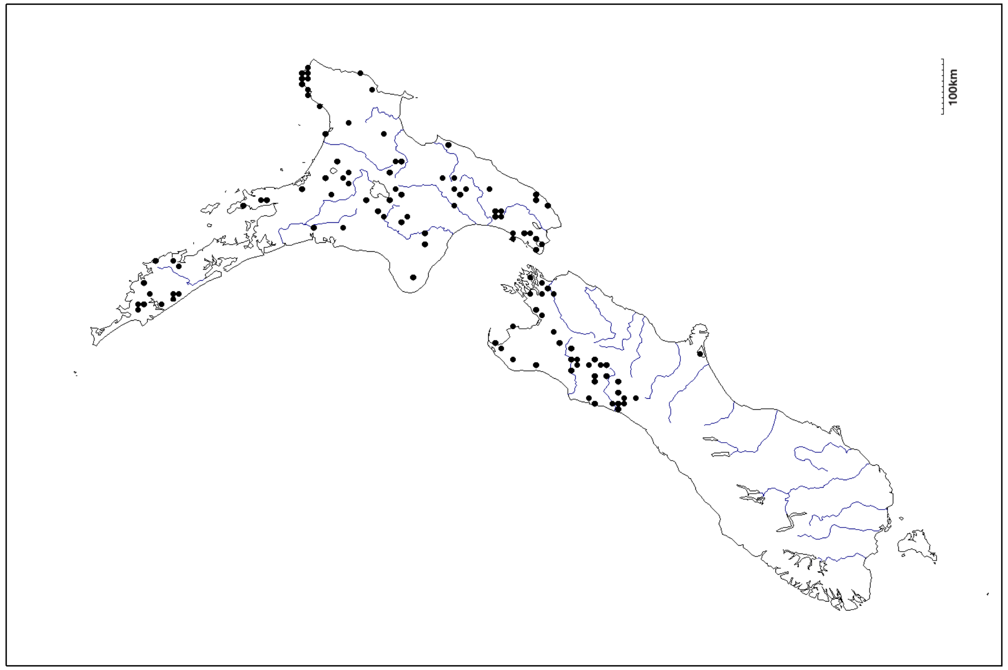

Fig 50: *Zephlebia versicolor* (Eaton, 1899) (180 records).

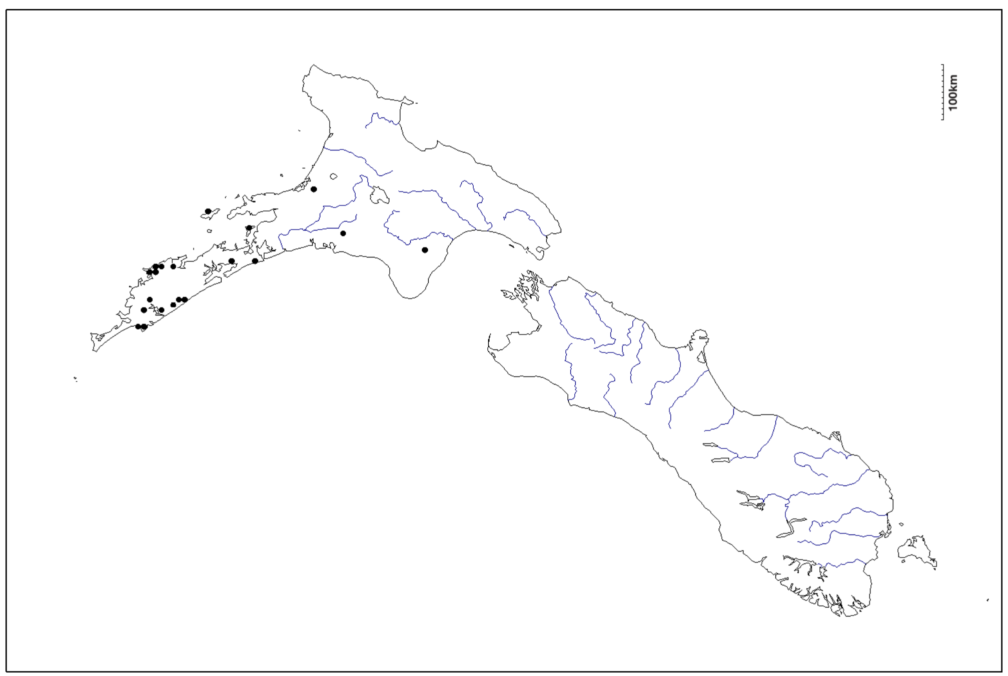

Fig 49: *Zephlebia tuberculata* Towns & Peters, 1996 (31 records).

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Harvesting of ngā hua manu (bird eggs) in Te Waipounamu (South Island), New Zealand

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ABSTRACT

The presence of large quantities of moa egg shell in a number of archaeological contexts has been interpreted as testimony that eggs formed a substantial seasonal component of the moa hunter diet as well as serving a wide range of other functions such as grave goods and raw material for artefacts. Despite the archaeological potential of eggshell, apart from moa, the analysis of eggshell in archaeological sites in New Zealand is to date non-existent. Eggshell is almost impossible to reliably identify taxonomically based on morphology alone and even where it has been retained, archaeological eggshell is often archived without taxonomic identification. This paper utilises ethno-historical evidence to establish that the eggs of a wide range of species are known to have been exploited in Te Waipounamu (the South Island) of New Zealand. The eggs of seabirds in particular, offered a significant resource that remained a seasonal focus of economic activity until the early twentieth century. The application of scientific advances in eggshell identification techniques are reviewed for their potential to be used to overcome perceived problems with the interpretation of eggshell in archaeological assemblages in New Zealand.

KEYWORDS

bird eggs; eggshell; genetic analysis; mass spectrometry; ethno-history; seasonal harvesting; archaeology.

INTRODUCTION

This paper undertakes a selected literature review of a variety of sources including recorded Māori traditional and ethno-historical accounts pertaining to harvesting bird eggs, the breeding biology of species identified in these accounts and the research outcomes of recent genetic and mass spectrometry analyses pertaining to eggshell. Although it might seem that these disparate sources are inherently incompatible it will be demonstrated that it is possible to draw a number of conclusions as to what this corpus of accounts can reliably establish about the Māori cultural practice of bird egg harvesting. It is not the purpose of this paper to undertake any in-depth critical analysis of the sources themselves, but to cautiously extract information deemed relevant to making a robust contribution to the current understanding of the economic role of bird egg harvesting in New Zealand.

ARCHAEOLOGICAL AND SCIENTIFIC EVIDENCE

This section includes a selective literature review of the evidence for the seasonal harvest of eggs of now extinct bird species, largely moa, and a brief summary of how recent research outcomes utilising genetic analysis have made possible a better understanding of the cultural practice of egg harvesting.

Moa and other large birds

Evidence of the intensive exploitation of moa is apparent in most early archaeological deposits by the presence of bone and eggshell. The bones of other large species such as Haast's eagle, geese, adzebills, takahe and swan have also been identified in early sites (Worthy and Holdaway 2002: 541). Moa eggs and eggshell have been found in various archaeological situations including in association with burials, in circumstances indicating they had been cooked and eaten, but more frequently the eggshell present, while clearly of archaeological origin, was unable to be ascribed any specific cultural context (Anderson 1989: 143, 184).

There is limited data concerning the clutch size of moa, but available data suggests that no more than one or two eggs are represented in any one collection of eggshell from each discrete nesting event (Anderson 1989: 81, 84; Worthy and Holdaway 2002: 187). The sequence of moa breeding behaviour remains essentially conjecture, based on analogy with the breeding patterns of other extant ratites, such as emu, where the female lays in April or May and the male incubates for about 56 days (Anderson 1989: 85). The widespread presence of moa eggshell (and occasionally bones of chicks) in archaeological sites is, however, clear evidence of exploitation during the incubating season, when both the eggs and incubating birds could be obtained simultaneously (Anderson 1989: 154).

Recent advances in protocols and techniques for the isolation, amplification and characterisation of ancient DNA (aDNA) preserved in eggshell of moa and other species demonstrate how the ability to genetically characterise historic and fossil eggshell from a range of species and sample sizes would benefit future archaeological research (Oskam et al 2010). Previously species identification using moa eggs had been based on relative size and shell thickness (Anderson 1989: 80-81). Reliable identification to species level using either visual or microscopic examination and measurement of thickness, however, has been shown to be virtually impossible (Oskam et al 2011: 2). The potential of archaeological sites in New Zealand to contain eggshell and remains of any of the six genera of moa, together with the remains of other extinct species of large birds and extant species such as kiwi and seabirds, further complicates species identification of eggshell. The accurate identification of fragmentary eggshell samples to species level is clearly an essential precursor for any reliable determination of the parameters of cultural uses of birds and eggs. Eggshell fragments excavated from archaeological middens potentially represent more than one egg and more than one species. Genetic analysis has now not only made it possible to reliably assign a species to eggshell fragments, even those that have been thermally modified, but can also be used to establish the minimum number of individual eggs the fragments represent (Oskam et al 2011: 6; Oskam et al 2012: 43).

A potential alternative technique for the identification of archaeological egg shell fragments by analysis of their protein component (ZooMS) has also been recently published (Stewart et al 2013). A recent application of this technique has shown that in contrast to genetic analysis it has the advantage of being rapid and much less labour intensive, and therefore more suitable for the analysis of large archaeological assemblages (Stewart et al 2014: 248). Unfortunately the process has some limitations that would appear to severely compromise its present value as an application appropriate for use in New Zealand archaeology. The primary issue appears to be that currently the level of resolution varies between taxa. For instance, at this time, there is no way of confidently distinguishing between different members of the closely related and highly specialised family Laridae (Stewart et al 2014: 250). It is likely, however, that compilation of a more robust and developed reference collection may eventually overcome this issue. The technique also has one further limitation when compared to the outcomes resulting from genetic analysis. While it will allow the identification of archaeological eggshell by analysis of their protein component, it will not allow the determination of the minimum number of individual eggs present in the study sample.

Results of genetic studies to date have confirmed the heavy exploitation of seasonally available moa eggs. A small sample of the total volume of eggshell previously excavated from seven sites has identified at least 105 individual eggs, fifty of which came from the Wairau Bar site (Fig 1) alone (Oskam et al 2012: 46). Given the estimate that one large ratite egg may contain the equivalent of a dozen or more chicken eggs the annual harvest would have made a significant dietary contribution (Oskam et al 2011: 1). A reasonable explanation for the widespread presence of thermally modified moa eggshell appears to be that the eggs were cooked. How, or indeed if, moa eggs were cooked remains conjecture, they may have been eaten raw, cooked in the shell or cooked outside the shell. Analogies to cooking methods employed with rhea eggs (Patagonia) and emu eggs (Australia) including placing them in hot ashes in a prepared hole as well as puncturing one end and placing them vertically on a slow fire have been suggested (Oskam et al 2011:4).

Because of the difficulties in obtaining reliable

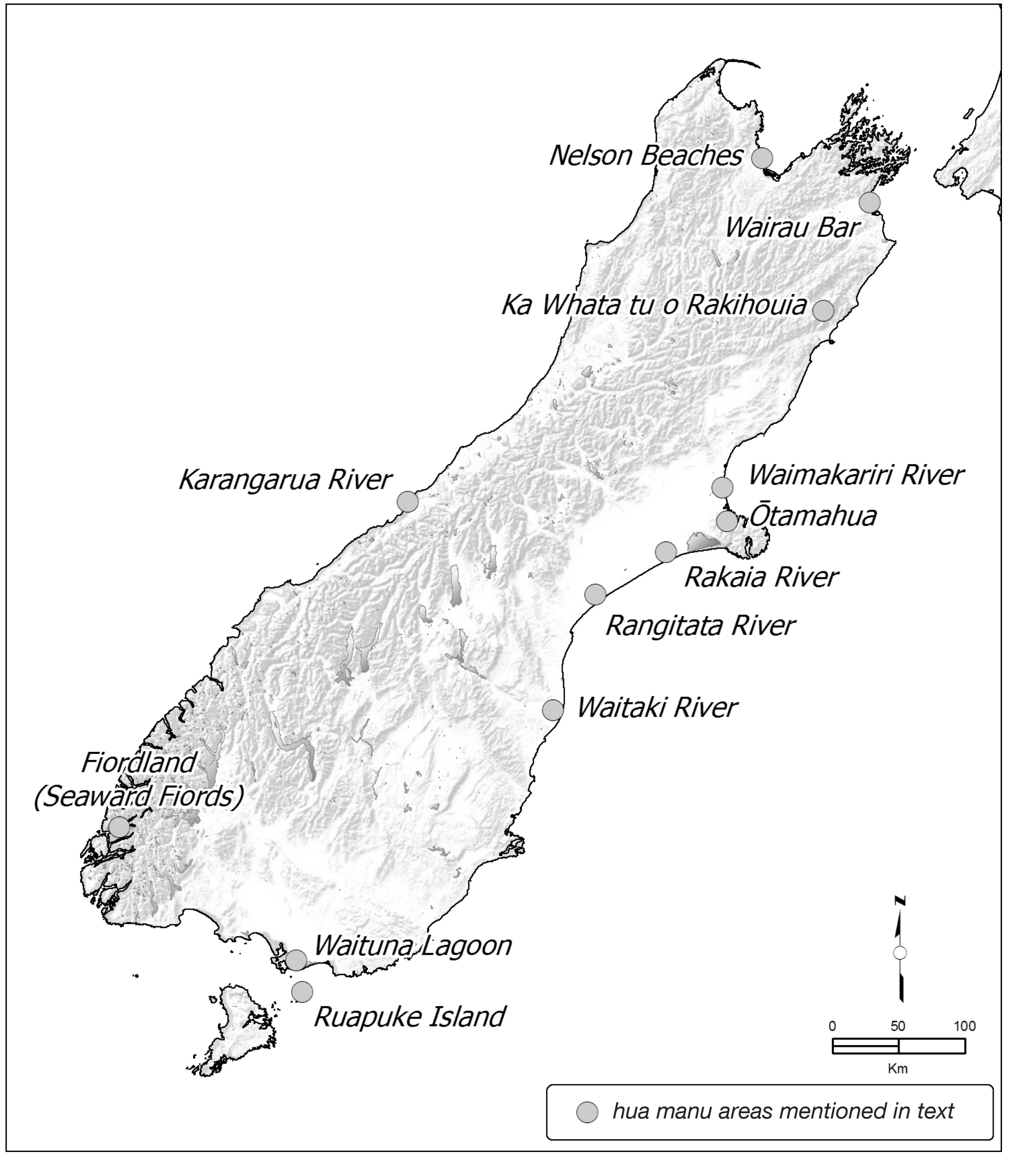

Fig 1: Map of hua manu areas mentioned in this text.

Fig 2: Selection of bird egg images, from left to right: *Larus bulleri*, Canterbury Museum AV103737, *Haematopus finschi*, Canterbury Museum AV4701, *Phalacrocorax varius*, Canterbury Museum AV4719, *Eupdyptes pachyrhynchus*, Canterbury Museum AV4106.

identification of eggshell fragments (examples of colour similarities and size differences can be seen in Fig 2) to species level prior to genetic analysis, there is an existing corpus of eggshell fragments previously collected from archaeological sites throughout New Zealand already available awaiting research. Research focused on the identification of eggshell of species other than moa would now seem to be a research project worth pursuing.

A very similar argument to that presented to support the rapid extinction of moa appears also to apply to other large birds such as Haast's eagle, geese, swan and adzebill (Worthy and Holdaway 2002: 547). Perhaps the most obvious evidence for this statement is that while the earliest archaeological sites contain the remains of almost all of the larger flightless species they are conspicuously absent from later sites. Although the presence of eggshell from these species has yet to be identified in archaeological contexts it seems reasonable, given the lack of research, to postulate that like moa they too would have been subjected to seasonal harvest of eggs.

Human arrival also had a demographic impact on several species of marine bird. The king shag (*Leucocarbo carunculatus*) was eliminated from the North Island and from most of the South Island, the Waitaha penguin (*Megadyptes waitaha*) was exterminated and the New Zealand crested penguin (*Eudyptes pachyrhynchus*) underwent substantial range reductions following Polynesian settlement (Rawelence et al 2015; Worthy and Holdaway 2002: 574). Ethnographic evidence presented later in this paper suggests that these species were likely to have been subjected to the practice of seasonal egg harvesting.

Waders, gulls and terns

This section includes a summary of distribution and breeding biology of bird species for which, as yet, there is only traditional and historical evidence for the cultural practice of seasonal harvest of eggs (Table 1).

With a long coastline, numerous islands and extensive braided river systems New Zealand has a diversity of species of waders, gulls and terns (Charadriformes). Although

MĀORI NAME	COMMON NAME	SPECIES	LAYING TIMES	NUMBER OF, INCUBATION TIMES
Kawau Paka*	Little Pied Shag	*Phalacrocorax melanoleucos brevirostris*	Oct–Dec	3–5 eggs, 28 days
Kawau tuawhenua	Black Shag	*Phalacrocorax carbo*	Apri–Jun, Dec–Feb	3–5 eggs, 27–31 days
Kāruhiruhi	Pied Shag	*Phalacrocorax varius varius*	Feb–Mar, Aug–Sept	2–4 eggs, 28 days
Kawau tūī	Little Black Shag	*Phalacrocorax sulcirostris*	Mar–May, Aug–Dec	2–4 eggs, 28 days
Kawau-a-Toru	King Shag	*Leucocarbo carunculatus*	Mar–Aug	1–3 eggs, 28 days
Māpua	Stewart Island Shag	*Leucocarbo chalcanolatus*	Any time of year	2–3 eggs, 28 days
Kawau tikitiki	Spotted shag	*Stictocarbo punctatus*	Aug–Nov	1–4 eggs, 28–31 days
Torea*	South Island Pied Oystercatcher	*Haematopus finschi*	Mid Sept–early Feb	2–3 eggs, 25–32 days
Pohowera	Banded Dotterel	*Charadrius bicinctus bicinctus*	Late Aug–early Dec	2–3 eggs, 25–27 days
Karoro*	Kelp Gull	*Larus dominicanus dominicanus*	Mostly summer, but also Winter and Spring	1–5 eggs, 23–30 days, may relay
Tarāpunga*	Red-billed Gull	*Larus scopulinus*	Late Sept–late Dec	1–3 eggs, 19–26 days, may relay
Tarāpukā*	Black-billed Gull	*Larus bulleri*	Sept–Jan	1–4 eggs, 20–24 days, may relay
Taranui	Caspian Tern	*Hydroprogne caspia*	Oct–Jan (gen. from Sept–mid Nov	1–2 eggs, 21 days, will relay several times
Tarapirohe*	Black-fronted Tern	*Childonias albostriatus*	Oct–Dec	2 eggs, 22–24 days, will relay several times
Tara	White-fronted Tern	*Sterna striata*	Mid Oct–Jan	1–2 eggs (rarely 3), 25–27 days, may relay
Tawaki*	Fiordland Crested Penguin	*Eudyptes pachyrhynchus*	Late July & Aug	2 eggs, 31–36 days
Hoiho	Yellow-eyed Penguin	*Megadyptes antipodes*	Sept or Oct	1–2 eggs, 39–51 days
Unknown	Waitaha Penguin	*Megadyptes waitaha*	Unknown	Unknown
Korora*	Little Penguin	*Eudyptula minor*	July–Dec	2 eggs, 33–43 days
Putakitaki*	Paradise Shelduck	*Tadorna variegata*		8–9 eggs (rarely 5–15) 21–22 days
Pateke*	Brown Teal	*Anas chlorotis*	June–Oct (peaks in Jul & Aug)	5–6 eggs (rarely 4–9) 27–30 days
Parera*	Grey Duck	*Anas superciliosa*	July–Dec	10–12 eggs (rarely 7–14) 26–32 days
Whio*	Blue Duck	*Hymenolaimus malacorhynchos*	Aug–Dec (rarely Jul–Mar)	5–6 eggs (rarely 4–9) 31–32 days

(* indicates a species mentioned in Maori traditional or ethno-historical accounts)

Table 1. Summary of breeding behaviour of potential range of target species (compiled from Scofield and Stephenson 2013)

there is a relatively limited range of breeding species of waders, these are all endemic. Terns are more diverse and include both endemic and cosmopolitan species. In the South Island there are five species of tern two of which, the black fronted and white fronted terns, are endemic. The Caspian tern reaches the southern limit of its huge breeding range in Southland, although distribution may have formerly been restricted to northern harbours and beaches. Isolated pairs nest at many points along the coast, but there are small colonies at some favoured places. The fairy tern is now extinct in the South Island and the population greatly reduced in the North Island. In the nineteenth century it was reported as breeding on the riverbeds in Canterbury. The white fronted tern breeds at many points along the coast, in pairs and in large colonies, from Northland to the Auckland Islands. Some white fronted terns also feed far up the larger South Island braided rivers.

Three species of gull breed in New Zealand. Only one species, the black-billed gull, is endemic and is adapted to nesting on braided rivers of the South Island. It is one of four different species, including the black-fronted tern, black stilt and wrybill, that is characteristic of the braided gravel riverbeds of the South Island. Red-billed gulls breed adjacent to where significant marine upwellings produce concentrations of food. The Kaikoura coast is currently the most significant South Island breeding site. Elsewhere small numbers nest near river mouths and rocky islands. Kelp gulls (commonly known as black-backed gull) have been reported as being uncommon both in the fossil record and when Europeans arrived. Most breeding colonies are on coastal dunes, salt flats and braided riverbeds. Isolated pairs nest beside high country tarns or on rocky coasts (Worthy and Holdaway 2002: 414-415).

TRADITIONAL AND ETHNO-HISTORICAL ACCOUNTS

All traditional and historic accounts located that refer to harvesting bird eggs were compiled by Herries Beattie and George Roberts and for that reason presumably all geographically relate to Te Waipounamu/South Island, which was the focus area for their oral history recording (Beattie 1994: 11–30). No comparable accounts relating to Te Ika a Maui/North Island were located, although they may exist. For clarity the accounts located will be quoted in full and presented as either traditional accounts or historical accounts and where appropriate presented in geographical groupings.

Traditional accounts

There are three references recorded that are clearly traditional accounts passed down in Ngāi Tahu oral history. The first records the relationship between geographic nomenclature, tipuna and cultural practice. The cliffs of the South Island (and in particular the cliffs of Kaikoura peninsula and seaward Kaikoura Ranges) are proverbially called 'Ka-whata-tu-a-Te Rakihouia' (Fig 1), or sometimes rendered 'Ka-whata-kai-a-Te-Rakaihouia' or more commonly 'Kā Whata Tū o Rakihouia', (the standing foodhouses of Rakihouia) because Rakahouia, the son of Rakaihautu, got food from them. Shags and seabirds lived on the cliffs and men were lowered over with ropes to secure the eggs and young birds, hence the origin of the name (Beattie 1918: 159).

A second traditional account referring to the practice of collecting bird eggs is also captured in a geographical place name (Te Kawakawa/Otamahua/Quail Island). Two authors record one of the traditional names for Quail Island in Whakaraupo/Lyttelton Harbour as Otamahua (Fig 1), which literally translates as 'the place where children gathered bird eggs. The relative marine isolation of Quail Island would have made it a preferred nesting site for kelp gulls and red-billed gulls and the island's physically less demanding terrain would make it a suitable location to engage children in egg gathering activities (Cowan 1923: 20; Andersen 1927: 97, 144).

The third account is of an unidentified species of bird known as Ruruwhenua (possibly Laughing Owl *Sceloglaux albifacies*) that was recorded as having been hunted at Lake Waituna (Fig 1) in the past. 'It had four or five eggs of a white colour and the party ate them and put the bird on a kohika (toasting stick) at the fire' (Beattie 1954: 40).

All these accounts suggest that the seasonal harvesting of bird eggs has been a longstanding cultural practice.

Ethno-historic accounts

For convenience the accounts are presented from north to south.

Whakatu/Nelson: This account presents a generic overview of the seasonal practice of harvesting and cooking of both eggs and chicks:

> *In Nelson the Maoris used to eat young karoro (seagulls)*

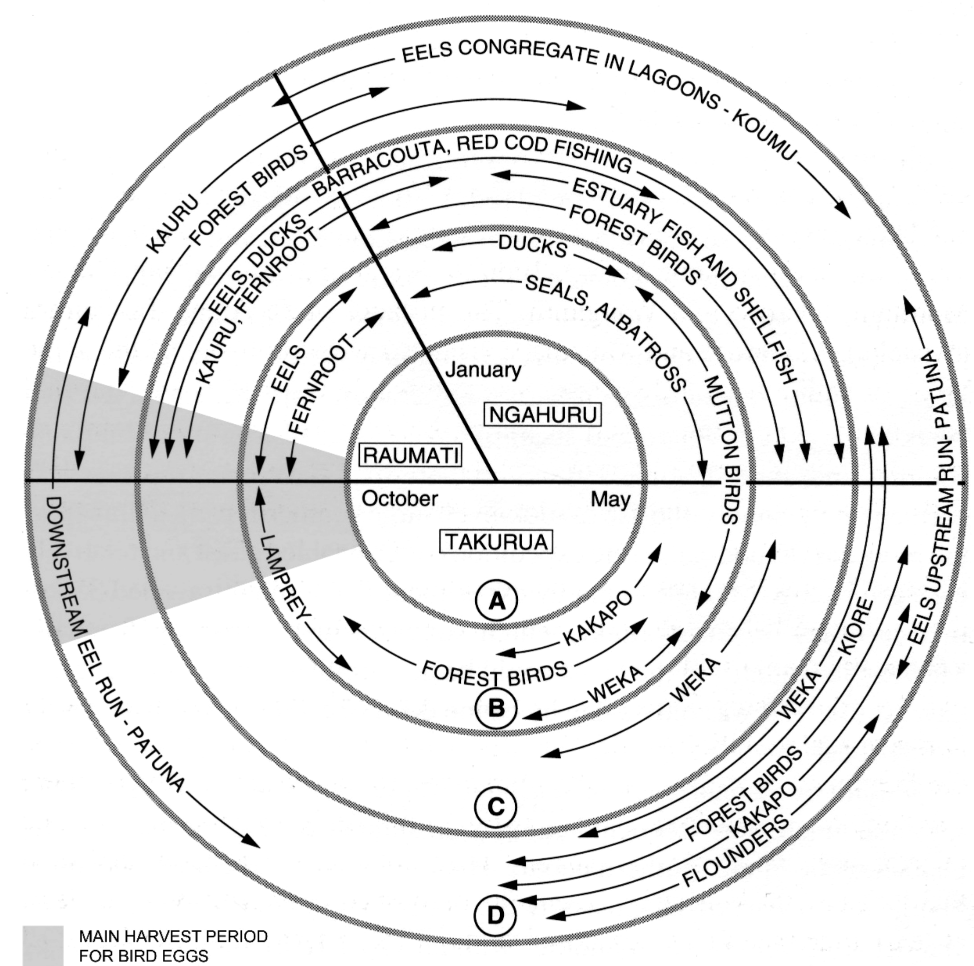

Fig 3: Ngāi Tahu seasonal calendar, with egg harvest information added (after Anderson 1998: 117; Dacker 1990: 10–11).

> *which were found in nests on beaches and riverbeds. The people used to eat the eggs of the tarapunga (sea martin), the karoro, the torea and ducks. These eggs were put in ashes of fires or in hangi (ovens) – he had never heard of them being eaten raw. Long ago the Maoris went to a little rock island (about two acres in extent) near Nelson to get tarapunga eggs* (Beattie 1994: 506).

Nga Pakihi Whakatekateka o Waitaha and Waitaki/Mid-Canterbury, South Canterbury and North Otago: All these accounts relate to the exploitation of species of terns and gulls that breed on the major braided riverbeds of Waimakariri, Rakaia, Rangitata and Waitaki rivers (Fig 1).

There is one brief reference for the Waimakariri River mouth area: 'A Kaiapoi man said the people there got eggs of the torea, the sea martin, and other birds at Kairaki', so the practice was widespread (Fig 1) (Beattie 1954: 44).

There are both historic and eye witness accounts for the Waitaki River:

Some Maoris were quite ignorant of their customs and one aged woman told me the Maoris did not eat seabirds' eggs on the islands up the Waitaki River but along the seacoast. Crossing the Waitaki Bridge on the bus an alert school boy pointed out to me flocks of seabirds flying about in a very agitated state, and he pointed out one or two human figures moving about below the circulating flights, saying they were Maoris collecting eggs. I asked a Maori matron about this and she said it was an annual affair. The eggs were lying about all over the place, and it was easy to go round with a basket and pick them up. The parent birds resented this appropriation of their lawful property and would pick up pebbles in their beaks and fly overhead dropping them on the searchers. In the riverbed (sic riverbed) the usual kinds were tarapirohe, or sea martin, which was all grey, and the tarapuka (accent second vowel) about the same size as a black head. The eggs were small and dainty, but the karoro or seagull laid a larger egg of richer quality. At Tauhinau, the site opposite the last ferry, there is an old Maori cemetery and opposite it on the islands out in the river is a noted karoro nesting place where the Maoris go to collect the eggs in their due season each year (Beattie 1954: 44).

A further account pertains to the Rakitata River (Rangitata River):

An Arowhenua Maori told me he and his neighbours got kerosene tins full of seabirds' eggs from the Rakitata River. They could bake them in an umu and then break the shell and eat the eggs hard, but he could not say how old the custom was. Another Arowhenua resident said the birds eggs were principally those of the karoro (seagull). This bird usually laid three eggs and rarely four, and they were very rich. The gatherers would make a fire in a hole in the sand and let it go out; gather the eggs and put them in the ashes and let them boil hard before eating. For cooking the sand was always wet, and this with the ashes of the fire generated steam and this did the eggs excellently (Beattie 1949: 45).

A brief, perhaps traditional, account also confirms that bird eggs were also harvested along the Rakaia River:

A favourite settlement of the ancient Rapuwai people was called Huatau. It is inland up the Rakaia River and the karoro (seagull) nested there and you could collect the hua (eggs) there. It was between the uppermost bridge and the sea (Beattie 1949: 138).

Murihiku/Southland: There are three accounts from Murihiku (Fig 3), which record the harvesting of gull and also penguin eggs:

A Bluff woman told me that besides the eggs of karoro, tarapuka, and tarapirohe, they ate the eggs of torea (red bill) and korora (penguin). The last were not so good as the others, and they could only eat the yolk as the rest went to jelly. She forgot the name for the yolks. The other eggs ate just like hen's eggs and were very good for baking as they were rich and tasty. A Bluff man included in the list the big yellow eggs of the tawake penguin (Beattie 1949: 44).

There is another generic account of harvesting and processing seabird eggs on Ruapuke Island. A Māori informant states that:

…the karoro eggs were a little stronger than ducks' eggs. The terapuka eggs were smaller. The big gulls' nests are well separated, but the small gull nests in clusters and you can pick up dozens of their eggs at one spot. They lay about November 25, and you can collect at once as they turn in two days. The tarapirohe laid at the same time on the rocks; the eggs perhaps were smaller but were edible, and had to be used within three days or they were no good. On Ruapuke the men got suitable kelp and would caw-caw (perhaps a transliteration of an unknown Māori word that denotes a separation to make a cavity) the blades open and break the eggs into them for carrying, the shells being thrown away. At home the contents of their kelp bags would be poured out and would keep for two or three days. I never went in for the big gulls' eggs as it would have taken a whole day to find enough to be of any use, but the others were so thick and handy they could be gathered quickly (Beattie 1949: 44).

There is one reference to the plentiful resources available in Fiordland that includes an oblique reference to harvesting penguin eggs: '…the Maori could get plenty of the best clothes, and to his taste delicious food also; abundance of fish in the smooth water, penguins in season and their eggs, and mutton birds on some of the islands…' (Beattie 1949: 69).

Poutini/West Coast, Westland: There is one ethno-historical account from Poutini, West Coast (Fig 1), which is based on notes made from discussions with kaumatua at Makawhio (Jacobs River) in 1897 by surveyor William Wilson on behalf of GJ Roberts, Commissioner of Crown Lands for Westland: 'At Black River, Karangarua, and other sandy spits they got gulls' eggs. They would make a large fire near the nesting-ground, heat stones, and roast two or three hundred eggs at a time' (Skinner 1912: 144). In an interesting endnote to this paper Skinner postulates, 'The same procedure seems to have been followed with moa eggs by Moa-hunters' (Skinner 1912: 150).

DISCUSSION

Recent research involving the genetic analysis of moa eggshell has demonstrated that it is possible to not only establish the range of species represented but also to establish the minimum number of individual eggs the fragments represent (Oskam et al 2012). The presence of quantities of moa eggshell in excavations of most hunting sites indicates that at least some hunting commonly occurred during the incubating season. Whether moa nested communally at specific favoured locations and were therefore more economically located by hunters during the incubating season is not known. There is no doubt, however, that egg harvesting was a contributing factor in the rapid decline of moa. The presence of both moa and small bird bones in early archaeological sites indicates that moa hunting was pursued as part of a wider fowling strategy. Whether harvesting of eggs of smaller species was also part of this strategy is yet to be established.

Further genetic analysis of eggshell from archaeological contexts will no doubt resolve the issue as to whether the cultural practice of harvesting bird eggs in early archaeological sites also included a wider range of species. Of particular interest will be the opportunity to examine the potential hypothesis that following the demise of moa and other large birds, the focus of egg harvesting reflected the modus operandi of the new hunting strategy, where intensive hunting was transferred to particular, preferred, alternative, smaller extant species. Ethno-historical evidence suggests that this might be the case and that the preferred species that were the focus of the new collecting strategy became a limited range of habitual, communal breeding species where egg size provided sufficient return to justify the effort expended (Table 1). For species where nesting behaviour resulted in more dispersed colonies (kelp gulls and penguins) it appears likely that harvesting may have had a somewhat more opportunistic bias and focussed towards localised exploitation of nests adjacent to human habitation or encountered during seasonal movement to take advantage of other resource availability. The fact that both kelp gull and penguin eggs were somewhat larger than other target species may have in part off-set the extra time required for location and harvest.

This paper demonstrates, however, that by combining the information contained in traditional and historic accounts of bird egg harvesting in several regions of Te Waipounamu with the known breeding biology of the target species identified it is also possible to establish a useful overview of the economic and cultural significance of harvesting bird eggs (Fig 2). In addition, the evidence raises the possibility that the practice of egg harvesting may also be implicated in the demographic and distributional impacts observed for two species of penguin (yellow-eyed penguin and New Zealand crested penguin) following human arrival. While most of the ethno-historical accounts cited date to the late nineteenth and early twentieth century it seems reasonable to suggest that some of the key elements observed, especially those relating to cooking and processing of eggs, may be useful analogies for the interpretation of the presence, or absence, of eggshell in archaeological contexts. The recorded traditional accounts may also be used cautiously to suggest the possibility of continuity and longevity of egg harvesting as a cultural practice across the time period of human occupation of New Zealand. The validity of this will only be established once eggshell samples from archaeological contexts reflecting the full chronology of settlement have been analysed.

While ethno-historical accounts confirm that bird eggs were a welcome seasonal delicacy that could not be preserved and therefore needed to be consumed within a few days of harvesting, they were, however, clearly a brief annual resource that offered a very timely dietary contribution in many localities. The spring breeding schedule of the target species occurred at a time when other seasonal resource possibilities were either limited or absent in many districts (Fig 2). As with many other seasonally available resources egg harvesting would clearly require a degree of group mobility and planning to be present at the breeding colonies at just the right time to take advantage of the resource. The harvesting of eggs of species with dispersed, isolated nesting preference is likely to have been more incidental and opportunistic and resulted in limited returns for the effort and site locating time involved. In contrast the harvesting of eggs of species that habitually nested at customary communal locations resulting in accumulated, concentrated egg resource would have made a substantial economic contribution, especially where the target species had the propensity to re-lay multiple times should a clutch of eggs be forfeited (Table 1). By taking advantage of this breeding behaviour it would also potentially be possible to manipulate egg laying to extend over several weeks and thereby greatly increase the total resource available.

The traditional and ethno-historical accounts also give insight into the processes of harvesting and consumption of eggs. The most challenging method of harvesting was clearly the traditional account that recorded the use of ropes to abseil down cliffs to reach nests. This same account is the only reference to harvesting shag eggs and simultaneously taking young birds. There is only one ethno-historical account that mentions gathering and eating both eggs and young birds and only one traditional account of collecting and consuming both eggs and adult birds. The majority of accounts of harvesting involve the collection by hand of freshly-laid eggs from communal nesting colonies and removing them intact from the breeding site in containers. Only one account records breaking the eggs, pouring the liquid contents into poha rimu (kelp bags) and discarding the eggshells at the place of harvest. There is no specific reference to the eggs being cooked in the poha rimu into which they had been poured during collection, only that they would last several days when collected in this manner. The majority of accounts that relate to the consumption of eggs refer to cooking them in hot ashes, only one reference refers to the use of a traditional hāngī/umu (stone lined earth oven). No accounts specifically refer to eggs being eaten raw. The most detailed account indicates that the cooking fire was always prepared in a hole in wet sand and was allowed to reduce to hot ashes before the eggs were introduced and then left until completely cooked by exposure to heat and steam.

Clearly when intact eggs were cooked by either of these methods the archaeological footprint left would be ash, a fire pit or hangi and an adjacent scatter of eggshell. Obviously where eggshells were discarded at the point of harvest subsequent archaeological evidence of egg harvesting would be impossible to interpret. Further genetic analysis of eggshell from a wider temporal range of archaeological sites will not only clarify the range of species from which eggs were harvested, but also have the potential to assist with the interpretation of the function of archaeological hearth-like features situated adjacent to eggshell concentrations.

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