Integrating Zooarchaeological and Biochemical Approaches to Seasonality in Prehistoric Japan

Tansy Branscombe, School of Archaeology, University of Oxford
Supervisors: Prof. Julia Lee-Thorp, Assoc. Prof. Rick Schulting
Contact: tansy.branscombe@arch.ox.ac.uk

UNIVERSITY OF OXFORD

Abstract

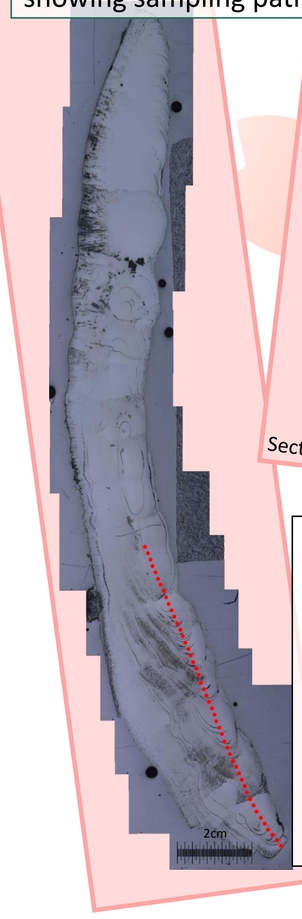
This study investigates seasonality in prehistoric hunter-gatherers from Hokkaido (Northern Japan), with a focus on the site of Hamanaka II. Archaeologists often rely on zooarchaeological methods to test seasonality, focusing on migratory species and faunal reproductive cycles. However, in isolation these approaches can produce ambiguous results (e.g. Milner, 1999). Biochemical methods provide a more explicit way to seasonally date archaeological activity, and simultaneously function as fine-scale palaeoclimatic reconstructions. The integration of traditional zooarchaeology with new biochemical results will provide a more complete picture of the annual cycle of Hokkaido hunter-gatherers, and will help highlight continuity and change across the Holocene in this region.

Research Questions

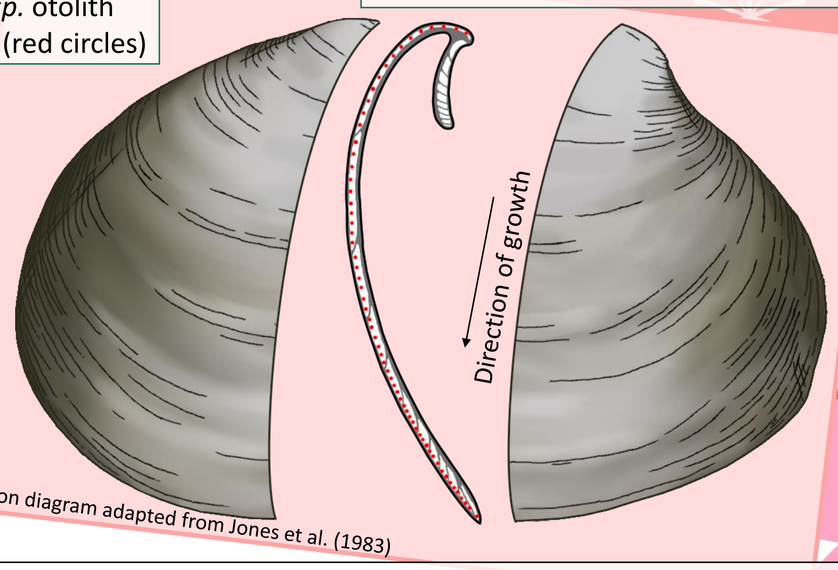
- Was initial occupation of Rebun island seasonally limited?
- At what point did this occupation become year-round?
- How did diet change according to season?
- Can changes in scheduling be linked with Holocene environmental change?
- How do seasonal signals compare with established models of hunter-gatherer diet, and with other nearby sites?

Left: In situ shell midden, Hamanaka II (2018). Right: Rebun Island landscape.

Sectioned Sebastus *sp.* otolith showing sampling path (red circles)



Spisula *sachalinensis* shell showing section and sampling path (red circles)



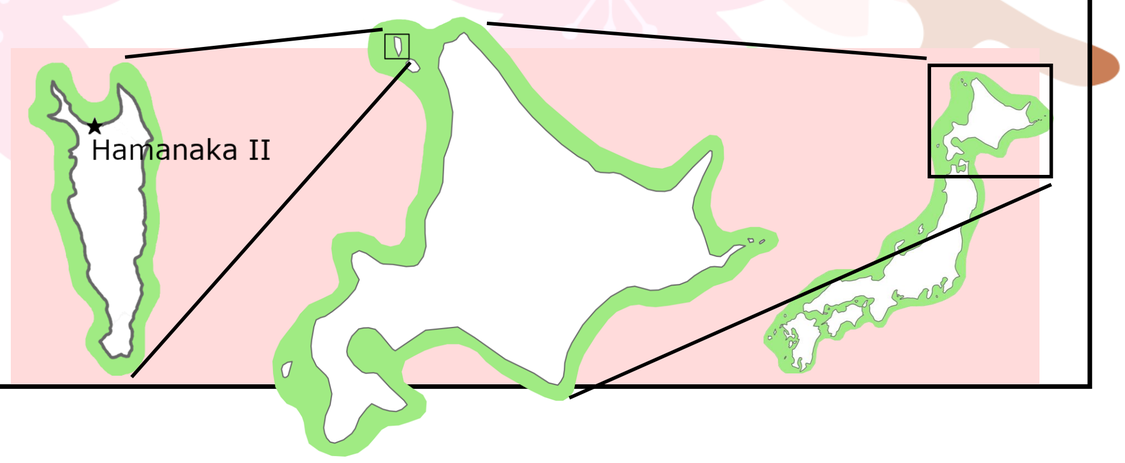
Section diagram adapted from Jones et al. (1983)

Sample Collection

Otoliths and marine molluscs are both comprised of calcium carbonate, including aragonite. Once sectioned, a micromill is used to drill powdered aragonite samples for isotope analysis. Electron microprobe analysis is non-destructive.

Hamanaka II, Rebun Island

The site of Hamanaka II is located on Rebun Island, just off the northwest coast of Hokkaido. It provides a continuous record from the late Jomon (4000 cal. BP) to the historic Ainu (19th century AD), and unlike much of Japan its sandy soils lead to good faunal preservation. This site was chosen due to its long hunter-gatherer history, and also presence of sufficient animal bones and shellfish for this methodology.



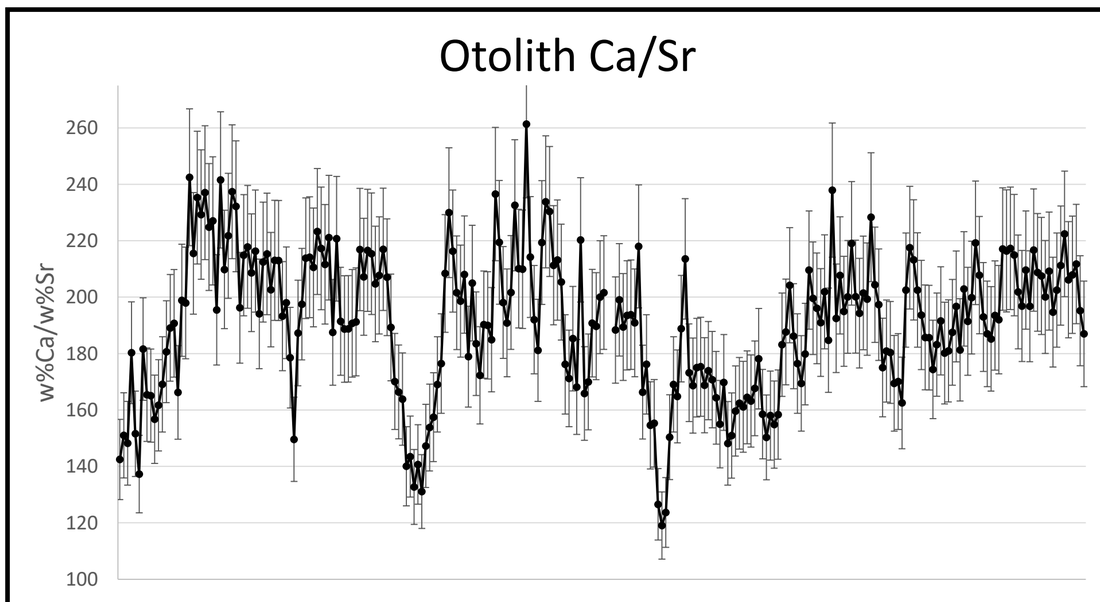
Methods

Oxygen Isotope Analysis

This technique can be done on archaeological carbonates, including shellfish and otoliths. $\delta^{18}O$ is incorporated into these structures incrementally, and in equilibrium with sea surface temperatures (Leng and Lewis, 2016; Ritchie et al. 2013). Due to this relationship, if $\delta^{18}O$ is measured sequentially across an individual (e.g. a single shell), $\delta^{18}O$ should show seasonal temperature fluctuations.

Trace Element Analysis

A pilot study is also being undertaken to see if Sr/Ca ratios in otoliths can be used similarly to track seasonal temperature (see right). This work will be done using electron microprobe analysis, and can then be compared to oxygen isotope results from the same specimen.



Preliminary Results

The above charts results of trace element analysis on a single otolith, showing relative percentage of Ca and Sr. There appears to be some pattern of max/min peaks and troughs, but due to large errors, comparison to $\delta^{18}O$ results will be needed before we can establish if there is a significant seasonal relationship.

Acknowledgments

With thanks to the Clarendon Fund, the Sasakawa Fund and the Brasenose College Graduate Research Fund for supporting this work financially. Maps made using 'Stamen.TonerLite' in R.

References

Leng, M. J., & Lewis, J. P. (2016). Oxygen isotopes in Molluscan shell: Applications in environmental archaeology. *Environmental Archaeology*, *21*(3), 295–306.
Milner, N. (1999). Pitfalls and Analysing and Interpreting the Seasonality of Faunal Remains Seasonality. *Archaeological Review from Cambridge*, *16*, 51–67.
Ritchie, K., Folkvord, A., & Hufthammer, A. K. (2013). Oxygen isotope ratios in cod otoliths used to reveal seasonality of fishing at Late Mesolithic sites in Denmark. Archaeofauna, 22, 95–104.
Jones, D. S., Williams, D. F., & Arthur, M. A. (1983). Growth history and ecology of the Atlantic surf clam, Spisula solidissima (Dillwyn), as revealed by stable isotopes and annual shell increments. Journal of Experimental Marine Biology and Ecology, 73(3), 225–242.