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THE CHRONOLOGY AND INTERPRETATION OF ITALIAN CREEK ROCKSHELTER, CENTRAL OTAGO

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Introduction

The publication of a model for moa extinction (Holdaway and Jacomb 2000) in which the authors expressed their preference for extinction a mere fifty years or so after the first arrival of human colonists, prompted a number of responses. Among them, the model was criticised on grounds of ecological theory, by Anderson (2000) and Brook and Bowman (2002), for failing to take into account expected progressive or cyclic release of hunting pressure on moas as their decreasing availability raised the relative value of alternative prey. This is a common process in predator-prey relations which leads ineluctably, in theory and in practice, to the significant lengthening of population survival. Culturally its efficacy is generally enhanced by the social practices of human foraging to produce what has been described as "protracted overkill" (Burney and Flannery 2005). They comment that

> AMS dating of pretreated bone collagen from a wide array of the extinct fauna shows…that most species held on at least tenuously for centuries after the initial… population crash, to go extinct after the environment had already been transformed in many areas and human populations had become archaeologically visible (Burney and Flannery 2005: 399).

In arguing for just such a protracted decline to extinction Anderson (2000) noted the deficiencies of relying upon evidence from a site, Monck's Cave, on the outer edge of the Canterbury Plains, where moa populations were unusually vulnerable to human predation, and pointed to the substantial number

of radiocarbon dates associated with moa-hunting sites elsewhere which were significantly younger than predicted by the preferred values of the Holdaway and Jacomb (2000) model, and which had not been considered explicitly by them (see also Schmidt 2000). In particular, these included a series of radiocarbon ages on moa bone collagen with median values extending up to the 17th century (Petchey 1997).

Consequently, one way of working toward resolving the issue of when moa became extinct is to minimise issues of inbuilt age in other materials, and radiocarbon date much more material directly from moas (Anderson 2000: 198). This could include preserved moa soft tissues and feathers, and moa bone and moa eggshell from archaeological or natural sites for which radiocarbon ages already exist on other materials which are relevant to the period of extinction. One such site suggested as potentially useful in this regard was the Italian Creek rockshelter (NZAA site number S133/258) in Central Otago, excavated in 1978 (Ritchie 1982). Here we report new radiocarbon ages from the site and discuss them in relation to the earlier chronology.

Italian Creek initial chronology

The moa-hunting credentials of the Italian Creek rockshelter are not unequivocal. They depend upon interpretation of abundant fragments of moa eggshell, many of them burnt, which were found around two hearths in the site. Ritchie (1982: 25-26) considered the options at some length, the main two being that the eggshell resulted from moa nesting in the rockshelter prior to the arrival of people and the hearths happened to be dug later in the same location, or that it reflected human consumption of moa eggs and discard of the shell into the active hearths. He preferred the latter interpretation on the grounds that there was a locational association between eggshell abundance and hearths (most eggshell occurred within the hearths) and some burnt eggshell was found at a distance from the hearths. Nevertheless, given that some eggshell could have been moved by bioactivity, notably by rabbit burrowing, the argument rested essentially on the locational coincidence of the hearths with the bulk of the eggshell. Ritchie (1982: 26), concluded that

> overall the Italian Creek evidence does not enable a watertight case to be presented to show that moa eggs were definitely consumed at the site, but the possibility cannot be ruled out, and in fact seems the most plausible explanation for the ground evidence.

The particular significance of this conclusion lay in the associated radiocarbon dates (Table 1). Two dates (NZ-4714 and NZ-4715) came from either side of one of the two hearths in square A2/A3. The ages were on charcoal associated with the moa eggshell. If the association was true, and assuming that

fresh eggs had been collected, then moa eggs were being produced up to about the 16th century. A third date (NZ-4716), on charcoal from the second hearth, was earlier, suggesting occupation around the 14th century. However, if there was inbuilt age in the charcoal samples, then it was most probable in NZ-4716, which contained the greatest proportion (66%) of charcoal from matagouri (*Discaria toumatou*), amongst which there might have been pieces from the heartwood of trees several hundred years old (Table 1). That aside, and given that both hearths were contemporary, as seemed assured by the stratigraphy and side-side position, then the age of occupation suggested by the overlap of the two younger ages with the single older age was probably the beginning of the 15th century. Either way, the data suggested that moas had remained extant in the Cromwell Gorge until at least AD1400. However, the crucial issue was clearly one of association.

Additional radiocarbon ages

In order to date the age of moa remains directly we selected samples of moa eggshell from three squares in the site, two of them matching the squares from which charcoal samples had been dated earlier. All samples were from the same stratum, Layer 1A (Ritchie 1982). The samples were dated at the Waikato Radiocarbon Laboratory, University of Waikato, according to procedures outlined by Higham (1994). They were cleaned using an acid wash and then CO_2 evolved using a reaction with dilute HCl *in vacuo*. The CO_2 was converted to benzene using established procedures (Higham and Hogg 1997) and radiocarbon dated using liquid scintillation counting (LSC). The results were calibrated using the Southern Hemisphere calibration curves (McCormac et al. 2002; Hogg et al. 2002) and the OxCal 3.10 computer programme (Bronk Ramsey 2002). The calibrations are shown in Figure 1.

The results are generally at odds with the ages on charcoal samples. Only in the Square A4 hearth do ages overlap at 2SD (NZ-4716 and Wk-8874). In the case of the A2/A3 hearth, the charcoal and eggshell dates clearly record different events, and the B3 date is even further adrift of the charcoal chronology. As the charcoal dates are likely to be maximum ages, and the eggshell dates have almost no inbuilt age, the chronologies on different materials appear to be recording different sets of events.

Conclusions

In the light of the eggshell ages, we think that the interpretive possibilities at Italian Creek need to be re-ordered. On the current evidence the moa eggshell as a whole cannot represent consumption events associated with the hearths. The simplest hypothesis is that Italian Creek was used for moa nesting on several

Table 1. Radiocarbon ages on samples from Italian Creek rockshelter. The determinations were calibrated using INTCAL04's Southern Hemisphere dataset (McCormac et al., 2002; Hogg et al., 2002) and OxCal 3.10 (Bronk Ramsey, 2001).

Lab number	Provenance	Material	Radiocarbon age BP	$\delta^{13}C$ (‰)	Calibrated age AD (one sigma)	Calibrated age AD (two sigma)
NZ-4714	L.1A/Sq.A2	Charcoal *Hebe* sp. 84%, *Discaria toumatou* 16%	410±90	-25.5	1450–1520 (30.9%) 1530–1630 (37.3%)	1400–1680 (93.3%) 1740–1770 (1.0%) 1780–1800 (1.0%)
NZ-4715	L.1A/Sq.A2	Charcoal *Hebe* sp. 50% *Discaria toumatou* 50%	309±82	-25.9	1490–1680 (59.4%) 1740–1770 (4.3%) 1780–1800 (4.4%)	1450–2000 95.4%
NZ-4716	L.1A/Sq.A4	Charcoal *Hebe* sp. 34% *Discaria toumatou* 66%	579±96	-26.5	1300–1360 (24.5%) 1370–1460 (43.7%)	1270–1520 (91.2%) 1570–1630 (4.2%)
WK-8874	L.1A/Sq.A4	Moa eggshell (species indet.)	700±50	-13.2	1285–1325 (30.6%) 1345–1390 (37.6%)	1270–1400 (95.4%)
Wk-8875	L.1A/Sq.B3	Moa eggshell (species indet.)	928±38	-13.2	1050–1080 (14.7%) 1140–1220 (53.5%)	1040–1230 (95.4%)
Wk-8876	L.1A/Sq.A2	Moa eggshell (species indet.)	850±50	-12.8	1185–1195 (1.9%) 1200–1275 (66.3%)	1140–1290 (95.4%)

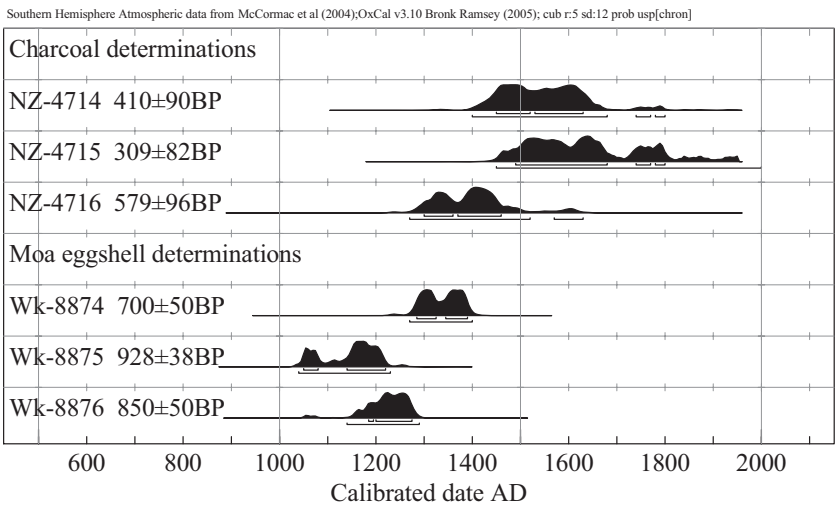

Figure 1. Calibrated age ranges AD for the 6 determinations from Italian Creek, Otago.

several occasions prior to the arrival of people, and that such activity stopped sometime between the 13th and 15th centuries, after which the rockshelter was used by Maori travellers. Their hearths happened to penetrate and partly char a deposit of moa eggshell (Ritchie's 1982 alternative hypothesis). A more complex proposition is that two habitations are represented: the A4 hearth represents a relatively early episode of moa egg predation and consumption, and there was a later occupation represented by the A2/A3 hearth that occurred after moas were extinct and which was concerned mainly with fishing, as other evidence from the site suggests (Ritchie 1982). On present data it is impossible to discriminate usefully between these hypotheses.

In terms of the testing of moa extinction ages, the Italian Creek case is now much less useful than it first appeared. The relatively young hearths are not generally supported by ages on associated moa eggshell, so Italian Creek is less certainly a moa-hunting site. To establish whether the three rather different ages on moa eggshell cover the full age range of moa nesting in the shelter would require radiocarbon dating of additional samples from a wider spread of excavated localities than those squares now represented, which are all adjacent to the hearths. However, in terms of rapid overkill models of the Holdaway and Jacomb (2000) kind, it is worth noting that the eggshell dates suggest with reasonable probability that moas continued to nest at Italian

Creek until within the second half of the 14th century, at least a century after the beginning of archaeologically documented human habitation in the South Island (Anderson 1991). Further research on the chronology of moa survival needs to be undertaken.

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