

# Reopening the Mother's Day Quarry (Jurassic Morrison Formation, Montana) is Yielding New Information

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## ABSTRACT

The Mother's Day Quarry (MDQ) is a dinosaur-bearing bone bed in the Late Jurassic (Kimmeridgian) Morrison Formation located in Carbon County, Montana. First discovered in 1994, the quarry has yielded well over 2,500 elements after having been excavated for two seasons by crews from the Museum of the Rockies, and subsequently from 2000 to 2012 by teams from the Cincinnati Museum Center. Aside from approximately 12 theropod teeth and numerous skin impressions, all of the vertebrate remains are exclusively from the sauropod dinosaur *Diplodocus* sp. The fossil-bearing unit has been interpreted to be the result of a debris flow following a drought-induced mass mortality event.

The size of these *Diplodocus* elements is notable, as they range from 38% to 75% of the length of the same elements in the smallest adult *Diplodocus* specimen at the Carnegie Museum (CM-94). Initially, the consistently small sizes were interpreted as representing an age-segregated herd of juvenile to subadult individuals. More recently, however, histological evidence suggests that there were both subadult and adult animals comprising a herd of exclusively dwarfed individuals, caused by a decrease in growth rates.

The Bighorn Basin Paleontological Institute (BBPI) has resumed excavations at the MDQ each summer since 2017. Four theropod teeth and two skin impressions have been collected, as well as approximately 125 (updated) isolated or partially articulated *Diplodocus* elements, the modest sizes of which are consistent with the previously reported remains. Additionally, numerous pathologies have been observed on these elements, including a well excavated furrow on the mediobasal portion of an ulna, as well as several rib fractures showing differing levels of reactionary bone growth.

The prevalence of pathologies observed on these BBPI-collected elements suggests that hundreds may be present on the previously collected remains. A systematic study of those pathologies may yield important information about the life histories of these iconic sauropods, and contribute to the subadult vs. dwarf population discussion.

## THE MOTHERS DAY QUARRY 1994-2012

Excavated by the Museum of the Rockies in 1994 and 1995, and by the Cincinnati Museum of Natural History & Science for 11 seasons between 1996 and 2012, the MDQ preserves a drought-induced mass mortality event in which a mono-dominant, age-segregated\* herd of *Diplodocus* was transported & preserved by a high-density debris flow following potentially monsoonal rains (Myers & Fiorillo, 2009; Meyers & Storrs, 2007; Storrs et al., 2013; Woodward et al., 2018). Those excavations yielded:

- >2,500 elements, including skin impressions
- Taphonomic evidence suggests a single mass-mortality event following a period of drought and desiccation
- Every element (except ~12 theropod teeth) are from *Diplodocus* sp.
- Minimum Number of Individuals is 15, based on right metatarsal I
- Each *Diplodocus* sp. element is 38 - 75% of the size of the smallest adult (Carnegie Museum CM-94)
  - \*Initially interpreted to represent an age-segregated herd of juvenile to subadult individuals
  - \*More recent evidence may suggest a herd of exclusively dwarfed individuals
- Sedimentological & taphonomic evidence suggests a high-density debris flow transported and deposited the fossil remains a short distance (<0.25 miles)

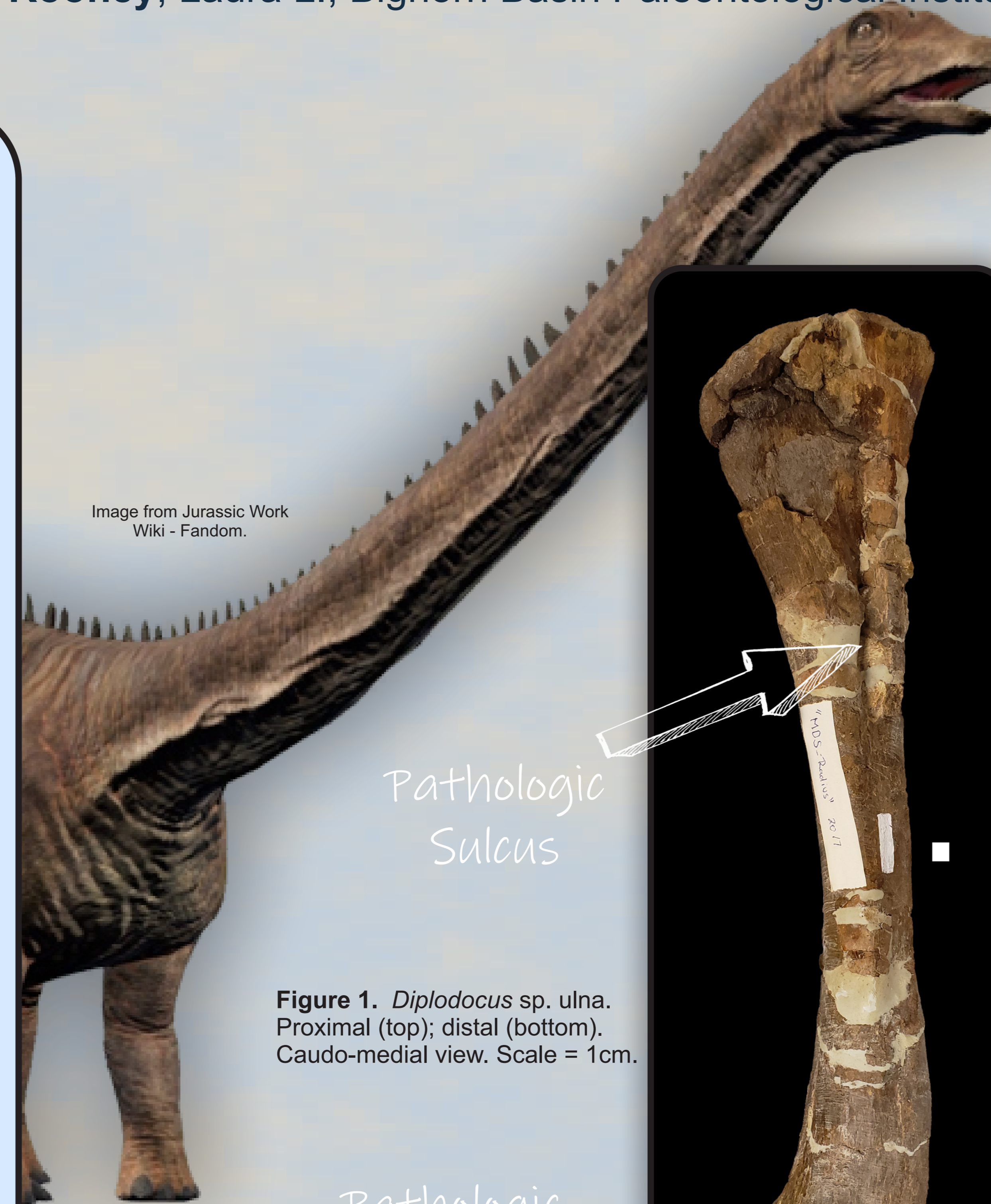


Figure 1. *Diplodocus* sp. ulna. Proximal (top); distal (bottom). Caudo-medial view. Scale = 1cm.

Figure 2. *Diplodocus* sp. cervical rib. Proximal (left); distal (right). Scale = 1cm.



## THE MOTHERS DAY QUARRY 2017-2019

The BBPI resumed excavations at the Mother's Day Quarry each field season since 2017. In that time, we have excavated approximately:

- >125 additional elements, including;
  - 4 theropod teeth
  - 4 skin impressions
  - numerous partially articulated elements
- All of the elements continue to be relatively small relative to adult *Diplodocus* sp.
- numerous elements are loosely fused, suggesting ontogenetically young individuals

## PATHOLOGIES

Numerous pathologies have been identified on the newly collected specimens. These include:

- a well excavated sulcus on the proximomedial surface of an ulna (Fig. 1)
- several rib fractures showing differing levels of reactionary bone growth and bifurcation (Fig. 2)

Further analysis of the pathological features and their prevalence among all Mother's Day material is likely to provide important additional information on the life histories of this common North American Late Jurassic taxon. Just as importantly, it may provide new insights into the ongoing "subadult vs. dwarf population" discussion.

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