MS Thesis
Department of Environmental Science and Policy
George Mason University

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Title: A STUDY IN A MINIMALLY DESTRUCTIVE METHOD OF ANCIENT DNA EXTRACTION IN NARWHAL (*MONODON MONOCEROS*) TUSK MATERIAL

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ABSTRACT

Narwhals (*Monodon monoceros*) are elusive animals, and have inspired myths, legends, and awe for centuries, which is exacerbated by their inaccessibility in the heavily iced high Canadian Arctic waters. With a current "Near Threatened" classification by the International Union for Conservation of Nature and Natural Resources (IUCN) and a total population estimate of roughly 80,000 animals, unlocking the genetic code of this species may be the key to beginning to unravel much of the mystery that surrounds them, both in the past and the future. This study compared a drilling method and a grinding method to provide a reliable, minimally destructive method to extract ancient narwhal DNA from samples that need to remain physically unmarred for display purposes. Short pieces of unprocessed pre-1972 narwhal tusk (n = 50) have been obtained from Pond Inlet, Nunavet Canada. This study utilized narwhal cytochrome *b* mitochondrial DNA (mtDNA) data from the National Center for Biotechnology Information's (NCBI) GenBank, where two primers, NAR-4 (581 bp) and NAR-6 (241 bp), were created for use in Polymerase Chain Reaction (PCR). Using a grinding technique on the tusk surface, the study outlines a reliable method to extract ancient deoxyribonucleic acid (DNA) from narwhal tusk and amplify it for further analysis using PCR. The amplified DNA from the grinding method was compared to the traditional drilling method using electrophoresis and the grinding method yields the same level of amplification of DNA as the drilling method. The extracted DNA was then sequenced using the designed primers and compared to narwhal mitochondrial DNA samples in GenBank to positively confirm narwhal as the sample's identity. This study's grinding technique caused a significant reduction in physical marring to the surface of the narwhal tusk samples and provides evidence for a reliable method to extract ancient narwhal DNA while preserving historical samples for unmarred display.