Does oreodont morphology and their extinction correlate with grassland expansion in North America's central-western Great Plains?

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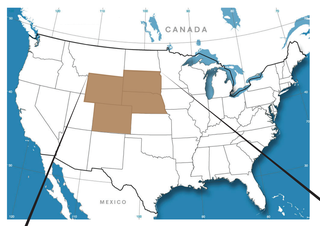
Introduction

Oreodonts are one of the most abundant, widespread, and diverse mammal groups in early Neogene North America. Yet, oreodonts went extinct in the late Miocene while other less abundant groups such as camels and peccaries survived. As grasslands expanded, open savannas replaced closed forests. This change increased selection for grazing morphologies reflecting a change of diet. As distances between feeding patches increased, efficiency of locomotive morphology (cursoriality) became more widespread among species of surviving mammals. To assess the response of oreodonts to environmental change, a series of mastication and cursorial traits were measured and tested for correlations with an increasingly open, grassland environment using Principal Component Analysis (PCA).

QUESTIONS

1. **What are the driving attributes in an oreodont morphospace?**
2. **Does oreodont morphospace occupation change through time?**
3. **Is a trend toward grazing morphologies observed?**
4. **How do the current, competing hypotheses of taxonomic relationships compare in an oreodont morphospace?**

Methods

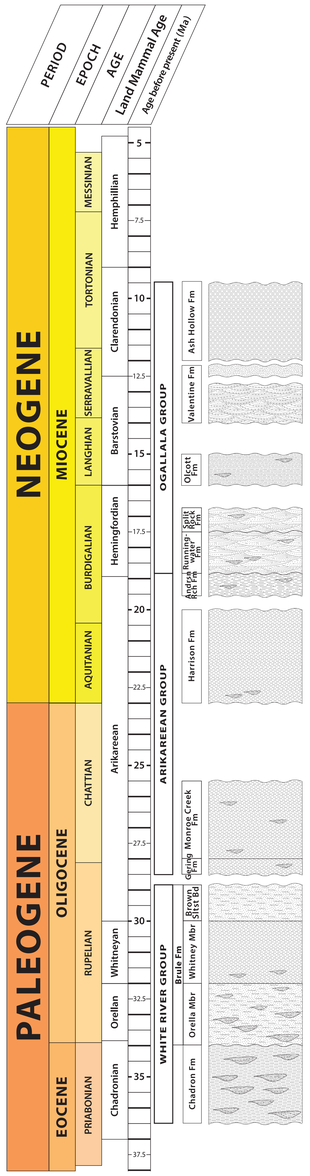


Specimen Data Summary

Data Set	No. Specimens	No. Specimens	Age Range (Ma)	Subfamily Groups	Crania	Mandibles	Associated Limbs
Complete	234	121	36.5 -9.5	8 of 8	171	150	104
Morphospace	111	55	34-9.5	8 of 8	108	74	na

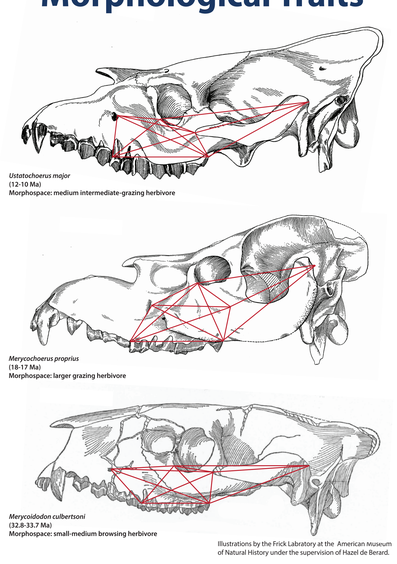
Data was gathered in collections at the American Museum of Natural History, the University of Nebraska State Museum, the Carnegie Museum of Natural History, and the Peabody Museum of Natural History.

Stratigraphy and Time



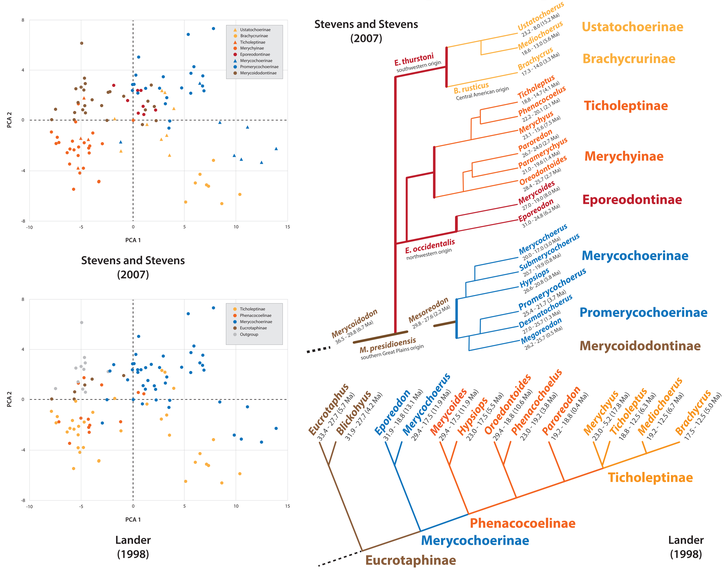
A generalized stratigraphic column of the North American central-western Great Plains (Joekel et al. 2017; Tedford et al. 2004; Prothero and Emry 2004; Swinehart et al. 1985).

Morphological Traits



Attributes measured (up to 69 per specimen) include 13 cranial traits to construct a 3D mesh of mastication, depicted in red. Illustrations not to scale and oriented for direct comparison.

Taxonomic Relationships Compared



Stevens and Stevens (2007) subfamily group identifications and relationships (top) and Lander (1998) subfamily group identifications and relationships (bottom) are applied to specimens in the morphospace.

Conclusions

1. Body size is the primary driving attribute in the oreodont moprhospace (43%) and is observed along PCA axis 1. Herbivory type is the secondary driving attribute (13%) and is observed along PCA axis 2.

2. Oreodonts start in the morphospace as small-medium browers followed by a period of size range expansion as they transition from browsing to an intermediate herbivore (generalists). This is followed by a second period of specializing in which two groups emerge, smaller intermediate herbivores and larger grazers. Finally, oreodonts return to a more generalist space of medium body size and intermediate herbivory type.

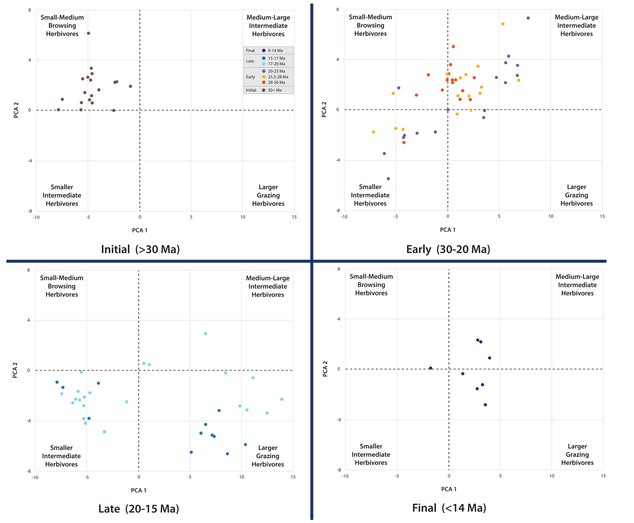
3. Although oreodonts trend through time toward a larger grazing specialized morphology, they return to a more generalist intermediate herbivory type just prior to their extinction.

4. Commonalities between the hypotheses of taxonomic relationships are supported overall in the oreodont morphospace. However, several opportunities for consideration of new traits in refining these relationships may be considered within the oreodont morphospace.

Morphospace

Trait correlations with PCA axis 1 (Body Size) and PCA axis 2 (Herbivory Type).

Morphospace Through Time



Morphospace occupation changes through time along PCA axis 1 (Body Size) and PCA axis 2 (Herbivory Type).

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