Quantifying changes in fish consumption in Roman and early medieval Italy using stable isotope analysis
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Diet Change in Post-Roman Italy
The 1st millennium AD was a period of ongoing political change and instability in Italy. Did the interaction between invading Germanic populations (Goths, Lombards and Franks) and local Romans result in a new cultural and economic system for the average person? Here we look for such changes through dietary analysis, and specifically, by attempting to quantify changing patterns of fish consumption in the 1st millennium.

Material
This pilot study compared the bulk δ13C and δ15N values for rib collagen from 44 individuals of Roman imperial date (Casale del Dolce, 1st-3rd century AD) and 59 adults from the cemetery at the medieval monastery of S. Pietro di Villamagna, Lazio, Italy.

Results
- very low δ15N and δ13C suggesting a low-trophic level (little animal protein) terrestrial diet
- Some individuals (mostly Roman) have a different diet, perhaps including some fish
- significant sex-based dietary differences in the medieval population, with males having higher δ15N, indicating slightly better access to animal protein

How can we quantify the amount of fish consumed at each of these sites?

Quantifying fish consumption: Improvements to mixing models by incorporating error range estimates
Simple three-way mixing models, based on extreme dietary endpoints are unrealistic. It is mathematically unlikely to derive a zero value for any end point, while in reality it is very likely that many individuals in the population may not have consumed a particular isotopic category, such as fish.

A new model
- expand estimate of extreme dietary endpoints to include an error range
- calculate the estimated contribution of marine food with linear algebra for each individual for each possible dietary triangle (43 = 64)
- values that fall outside a logical solution must be eliminated
- all unsolvable points whose δ13C was less than the maximum estimate for a terrestrial diet should be re-inserted into the model as marine consumption = 0.

Conclusions
Based on the new model, fish consumption did not change in central Italy during the 1st millennium AD. The new model provides a more realistic estimation of fish consumption in an archaeological population because it accounts for zero consumption of a particular resource (in this case, marine).

Acknowledgements
This research is funded by a Doctoral Fellowship from SSHRC, and by a DPhil Studentship from the School of Archaeology, University of Oxford. Many thanks to Elizabeth Fentress and Mauro Rubini for providing samples.