fibre. As expected, *harakeke* dominates this group of cords, and it was the sole material used in the twisted category. In addition, the *harakeke* leaves were further processed into *muka*, reflecting both the unique material qualities of this plant, and an abundance and ease of access to the raw material. The versatility of the two-ply twist and of *harakeke* is demonstrated by a binding cord and a rope. The narrow *muka* cord binds the fish hook shank to a piece of European rope, AM#31727. This demonstrates continuity in technology and practice post-contact. In contrast, the large anchor rope, AM#33011.4, is made from tightly twisted shredded *harakeke* (see Figure 4). The process of shredding leaves splits the blade but retains the epidermis. This is the most waterproof part of the leaf (McAra 2004) so may have ensured the anchor rope was more water resistant. The collection of *miro* artefacts illustrates the importance of twisted cordage for fishing related activities.

### Miro Cords

The complete fishing lines are valuable examples of cords considered to be “far superior in quality to those of Europeans at first contact” (Paulin 2007:14). The two fishing lines are tightly and evenly twisted, indicating mastery of the material and technique. As the fishing lines are manufactured from three two-ply S-twist cords, the presence of short two-ply S-twist fragments with the fishing line, AM#18072, could indicate strands being prepared, or unravelled, from a three-ply Z-twist line (see Figure 5). The remaining cord fragments of Z-twist and bound cords may be from a stone sinker recorded by Fairfield in 1933, along with a fishing line from Karekare. The cord fragments have similar dimensions as those illustrated by Fairfield (1933:146, fig.2) and represent the finest quality of workmanship. However, this is not evident in all the twisted cords examined.

The roughly made two-ply Z-twist line attached to the fish hook shank in AM#31727 contrasts with the evenness and tightness of the fishing lines. This pattern is reflected in the fragments from AM#42138 and the snood cord from AM#17107.3 which are also uneven and loosely twisted. This shows inexperience or lack of skill in the *miro* technique (Best 1924), but may reflect the post-contact environment and decline of fibre-working knowledge. The relationships between these lines was lost when harvested by fossickers, and deposited in various groups over many years. In addition, this is a small collection, which limits the scope of interpretation. The rough cords could reflect a disruption in the transfer of knowledge and different passages of time, expediency or may simply be the work of a beginner. The twisted cords appear to be primarily for fishing related activities, however, it is more difficult to determine the specific uses of the plaited cords.

### Whiri Cords

The variability in plait widths and raw materials indicates diverse functions. The cord fragments could represent many different original forms; binding for composite tools, lashing for house and boat structures, carrying loads, nets, basket handles or general everyday use cords. The most common plait, the three-ply plait, was present with two distinct structural variations, which inform about the possible use of the cords. In a typical flat three-ply plait, each strand is folded over another, resulting in the upper and lower sides of the leaf alternating along the plait, and a flat surface. In contrast, as in AM#17107.1, when each strand is twisted before being replaced in the plait, the same side of the strip faces upwards (see Figure 7). This is identifiable in *harakeke* leaf strips as the upper and lower surfaces differ in colour and textural qualities, which remain even when deteriorated (Goulding 1971). In addition, the twisted edge of the leaf strip creates an irregular texture along the outer edges of the plait. This is not suitable for lashing and may

have been a decorative handle for a basket.

The twist tightness of cords is rarely reported, yet the tightness of a plait impacts on its flexibility and therefore functionality (Cameron 2012). A pattern emerged from measuring the crossings/100 mm, or the twist tightness of the plaited cords. The wider the plait, the less tight the crossings. This is likely to be determined by the nature and size of the individual strands. The importance of considering the diameter of twisted cords when analysing twist tightness is well-reported (Emery 1966; Hurley 1979; Wendrich 1991). This appears to apply to plaits also, as a wider plait is usually made from wide, and thick strands. Therefore, less folds are required per length. This effect was also noted by Smith (2014) in plaited cords from the Southland Museum and Art Gallery. A comparison among the tension of three plaits, illustrates this effect and the influence of the raw material.

### Case Study

The plait AM#23887, with the lowest number of crossings per 100 mm, is made from *kiekie* root, and the semi-rigidity and roundness of the roots prevents the strands lying next to each other, resulting in the appearance of a loose plait. However, given the nature of the material they are plaited as tightly as is possible. The widest plait, AM#2012.X.219, made from shredded *harakeke*, appears to be plaited tightly, however the crossing tension is loose, reflecting the density of the strands. The narrowest cord, AM#31729, has a very tight tension, over 18 crossings per 10 mm. This reflects the thinness of the strands, and the raw material, human hair. The end uses of these three cords are also likely to differ.

There is little ethnographic information concerning the use of *kiekie* root for baskets or nets in Aotearoa. The *kiekie* plaits have a slight curve, indicating they may part of a larger circular structure. Puketapu-Hetet (1999) describes their use for making eel baskets but does not mention whether they were plaited or twined. As most rigid nets were twined, some with vine structures (Hiroa 1923), these plaits could be part of the inner structure of a net or bird snare. The wide plait could be the tie cord of a *kōheke* (a cylindrical bag to extract juice from tutu berries), *tātua* (man's belt) or *kawe* (burden carrier).

In contrast to these two textiles, early ethnographic accounts describe human hair as sacred and often incorporated into a range of ritualistic acts, though specific practices varied widely (Taylor 1855; Tregear 1904; Best 1977). Human hair is very difficult to plait due to its fineness, and the evenness of this plait demonstrates extreme competency in cord manufacturing. Previously, Lawrence (1989) has argued that this human hair cord is a fishing line, possibly because of how it is coiled. However, both the Takatu Point, Piha and Waimamaku collections contain a three-plait human hair cord that has been used to bind a separate bundle of human hair (Turbott 1947). Hu-

man hair cords were used for fishing lines in Hawaii, but in Tahiti they were for decorative and ritualistic purposes (Turbott 1947), and in the Tuamotus they were used as necklace cords (Emory 1975). This suggests human hair cords could be manufactured for very different purposes and further research on the use of *makawe* is required. In the main, the types of *whiri* and *miro* cords in the Te Wao Nui a Tiriwa collection are represented in other archaeological cordage assemblages in Aotearoa.

### Archaeological Comparisons

The fishing lines investigated here are comparable with a fish hook collection held at Tāmaki Paenga Hira, known as the ‘Karekare Kit’. This exceptional assemblage, fossicked from a rock-ledge at Karekare, contains one-piece (wood and bone) and composite fish hooks, many with intact snood binding and leaders. Fairfield (1933) describes and illustrates the lashing and binding from the Karekare Kit as two-ply *muka* cords, and some of the leaders as three-ply with each cord tapering in width from 1.5–2.5 mm. In addition, the use of twisted *muka* cords for fish hook binding is as expected from ethnographic reports (Best 1986). However, the archaeological record reveals the use of diverse materials and strand forms for the binding of fish hooks.

A fish hook cache from Pohara, Takaka has cordage that is “almost all of rectangular sectioned pieces of uncutched strips of plant” (Davidson and Leach 2006:187). The fibre was unable to be definitively identified, however, it may be *nikau* (*Rhopalostylis sapida*) (Dr. Rod Wallace, pers. comm 2016). This cache consists of one piece hooks only, which could be considered examples of Archaic fish hooks. Yet, the archaeological record reveals a range of hook forms continuing over time, with evidence of customised design (Leach 2006:114). Therefore, the use of fibre strips rather than *muka* may illustrate an early form of binding, be the preference of the maker and user of the hooks, or the availability of material. In addition, the Pitt Rivers Museum has recently identified *kiekie* as the binding material on one fish hook collected by Captain Cook (Cartwright 2013). This demonstrates Māori used a range of materials and structures for binding and lashing cordage.

As with the Te Wao Nui A Tiriwa *miro* cordage collection, the archaeological record reveals two-ply twisted cords made of shredded fibres. In contrast to the sole use of *harakeke* across all the locations, evidence from South Island sites in Aotearoa demonstrate the use of diverse raw materials for *miro* cords. The three twisted cords from the Southland Museum and Art Gallery are made from thin strips of plant material, both leaf strip and fibre aggregates, possibly *tī kōuka* (Smith 2014). The twisted cords from Lee Island were made from shredded *harakeke*, *tī kōuka* and *kiekie* (Anderson *et al.* 1991). Acknowledging the small sample size, this may reflect the varying access and availa-

bility of raw materials or the different functions for twisted cords at South Island sites compared to the North Island. For example, the complete fishing lines and anchor rope from Karekare may reflect its abundant marine resources, and coastline suitable for line fishing. In the main, twisted cords are rare finds, as most Māori cordage fragments recovered or excavated are plaited.

This is reflected in the Te Wao Nui a Tiriwa collection as there are more plaited cords than twisted. This is similar to the Auckland War Memorial Museum cordage (Gould 1971), the Kohika cordage (McAra 2004; Aranui 2006) and the Southland Museum and Art Gallery cordage (Smith 2014). However, in contrast to twisted cords, plaited cords are made from numerous raw materials, forms, plait widths and tightness measures, regardless of location. This demonstrates the value of the three-ply plait, the common use of local resources across Aotearoa and perhaps reflects their diversity of purpose. For example, the plaited cord in a Y form (AM#33011.8) was also represented in the Kohika assemblage (Aranui 2006:57) and identified as the rim and handle of a basket. This cord was 12 mm wide, indicating the wider cords may be the remains of basket handles. Additional research on cordage structures that are a component of another textile, and on larger collections is required to aid in the interpretation of fragmented cords.

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