Patterns of Dental Morphology and Disparity in the Eocene Herbivore Lineage *Esthonyx* (Mammalia, Tillodontia)

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**ABSTRACT:** The extinct clade Tillodontia includes numerous species representing relatively common, specialized herbivores of the Paleogene. The Eocene (56–33.8 Ma) fossil record of the Bighorn Basin, Wyoming contains abundant fossils of the Tillodont lineage, *Esthonyx*. Due to the abundance of specimens and their specialized diet, *Esthonyx* provides a valuable case study in phenotypic variation during climatic change over an extended temporal scale. Our objective was to quantify morphological disparity along the tooth row and assess variation between species and through time. To evaluate patterns of dental variation within *Esthonyx*, we used landmark-based geometric morphometrics. Twelve landmarks representing prominent cusps and additional anatomical features in occlusal view of the lower fourth premolar and the three molars were digitized for analysis. Principal components analysis indicated that the majority of shape variation, though very slight, occurred within the trigonid. Along the tooth row, p4 and m3 possessed greater disparity than m1 and m2; however, those differences were not significant. When dental loci were examined by both species and temporal unit, distinct species groupings and temporal shifts were difficult to distinguish because of the well-conserved dental morphology within the lineage. In total, these results indicate that the lower dentition of *Esthonyx* is relatively conservative both along the tooth row, as well as between species and through time. The lack of evidence for morphologic change during significant climatic events may indicate low capacity for evolution and could have ultimately led to the extinction of this lineage.

**INTRODUCTION:**

- *Esthonyx*, a member of the extinct herbivore clade Tillodontia, was a relatively common taxon in the Eocene of Wyoming, a time of significant climatic fluctuation.
- Some herbivorous adaptations include a high trigonid, submolariform premolars, gliriform incisors, and hypsodont molars (Gingerich and Gunnell, 1979).
- Because little is known about their evolution, our objective was to describe dental variation along the tooth row and investigate patterns of inter-specific and temporal periods of climatic change.

**METHODS:**

- Specimens from the National Museum of Natural History: p4 (26), m1 (44), m2 (44), m3 (25).
- Geometric morphometrics was used for quantitative analysis of size and shape.
- 12 homologous landmarks (based on Wilson, 2013) in occlusal view were replicated 3 times in TPSdig2.
- Principal Component Analysis was performed in MorphoJ and disparity along the tooth row was assessed in MATLAB.

**CONCLUSIONS:**

Disparity along the tooth row: As seen in the PCA of all dental loci, there is a clear distinction of p4 and m3 morphology, while m1 and m2 are similar in morphology. This is similar to the pattern of constraint of m1 and m2 as seen in other mammals (Gingerich, 1974; Gingerich and Gunnell, 1979). Mean Pairwise Distance indicates p4 and m3 have greater disparity than m1 and m2; however, it is not statistically significant.

Inter-specific and temporal patterns: Distinct species groupings and trends through time were difficult to distinguish because of the well-conserved dental morphology within the *Esthonyx* lineage. This could be due to stabilizing selection as observed in other Eocene mammals (Wood et al., 2007), or suggest that there are taxonomic issues with the species.

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