Osteohistological Assessment of *Edmontosaurus* Radii from the Liscomb Bonebed, Prince Creek Formation, North Slope, Alaska

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INTRODUCTION

Hadrosaurs were one of the most diverse dinosaur groups in the Late Cretaceous period and are known for their numerous articulated skeletons and monodominant bonebeds (Wosik et al., 2020). They are more commonly known as duck-billed dinosaurs and are found globally including latitudinal extremes such as the arctic and Antarctica. *Edmontosaurus*, a genus of hadrosaur, are herbivores and are very large growing up to 8,000 pounds. *Edmontosaurus* were known to travel in herds as a defense mechanism and were one of the last non-avian dinosaurs living during the late Campanian stage through the end of the Maastrichtian stage, right up to the K-Pg boundary.

In previous research most *Edmontosaurus* bonebeds have only held 2-year-old individuals up through maturity. The one-to-two-year individuals seem to be missing in fossil records. The Liscomb bonebed is the only one known to preserve yearling sized individuals. These are presumed to be yearlings based on the size and anatomical structure of the fossils.

Figure 1. Image of an *Edmontosaurus*

RESEARCH QUESTION:

- Do the radii of *Edmontosaurus* from the Liscomb bonebed correlate with yearling-aged individuals?

BACKGROUND

The Prince Creek formation found in the North Slope of Alaska holds disarticulated *Edmontosaurus* specimen. Specimen in this bonebed are thought to have encountered minimal post-mortem alterations leaving the fossils well preserved. This region was known to have very harsh winters with over 100 days of complete darkness. The land at the time was thought to be a polar woodland and neighbored the Colville River as well as other large bodies of water creating a muddy coastal plain. The snowmelt causing seasonal floods in this region is thought to be the cause of all the fossils deposited in one spot.

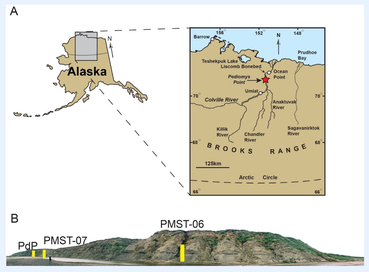


Figure 2. Prince creek formation location in the North Slope, Alaska

MATERIALS AND METHODS

Pre-Sectioning

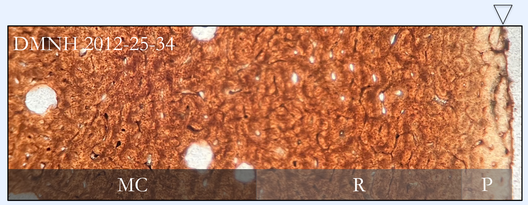
Six (6) Radii specimen were collected from the Perot Museum of Nature and Science and pre-sectioning steps were required to preserve the bones for the museum. The first step is to photograph each specimen. Using a Nikon camera, specimens were photographed at a series of angles covering the entirety of the bone surface. Photos were edited in Photoshop and then placed in a Agisoft PhotoScan software to get a 3D model of the specimen. Once modeled different measurements such as the length, width, and minimum circumference were taken.

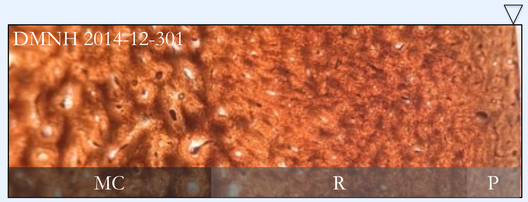
Post-Sectioning

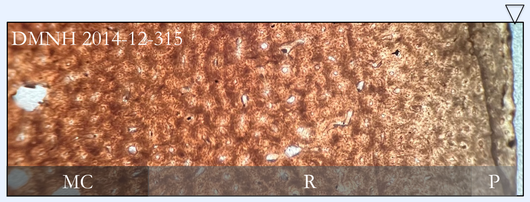
Once photographed, the first step for sectioning was to find the minimum circumference on the diaphysis of the bone and cut at this point. The smaller half was then taken and embedded in a resin block. This resin block was then glued to a plexiglass slide. Once set the Isomet machine was used to cut the resin block off leaving behind a 5 mm thick section of the bone on the slide. Further grinding and polishing was done to remove any saw marks and leave a nice thin section of the bone on the slide. The slide could then be observed under a microscope to study the histological structure.

RESULTS

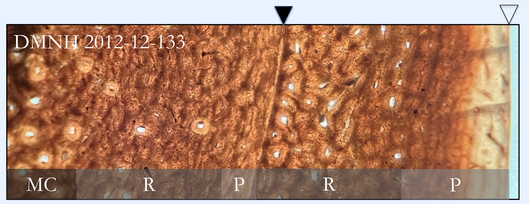
Class Size 1 – under 1 yr

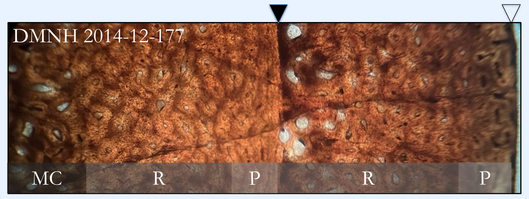




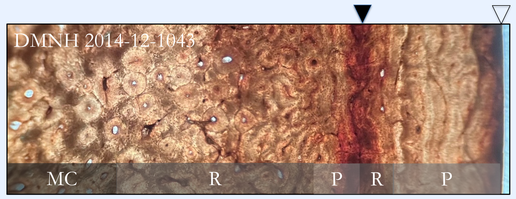


Class Size 2 – under 2 yrs





Class Size 3 – between 2-3 yrs



Class sizes were determined based on the outer circumference of the specimen where the section was made and based on the number of growth marks present. We divided the 6 radii into 3 different classes to further analyze the results. A solid black arrow represents a definite growth mark, and a clear arrow represents what we think may have been a growth mark beginning to form before death.

DISCUSSION

Osteohistology

In juvenile sized individuals they are growing at very rapid rates due to the presence of reticularly oriented vascular canals and woven fibered bone and have a very disorganized growth pattern. They have very large medullary cavities with reticular growth following this. Due to the rapid growth the bone structure is very disorganized. As the individual grows it will start to slow its growth rate, switching to a plexiform style that is slightly more organized.

Determining the age of individuals is done by looking at growth marks, which have been interpreted as annual growth cycles in modern taxa. These are points where the vascular orientation is changing patterns and creating a clear ring across the entire circumference of the cross section. One growth mark would show the individual is still in the early stages of its life whereas having more growth marks represents an older individual. These growth marks may appear as an individual goes through an environmental stressor, such as low resource allocation, and is therefore slowing their growth.

Analyzing Results

When looking at class size 1 these had the smallest circumference (54-59mm) of the specimen, and all of these have no growth marks. On specimen DMNH 1012-25-34 and DMNH 2014-12-301 one can see the border start to transition to a plexiform orientation showing that growth is slowing down and may be approaching the first growth mark when the organisms' died. Class size 2 were a slightly larger specimen (68-75mm circumference) and both have one growth mark present. The second growth mark may have been approaching but the organisms died before it appeared. Lastly, we classified one organism in class size 3 (91mm circumference) and this organism had one definite growth mark and another possible one near the periosteal surface.

Overall, we can conclude that most of these individuals are within their first 2 years of their life. There are definitely yearlings present from this bonebed and a few specimen above that yearling mark. The radii tell us that these specimen were not above the 2-year mark when they died and help confirm that this bonebed is mostly 1–2-year individuals.

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