Duck-billed dinosaurs endured long, dark polar winters

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This is an *Edmontosaurus* bone that was excavated in Alaska and tested at Temple University. Credit: Preston M. Moretz/Temple University

Duck-billed dinosaurs that lived within Arctic latitudes approximately 70 million years ago likely endured long, dark polar winters instead of migrating to more southern latitudes, a recent study by researchers from the University of Cape Town, Museum of Nature and Science in Dallas and Temple University has found.

The researchers published their findings, "Hadrosaurs Were Perennial Polar Residents," in the April issue of the journal *The Anatomical Record: Advances in Integrative Anatomy and* Evolutionary Biology. The study was funded through a grant from the National Science Foundation.

Anthony Fiorillo, a paleontologist at the Museum of Nature and Science,

excavated Cretaceous Period fossils along Alaska's North Slope. Most of the bones belonged to *Edmontosaurus*, a duck-billed herbivore, but some others such as the horned dinosaur Pachyrhinosaurus were also found.

Fiorillo hypothesized that the microscopic structures of the dinosaurs' bones could show how they lived in polar regions. He enlisted the help of Allison Tumarkin-Deratzian, an assistant professor of earth and environmental science, who had both expertise and the facilities to create and analyze thin layers of the dinosaurs' bone microstructure.

Another researcher, Anusuya Chinsamy-Turan, a professor of zoology at the University of Cape Town, was independently pursuing the same analysis of Alaskan *Edmontosaurus* fossils. When the research groups discovered the similarities of their studies, they decided to collaborate and combine their data sets to provide a larger sampling. Half of the samples were tested and analyzed at Temple; the rest were done in South Africa.

"The bone microstructure of these dinosaurs is actually a record of how these animals were growing throughout their lives," said Tumarkin-Deratzian. "It is almost similar to looking at tree rings."

What the researchers found was bands of fast growth and slower growth that seemed to indicate a pattern.

"What we found was that periodically, throughout their life, these dinosaurs were switching how fast they were growing," said Tumarkin-Deratzian. "We interpreted this as potentially a seasonal pattern because we know in modern animals these types of shifts can be induced by changes in nutrition. But that shift is often driven by changes in seasonality."

The researchers questioned what was causing the dinosaurs to be under

stress at certain times during the year: staying up in the polar region and dealing with reduced nutrition during the winter or migrating to and from lower latitudes during the winter.

They did bone microstructure analysis on similar duck-billed dinosaur fossils found in southern Alberta, Canada, but didn't see similar stress patterns, implying that those dinosaurs did not experience regular periodic seasonal stresses. "We had two sets of animals that were growing differently," said Tumarkin-Deratzian.

Since the Alaska fossils had all been preserved in the same sedimentary horizon, Fiorillo examined the geology of the bonebeds in Alaska where the samples were excavated and discovered that these dinosaurs had been preserved in flood deposits.

"They are very similar to modern flood deposits that happen in Alaska in the spring when you get spring melt water coming off the Brooks Mountain Range," said Fiorillo. "The rivers flood down the Northern Slope and animals get caught in these floods, particularly younger animals, which appear to be what happened to these dinosaurs.

"So we know they were there at the end of the dark winter period, because if they were migrating up from the lower latitudes, they wouldn't have been there during these floods," he said.

"It is fascinating to realize how much of information is locked in the bone microstructure of fossil bones," said Chinsamy-Turan. "It's incredible to realize that we can also tell from these 70 million-year-old bones that the majority of the polar hadrosaurs died just after the winter season."

Provided by Temple University