

Post-Cranial Remains from a *Subhyracodon* Bonebed from the Brule Formation of Niobrara County, Wyoming, USA

Sydney Becker¹, Nathan Michaelson^{2,3}, Bailey Jørgensen³, and Mairin Balisi³

¹ The Webb Schools, Claremont, California, USA; ² Science Illustration Certificate Program, California State University - Monterey Bay, USA; ³ Raymond M. Alf Museum of Paleontology, Claremont, California, USA



Introduction

- Rhinocerotidae (Perissodactyla):
 - Long disappeared from North America and now globally endangered
 - Previously plentiful: at least 14 genera in North America over the last 40 million years (5)
- *Subhyracodon occidentalis*:
 - Extinct genus of small hornless rhinoceros
 - Widespread across the High Plains (Fig. 1), including in the Brule Formation (White River Group):
 - 34 to 33 million years old
 - Exposures in South Dakota, Nebraska, Colorado, North Dakota, Wyoming
 - Represent stream and floodplain deposits that developed in savannah-like environments (2)

This study aims to describe specimens preserved in a bonebed of Subhyracodon occidentalis from the Brule Formation of Wyoming, and potentially draw inferences about Subhyracodon behavior and ecology using common taphonomic metrics.

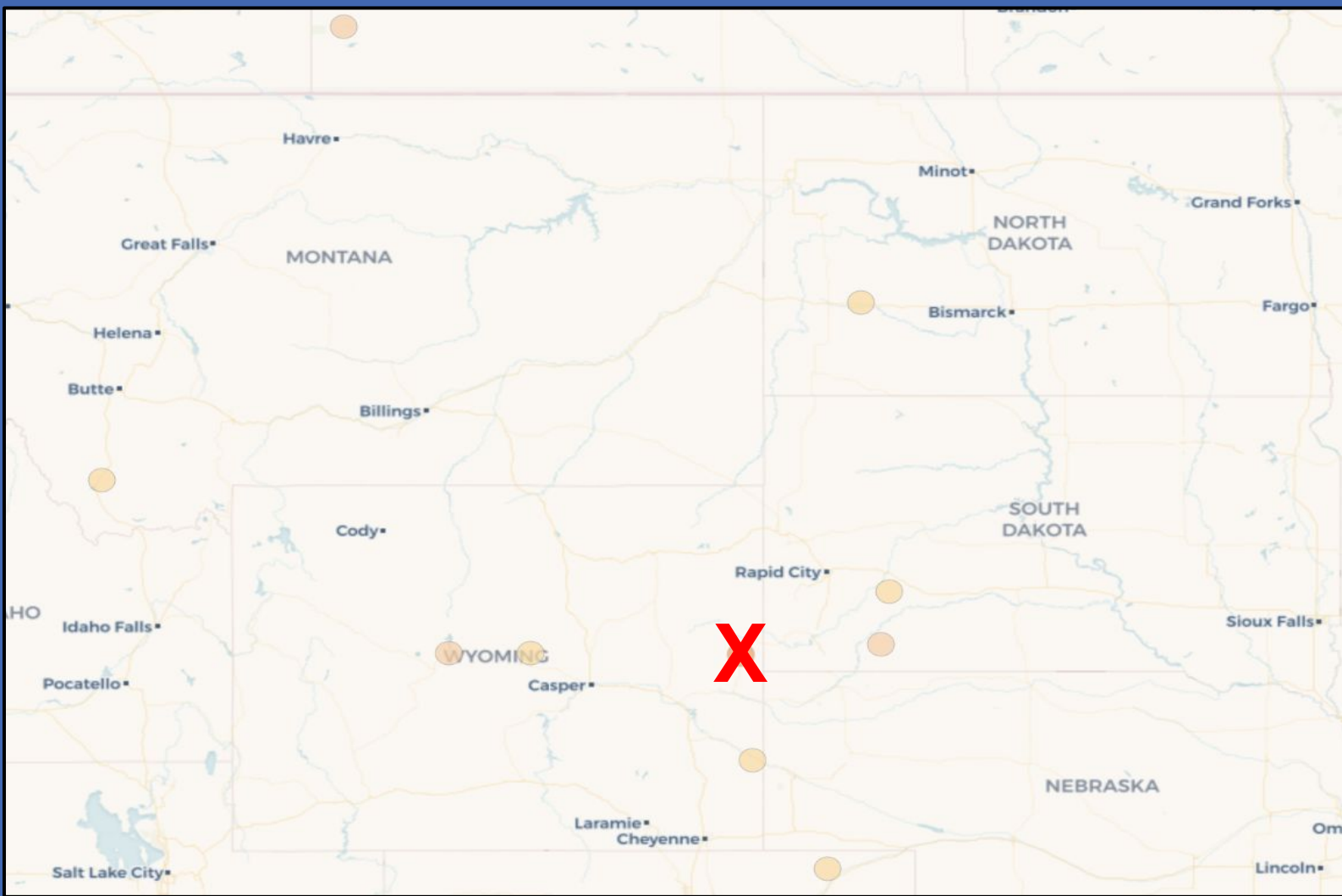


Figure 1. Localities (circles) in the High Plains where *Subhyracodon occidentalis* has been found. Red X marks Nuttal Ranch / Rhino Quarry locality where specimens for this study were collected by RAM field parties. Image source: Paleobiology Database.

Acknowledgements

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References

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Materials & Methods

- Site: Nuttal Ranch or Nuttal Rhino Quarry
 - Early Oligocene deposit in Niobrara County, Wyoming, USA (T 34 N, R 67 W, Sec. 26 N ½, NE ¼; Sec. 25 N ½, NW; Fig. 1)
 - Hundreds of preserved *Subhyracodon* bones
 - Some specimens in Frick collection at American Museum of Natural History (5)
 - Collection at Raymond M. Alf Museum likely by field parties led by Grant Meyer in the 1980s
- Sample: *Subhyracodon occidentalis* post-cranial specimens
 - $n=382$, excluding ribs
 - Assessment focused on forelimb and hindlimb:
 - Identified and sided bones (humerus, radius, ulna, femur, tibia)
 - Categorized as either Juvenile or Adult
 - Juvenile status determined based on the presence of unfused epiphyses (e.g., Fig. 2)
- Taphonomic abundance metrics (as in (4) and (7)):
 - Number of Identified Specimens (NISP)
 - Minimum Number of Elements (MNE)
 - Minimum Number of Individuals (MNI)

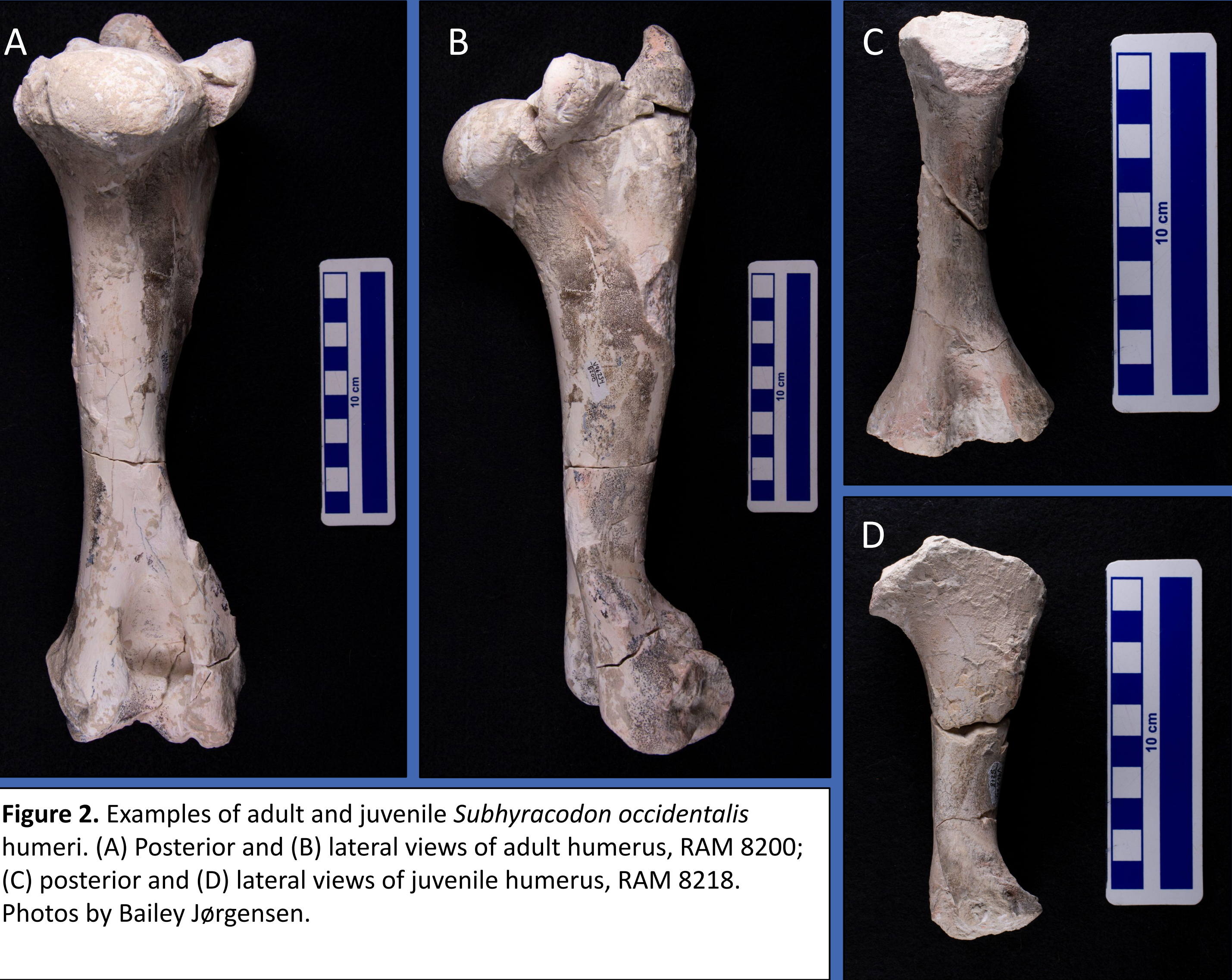


Figure 2. Examples of adult and juvenile *Subhyracodon occidentalis* humeri. (A) Posterior and (B) lateral views of adult humerus, RAM 8200; (C) posterior and (D) lateral views of juvenile humerus, RAM 8218. Photos by Bailey Jørgensen.

Results

- Most Abundant Long Bones:
 - Humerus (NISP=27, MNE=20)
 - Femur (NISP=25, MNE=17)
 - Tibia (NISP=18, MNE=18)
- Minimum Number of Individuals:
 - Total MNI across adult and juvenile = 11 (based on left humerus)
 - Juvenile MNI = 4 (based on right femur and left tibia)
 - Adult MNI = 9 (based on left and right humerus)
- Juvenile Minimum Number of Elements:
 - Forelimb elements number half as many as hindlimb elements (Fig. 3)

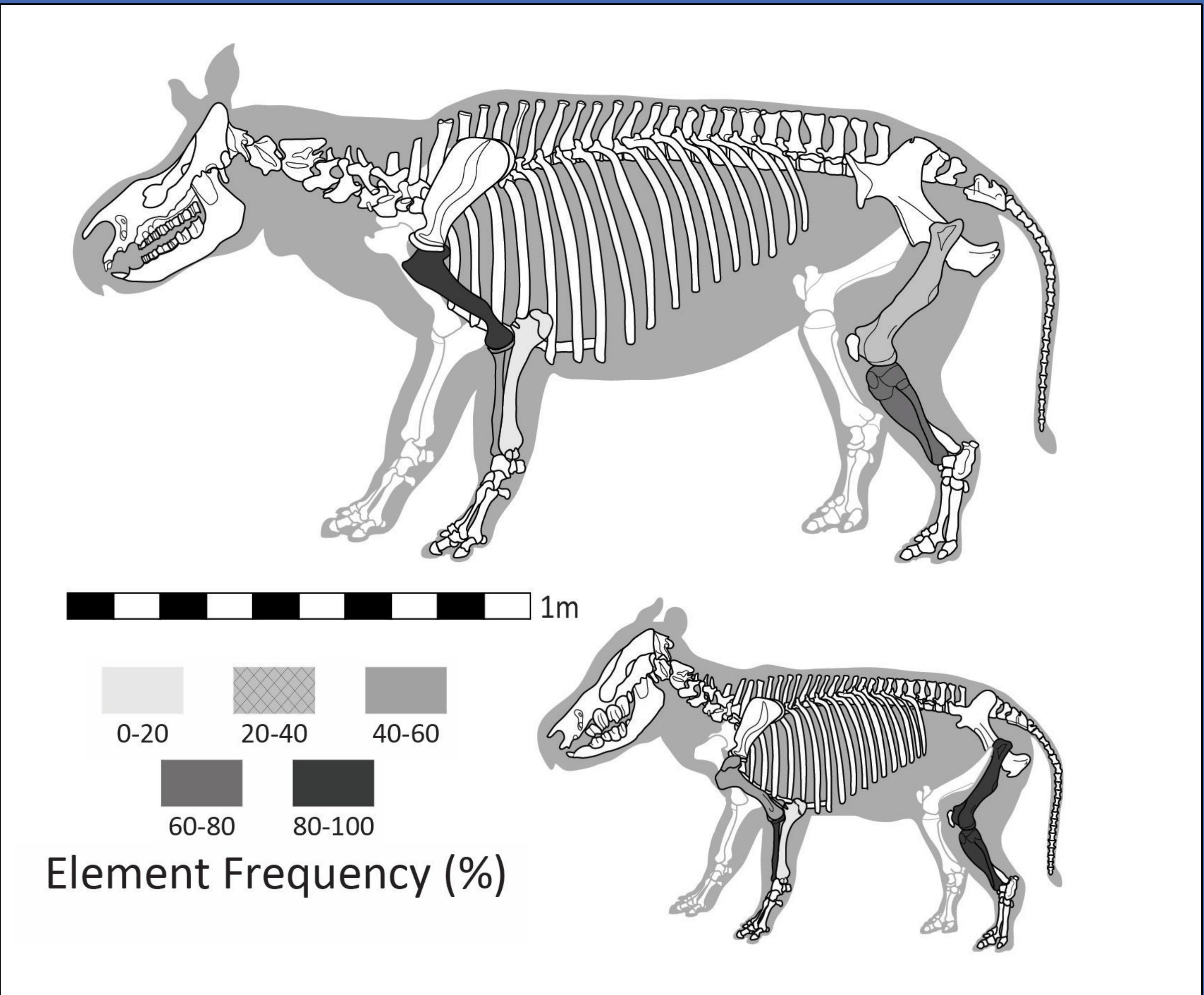


Figure 3. (A) Relative representation (% Minimum Animal Units (%MAU)) of forelimb and hindlimb elements of *Subhyracodon occidentalis* in the Raymond M. Alf Museum sample from the Nuttal Ranch bonebed. No distinction is made between left- and right-side elements. Bones in white are currently unstudied.

Discussion & Conclusion



Figure 4. Rendering of a *Subhyracodon* adult and juvenile in their likely paleoenvironment, a stream bank where fossils would have been preserved. The cooling of the Eocene saw temperate forests turning into grasslands and savannah; large sedges (Cyperaceae) became more prominent as well (1, 3, 8). A similar climate today can be found in Central and South America, where there are swamps, marshes, and riparian woodlands. One extant perissodactyl in this climate is the Baird's tapir (*Tapirus bairdii*), which inspired the adult and juvenile *Subhyracodon* coloration. Illustration by Nathan Michaelson.

- Adult to Juvenile Ratio (2.25 : 1):
 - Modern adult male rhinos are typically solitary, and gestation yields one calf -> expected 1:1 ratio
 - Observed *Subhyracodon* adult:juvenile ratio of 2.25:1 based on MNI suggests two possibilities:
 - Male and female adults cohabitating with juveniles, or
 - Predation or scavenging of juveniles
- Juvenile Hindlimb to Forelimb Ratio (2 : 1):
 - Forelimb elements more easily disarticulated from axial skeleton - suggests predation of juveniles
- Other Brule Formation localities:
 - Big Pig Dig in Badlands National Park, South Dakota preserves *Subhyracodon* alongside:
 - Other herbivores; e.g., entelodont *Archaeotherium*, deer-like *Leptomeryx*, horse *Mesohippus*
 - Predators: e.g., amphyconid *Daphoenus*, nimravids *Dinictis* and *Nimravus*
 - All of which could have preyed on *Subhyracodon* juveniles
- Future Directions:
 - Postcranial measurements to estimate body size and investigate sexual dimorphism (6)
 - Preliminary results: no sexual dimorphism, or too small of a sample to be conclusive
 - Body size estimates average 400 kilograms (in prep) - confirming *Subhyracodon* as a small rhino
 - Craniodental analysis as another examination of ontogeny
- **Conclusion:**
 - *Subhyracodon occidentalis* juveniles in the High Plains likely experienced predation
 - Social dynamics may have differed from modern rhinos, with males and females cohabitating