

Reconstructing Bovid Diet from Dental Wear: a New Quantitative Mesowear Approach

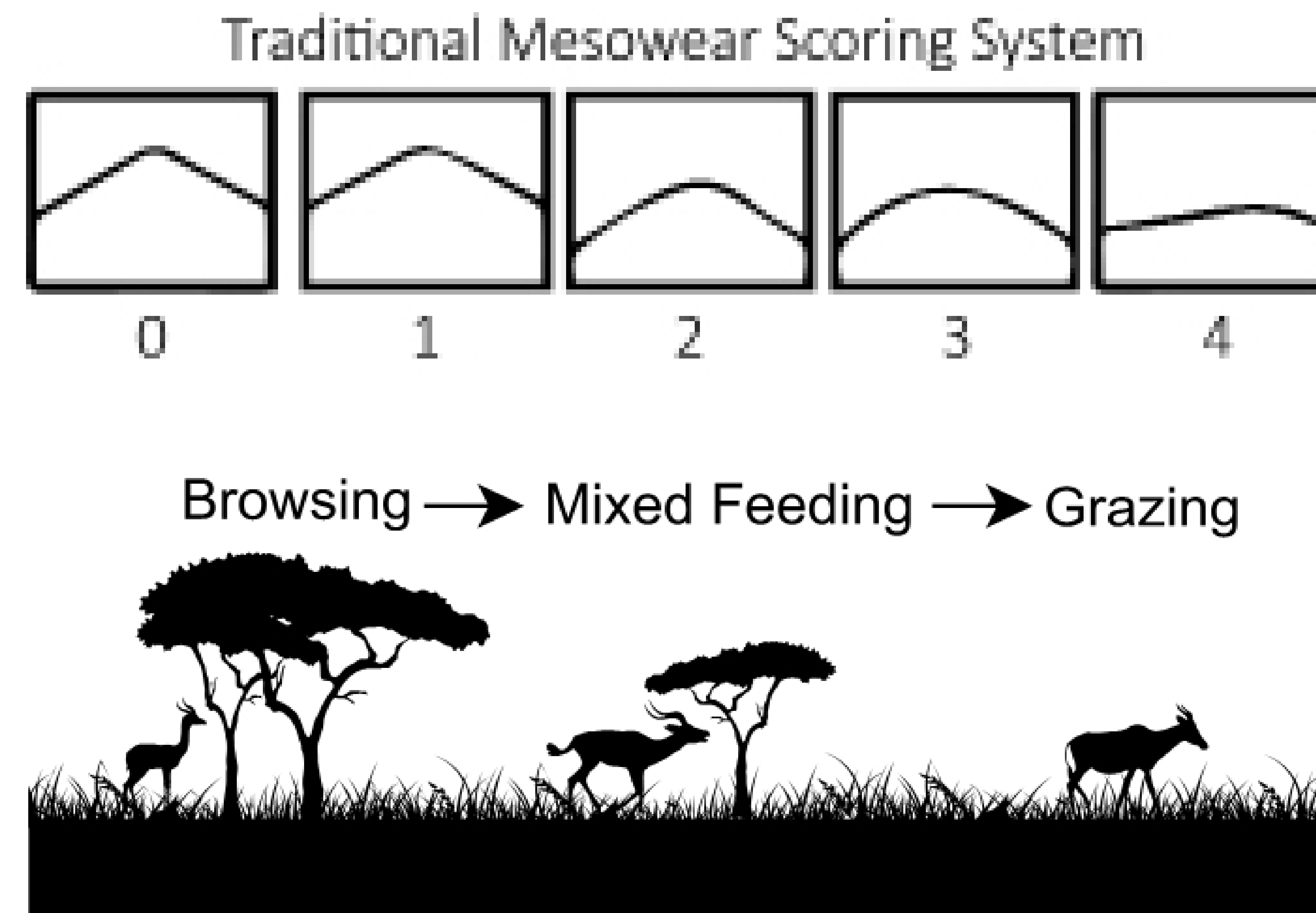
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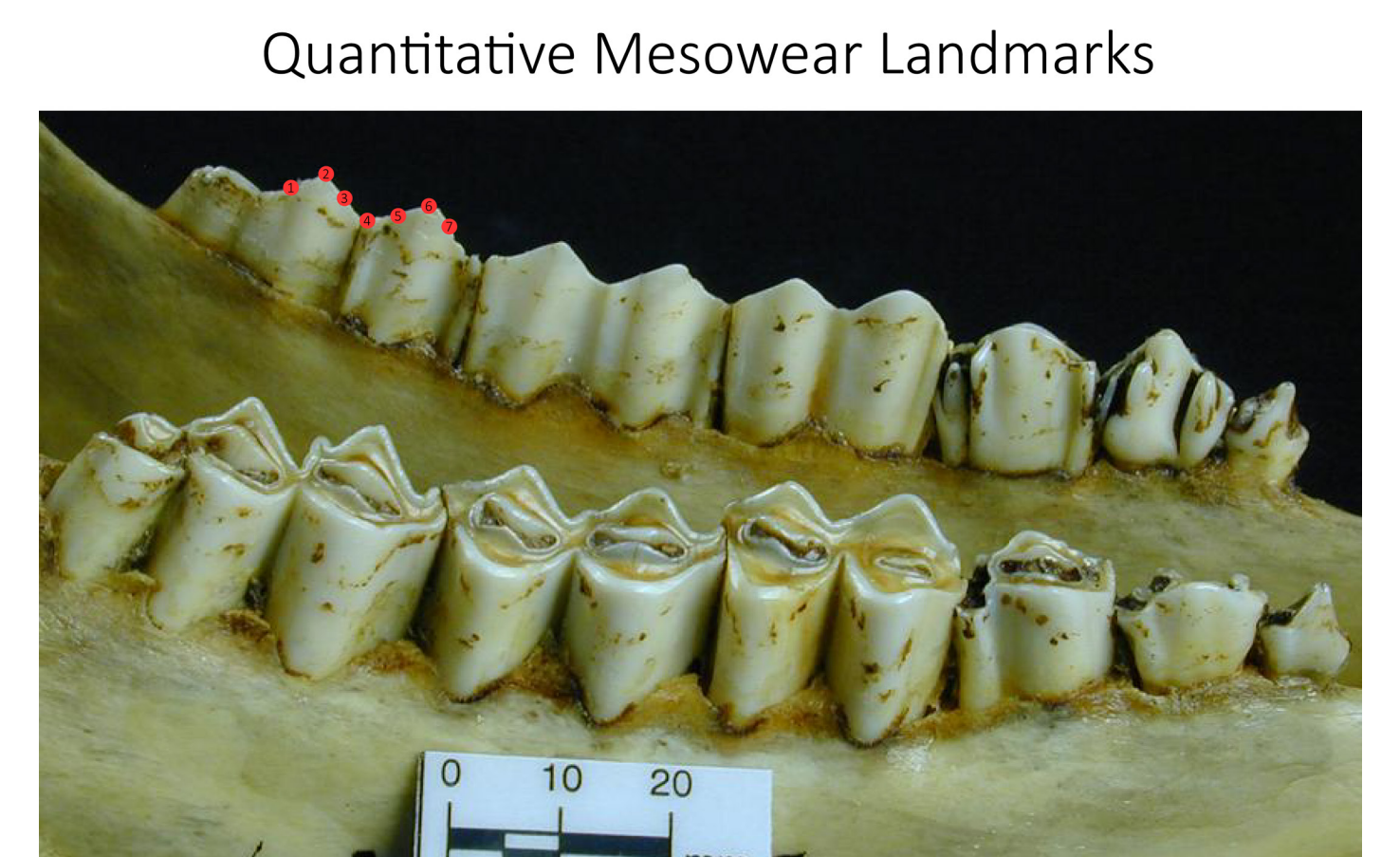
Introduction

- Fortelius & Solounias, 2000 presented a new approach to reconstructing paleodiet through qualitative mesowear.
- Their qualitative method classifies the occlusal relief as high or low and the cusp shape as sharp, rounded, or blunt.
- Since then, numerous studies have applied this approach. However, few studies have re-evaluated the method and offer new quantifiable approaches.
- By quantifying the method, we can further eliminate sources of error or biases (such as inter-observer bias).
- Our study sought to create a more accurate and quantitative approach for reconstructing diet from mesowear.



Materials & Methods

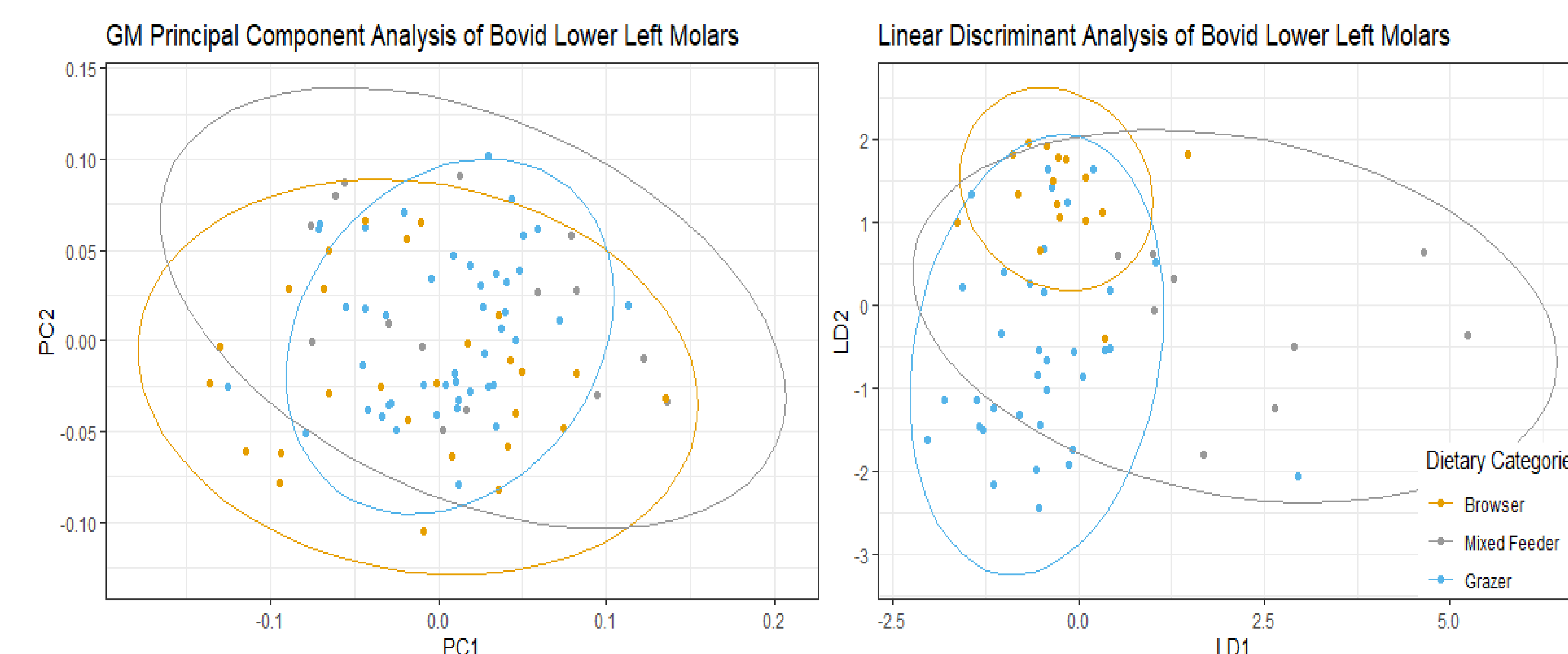
- We collected 2D landmark data from 19 extant African bovid species (n=189) prevalent in Eastern African environments and with different dietary categories from the Smithsonian National Museum of Natural History.
- All landmarks were recorded and measured using ImageJ.
- We included upper and lower first, second, and third molars and used four categories: grazer, browser-grazer intermediate, and browser.
- These seven landmarks (Figure 1) were chosen as the closest approximation to traditional qualitative mesowear approaches.
- We transformed the data using the geomorph package before performing generalized Procrustes analysis.
- We applied random forests algorithms to test dietary category prediction accuracy. The random forest model was tuned by adjusting the number of trees used and variables used at each split to improve accuracy.



Dietary Category	Species	N
Browser	<i>Litocranius walleri</i>	12
Browser	<i>Madoqua guentheri</i>	12
Browser	<i>Madoqua saltiana</i>	6
Browser	<i>Taurotragus derbianus</i>	6
Browser	<i>Tragelaphus eurycerus</i>	6
Browser	<i>Tragelaphus scriptus</i>	12
Browser-Grazer Intermediate	<i>Aepyceros melampus</i>	24
Browser-Grazer Intermediate	<i>Raphicerus campestris</i>	24
Browser-Grazer Intermediate	<i>Taurotragus oryx</i>	9
Browser-Grazer Intermediate	<i>Tragelaphus imberbis</i>	12
Grazer	<i>Alcelaphus buselaphus</i>	12
Grazer	<i>Gazella granti</i>	12
Grazer	<i>Gazella thomsonii</i>	12
Grazer	<i>Syncerus caffer</i>	12
Grazer	<i>Connochaetes taurinus</i>	12
Grazer	<i>Damaliscus lunatus</i>	12
Grazer	<i>Kobus ellipsiprymnus</i>	12
Grazer	<i>Kobus kob</i>	6

Results

- The random forest method correctly identified diet 59% when using upper and lower molars, 50% using lowers, and 64% using uppers.
- The linear discriminant analysis correctly classified diet in the test cases 57% when using upper and lower molars, 41% using lowers, and 67% using uppers.
- Researchers traditionally evaluate the accuracy of qualitative mesowear through PCA and cluster analysis. However, random forests allow for the possible extraction of additional information.



Conclusions

- The results of the PCA and LDA suggest that quantifiable mesowear could be a viable method for reconstructing diet.
- Both the max accuracy of the random forest and LDA were similar despite different filtering. The random forest model correctly classified upper molars at 64% and the LDA correctly classified uppers at 67%.
- Fortelius & Solounias, 2000 reported a DFA accuracy of 72% with 'radical' modern species. Our accuracy resembles theirs despite our reduced sample size (n=189) before filtering compared to their original paper (n=2200).
- Traditional mesowear has a recommended minimum sample size of 20 specimens per species. By further refining our approach, this minimum could be reduced.
- Future studies should expand this approach to include 2D landmarks collected using a microscribe and increase sample sizes of each taxa.

Acknowledgments & References

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Fortelius, M and Solounias, N., 2000. Functional Characterization of Ungulate Molars Using the Abrasion-Attrition Wear Gradient: A New Method for Reconstructing Paleodiets. American Museum Novitates.