A review of the role of diadromous ikawai (freshwater fish) in the Māori economy and culture of Te Wai Pounamu (South Island), Aotearoa New Zealand

Roger Fyfe and Julia Bradshaw[1]

Canterbury Museum, Rolleston Avenue, Christchurch 8013, New Zealand

[1]Email: jbradshaw@canterburymuseum.com

Canterbury Museum holds two rare examples of kupenga (nets) used to catch diadromous freshwater fish in Te Wai Pounamu (South Island). This paper places the kupenga in context and gives details of the eight species of freshwater fish harvested (five species in the family Galaxiidae (*Galaxias maculatus*, *G. brevipinnis*, *G. fasciatus*, *G. argenteus* and *G. postvectis*), the extinct upokororo (grayling, *Prototroctes oxyrhynchus*) and two types of paraki (smelt, *Retropinna retropinna*, *Stokellia anisodon*)). A review of ethnohistorical accounts highlights the significance of the fishery as a seasonal food source and demonstrates that traditional fishing technology is the source of techniques for modern day whitebaiting.

Keywords: fish preservation, food preparation, food source, freshwater fish, ikawai, īnaka, kōaro, kōkopu, kupenga, mata, nets, paraki, upokororo, whitebait

Introduction

Traditional Māori fishing practices exhibited an extensive knowledge of the most productive times and techniques for catching fish in both marine and freshwater environments. In most New Zealand ethnographic literature, tuna (eels, *Anguilla australis*, *A. dieffenbachii*) have been widely documented as the most important dietary freshwater species exploited. In contrast, the focus of this paper is to review both biological and ethnohistorical information relating to the economic and cultural significance of the seasonal harvest of eight additional species of diadromous native freshwater fish taken from the rivers of Te Wai Pounamu (South Island).

The review will demonstrate the economic importance of fishing strategies that focused on the seasonal harvest of smaller diadromous species, targeting predictable migrations of concentrated shoals of fish to ensure the capture of substantial numbers, far exceeding the requirements for immediate consumption. The intention was to produce a substantial surplus that would be preserved for later consumption (Anderson 1998: 136).

To achieve this outcome, a comprehensive range of fishing equipment was developed. Ethnohistorical records demonstrate that local practices combined selected technology with a variety of freshwater fishing methods in order to ensure the efficient exploitation of widely differing riverine conditions encountered throughout Aotearoa (Best 1929: 170–212).

Many types of traps and nets were utilised, often in conjunction with human-made obstacles or other forms of modification to river channels. While numerous recorded ethnohistorical accounts of Māori freshwater fishing methods have survived, the same cannot be said of examples of the technology used or related archaeological evidence.

Traditional traps and nets constructed using organic materials were not inherently durable and in many cases no complete examples of the nets recorded in the ethnohistorical literature

now exist. The fragile lightweight nets designed to capture the smallest diadromous species were of course susceptible to degradation and no surviving examples can now be located of seine and bag nets recorded as once being in widespread use in Te Wai Pounamu.

However, Canterbury Museum is fortunate to care for two examples (E72.85 and E139.74) of a third variety of lightweight scoop net described in the literature. These nets are particularly significant because they are thought to be the only examples in any public collection worldwide.

This paper reviews a variety of relevant sources including Māori traditional and ethnohistorical accounts pertaining to the harvest of eight diadromous freshwater fish species identified as having been exploited in Te Wai Pounamu. Relevant aspects of the biology of these species is discussed, the technology used during harvest described and a brief outline of the cultural practices involved in the capture and subsequent preservation of the surplus catch for later consumption is presented. The significance of the dietary and economic contribution of eight species is evaluated and both examples of the nets in Canterbury Museum are described in detail.

Overview of natural historical evidence of subject species

Every family of native freshwater fishes in Aotearoa has at least one species that must spend part of their life in the sea. This migratory lifecycle between sea and freshwater is called diadromy, of which there are three main types: anadromy, catadromy and amphidromy. The eight subject species in this paper are either anadromous or amphidromous.

Most of the growth of anadromous fish, such as paraki, takes place at sea. Mature or near mature fish migrate upstream into freshwater to spawn and resulting larvae are later carried downstream to the sea where they live until it is time to breed. Catadromous fish such as tuna enter rivers as juveniles and return to the sea to spawn. Adults of amphidromous fish, such as īnaka/mata, spawn in freshwater with larvae going to sea for a short period of rapid growth before returning to freshwater to grow to adulthood.

A feature of Aotearoa's native freshwater fish fauna is the high proportion (more than 50%) of species that are diadromous. The migration of fish between freshwater and the sea provided an opportunity for Māori to collect vast numbers of them, both as adults when they migrated downstream to spawn and as juveniles when they returned from the sea.

The eight diadromous species seasonally exploited in Te Wai Pounamu include five species in the family Galaxiidae, New Zealand's only species from the family Prototroctidae and two species in the family Retropinnidae (see Table 1). The Māori names used in this paper are those most frequently recorded in published references relating to Te Wai Pounamu.

Shoals of juveniles migrating upstream in springtime were traditionally referred to as īnaka or mata (īnaka is the Ngāi Tahu dialectic pronunciation of īnanga, while mata is the term used most often in Te Tai o Poutini (West Coast)) and were called whitebait by Pākehā. It is now recognised that this migration may comprise up to five distinct species of Galaxias, which were captured in mixed-species shoals. Like modern whitebaiters, traditional Māori did not distinguish between the various species present. This is not surprising as this exercise is still sometimes challenging for biologists (for a comprehensive discussion of this see McDowall 2011: 280–282).

One of the difficulties encountered when analysing ethnohistorical accounts relating to Māori freshwater fishing is establishing exactly to which species any particular Māori name refers. Of the hundreds of names recorded some have widespread use, some are limited to a certain region, some names refer to multiple species and yet others appear to refer to particular life-stages. It is important to note that the usage of any particular Māori name will also reflect elements of indigenous knowledge and

Table 1. Overview of diadromous species discussed.

Scientific Name	Māori Name	Common Name	Diadromy
Galaxias maculatus	īnaka, mata	īnanga/whitebait	amphidromous
Galaxias brevipinnis	kōaro	kōaro	amphidromous
Galaxias fasciatus	kōkopu	banded kōkopu	amphidromous
Galaxias argenteus	kōkopu	giant kōkopu	amphidromous
Galaxias postvectis	kōkopu	shortjaw kōkopu	amphidromous
Prototroctes oxyrhynchus	upokororo	grayling	amphidromous
Retropinna retropinna	paraki, pōrohe, īnaka	common smelt	anadromous (complex and regionally variable)
Stokellia anisodon	paraki, pōrohe, īnaka	Stokell's smelt	anadromous

cultural significance of individual species. For instance, as many as four species of diadromous galaxiids were often collectively grouped under the name kōkopu. In the context of this paper it is really of little consequence that scientists later identified them as four individual biological species; to Māori they were all caught using the same techniques during the same seasonal period and collectively provided an abundant dietary resource to be exploited.

There is also little doubt that Māori would have observed strong similarities in the life-cycles of these species. The kōaro and all three kōkopu species spawn during autumn floods in their inland habitats, although the giant kōkopu tends to make a slight downstream migration first. They spawn in gravels, vegetation or organic debris along the edges of floodwaters, leaving eggs stranded when the flood abates. A second flood is required to inundate and stimulate the eggs to hatch and carry the larvae to sea. Kōkopu and kōaro mature at 2 or 3 years old and can live for a decade or more unlike īnaka/mata, which are an annual species that die after spawning (for further details see McDowall 2000).

The spawning behaviour of īnaka/mata differs only slightly in that they use high tides instead of floods. In autumn īnaka/mata migrate downstream in large shoals to spawn during a very high (king) tide, depositing eggs amongst riparian vegetation. The next king tide, usually a few weeks later, stimulates hatching and the receding water carries the larvae to sea. The larvae of all these galaxiid species spend 3 to 5 months at sea before the juveniles return as whitebait (McDowall 2000: 85). The migratory patterns of īnaka/mata are unique in that it offers fishers two opportunities to exploit migratory shoals, firstly in the spring when juveniles are moving upstream to freshwater habitats and later in the autumn when adults are moving downstream to spawn. An added economic benefit of the autumn harvest was that the fish were larger adults and in optimal breeding condition.

Prototroctes oxyrhynchus (upokororo, Fig. 1) are closely related to retropinnids (smelt) and their life cycle was probably similar to smelt and whitebait. Adults were known to Māori as upokororo and the young as haparu. Now extinct, knowledge of their life cycle relies on traditional accounts and observations made by ichthyologists before their numbers plummeted in the 1870s.

In the 1870s, ichthyologist Frank Clarke found grayling juveniles amongst the shoals of whitebait arriving during spring but noted that they did not appear until later in the season (usually the start of November) along with the fry of paraki and bullies (*Gobiomorphus* spp.). Then all three species formed a large part of the

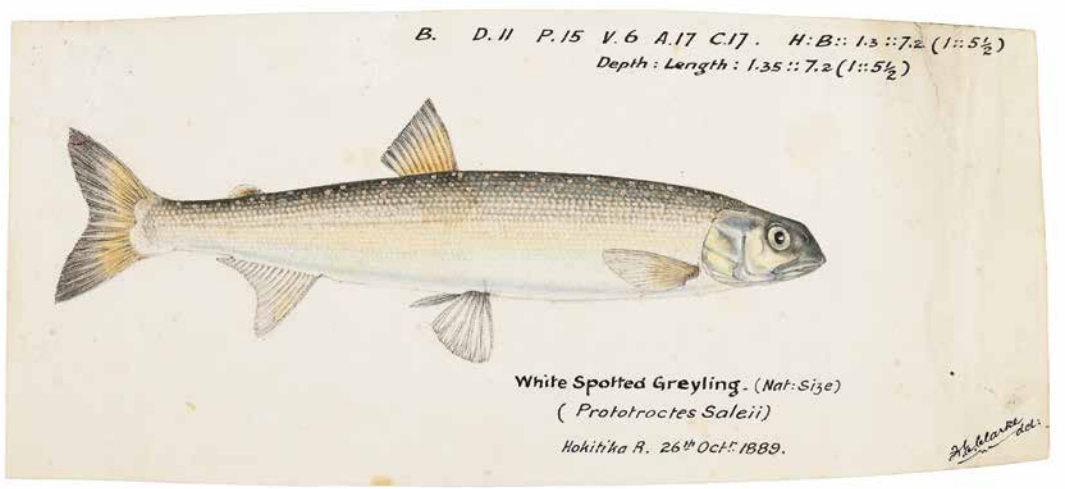

Figure 1. Frank Clarke's drawing of an upokororo/grayling caught in Hokitika River in 1889. Museum of New Zealand Te Papa Tongarewa 1992-0035-2278/1

shoals until the end of the season (Clarke 1898: 78).

Adults were generally between 350 and 560 grams, though some were significantly heavier, and were typically 255 to 300 mm long. Upokororo were noticeable in immense shoals in the mid-reaches of rivers during January and again in autumn when they were presumably migrating downstream to spawn (Phillipps 1923: 115–117).

Both retropinnid species are frequently referred to as paraki and sometimes as silveries or cucumbers. Paraki spend most of their growth phase at sea and migrate into rivers in spring and summer. Common smelt spend several months in fresh water feeding and maturing before spawning in autumn and winter on sandy bars and estuary shorelines. In contrast, Stokell's smelt do not feed in fresh water and only spend a short time there before spawning, mainly on gravels located in the vicinity of freshwater riffles above estuaries. The eggs of both species sink and adhere to the substrate, hatching several weeks later when the larvae are swept to sea. Both species die after spawning. The distribution of Stokell's smelt is limited to the tidal reaches of larger braided rivers on the East Coast between the Waiau and Waitaki rivers. The distribution of common smelt is widespread, usually near the coast, but they can penetrate far upstream when the gradient is low (McDowall 2000: 44–49).

Paraki enter estuaries and river mouths in huge roving shoals to spawn between late spring and autumn. Paraki are listed as a taonga/taoka species in southern Te Wai Pounamu and were a highly valued seasonal food. They were harvested in spring and summer and eaten either fresh or dried and stored for later consumption. Dried paraki are very nutritious and would have been useful to carry when travelling as they are very light and would keep for quite some time if kept dry (McDowall 2011: 254).

Historical and ethnohistorical records of species abundance

The analysis of records relating to species abundance again raises the issue encountered in establishing a clear correspondence between Māori names, names used by Europeans and specific species recognised by biologists. However, it is possible to make some broad observations based on information derived from the ethnohistorical records.

Ethnohistorical accounts confirm that Māori communities harvested īnaka/mata during both migration phases and that capture during the adult downstream spawning movement in

autumn was a seasonal activity of considerable dietary significance due to the plumpness of the adults, perhaps more so than the spring migration of juveniles. For example, in the Kawatiri (Buller) River weirs and eel baskets were used to catch fully grown īnaka/mata returning to the sea (Mitchell 1948: 45). Today capture is legally restricted to spring migration.

It is difficult to quantify how abundant the spring migration of īnaka/mata was prior to early European catch records, but it seems logical to accept that at least reasonably similar quantities would be available for harvest during the pre-European period. Māori remembered shoals of īnaka/mata in the Kawatiri River that "covered the face of the water" for miles and, as late as 1890 in the same river, "shoals several hundred feet long and varying from three to six feet in width were not uncommon sights" (Mitchell 1948: 45).

The largest historic harvests recorded are from South Westland. In 1930, a staggering 2.75 tonnes was recorded as being harvested by one person in a single day, while records of another catch by a single fisher over a period of little more than a decade (late 1940s to early 1960s) amounted cumulatively to 104 tonnes (McDowall 2011: 284–285). From the small Awarua River, which runs into Te Hokiauau (Big Bay), an average of 900 kg per week was caught during the 1950s with the best single day yielding 590 kg (Simpson 1959: 15).

While lacking in any quantitative estimates of volume, the earliest ethnohistorical accounts of harvesting īnaka/mata from Te Tai o Poutini (West Coast) clearly indicate the traditional dietary significance of the seasonal īnaka/mata harvest (Brunner 1850: 359; Heaphy 1862: 167). The ongoing significance of the practice is reinforced by later twentieth-century observers who confirm the cultural continuity of the traditional seasonal harvest of īnaka/mata at numerous locations on Te Tai o Poutini (Harper 1921: 780; McCaskill 1954: 138).

Although īnaka/mata are present throughout Te Wai Pounamu it would not be a valid exercise to extrapolate catches quantified for Te Tai o Poutini to other districts such as Waitaha (Canterbury). However, ethnohistorical accounts relating to methods of capture from various districts suggest that large catches were traditionally taken and that the seasonal dietary contribution made by the īnaka/mata harvest was widespread in all coastal areas of Te Wai Pounamu. During the nineteenth century, Ngāi Tahu hapū (subtribe) occupying kāika (villages) along the lower Taieri River left nets set permanently during the spring seasonal migration of īnaka/mata, at which time they provided a staple part of the diet (Wanhalla 2005: 92).

Other species were abundant too. Hector (1902: 314) recorded that upokororo were originally found in clear running streams in all parts of Aotearoa but by the 1880s they had vanished from most rivers. There are several references to rivers swarming with shoals of upokororo during the summer and autumn. "Explorer" Douglas who spent more than 30 years in South Westland commented that grayling "sometimes 20 inches long" (about 500 mm) occurred in "shoals of thousands" (Pascoe 1957: 223). One fisher recorded that he caught 207 in one day on the Nile River in April 1877 (*Westport Times*, 24 April 1877: 2) and two weeks later 552 were caught on the Taramakau River in one haul of a net (*Kumara Times*, 2 May 1877: 2).

Edward Shortland appears to have been the first European to record the capture of paraki in Te Wai Pounamu when he described "a small fish like whitebait caught at the mouth of the Waitaki River" (Shortland 1851: 312). In September 1865, it was recorded that Kaiapoi Māori were fishing for whitebait and "smelts, little fish about six to eight inches long" that were more prized by some than whitebait (*Press*, 9 September 1865: 2). Large catches have been recorded. One account from South Canterbury records that "when the silveries (cucumber smelts) were running up the rivers in the spring of the year, the Maoris would catch huge quantities of them in nets … I have known them to catch drayloads in a day or two, for some of the shoals would

keep running for weeks" (Studholme 1940: 22)

Methods of capturing Ikawai

Various ethnohistorical accounts describe different nets and techniques used in Te Wai Pounamu for catching diadromous freshwater fish (see Table 2).

Capture: īnaka/mata

Teone Taare Tikao told researcher Herries Beattie that, "Whitebait (mata) were caught in a kohao (net) of very close weave known as koko. It was put in the side of a river, and when full, the string around the mouth was pulled, and it was lifted out and emptied into a basket" (Beattie 1939: 137).

Nets such as those previously described as set permanently in the lower Taieri River were probably bag nets, but without associated descriptions of how they were used, these conclusions remain speculative. The use of "bag nets" was observed at Whakatipu Waitai (Martins Bay), Fiordland (Hector 1872: 126). There is no record of dimensions of the bag or method of use, which now only allows the generic description of bag net.

Beattie (1994: 527) was told that in Te Tai o Poutini one method used was to "… place a

Table 2. Summary of nets referred to in the text.

Name*	Description**	Location	Source
Kohao/koko	Bag net, draw string	Waitaha (Canterbury)	Beattie 1939: 137
?	Bag net	Martins Bay	Hector 1872: 126
?	Long bag net	Taieri	Wanhalla 2005: 92
?	Set net	Te Tai o Poutini, Waitaha	Beattie 1994: 527
Kohao/koko	Scoop net with pole	Te Tai o Poutini, Waitaha	Beattie 1994: 527
?	Circular set bag net	Te Tai o Poutini	Beattie 1994: 527
Koko harakeke	Scoop net with pole	Murihiku, unknown, Waimakariri River, Te Tai o Poutini	Beattie 1994: 137, 139, 310. Grey River Argus, 9 December 1913: 7
Kaka	Woven set net, 1.5 metres x 4.5 metres	Te Waihora (Lake Ellesmere)	Beattie 1994: 310
Kaka	Woven funnel, spout	Waitarakao (Wash-dyke)	Beattie 1994: 139
Kaka	Woven seine net	Wairewa (Lake Forysth), Riverton	Beattie 1994: 135
Kaka	Woven seine net, 1.8 metres x 91 metres, 2 metres x 30 metres, 20 metres long	Te Waihora, Waiwera, Southland	Phillipps 1926: 291, Beattie 1920: 59
?	Woven seine net 15 metres x 1.2 metres	Te Tai o Poutini	Brunner 1850: 347
?	Woven seine net	Te Tai o Poutini	Heaphy 1863: 5

*The generic term for a mesh net was koko. The generic term for a handle fitted to a net was kohao.

**All nets were made of a fine mesh of strips of harakeke (flax), *Phormium tenax*.

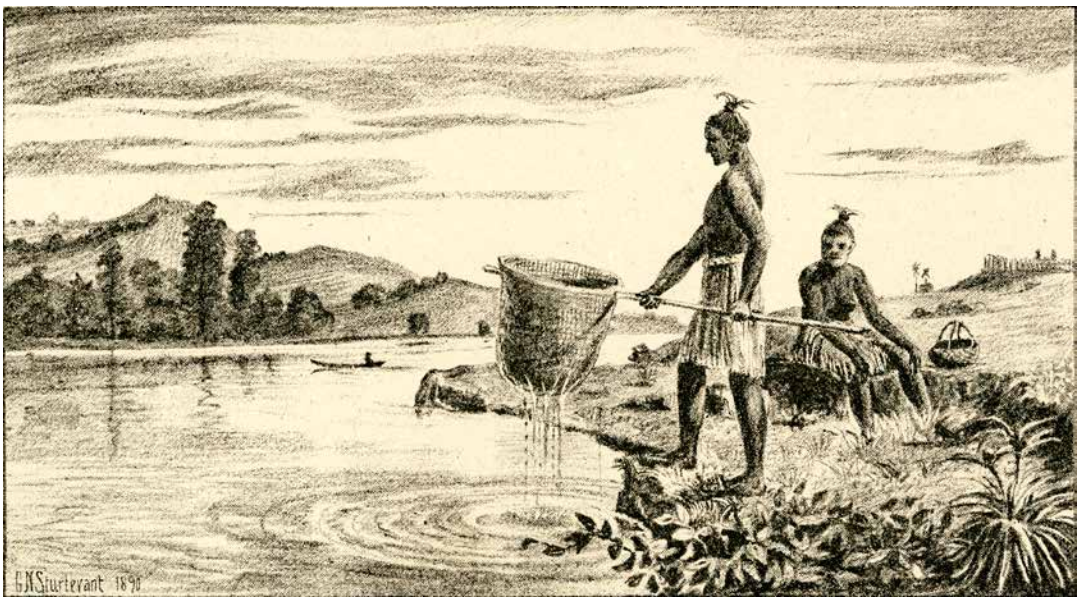

Figure 2. Catching īnaka using a small koko. Reproduced from White 1891

basket facing downstream and in the morning lift it out well laden. The basket was open-mouthed and had no contrivance to hold the mataa [sic] prisoner but they would swim into it and fiddle away inside it for hours." Beattie's informant further noted that, "The stronger the current the more they remained in the basket and he had known them to stick there all night". This account shows that the same kind of net could be used with a handle as a scoop net or as a set net with the handle removed.

Several more detailed accounts of nets and techniques for use were recorded by Beattie. According to one informant, īnaka were caught by "… placing a koko [Fig. 2] or finely woven net or basket on a long stick and kahao the tiny fish out of the rivers and creeks in which they were swarming in apparently endless lines" (Beattie 1994: 527).

A female informant told Beattie that:

> *We used to catch inaka in a basket called a koko-harakeke. It is closely woven … The aho (string) of which it is made is wound round the flax whenu (string running lengthwise) strand after strand … If the mat is made long enough it is doubled and the sides sewn, leaving the top open as a waha (mouth). If it is knit in two parts separately, one of these is placed on the other, the sides are sewn and one end also and there you have your koko-harakeke. If the mouth requires stiffening use pirita (supplejack)* [*Ripogonum scandens*]. *The basket is tied to a pole and it taken to a potirimata (shoal of whitebait) and put in the water you can koko (scoop) the whitebait out easily.* (Beattie 1994: 139).

During the 1860s, Māori were using scoop nets on the Mawhera (Grey) River, which were described as "large oblong baskets made of flax and fitted with a manuka pole" (*Grey River Argus*, 9 December 1913: 7). These descriptions match the two nets at Canterbury Museum described later in this paper.

Scoop nets were further described to Beattie. A Murihiku woman said:

> *The Kahao was to catch fish and the stick which formed its handle was te kakau o te kahao. The mesh was flax … The mouth of the net was kept circular by a rim (called kaututu) of supplejack* [pirita]*, aka or the tororaro vine* (Beattie 1994: 137).

A Ngāi Tūāhuriri man described kaka used in the Waimakariri River to catch īnaka, paraki

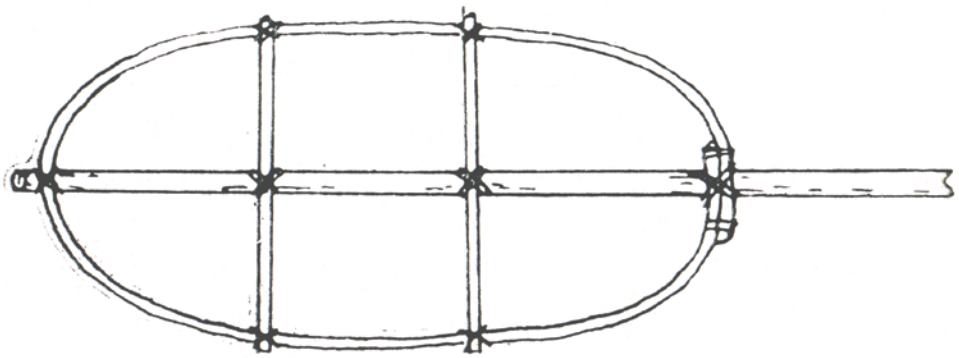

Figure 3. A drawing of an upokororo kupenga (net for catching grayling) that clearly shows the oblong pirita frame to which the net was attached. Reproduced from Hiroa 1926

and other small fish as:

> *made all of flax and lines run down and others across in close formation. For whitebait (mata) a length is doubled and sewn up edges leaving a waha (mouth) using pirita (supplejack) as a stiffener. The whole net is then known as a koko and a pole (forgets name) is attached to lift it handily. In the bottom an opening (kumu) about nine inches long is made and attached to koko is a flax bag (te kotere or te kumu)* (Beattie 1994: 310).

The flax bag made it much easier to empty the īnaka/mata out of the koko. See the following description of E139.74 for another example of this.

Alternative methods of capture are also recorded. One method recorded by Beattie states:

> *About February you will see the minnows (inaka) rushing to the sea, and the Maori caught them with kaka (nets). I have seen the net laid out flat at the lake end nearest the sea and tapered to a spout … Closely knit baskets (kete-putaputa) were placed under this spout, and as each filled with inaka, another was substituted until thirty, forty or fifty baskets were filled as required and then you stopped* (Beattie 1994: 139–140).

Charles Heaphy noted that on the West Coast he saw "quantities of dried inanga or whitebait taken with fine meshed nets of enormous length" (Heaphy 1863: 5). Beattie also records the use of long nets in southern Aotearoa, "mata … was caught with Maori nets (kaka) which were sometimes a chain [about 20 metres] long" (Beattie 1920: 59). It is possible that long nets were designed to function as seine nets used to catch by the dragging method. Beattie recorded that an informant said:

> *To catch inaka use a close net, the kaka, with a pou (pole) at each end. A man holds each pole and drags the net along enclosing the fish. We call this dragging rau. When plenty of inaka are enclosed, pull the kaka ashore and secure the catch* (Beattie 1994: 139).

No examples of long nets are known to exist. A similar system of awa or channels made to catch eels was also used to catch whitebait. The ditches made along a river bank had the mouth facing downstream rather than upstream as in awa-tuna (eel channel). Beattie recorded that, "The tiny fish were caught in a net with a round mouth which was put in the drain, filling it from side to side, and through which water flowed" (Beattie 1994: 139).

Evidence of the use of artificial channels in Te Wai Pounamu was also supplied to Elsdon Best:

> *The first run of these fish commenced in the autumn, and these early ones are called pukoareare. When they entered the streams, the channels dug for the purpose of taking them had already been prepared by the Maori. The water of the stream was allowed flow through these channels even to the time*

> *the inanga migrated. When the fish entered a channel it was blocked with a kaka, a form of fish trap. The place selected for taking the fish was carefully prepared. In the early morn they were arranged when the sun was well up, then the traps were lifted and found to be full of fish* (Best 1929: 177–178).

Beattie records catches of eight or nine tonnes, which suggest traditional catches were potentially larger than modern and recreational catches (Beattie 1994: 314). Beattie also noted that adult īnaka/mata were caught at 36 rivers and streams along the Ngā Pākihi Whakatekateka o Waitaha coastline (Beattie 1945: 63).

There are several records of the capture of īnaka/mata during their mass downstream breeding migration in autumn. An informant told Herries Beattie that:

> *…as the tiny fish rush to the sea the Maori fisher gathers them in with the kaka, a closely woven net (or mat) four or five feet in depth and up to fifteen in length … one and all were full of roe (hua)* (Beattie 1994: 310).

It is probable that this is the same style of net and rau (dragging technique) previously described.

Beattie was also told of the preference for ripe females rather than males, "The males … have a whitish paste and are more bitter to eat than the female with its brownish roe like very wee sago" (Beattie 1994: 316). It seems that any surplus of the juvenile īnaka/mata caught in the spring upstream migration were preserved for later consumption, "If the olden Maoris had plenty of inaka, they would put out the males as these were bitterer and as they shrivelled up flatter when dried" (Beattie 1994: 314).

In the absence of evidence to the contrary it appears likely that the second harvest was captured and preserved using the same methods discussed later in this paper.

Capture: upokororo

As they returned from the sea at a similar time of year as īnaka/mata, (albeit slightly later), the young of upokororo (haparu) were caught in the same way as (and with) īnaka/mata using set or scoop nets in estuaries or the lower reaches of the rivers (Clarke 1898: 78).

Adults were caught using set nets in the middle reaches of rivers where there were shallow rapids. The design of the set net (Fig. 3) used to catch upokororo was similar to that of a scoop net but with short handles on either side of the long end of the hoop, which were used to fix the net in a stationary position (Hiroa 1926: 637).

Positioning of the nets took advantage of the fact that, when startled, upokororo always fled downstream. When a shoal were spotted in a river, set nets would be placed in the next shallow rapids downstream of the shoal (Fig. 4) and the fish deliberately startled into the nets (Beattie 1994: 526–527).

Seine nets were used to catch adults in deeper rivers such as the Kawatiri. In January 1847, Thomas Brunner, in his journal of his journey down the river, noted that Ekehu and his other Māori guides had finished making a net about 50 feet long by four feet (approximately 50 metres by 1.2 metres) which they used to catch 150 upokororo over the next week (Brunner 1850: 347).

Capture: paraki

Paraki were caught in Te Wai Pounamu using a similar range of techniques described for īnaka/mata (sometimes as a mixed species catch). When Hector was at the mouth of the Whakatipu-ka-tuku (Hollyford River) in September 1863 he noted that Māori were catching paraki "as the tide fell by closing weirs made of flax net across the small creeks" while smaller fish were caught with "bag nets" (Hector 1902: 316).

Several references suggest that in lakes or estuaries the use of seine nets appears to have been the method that prevailed. One of Herries Beattie's informants told him of catching "paraki … in Lake Forsyth (Wairewa) with a kaka [seine net] weighted with pohatu (stones) at the bottom" and another informant had seen seine nets used in "the estuary at Riverton [Aparima River] years ago when they secured baskets and

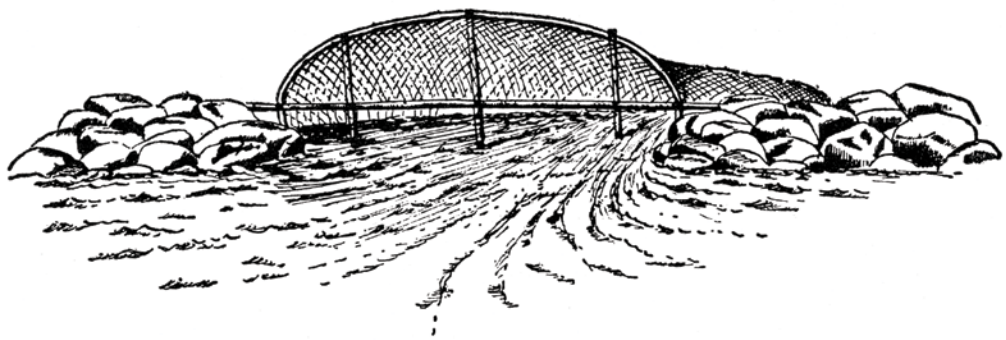

Figure 4. A sketch by B Osborne showing how an upokororo kupenga was used. Reproduced from Best (1929)

baskets" of various fish species including paraki (Beattie 1994: 135).

William Phillipps observed the making and use of seine nets in Wairewa (Lake Forsyth) and Te Waihora (Lake Ellesmere) to catch large quantities of paraki:

> *To make a net, blades of flax were stripped down to a width of approximately 3 mm and plaited with cross-stands, all being kept uniform to prevent weak patches* [Fig. 5]. *The net was 6 ft.* [1.8 metres] *high and 30 to 100 yards* [27–91 metres] *in length and the mesh seldom exceeded 1 ½ mm. Poles held the net upright at the ends, and sinkers were attached below. The net was dragged along parallel to the shore, held by a party on land and another party in a canoe, each moving simultaneously, until a sufficient catch was obtained* (Phillipps 1926: 291).

Phillipps made a sketch of the use of the net for Elsdon Best (Fig. 6) and added the following information:

> *The net was taken to point A in a small bay of the lake. Here the net was placed on board a canoe, one end being left on shore, where it was held upright by one or more natives. The canoe was then taken in a semicircular direction to the point B, the net being payed* [sic] *out as the canoe proceeded. On arrival at B, assuming all the net to have been payed* [sic] *out, the boat was turned to row slowly with the net parallel to the shore in the direction of D, while simultaneously natives at A commenced to drag their end of the net to C* (Best 1929: 177).

Rare archaeological evidence for the use of kaka/seine nets possibly exists. During salvage excavations at Pegasus Town, 25 km north of Christchurch, a group of elongated greywacke pebbles, interpreted as net sinkers, was uncovered adjacent to a former lagoon/estuary dating to about 500 years ago (Witter 2007: 176–185). Based on the pattern of the sinkers the net was interpreted to be about 8 metres long and made of dressed cordage, possibly in a gill net pattern, rather than plaited split flax. The suggested target species was juvenile red cod (*Pseudophycis bachus*). Five alternative methods of use were also suggested: a set net, gill net, wing net, drag net and throw net. The evidence for the use of seine nets in Waiwera and Te Waihora is not cited and it seems reasonable to suggest the strong possibility that the net weights once belonged to a short kaka or seine net used to capture paraki rather than the other options offered by Witter.

Cooking, preservation and storage

Īnaka/mata

Because they are small and boneless, īnaka/mata were always eaten whole. Māori often boiled them and, after the water was drained, the fish were pressed into a solid mass before being eaten and the flavoured water drunk (Tregear 1904: 108). Īnaka/mata were also observed being cooked in umu (underground ovens) (Power 1849: 78). It can be assumed that

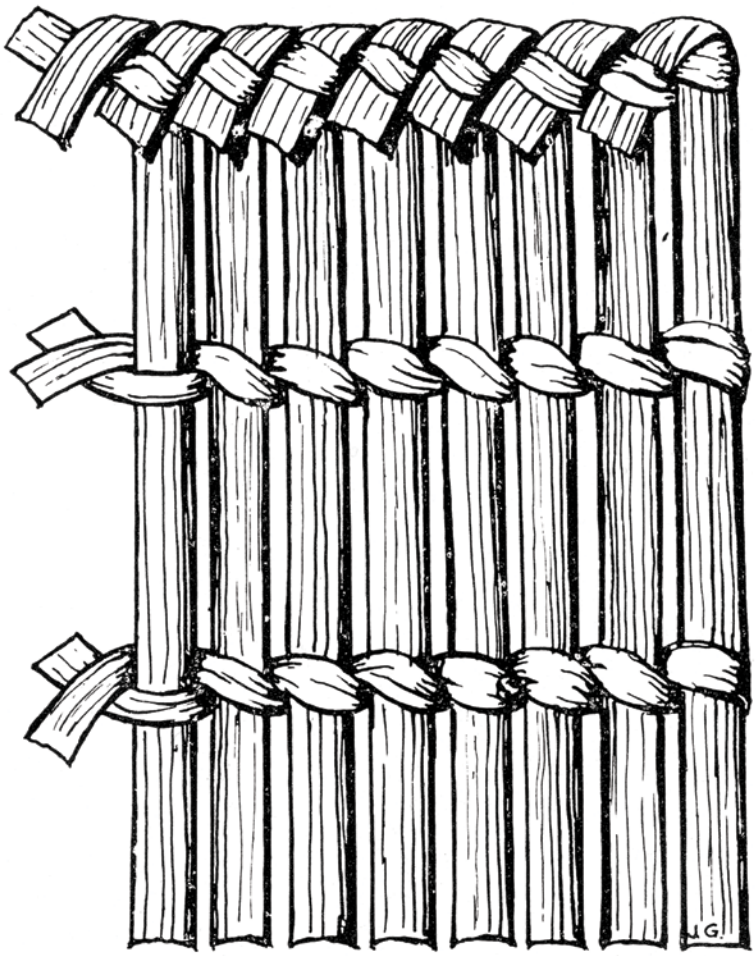

Figure 5. Sketch by B Osborne showing the universal whatu aho patahi (single pair twining) technique used for all kupenga īnaka/mata and described by Phillipps. Reproduced from Best (1929)

cooking in an umu was the traditional method and boiling was adopted once European cooking vessels became available.

Māori communities in many districts were observed preserving surplus catch by sun drying them for later consumption. In Murihiku (Southland), Beattie's informant said "inaka caught at the [Mataura] falls were spread on flax mats and sun-dried. When properly done they would last a long time" (Beattie 1920: 70).

Thomas Brunner observed a similar process in Te Tai o Poutini when he travelled through the district in 1847, "The natives take large numbers, which they lay on flax mats, and expose them to the sun for three of four days; then pack them tightly, and preserve them in their storehouses for winter use" (Brunner 1850: 357), perhaps using the storage method illustrated in Figure 7. On an earlier journey to Te Tai o Poutini, Brunner and Heaphy had left Kararoa village (south of Barrytown) in June with 12 lbs (5.4 kg) of dried whitebait, which must have been preserved the previous season (Heaphy 1846: 2).

Another account of the drying process comes from Ngā Pākihi Whakatekateka o Waitaha (Canterbury Plains):

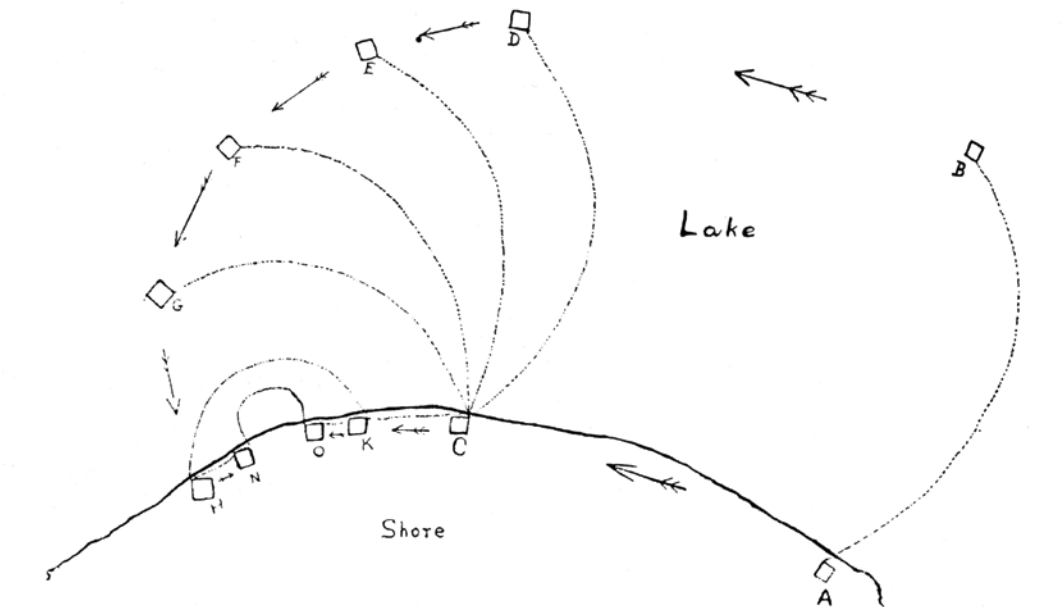

Figure 6. Sketch made by W J Phillipps to illustrate his explanation of how a seine net was used to catch paraki in Wairewa (Lake Forsyth) and Te Waihora (Lake Ellesmere). Reproduced from Best (1929)

> *The people prepared gravel beds (wahi taurakitaka inaka) to dry the inaka in the sun (taraki=drying) and the little fish were spread on these drying grounds, which were commonly known as ka-wa-inaka. Two or three good days will dry them, but you must hurihuri or keep turning them* (Beattie 1994: 140).

Elsdon Best recorded a similar account of preservation provided by a Te Wai Pounamu (South Island) informant who said that the īnaka/mata:

> *…were spread out on papaki or on ordinary mats* [Fig. 8]. *These papaki fabrics were carefully plaited by women to serve as mats on which to spread these fish. They were so exposed for as long as seven days, or even longer, then packed in baskets and stowed on stages … Great numbers were taken in kaka traps, and spread out to dry. Those who did not care to spread their fish out on the papaki flax mats just spread them on the surface of the earth or on tussock-grass; some considered that the fish acquired from the flax mats was an acquired taste* (Best 1929: 178).

It is possible that although Best's informant described the fish being preserved as īnaka/mata they may possibly have been paraki as in some localities the same name was used collectively for both species.

Dried īnaka/mata was eaten during the leaner winter months and was sometimes beaten into mashed aruhe (fern root). The resulting mash was known as kohere-aruhe (Beattie 1920: 67).

Particularly in Te Tai o Poutini (West Coast), which can have long periods of rain during the spring, a comprehensive understanding of weather patterns would have been necessary to ensure that whitebait was caught when a sunny spell was sure to follow, allowing the fish to dry thoroughly before the next spring downpour.

Upokororo

Upokororo were widely regarded as good eating. In January 1866 Te Tai o Poutini Māori were recorded as journeying to an island near the confluence of the Māwheranui and Māwheraiti Rivers (near present day Ikamatua)

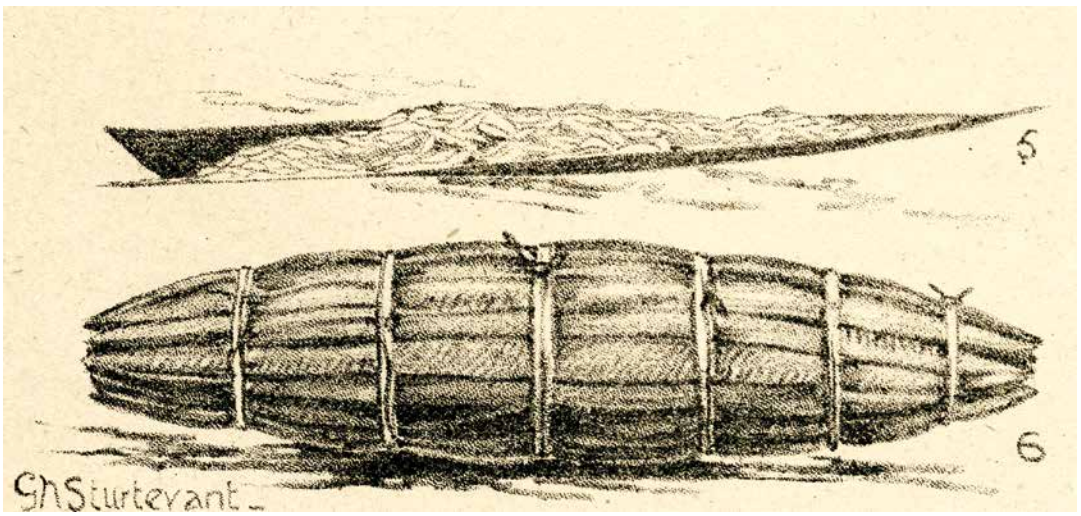

Figure 7. Dried īnaka/mata (top) and poha (kelp bags wrapped in totara bark) used to store dried īnaka. Reproduced from White (1891)

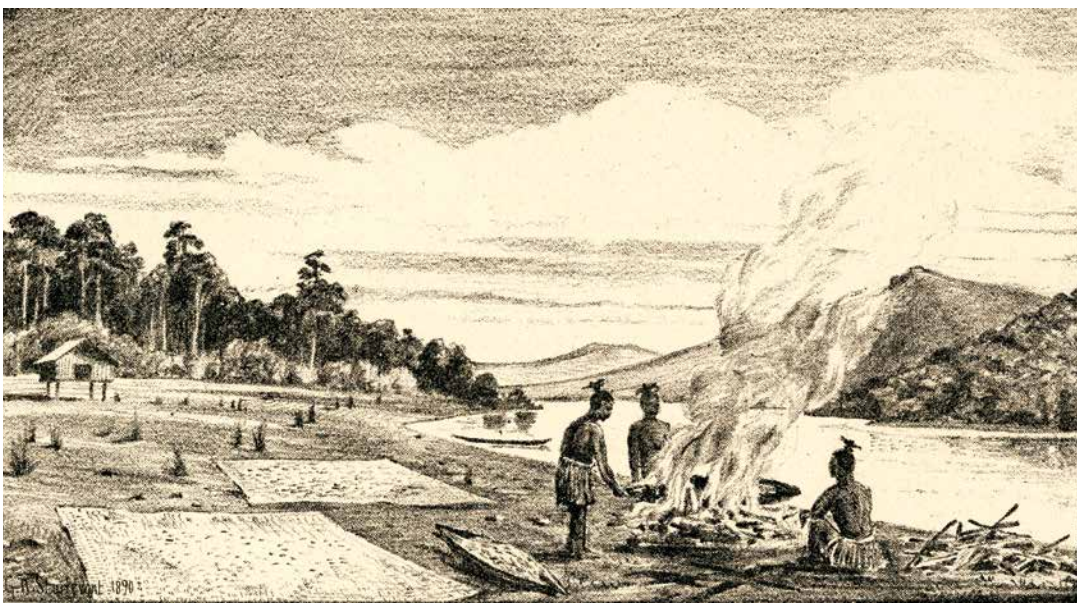

Figure 8. Drying īnaka/mata on harakeke (flax) mats. Reproduced from White (1891)

and spending a week catching and preserving upokororo, a task they undertook at the same time every year (*Nelson Examiner*, 20 January 1866: 3). There is scant information about the cooking and preservation of upokororo but one of Beattie's Nelson informants said that it was cooked in a hangi or on a rara (grid) (Beattie 1994: 501).

Paraki

Paraki were probably cooked, preserved and stored in the same manner as īnaka/mata including being compressed in bundles of leaves or kete (woven bags). They were sun-dried for up to 7 days on specially prepared flax mats, tussock, gravel or rock surfaces for preservation and later consumption (Studholme 1940: 23, McDowall 2011: 259). Occasionally paraki were

Figure 9. The kupenga īnaka/mata attributed to Te Ana o Hineraki (Moa Bone Point Cave), intact but in very fragile condition. Canterbury Museum E72.85

"dried by hanging them in kits so that the air could circulate" (Studholme 1940: 23). Paraki have not been captured for consumption in Te Wai Pounamu since the mid-twentieth century and awareness of their traditional significance as a taonga species is almost forgotten.

Kupenga īnaka/mata at Canterbury Museum

Canterbury Museum has two rare examples of whitebait nets in its collection.

E72.85 Whitebait net

This net is believed to be the one found in Te Ana o Hineraki (Moa Bone Point Cave) at Redcliffs during an excavation directed by Canterbury Museum Director Julius Haast in 1872. In a paper given to the Philosophical Institute in September 1874, Haast's list of items found included "a portion of a net for catching inangas" (Haast 1874: 3).

The net appears to have been displayed by Haast amongst the exhibition of taonga Māori within the carved meeting house Hau Te Ananui o Tangaroa which opened to the public in 1874. The 1895 "Guide to the Collections in the Canterbury Museum" refers to the presence within the displays of "nets for cray-fish and white-bait" (Hutton 1895: 217). In 1933, a newspaper article stated that the Museum housed a "portion of finely woven whitebait netting" which had been found at the Te Ana o Hineraki in 1872. (*Press*, 11 July 1933: 9).

The first catalogue inventory for Canterbury Museum was a card index initiated by then Museum Director Edgar Ravenswood Waite in 1907 (Burrage 2002: 97). All taonga in the "Maori House" were allocated the prefix MH. The MH card numbered 43.0 is for a whitebait net, but no direct provenance attribution to Te Ana o Hineraki is included in the text.

The first attribution of a whitebait net to Te Ana o Hineraki is an entry in the hand written Ethnology Register No.1 compiled by Roger Duff in 1938. This records the archaeological material excavated in 1872 and includes E72.85, which is described as "portion whitebait net" from the upper deposits of Te Ana o Hineraki.

The degraded condition of E72.85 is distinctly similar to other organic taonga in the Canterbury Museum collection securely provenanced to Te Ana o Hineraki. However,

given the relatively thin inventory trail analysed above and the absence of other material evidence (such as radio carbon dates) to give weight to provenance, it is probably best, in the interim, to adopt a cautious approach and refer to whitebait net E72.85 as "Te Ana o Hineraki (Moa Bone Point Cave) (attributed)".

Method of manufacture

The process used in the construction of kupenga īnaka/mata appears to borrow techniques widely employed in traditional whatu (cloak) weaving and also elements from traditional raranga (plaiting).

The first stage in the process would have been the preparation of long, thin strips of harakeke for the whenu or warps (the vertical elements). These flax strips were not modified in any way. Each whenu strip would be approximately 2–3 mm in width and 1,400 mm in length as, once woven together, they were folded in half to create the 700 mm deep bag net. Approximately three whenu are required for every 10 mm of width.

The whenu were woven together horizontally with aho (wefts) of very thin strips, (approximately 1.5 mm wide) of unmodified harakeke, using the whatu aho patahi (single pair twining) technique (see Fig. 5). Each row of whatu aho patahi were woven approximately 17–18 mm apart.

Both upper and lower exposed ends of the whenu were incorporated back into the body of the weave by using the process known as selvedge commencement, in which a tag left at the top of each whenu is bent over and re-enters the same aho (weft), usually two whenu to the right.

Once the body of the kupenga (net) was complete it was folded in half and the seams at either end were neatly bound together with what appears to be a form of cross stitch incorporating two thin strips of unmodified harakeke. This completed the body or bag of the net. The approximate external dimensions of the whitebait net E72.85 are 1,860 mm wide by 700 mm deep (Fig. 9).

E72.85 still has its hoop opening attached. It is made from two lengths of light, slender pirita (supplejack) lashed together (2,150 and 2,400 mm long respectively), which would have held the mouth of the net open. The netting bag is laced onto the pirita hoop by a thin, knotted, continuous strip of unmodified harakeke which is lashed using loop knots at variable intervals (approximately 30–50 mm apart) around the pirita and through the netting immediately beneath the selvedge commencement (Fig. 10).

The natural tension present in the pirita would have resulted in a circular or semi-circular shaped opening. However, as the hoop is flexible the shape could easily have been modified into a more oval outline by the addition of a pole handle to form a scoop net, or by the addition of wooden cross braces to form a set net (see Figs 3 and 4).

E139.74 Whitebait net

This scoop net was donated to Canterbury Museum on 30 March 1939 by James Gibbs Stanton (Canterbury Museum Accession Register 62/39). The following information was recorded by the Museum at the time:

> *Whitebait net given to donor over 60 years before by Tuahiwi Maori. This net was subsequently used by the donor to catch whitebait until now. It is somewhat damaged but the green flax fabric after 60 years is still strong* (Canterbury Museum Ethnology Register: E139.74).

The net has been crudely repaired with both twine and strips of flax, almost certainly by Stanton (Fig. 11).

The donor, James Gibbs Stanton (1856–1945), was an early settler at Woodend in North Canterbury, living there from about 1858 until his death. Stanton remembered Māori nets as "a work of art" and said that it took about two weeks for a woman to make a large net from flax. "The net was suspended from a wooden frame, and had a little trap-door in one corner to let out the catch" (Stanton 1932: 12). This description matches well with the net he later donated to Canterbury Museum, which has a spout at one end (Fig.11).

Figure 10. Photograph showing the loop knot lashing used to lace the pirita hoop onto whitebait net. Canterbury Museum E72.85

Stanton described the net as over 60 years old when he donated it in March 1939 which suggests that it was made prior to the autumn of 1879. Interestingly, Stanton married in July 1878, at the start of the whitebait season, and it is possible that this net was made for him as a wedding present.

Method of manufacture

The process used to construct E139.74 is very similar to that previously described for E72.85 and the net is of a similar size (approximately 1,720 mm wide and 600 mm deep).

The long, thin, unmodified harakeke strips for the whenu (warps) are approximately 2–3 mm in width and 1,200 mm in length and once woven and folded in half they would have created a bag net 600 mm deep. As with E72.85, approximately three whenu were required for every 10 mm of width.

The whenu were woven together horizontally with aho (wefts) of very thin, approximately 1.5 mm wide, strips of unmodified harakeke, using the whatu aho patahi (single pair twining) technique (Fig. 12). Each row of whatu aho patahi were woven with approximately 30 mm spacing between most rows (although one is 25 mm and one other 40 mm).

Both the upper and lower exposed ends of the whenu were incorporated back into the body of the weave by using the process known as selvedge commencement. This results in, not only a tidier, but also a stronger aho (weft) corresponding to the point at which the net would later be lashed to the hoop of pirita to define the mouth of the net.

Once the body of the kupenga was complete it was folded in half and the seams at either end were neatly bound together with what appears to be a form of cross stitching utilising two thin strips of unmodified harakeke (Fig. 13).

It is apparent that Stanton made many repairs to the fabric of the net using both cotton thread and split flax and in some areas these cover the integrity of the original workmanship (Fig. 14).

One very innovative design incorporated into the lower corner of one side-seam of E139.74 was a tapered conical spout also created by the whenu (warp) and aho (weft) technique. This convenient feature was designed to facilitate pouring of the catch from the net into another container (Fig. 11).

Figure 11. Whitebait net E139.74 with the spout for pouring out the catch at lower left edge. Note also the repairs made to the net. Photograph by Jane Ussher

There was no hoop attached to the mouth of E139.74, but there is some stretching clearly indicating one had previously been attached, but subsequently removed by the owner. This process may have been traditionally done annually as it would not only facilitate storage by allowing the net to be rolled or folded, but would also potentially minimise damage to the net weave by releasing inherent tensions caused by the pirita hoop.

Conclusion

The two scoop style kupenga that survive in Canterbury Museum are possibly the only surviving examples worldwide and are highly significant as evidence of construction techniques and size of this type of net. Their manufacture appears to have obvious similarities to raranga and some whatu (cloak) weaving techniques. The nets were multi-purpose and could be used as koko harakeke (scoop nets) to catch īnaka/mata or attached to a frame and used as a set net to catch young upokororo.

The nets at Canterbury Museum could become templates for weavers and assist with the rescue of the almost abandoned manufacture of harakeke nets.

The ethnohistorical evidence presented in this paper firmly establishes the economic, dietary and cultural significance of the seasonal harvest of eight diadromous species in Te Wai Pounamu. Targeting predictable migrations of shoals ensured substantial quantities of fish were caught, which far exceeded the requirements for immediate consumption. There was an obvious economic strategy in operation; well organised fishing parties moved and camped at the right place, at the right time, with the right gear to catch and preserve target species. To be effective, the application of this strategic approach clearly required Māori to have developed intimate awareness and understanding of the life-cycles of each of the targeted diadromous species.

Historical evidence refers to huge quantities that could be preserved for later consumption when required. Most of the literature reviewing Māori cultural food gathering practices in Te Wai Pounamu greatly underestimates the vital contribution that these eight diadromous species made to traditional subsistence economies. Large quantities of juvenile fish were harvested from August to January and many were preserved for the leaner months of winter. A second harvest of migrating adult fish took place in autumn and this important protein rich food may also have been preserved.

Although the historical accounts reviewed in this paper are chronologically and geographically scattered, all Māori communities across Te Wai Pounamu would have undertaken seasonal freshwater fishing activities simultaneously in

Figure 12. Detail of whitebait net E139.74 showing weaving technique. Canterbury Museum E139.74

Figure 13. Photograph showing cross stitching method of binding together two edges of the kupenga/net E139.74. Canterbury Museum E139.74

Figure 14. Two views of kupenga/net E139.74 showing repairs. **A**, repair made with harakeke. **B**, repair made with string. Canterbury Museum E139.74

rivers and lakes within their individual rohe (tribal areas).

There are two conspicuous differences between traditional and modern harvests. It is now illegal to harvest adult īnaka/mata on their autumn downstream breeding migration and today paraki are not seen as desirable for consumption. Paraki were traditionally a taonga species, particularly on the east coast, and frequently a catch more prized than īnaka/mata.

It may be surprising to modern-day whitebaiters to discover that contemporary fishing practices, such as set nets, sock nets and scoop nets, are virtually identical to traditional Māori techniques and technologies which are centuries old (Fig. 15). The one legal and technological exception is the construction and use of seine nets like those designed to catch huge shoals of paraki and īnaka/mata in Te Waihora (Lake Ellesmere) and possibly at Pegasus Town.

Now that all diadromous species are under threat it is further hoped that the evidence presented in this paper will help raise public awareness and be a timely reminder of the former cultural significance of these taonga species.

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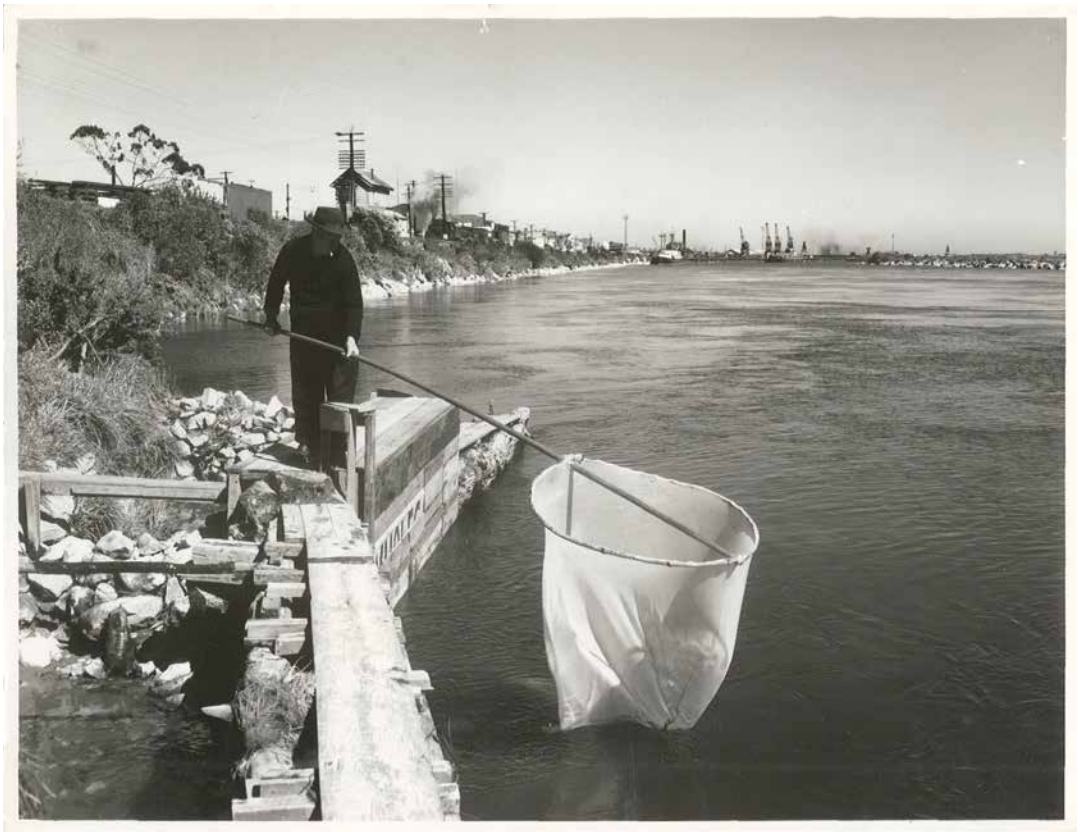

Figure 15. A whitebaiter on the Grey River in 1959 using a scoop net that, despite the modern bag, is almost identical in design to the two scoop style kupenga at Canterbury Museum. Archives New Zealand AAQT 6539 W3537 57/ A71885

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