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Determining Dietary Niche in Primates Using Portable X-Ray Fluorescence

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McNair scholars PROGRAM

Introduction

- Dietary reconstructions can tell a lot about an animal's life, but often rely on destructive methods.
- X-Ray fluorescence (pXRF) is a non-destructive method of gathering elemental data from skeletal remains, plants, etc.
- However, there is a gap in studying its implementation for dietary reconstructions.
- In this study, we examine if folivores (leaf-eaters) and frugivores (fruit-eaters) differ in their strontium-calcium (Sr/Ca) ratios.
- Strontium(Sr) is a non-essential element found in soil, is taken up by plants and the body.
- Calcium(Ca) is essential for bone growth and development.
- These elements are atomically similar and the ratio at which you find them in tissues such as teeth and bones differs based on diet.

Research Question

To what extent can we reconstruct the diets of an unknown primate sample using portable XRF?

Hypothesis

Primates with low Sr/Ca ratios will have eaten a diet of fruits whereas, primates with high Sr/Ca ratios will have had a diet of leaves and stems.

Comparative study

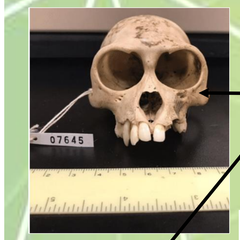
ID #	Genus	Species	Sex	Age	Diet
#07652 "Treese"	*Chlorocebus*	*Pygerythrus*	F	Adult	Folivore
#07645	*Colobus spp.*		F	Juvenile	Folivore
#07648	*Macaca spp.*		U	Juvenile	Omnivore
#07643	*Chlorocebus*	*Pygerythrus*	M	Adult	Folivore
#07653	*Chlorocebus*	*Pygerythrus*	M	Juvenile	Folivore
#09629"Food"	*Chlorocebus*	*Pygerythrus*	M	Adult	Folivore

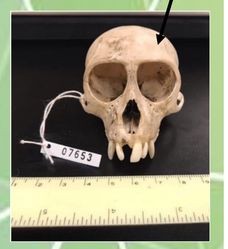
Methods

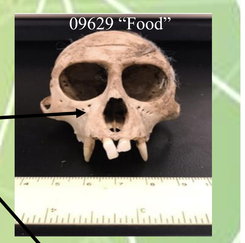
- X-ray fluorescence works via a laser that expel low- level X-rays onto a surface (in this case teeth) causing the emission of a photon. An elemental signature is indicated by the resulting energy spectrum, which includes energy peaks for each unique element present.
- I collected qualitative and quantitative spectra from two teeth (preferably an incisor, canine, or molar) and the occipital bone of the skull.

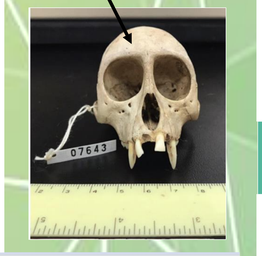
Sample

Primate skeletons were donated to UNC with unknown background, likely from a North American zoo.

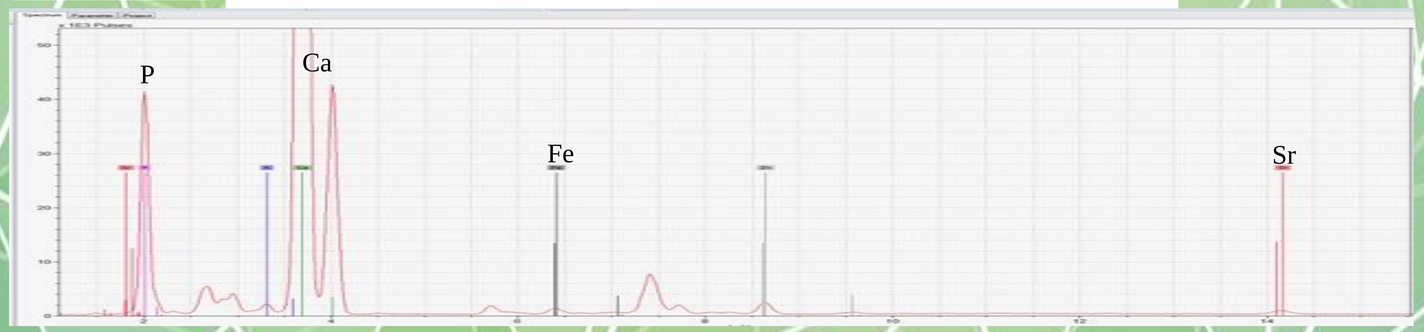








Results



Discussion

- As expected, based on the comparative study, all samples have ratios more in line with folivory than frugivory.
- Primate 07648 had the widest variation in samples indicating an omnivorous diet.
- Primate 09629 "food" had the least variation indicating specialization.
- In all but one primate, the occipital bone had a lower Sr/Ca ratio than enamel.
- Likely due to increased Ca levels in bone relative to enamel.
- This study was not able to test its original hypothesis due to a lack of frugivore samples.
- These results show that pXRF analysis can indicate dietary breadth (omnivory vs. specialization).
- I would like to implement pXRF on a greater scale with more samples and on our ancestral bipeds.

Acknowledgments

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References

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