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Introduction (937 of 1,000)

The publicized decline of *Eumoetopias jubatus* (Stellar sea lion) along the northeast Pacific coast has been speculated to be caused by various human demands placed on the environment that ultimately affects the diet of *Eumoetopias jubatus (*Pascual & Adkison, 1994). However, the evolution of earth's climate includes gradual trends of warming evidenced through increased marine temperatures (Zachos, 2001). This particular type of climate change has been linked to driving mammalian evolution as a side-effect (Alroy, 2000). My objective is to compare refined data sets for marine temperatures from deep sea cores in the area, body mass distributions and geographic range of dispersion for *Eumoetopias jubatus*. I hypothesize that the species abundance, body mass distribution and geographic range of distribution for *Eumoetopias jubatus* will exhibit a decline alongside increased pacific marine temperatures over the span of the Pleistocene and Holocene epochs.

Justification (943 of 2,500)

After bans on intentional culling in Southeast Alaska and Canada in the 1970s, the population of *Eumoetopias jubatus* has increased ever since, leaving it at the status of "Near Threatened" when looking to the IUCN Red List (Calkins, 1988). However, the reasons for the large declines in *E. jubatus* are unclear, but the threat of environmental variability is classified as

"potentially high" (Gelatt & Lowry, 2012). Although there is an array of evidence supporting global climate change with mammalian evolution, there is limited published research linking its impacts on *E. jubatus* (Trites, 2007). The large decline in *E. jubatus* has been a point of fixation for the international community beyond wildlife conservationists because of its dramatic decline in such a short period of time. Any results involved in this investigation can be potentially useful in better understanding the impact that global climate patterns have on marine mammals in the region (Sydeman & Allen, 1994).

Research Plan (1,709 of 2,500)

My research efforts will be a combined use of in-person research alongside the utilization of the Paleobiology Database and data sets provided by the International Ocean Discovery Program. I plan on travelling to the Alaska SeaLife Center, to collaborate with researchers that focus their work on *Eumoetopias jubatus*. My plan is to collaborate with scientist Katie Christie, as she specializes in using innovative quantitative techniques to understand how wildlife populations interact with and respond to their environment. I hope to gather information on the species abundance and body mass distributions from collaboration, as well as the many resources at the Alaska SeaLife Center. Information about geographic range size will be downloaded as "Spatial" data from the IUCN Red List of Threatened Species. The data sets for marine temperatures in the Pacific northeast will be obtained from the International Ocean Discovery Program. This data is collected from deep-sea cores that are drilled at various points in the Pacific northeast. This information will have to be filtered for the coordinates that correspond to the geographic range distribution in the Pacific Ocean. All data will be restricted to the Pleistocene and Holocene epochs, as the fossil record for *Eumoetopias jubatus* only dates as this far back.

In terms of analysis, I will be using R statistical software. I plan to order all data sets in chronological order and then plan to conduct individual levels of analysis, comparing Pacific benthic foraminiferal oxygen isotope ratios to species abundance, body mass distributions and geographic range dispersion by the means of statistical significance through a t-test (p-value=0.005).

References (1,683 of 2,500)

Alroy, John, Paul L. Koch, and James C. Zachos. "Global climate change and North American mammalian evolution." *Paleobiology* 26.sp4 (2000): 259-288.

Calkins, Donald Gary, and Enid Goodwin. *Investigation of the declining sea lion population in the Gulf of Alaska*. Alaska Dept. of Fish and Game, 1988.

Gelatt, T. & Lowry, L. 2012. *Eumetopias jubatus*. The IUCN Red List of Threatened Species 2012: e.T8239A17463451. http://dx.doi.org/10.2305/IUCN.UK.2012.RLTS.T8239A17463451.en. Downloaded on **03 April 2016**.

Pascual, Miguel A., and Milo D. Adkison. "The decline of the Steller sea lion in the Northeast Pacific: Demography, harvest or environment?." *Ecological Applications* 4.2 (1994): 393-403.

Sydeman, William J., and Sarah G. Allen. "Pinniped population dynamics in central California: correlations with sea surface temperature and upwelling indices." *Marine Mammal Science* 15.2 (1999): 446-461.

Trites, A. W., Miller, A. J., Maschner, H. D. G., Alexander, M. A., Bograd, S. J., Calder, J. A., Capotondi, A., Coyle, K. O., Lorenzo, E. D., Finney, B. P., Gregr, E. J., Grosch, C. E., Hare, S. R., Hunt, G. L., Jahncke, J., Kachel, N. B., Kim, H.-J., Ladd, C., Mantua, N. J., Marzban, C., Maslowski, W., Mendelsson, R., Neilson, D. J., Okkonen, S. R., Overland, J. E., Reedy-Maschner, K. L., Royer, T. C., Schwing, F. B., Wang, J. X. L. and Winship, A. J. (2007), Bottom-up forcing and the decline of Steller sea lions (*Eumetopias jubatus*) in Alaska: assessing the ocean climate hypothesis. Fisheries Oceanography, 16: 46–67.

Zachos, J., Pangani, M., Sloan, L., Thomas, L., Billups, K. “Trends, Rhythms, and Abberations in Global Climated 65 Ma to Present. *Science*. 27 April 2001: 686-693.