



An investigation of Mid-Holocene Bering Sea bear bones to provide insight into modern-day polar bear population changes in response to climate change



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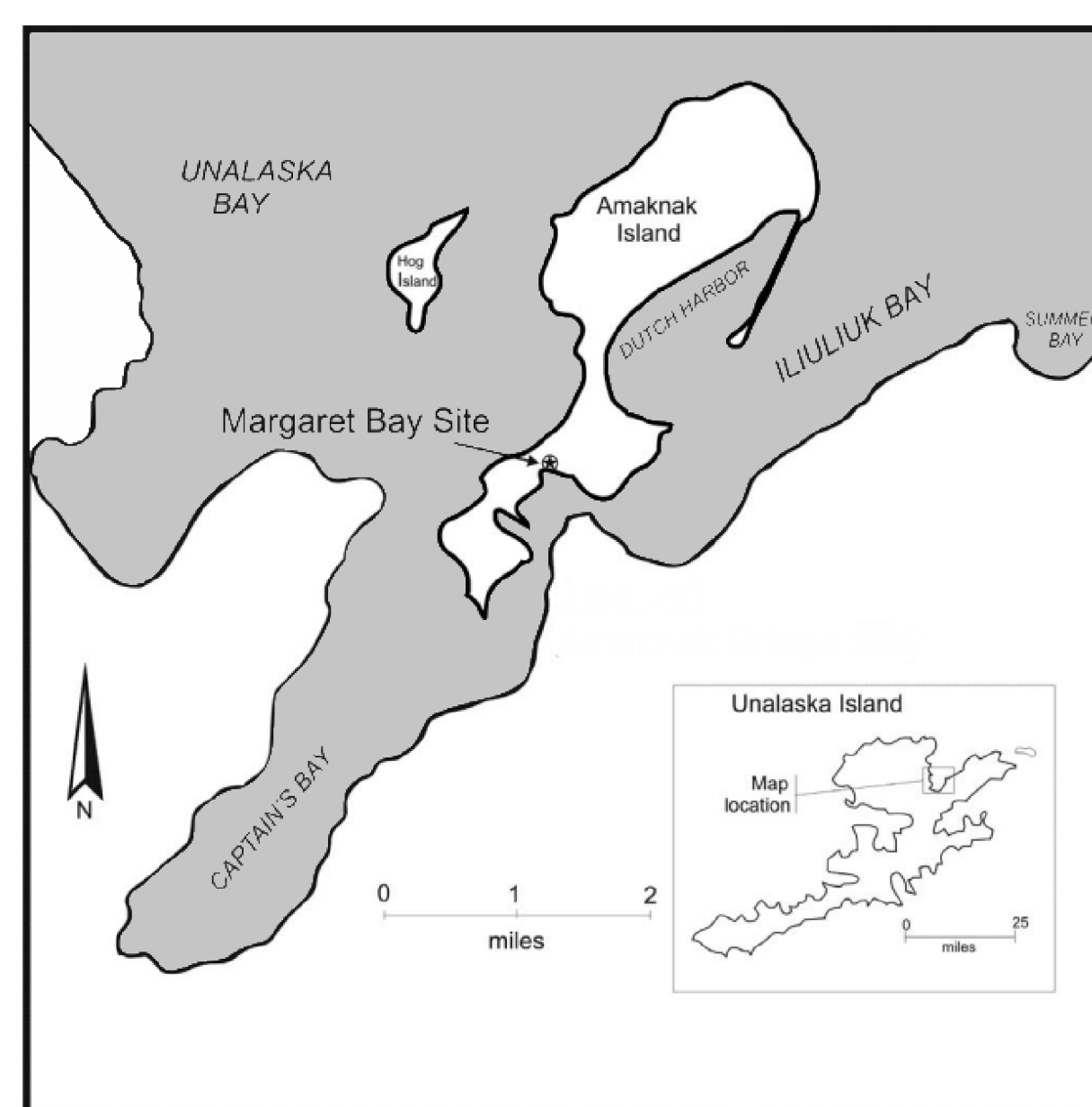
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Project Goals

- To identify the species of bear found at the Margaret Bay site in Unalaska, AK to better understand the environment and faunal response to Mid-Holocene climate changes.
- To gain a better understanding of the historical and cultural context of the dig site including the usage of bears by the ancient Unangax.
- To provide educational outreach materials about archaeology, the ancient Unanganax, and Bering Sea fauna to the Museum of the Aleutians (MOTA).

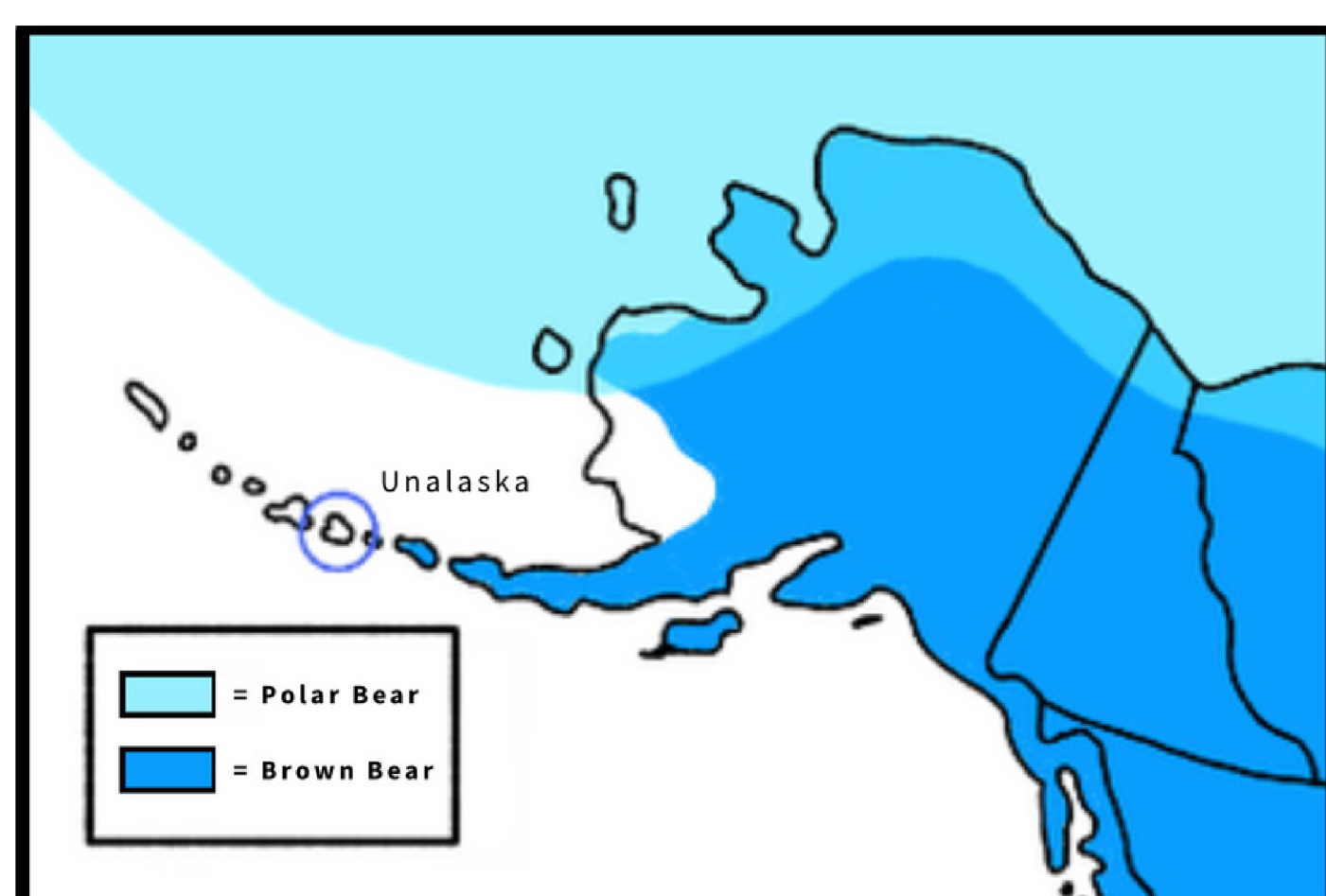
The Margaret Bay Site and The Unangan Culture

- The Margaret Bay archaeological site was dated to roughly 4,700 BCE.³
- The bones found at this site provide insight into the culture of the people and the environment of the time.
- This site was created by the Unangax. They are a subsistence based sea-faring culture which hunt sea mammals.¹ Although they have no record of hunting bears, there is evidence of long-distance trade with nearby tribes.



Margaret Bay site location on the island of Unalaska, AK

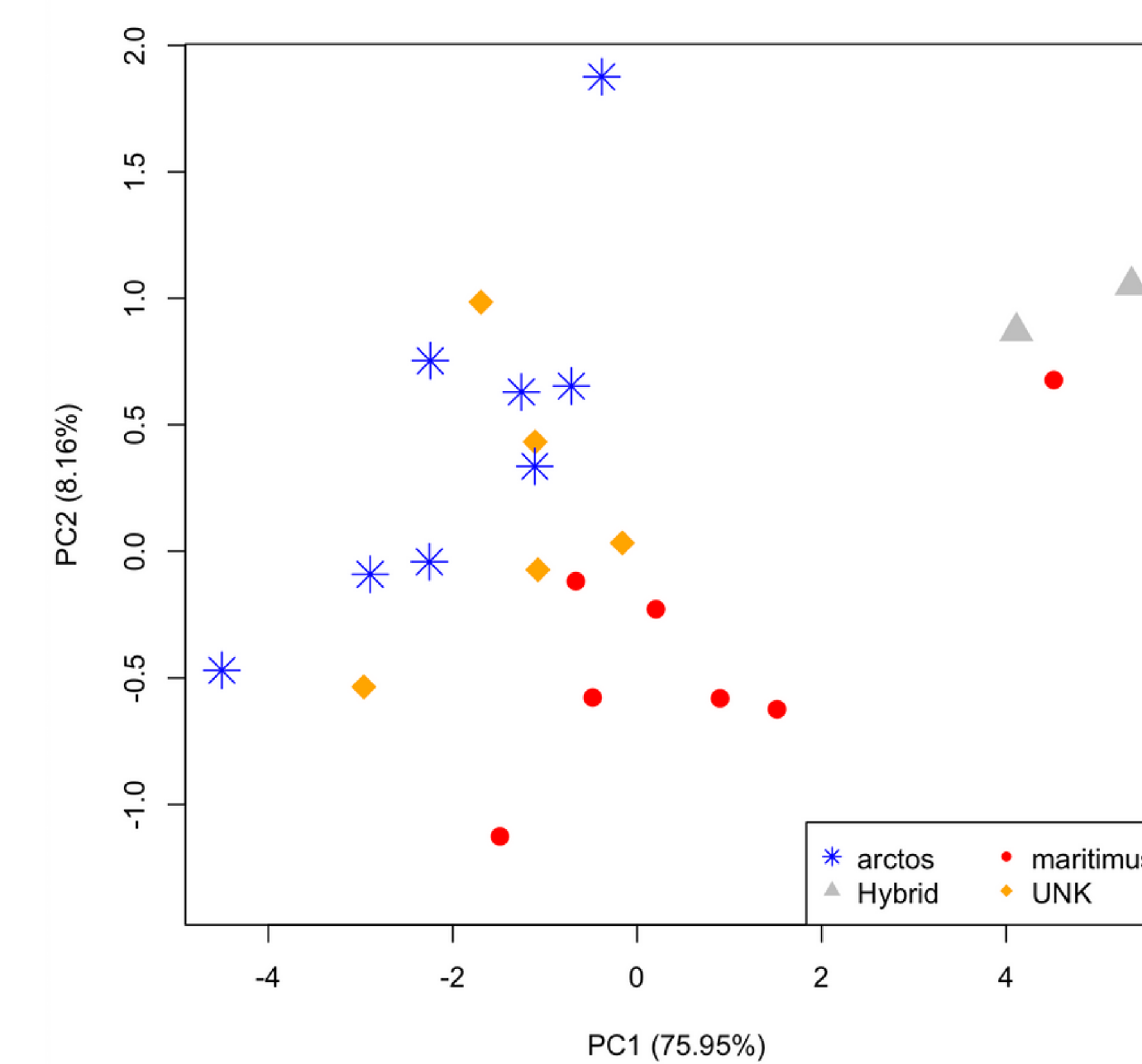
- There are no bears currently living on Unalaska, but the sea-ice during the Neoglacial era may have expanded the range of polar bears.²
- A change in their habitat may have also caused a change in diet and gene-flow between populations.
- By studying these bear bones, we hope to gain insight into the culture here, and the ways that bears adapt to a rapidly changing climate.



Distribution of brown and polar bears in Alaska and Northwestern Canada from State of Alaska database

Morphometric Analysis

- To determine the species of bear found at Margaret Bay, the bones were measured according to the Tsoukala and Grandal-d'Anglade system.⁴
- Comparative measurements from the Sam Noble Museum of Natural History and the Smithsonian's National Museum of Natural History.
- A principle component analysis (PCA) was run on each element to determine the relationship between the unidentified Margaret Bay samples and the museum specimens using R version 2.4.1.



PCA of metacarpal measurements taken from brown bear (*U. arctos* - blue), polar bear (*U. maritimus* - red), hybrid brownXpolar bears (gray), and unknown species samples from Margaret Bay (orange)



Photograph of a bear metacarpal from the Margaret Bay site

Educational Outreach

- 3D scans were taken using the DAVID 3D scanner at LMAMR and then used to create 3D printed models of the bones. These scans were given to the MOTA and the tribe for their records and use.
- These models were used for a hands-on component to an archaeological outreach activity for elementary school students which guides them through a simulated archaeology dig. They will learn about the historical context, identify the animal the bones belong to, and theorize how the bones ended up at the site.
- The 3D scans and activity packet have been uploaded to Thingiverse where they are free to download and use.



Fourth grade students at Marshall Elementary in Tulsa, OK using the 3D models with the activity packet.



Life-size 3D printed replicas of the bear bones from the Margaret Bay site

Research in Progress

- No conclusive data yet due to the small sample size of comparative measurements and indefinite morphometrics data analysis. Further genomic, isotopic, and radiocarbon dating research is currently in progress.
- DNA samples taken from comparative samples at the National Museum of Natural History.
- From these data we hope to determine species, the number of unique individuals, as well as gene flow, and relationships with modern day bears.
- The isotopic data from the Margaret Bay bones will give us information about the diet of the bears, and the radiocarbon dating will confirm the age of the site.
- We hope to gain insight into the response of bears in this region to Mid-Holocene climate change to possibly predict the ways that modern polar bears in this region will react to anthropogenic climate change to aid in conservation efforts.

Citations and Acknowledgements

We would like to thank the Qawalangin Tribe of Unalaska and the Museum of the Aleutians for their collaboration on this project. With this project, we stand with the Qawalangin tribe to preserve and educate others about Unangan language, culture, customs, and traditions for future generations. Further Information can be found at <https://www.qawalangin.com> or on facebook @myqtribe.

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