

A Vertebral Column of a False Saber-toothed Cat (*Dinictis*) from the Oligocene of South Dakota, USA

Saira Bhagat¹, Bailey Jorgensen², and Mairin Balisi (mbalisi@alfmuseum.org)²

¹The Webb Schools, Claremont, California, USA; ²Raymond M. Alf Museum of Paleontology, Claremont, California, USA

Introduction

Big Picture:

- “False saber-toothed cats” (Carnivora: Feliformia: Nimravidae) exemplify convergent evolution, demonstrating hypercarnivory independently derived from true cats (Felidae)
- Saber-tooth morphology not found in modern cats may suggest differences in ecomorphology, including in the spine
- Spinal structure may provide insight into locomotion, particularly spinal flexion, which could relate to predatory behavior

Study Taxon:

- *Dinictis*, a medium-sized nimravid from Oligocene age

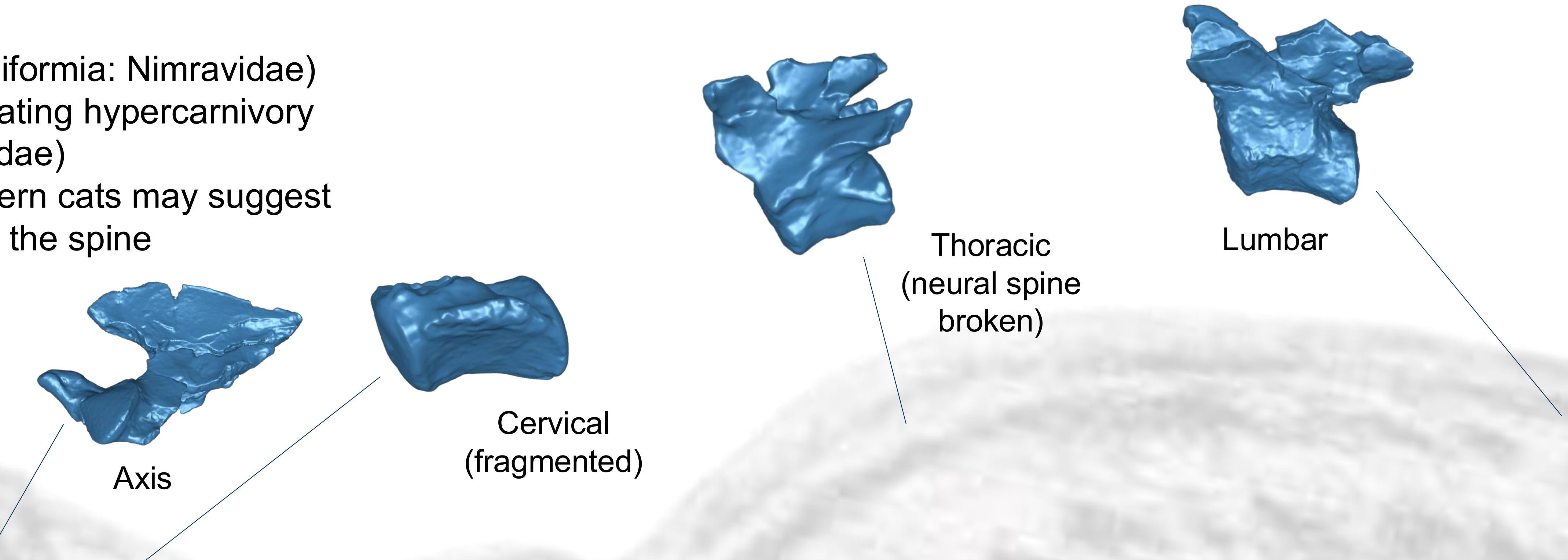
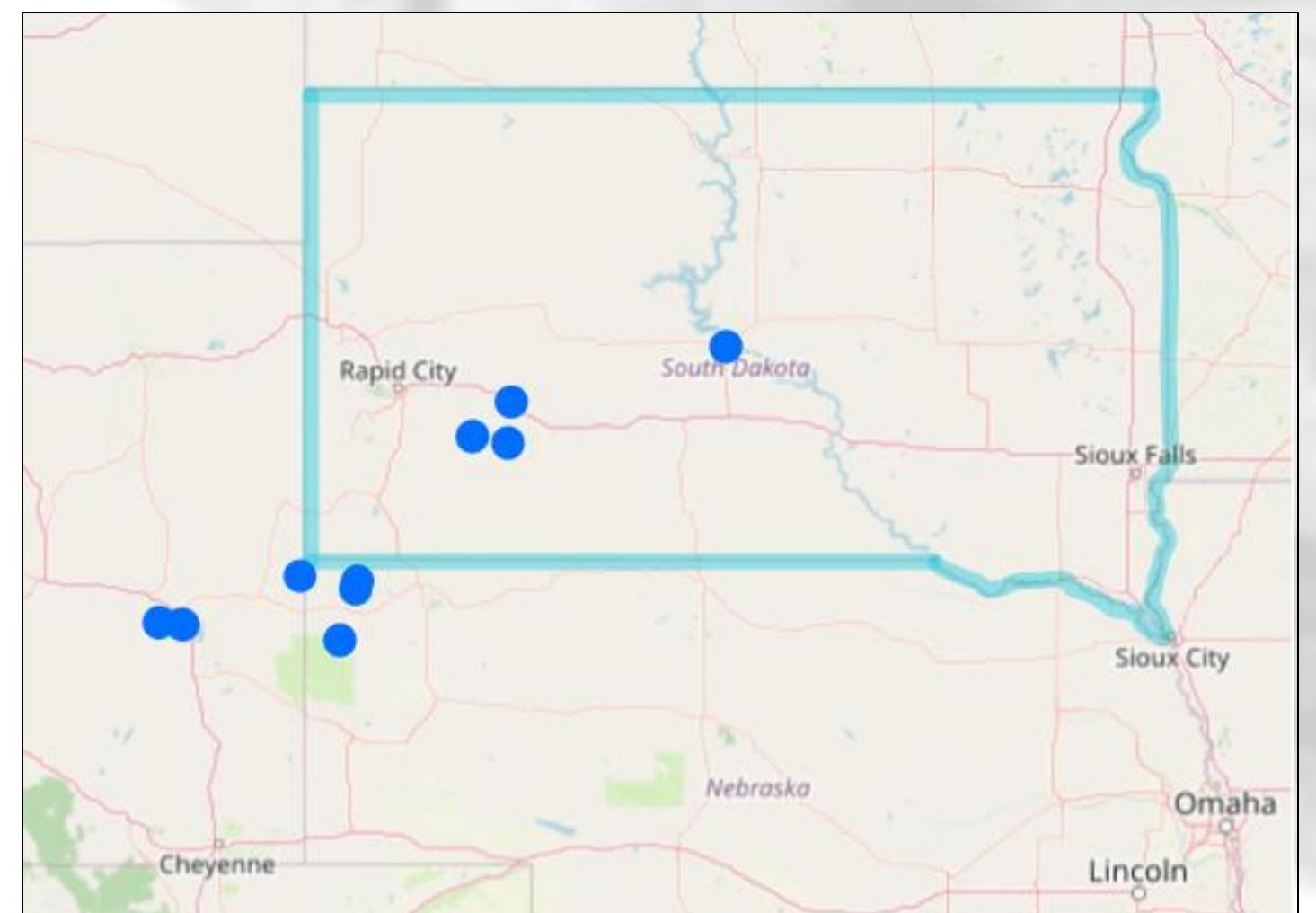


Figure 1. Localities (circles) in the Brule Formation of South Dakota (cyan outline) and Wyoming where *Dinictis* has been found, although the exact source of the current specimen is unknown. Image source: iDigBio.



Hypothesis:

- *Dinictis* hypothesized to pounce and grapple like modern clouded leopard (*Neofelis nebulosa*) and snow leopard (*Panthera uncia*) (Martin 1980)
- *Dinictis* post-crana possibly like that in modern felids of similar body size

Materials and Methods

Study Site:

- RAM locality V-94166, Brule Formation, White River Group, Pennington County, South Dakota, USA (Fig. 1)
- Orellian North American Land Mammal Age (33.9 - 31.8 Ma)

Specimen:

- *Dinictis* skeleton (RAM 3609), nicknamed “Buzz,” collected by the Alf Museum (RAM) in 1993
- Includes skull (not described here); and two cervicals, eight thoracic, & seven lumbar vertebrae + fragments (Fig. 2)

Methods:

- Measurements originally from Randau *et al.* (2016) (Fig. 3)
- Measurements modified for fragmentary vertebrae; custom protocol includes measuring under facets, estimating lengths from less fragmented sides, and taking lamina widths from below at the narrowest point of the centrum where appropriate
- Body mass estimated using regression based on condylobasal skull length & occipital-condyle width in modern felids (Fig. 4)
- Specimens 3D-surface-scanned using an EinScan Pro HD

- Results**
- Centrum lengths ranged from 17.9 (thoracic) to 31.4 mm (lumbar)
 - Estimated body mass: 19.2 - 30.2 kg, within the range of modern medium-sized felids (Fig. 4) - e.g., *N. nebulosa* (ca. 17 kg) and *P. uncia* (ca. 35 kg)

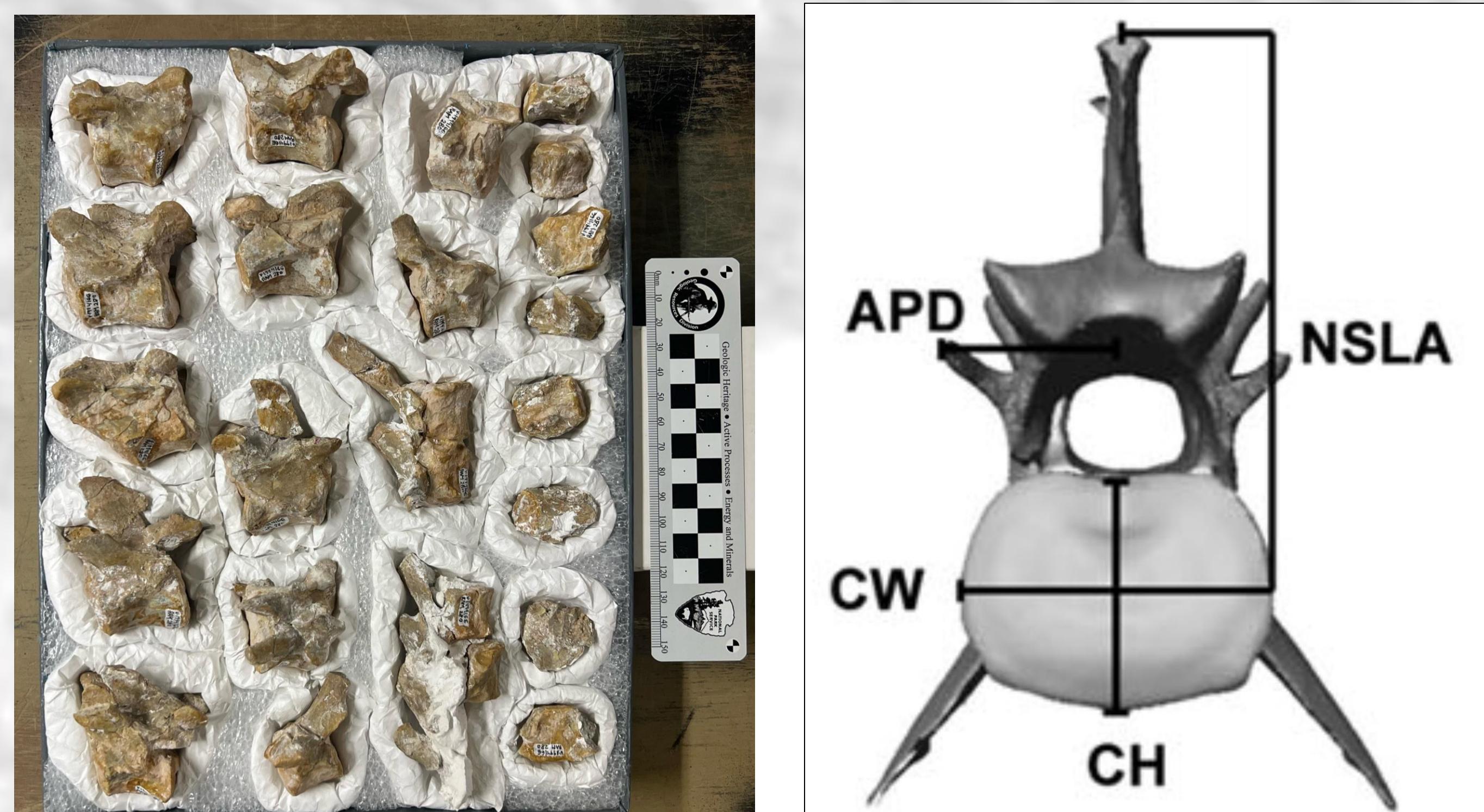


Figure 2. Vertebrae of *Dinictis* (RAM 3609) with scale bar.

Figure 3. Measurements from Randau *et al.* (2016) labeled on a thoracic vertebra. Because the neural spines were broken on most of our vertebrae, we prioritized metrics like centrum length (CL), centrum height (CH), and interzygapophyseal length (IZL).

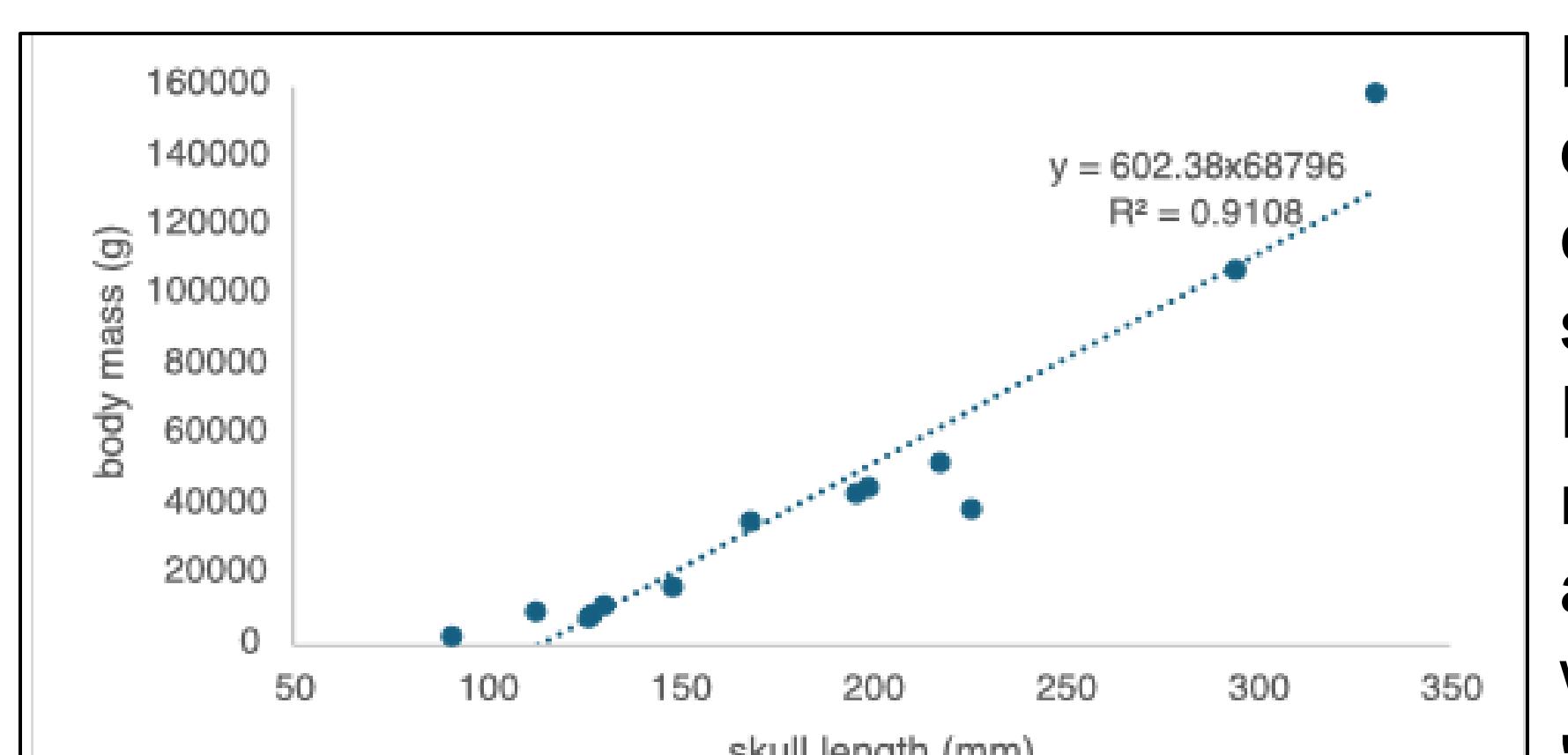


Figure 4. Felid-only regression developed using data on condylobasal skull length and body size in modern felids compiled in Engelman (2022). We applied the resulting equation, as well as another equation using condylobasal width, to estimate body size for “Buzz”.

Discussion & Conclusion

Dinictis vertebrae align with modern medium-sized felids

- Thoracic centrum length (avg. \approx 20.6 mm) in the range of smaller cats like bobcat and ocelot and shorter than those of larger felids like *P. uncia*
- Lumbar vertebrae show broader range (20.6–31.4 mm), suggesting potential flexibility in the lower back

Preliminary data on vertebrae support divergence in ecomorphology

- Comparison of pre- / post-zygopophyseal distances and transverse process angles may clarify if *Dinictis* shares spinal mechanisms with modern felids or had a distinct locomotion

Body structure suggests different movement style

- Without a long tail (despite the illustration here...), *Dinictis* likely had less balance than tree-climbing cats like *N. nebulosa*
- Saber teeth and body shape suggest a unique way of moving and hunting, not fully built for running or climbing

Next steps:

- 3D scanning and morphometric data of cervical, thoracic, and lumbar vertebrae and comparison with modern felid vertebrae to explore differences in movement and posture
- Comparison of vertebral lengths and angles to infer locomotor differences compared to extant medium-sized felids, including clouded leopard (*N. nebulosa*), snow leopard (*P. uncia*), ocelot (*Leopardus pardalis*), and bobcat (*Lynx rufus*)
- Future research may reveal information on the evolution of spinal function in false saber-toothed cats

Acknowledgements

- Thanks to Dr. Andrew Farke for his constant support.
- Jared Heuck meticulously restored and prepared the specimens.
- Omi Zhao & Theresa Chen scanned the specimens.
- Kylee Skinner followed morphological criteria in Barrett (2016) to ID the specimen as *Dinictis*.
- Thank you to Shining3D for training us in the use of the scanner.
- Funding comes from the Rogers Peccary Scholars program.

References

- (1) Engelman RK. 2022. *BMC Biology* 20:37.
- (2) Barrett PZ. 2016. *PeerJ* 4:e1658.
- (3) Barrett PZ. 2021. *Sci Rep* 11:21078.
- (4) Bryant HN. 1991. *J Mamm* 72:56–78.
- (5) Cuff AR, M Randau, J Head, JR Hutchinson, SE Pierce, A Goswami. 2015. *J Evol Biol* 28:1516–1525.
- (6) De Iuliis G & D Pulerà. *Dissection of Vertebrates* second edition.
- (7) Joeckel RM, S Peigné, RM Hunt, RI Skolnick. 2003. *J Vert Paleo* 22:830–847.
- (8) Martin LD. 1980. *Trans Nebraska Acad Sci* VIII:141–154.
- (9) Randau M, A Goswami, JR Hutchinson, AR Cuff, SE Pierce. 2016. *Zool J Linn Soc* 178:183–202.