Changes in Prey Utilization at the Shag River Mouth Site, Southern New Zealand

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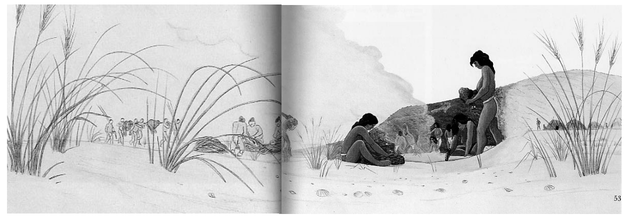
Introduction

As with many other Pacific Islands, the human colonization of New Zealand led to the decline and extinction of many native fauna and flora. In my previous research, I used foraging theory models to study how these faunal changes affected human subsistence patterns. In particular, I examined how subsistence changes with the decline of important dietary resources such as moas and seals. As the availability of these high ranked resources declined over time, the overall foraging efficiency decreases significantly. In other words, more effort was being put into producing the same net gains. In addition to the decline in foraging efficiency, foragers increased the number of resources, as well as the number of patches or environments they exploited.

While foraging theory models have proved useful in understanding broad subsistence changes, they can also be used to integrate changes in butchery and transport patterns into this larger picture. Resource depletion, and the corresponding decline in foraging efficiency, should affect how individual moas and seals are butchered, transported, and utilized over time.

Changes in the use of individual prey items that result from declining overall foraging efficiency can be studied by shifting the scale at which the patch choice models are applied. When the scale shifts from prey types to individual prey items, patch choice models examine how much time a forager spends extracting resources from prey items before moving on to the next one. As foraging efficiency declines, the proportion of each individual animal that is utilized is expected to change. In this poster, I examine these changes using the faunal assemblage from the Shag River Mouth site in southern New Zealand.



Expectations

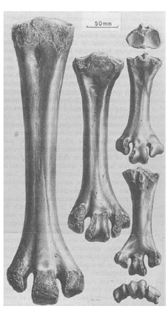
Using the patch choice models, several expectations can be generated about changes in butchery, transport, and utilization patterns as foraging efficiency declines..

- If transport costs are not changing significantly over time, then the marginal value theorem (MVT) predicts that as encounter rates of high ranked prey and overall foraging efficiency decline, the amount of time a forager spends extracting resources from a carcass should increase. Thus, foragers may exploit a broader range of elements with high and low net returns.

- Central place patch choice models predict that as transport costs increase due to increasing distance to prey, foragers will become more selective about what portions of those prey items are returned to the central place. That is, they will tend to transport higher return items in order to maximize their returns per trip.

- When skeletal elements are treated as patches, the prediction from the MVT is that with declining foraging efficiency, each element may be used more intensively through activities such as the extraction of marrow or grease. If marrow and grease extraction increases over time, then there should be a corresponding increase in bone fragmentation.

Methods



To determine if the kinds of elements being transported to the site changes over time, the mean utility, or the average returns per element for a given layer, is calculated. Samples with a high mean utility have a large proportion of high utility elements. If a broader range of elements is represented, then the mean utility for that layer will be lower.

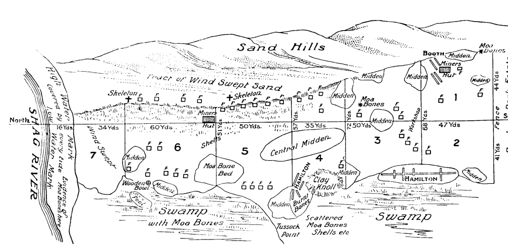
To determine if elements are being used more intensively over time, the degree of fragmentation is measured by the ratio of NISP to MNE. An increase in fragmentation should be represented by a corresponding increase in the NISP:MNE ratio.

Shag River Mouth Site

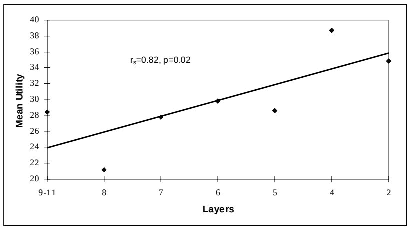
Shag River Mouth Site

The faunal data used in this analysis comes from the Shag River Mouth site located on the east coast of New Zealand's South Island. The site has a long history of excavations and is well known for its abundance of faunal remains and artifacts. The site has been interpreted to be a village site because of the large sample of midden and artifacts, as well postholes and firepits.

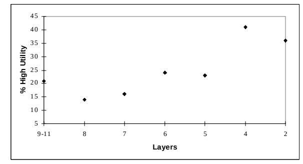
The assemblage I studied comes from the High Dune excavations conducted in 1988 by Atholl Anderson, then of the University of Otago. The excavations consisted of nine cultural layers dating from AD 1200-1400. It produced one of the largest faunal samples in New Zealand, with over 27,000 identified specimens of mammal, bird, and fish.

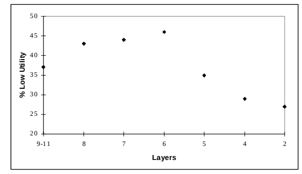


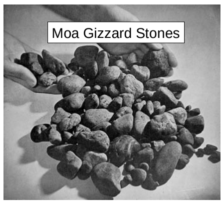
Changes in Moa Use



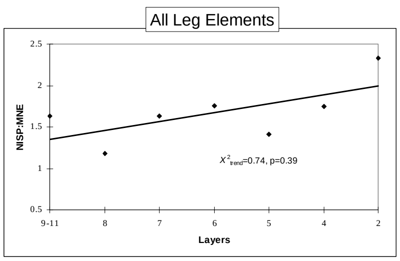
The mean utility of moa elements increases significantly over time. High utility elements (femura, tibiotarsi, fibulae, and cervical vertebrae) steadily increase, while the percentage of low utility elements (phalanges, tarsometatarsi, caudal vertebrae) declines over time. Thus, the range of elements transported is narrowing from the initial use of both higher and lower utility elements toward a focus on higher return elements later on. This is the pattern expected if the distance traveled to moas is increasing over time.



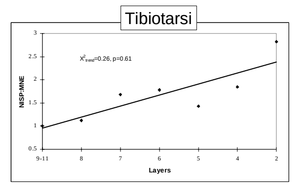


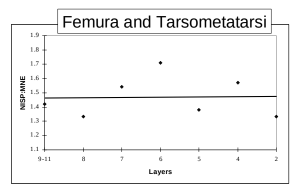


Evidence suggests that as foragers are becoming more selective about the elements they transport, field processing of moas is increasing over time. Tracheal rings, the ossified segments of the windpipe, decrease significantly over time. In addition, gizzard stones are found only in the lower layers. Both lines of evidence suggest the trachea and gizzard are being removed prior to transport. Thus, it appears that as foragers go farther to hunt moas, off-site processing of moas is increasing to create easily transportable packages, and thus maximize returns for distant sites.



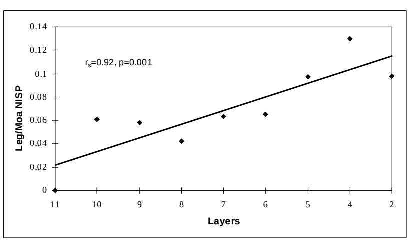
Fragmentation of leg elements increases, though not significantly, indicating that bone breakage has not increased significantly over time. Some have suggested that because of their size and shape, only tibiotarsi were regularly broken for marrow extraction. In fact, the fragmentation rates differ across elements. Tibiotarsi fragmentation rates increases slightly, while rates of the other leg elements remain relatively unchanged. Thus, it appears that the slight increase in fragmentation rates of moa long bones is driven mainly by the tibiotarsi data. Tibiotarsi may be the only element being broken for marrow and grease extraction, but the intensity with which it is used does not change significantly over time.



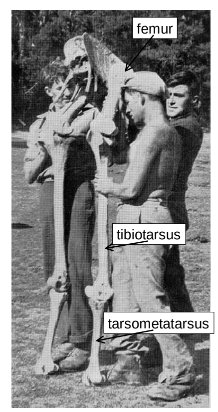


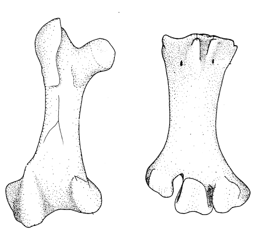
The difference in the fragmentation rates across elements may also be due to factors other than marrow extraction preferences:

- Tibiotarsi are more readily identified than other leg elements
- Tibiotarsi preserve better than other leg elements
- Tibiotarsi fragmentation was due to their tool value

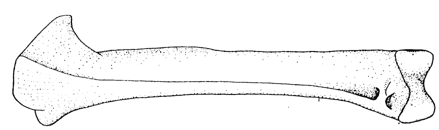


Tibiotarsi are easily identified even by small fragments. However, the identifiability of femura and tarsometatarsi increases with the size of the fragment. Fragmentation may actually be increasing, but identifiability of femura and tarsometatarsi is decreasing. If identifiability is declining, then we may expect an increase in the proportion of moa specimens that could only be identified as coming from an unspecified leg element. Indeed, the relative abundance of specimens identified to 'leg' increases significantly. This trend is not correlated with sample size (r_s=0.42, p=0.27). Since identifiability appears to be decreasing over time, the NISP:MNE ratios for the later layers, especially for elements other than tibiotarsi, may be underestimated.

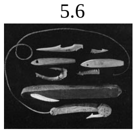




Differential preservation due to factors such as bone density can also affect skeletal element representation. Tibiotarsi appear to be denser than either femora or tarsometatarsi. Thus, femora and tarsometatarsi may be underrepresented. A bone density study using ratite relatives of the moa is planned to resolve this issue.



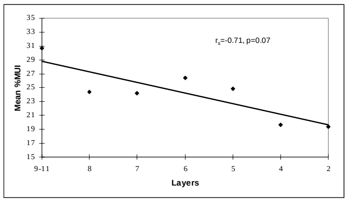
Layer	N	Barracouta Lure (%)	Minnow Lure (%)	Two-Piece Fishhook (%)	One-Piece Fishhook (%)
2	16	18.8	6.3	18.8	56.3
4	36	11.1	5.6	13.9	69.4
5	8			12.5	87.5
6	1				100.0
7	1				100.0
8	1				100.0
9	1				100.0

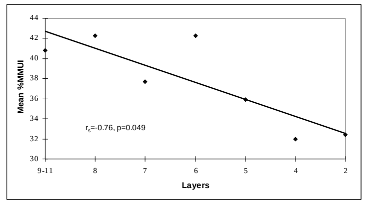


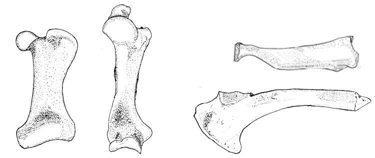
The difference in fragmentation across elements may also be due to the value of tibiotarsi as the preferred raw material for fishhooks rather than its nutritional value. If so, the increasing fragmentation of tibiotarsi may be due to the manufacture of smaller fishhooks. If so, the smaller two-piece fishhooks and lures should increase relative to the larger one-piece fishhooks.

Although the samples are small, two piece fishhooks and lures appear to occur later, supporting the idea that tibiotarsi fragmentation may be increasing due to the manufacture of smaller hooks. Additional research on the changes in the frequency of fishhook manufacturing traits such as cut marks, drill holes, tabs, and cores is required to better determine if and how tool utility is affecting moa bone breakage patterns.

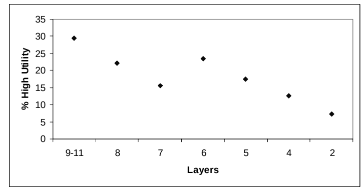
Changes in Seal Use

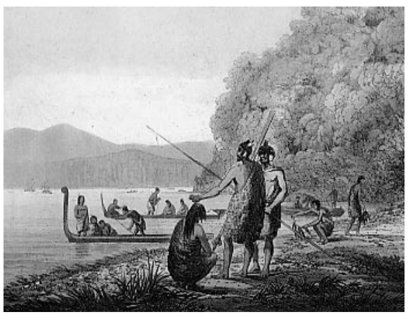






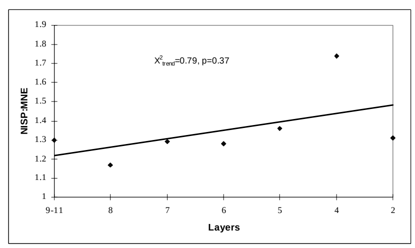
Mean utility was calculated using the two utility indices (%MUI, %MMUI) available for otariid seals. The mean utility for otariids declines over time. As with the moa, the high utility elements (ribs) decreases over time. The decreasing importance of high return elements indicates that a wider range of elements are being transported back to the site. Thus, it seems that the transport costs for exploiting otariids did not significantly increase.



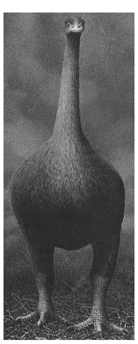


The increase in the range of elements transported back to the site indicates that increasing transport costs are not a factor in transport decisions. Thus, the changing pattern of otariid skeletal elements may reflect the effects of a declining local population that has been constantly harvested over many years. An alternative explanation is that transport costs are not increasing because of the use of efficient transport mechanisms such as canoes. Unfortunately, since it is difficult to differentiate between the exploitation of local and distant colonies, both explanations are possible.

Fragmentation of otariid long bones does not increase significantly over time at the Shag River site. Rather, the NISP:MNE ratio remains fairly constant, with the exception of Layer 4. The otariid skeletal elements returned to the site do not appear to be used more intensively over time. Thus, it is likely that the foraging efficiency did not decline sufficiently for more intensive use of seal elements to be warranted.



Summary



The use of foraging theory models allows for the integration of the diet and butchery/ transport aspects of subsistence studies under one analytical framework. By integrating these two types of studies into general subsistence research, we can gain a better understanding of why and how these practices change over time.

At Shag Mouth, with declining foraging efficiency due to the loss of high ranked resources, we see two patterns of prey use emerge. Moa use initially encompasses a broad range of low and high utility elements. Over time, as moa populations dwindle, field processing appears to increase and a narrower range of elements, those with higher nutritional value, is transported back to the site. Thus, it appears that transport decisions are changing due to increasing distance traveled to find moas as local populations decline.

With the decline in moa populations and thus in foraging efficiency, it was expected that the elements returned to the site would be used more intensively through such activities as marrow and grease extraction. However, the bone fragmentation rate does not increase significantly suggesting that moa leg bones are not being used more intensively over time. One interesting outcome is that fragmentation rates vary across elements. These are four possible explanations for this pattern, however, each of the possibilities requires further research to better determine their effects on fragmentation rates.

Within the coastal patch, the pattern of seal use is different from that seen for moas. Initially, the seal elements transported to the site are mainly of higher utility. Over time, the range of elements broadens to include both high and low utility elements. The wider range of elements transported suggests that distance may not be a factor in transport decisions. Instead, as seal abundances and foraging efficiency decline, the use of local seal populations became more intensive, i.e., more of each individual was returned to the site over time. Although seal populations were declining, the drop in foraging efficiency does not appear to have been significant enough for individual elements to be used more intensively through such endeavors as marrow and grease extraction.