A Tale of Two Tusks

SADJ October 2021, Vol. 76 No. 9 p515

GH Sperber[1]

ABSTRACT

A record of the environment in which an Arctic Woolly Mammoth and a Narwhal existed is embedded in their dentitions. Variations in the landscapes and marine environments in which the animals lived is recorded in their post-mortem tusks. Odontographic evidence stored in teeth can provide an historic record of an animals' life experiences.

Key Words

Tusks; Mammoths; Narwhals.

Of all the categories of recorded evidence of life experiences, none exceeds that of the information buried within teeth. As the most durable of all tissues of once-living bodies, dentitions can provide post-mortem documentation of nutritional intake and metabolic disturbances during a past lifetime. Odontographic evidence stored in continually- growing tusks can provide an historic record of life experiences of an animal. By analyzing the biogeochemical markers in tusks, insights can be gained into the foraging ecology of an animal. Foods eaten not only impact the surfaces of teeth but also provide biochemical and biomechanical evidence of the characteristics of ingested foods. Rough diets score scratches and and pitting imprints on dental surfaces, allowing interpretation of the dietary environment. Acidic foods lead to enamel erosion.

The example of the neonatal line in the teeth of human infants demarcating the transition from breast feeding to masticatory nutritional intake provides odontological evidence of the altered nature of dietary intake.

Arctic Woolly Mammoth (Mammuthus primigenius) Tusk

The tracings of an extinct woolly mammoth's travels more than 17,000 years ago have been revealed in a study of the tusk of the extinct creature[1]. For the first time, scientists have translated the chemicals in an ancient tusk to reveal a prehistoric biography. The continuous eruption of the tusks throughout life provides an unprecedented insight into the environment in which the animal lived. Study of the isotopes of strontium deposited in the tusks of a woolly mammoth provided evidence of the geology of the environment through which the animal moved. The varying isotope data indicated four significant life stages: neonate, juvenile, adult and the last 1.5 years of life. During its life, scientists have translated the tusk's chemicals in the first two years of the animal's life.

Dental isotope data provided evidence of breast feeding during this time. The tip of the tusk revealed a young mammoth with minimal strontium variation. As a juvenile, (2-16 years) represented by the next 75 cms of tusk, strontium variation revealed a larger range of dietary intake. After the animal's teenage years, isotopic variations in the tusk revealed immense differences in dietary intake, reflecting its travels. After 16 years, a distinct transition of Strontium variation and other isotopic variations reflected a transition to sexual maturity and travels in response to seasonal changes and food availability. A distinctive isotope pattern recorded at the base of the tusk showed the telltale hallmark of starvation. At the base of the tusk, representing the last 1.5 years of its life, the mammoth's range was restricted, reflected in the tusk's composition that indicated starvation[2]. The strontium and nitrogen values in the root of the two-meter-long tusk established the age of death at a relatively early 28 years.

Author affiliations:

1. **Geoffrey H Sperber:** *BSc(Hon), BDS, MSc, PhD, Dr Med Dent,FICD,* FRSSAf.School of Dentistry, Faculty of Medicine & Dentistry, University of Alberta, Edmonton, Alberta, Canada. ORCID Number: 0000-0002-2590-6197

Corresponding author:
Geoffrey H Sperber
E-mail: gsperber@ualberta.ca

Narwhal (Monodon monocerus) Tusk

As its Latin Zoological classification, "Monodon" implies, a single toothed whale describes the species. Narwhal tusks are predominantly confined to the males of the species and are usually unilateral, representing the left canine tooth. The tusk can reach a length of up to nine feet and exhibit a left-handed spiral pattern. The tusk lacks an enamel covering, being covered by cementum[3]. The main tissue component is dentine, providing the dentine composition with dentinal tubules and an extraordinary sensory ability[4]. As a continually growing tooth throughout life, narwhal tusks provide an unprecedented opportunity to analyze the marine environment in which narwhals exist. The biochemical evidence contained within their tusks provides an opportunity to analyze the lifelong feeding ecology and mercury exposure in the seas in which they live[5].

The continuous growth of a narwhal's tusk provides a time-lapse record of the environment in which it lived. Arctic climate change and mercury exposure are revealed in the rapidly warming and environmental contamination of the ocean. The reduced sea-ice and pollution of the seas are being revealed in the migrations of narwhals by identification of the changing biochemical constitution of their continually growing tusks. Recent chemical analyses of narwhal tusks reveal a steep increase in tusk mercury accumulation[6].

Summary

The role of teeth in recording dietary changes and environmental climate variation is identified in two species- one land based (mammoth) and the other marine based (narwhal). The post-mortem permanence of their dentitions provides insights into the feeding ecology and past eras in which the animals lived.

References

1. 1.Wooller MJ, Bataille C et al. Lifetime mobility of an Arctic woolly mammoth. Science 373:806-808. (2021).
2. Uno KT et al. Palaeogeogr.Palaeoclimatol. Palaeoecol 559:109962 (2020).
3. Nweeia MJ, Eichmiller FC et al. Vestigial tooth anatomy and tusk nomenclature for Monodon monoceros. Anat Rec 295(6):1006-1016 (2012).
4. Nweeia MJ, Eichmiller FC et al. Sensory ability of the narwhal tooth organ system. Anat Rec 297(4):599-617 (2014).
5. Dietz R, Desforges J-P et al. Analysis of narwhal tusks reveals lifelong feeding ecology and mercury exposure. Current Biol. 31:2012-2019 (2021).
6. Chambault P, Tervo OM et al. The impact of rising sea temperatures on an Arctic top predator, the narwhal. Sci Rep 10:18678 (2020).