

New Analyses Suggest that All Horses (Perissodactyla: Equidae) Belong to a Single Holobaramin

Timothy R. Brophy and Jack R. Gregory

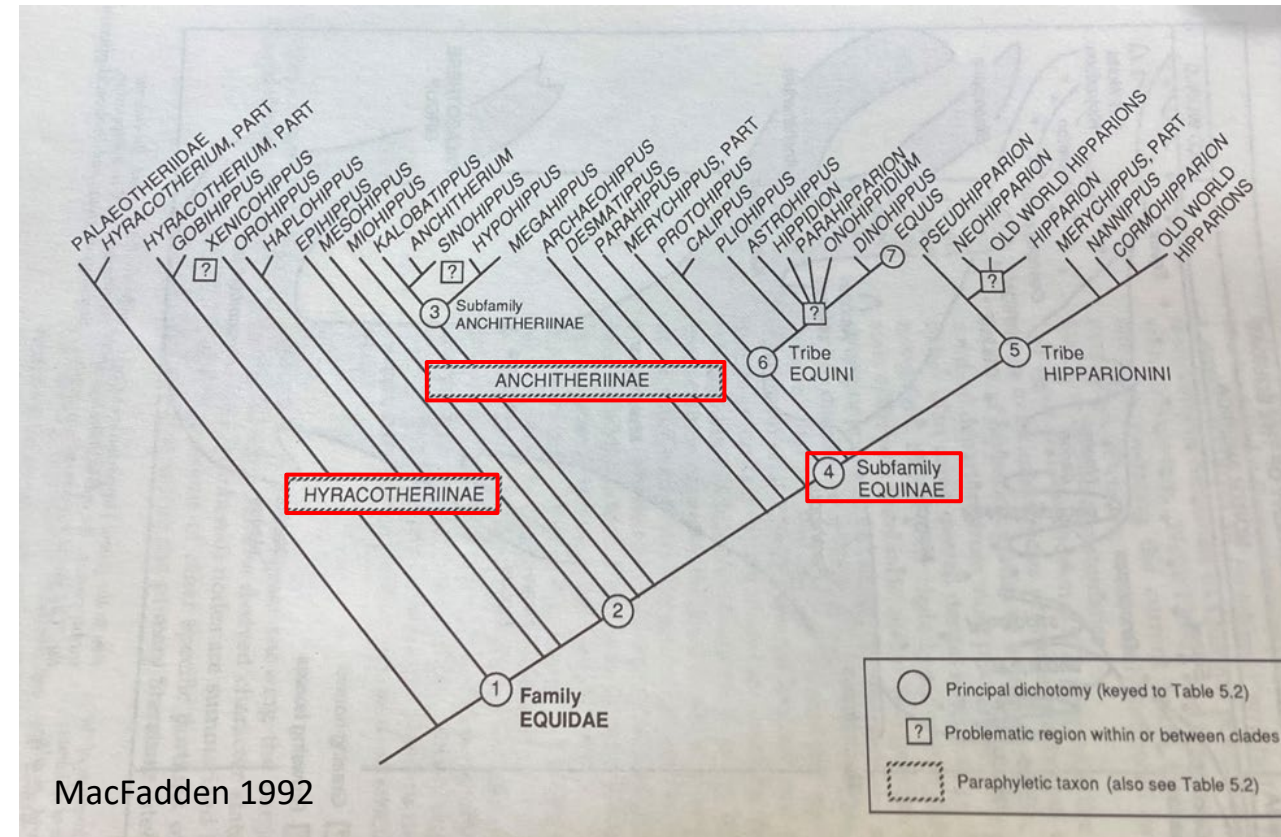
Center for Creation Studies
Department of Biology & Chemistry
Liberty University

Overview

- Background & Taxonomy of Horse Family
- Our Previous Baraminological Research of the Horses
- Methods, Results & Discussion of Present Study
 - 1) Statistical Baraminology of equids and outgroups (Froehlich 2002)
 - 2) Statistical Baraminology of equids and outgroups (Rose et al. 2014)
- Overall Conclusions

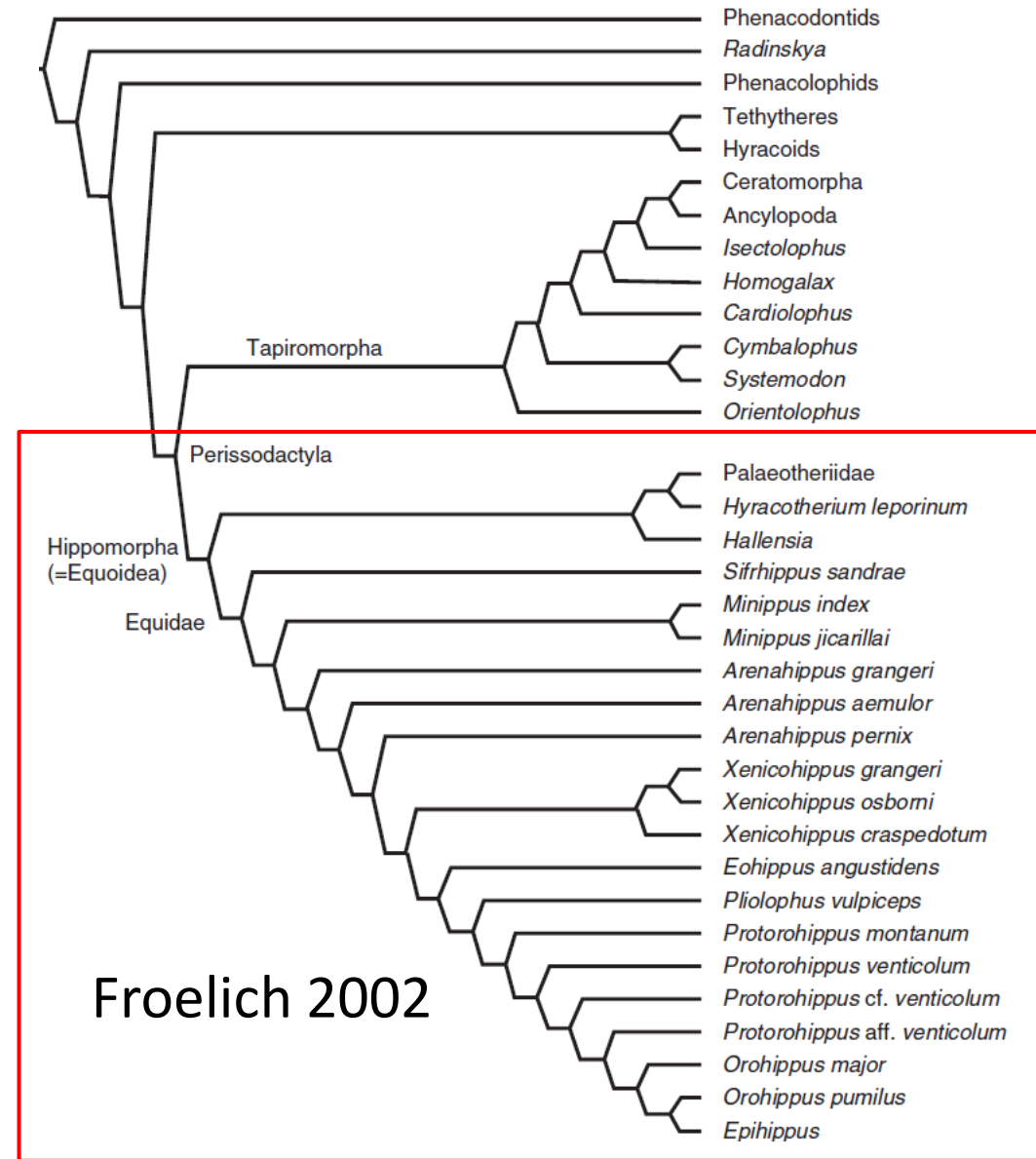
Background & Taxonomy

- The horse family (Perissodactyla: Equidae) is composed of approximately 35 genera
- These are primarily extinct forms from Cenozoic sediments, but also include the modern genus *Equus*



Background & Taxonomy

- The equids, along with some other extinct perissodactyls form the superfamily (or clade) Equoidea
- Equoidea = Equidae + Palaeotheriidae + other non-equid equoids (e.g., *Hallensia*, *Hyracotherium leporinum*, *Propachynolophus*)



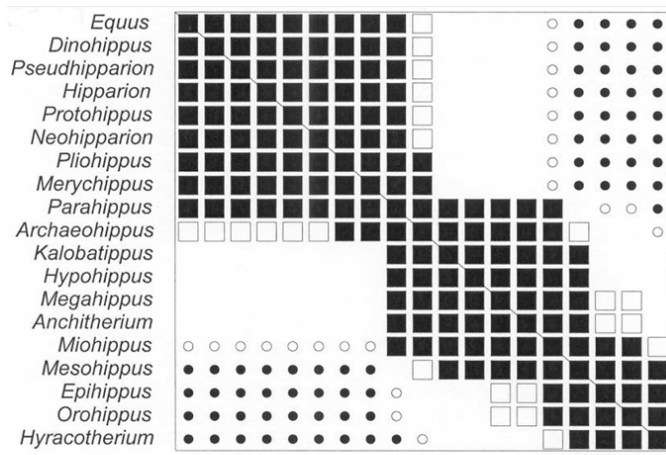
Background & Taxonomy

- Previous baraminological studies, utilizing published datasets of skeletal characters, concluded that the horses form a single monobaramin
- None of these studies, however, have detected consistent discontinuity between the horses and any outgroup taxa

<p>FOSSIL EQUIDAE: A MONOBARAMINIC, STRATOMORPHIC SERIES DAVID P. CAVANAUGH TODD CHARLES WOOD KURT P. WISE</p> <p>2003</p> <p>33 Cranial & Postcranial ↑↓ 19 Taxa</p> <p>PHYLOGENY OF THE FAMILY EQUIDAE ROBERT L. EVANDER</p> <p>1989</p>	<p>P9. Is the Equidae a Holobaramin? Paul Garner <i>Biblical Creation Ministries</i></p> <p>2004</p> <p>35 Cranial & Postcranial ↑↓ 13 Taxa</p> <p>The beginning of the equoid radiation J. J. HOOKER</p> <p>1994</p>	<p>A Further Attempt to Detect Discontinuity Surrounding the Equidae, Using a New Dataset P. Garner Biblical Creation Trust</p> <p>2016</p> <p>72 Cranial & Dental ↑↓ 26 Taxa</p> <p>A NEW EOCENE LOCALITY IN SOUTHERN FRANCE SHEDS LIGHT ON THE BASAL RADIATION OF PALAEOOTHERIIDAE (MAMMALIA, PERISSODACTYLA, EQUOIDEA) LAURE DANILO,¹ JEAN A. REMY,² MONIQUE VIANEY-LIAUD,¹ BERNARD MARANDAT,¹ JEAN SUDRE,³ and FABRICE LIHOREAU¹</p> <p>2013</p>
--	---	---

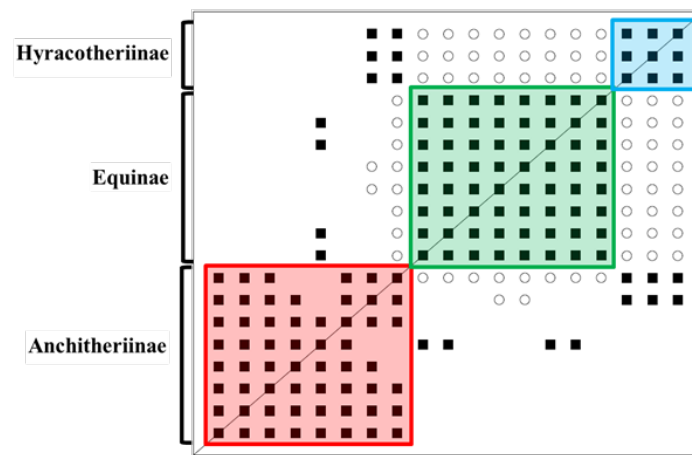
Our Previous Research

- Using new statistical baraminology techniques, we confirmed the conclusions of these previous studies that all horses belong to the same monobaramin (Gregory et al. 2022)



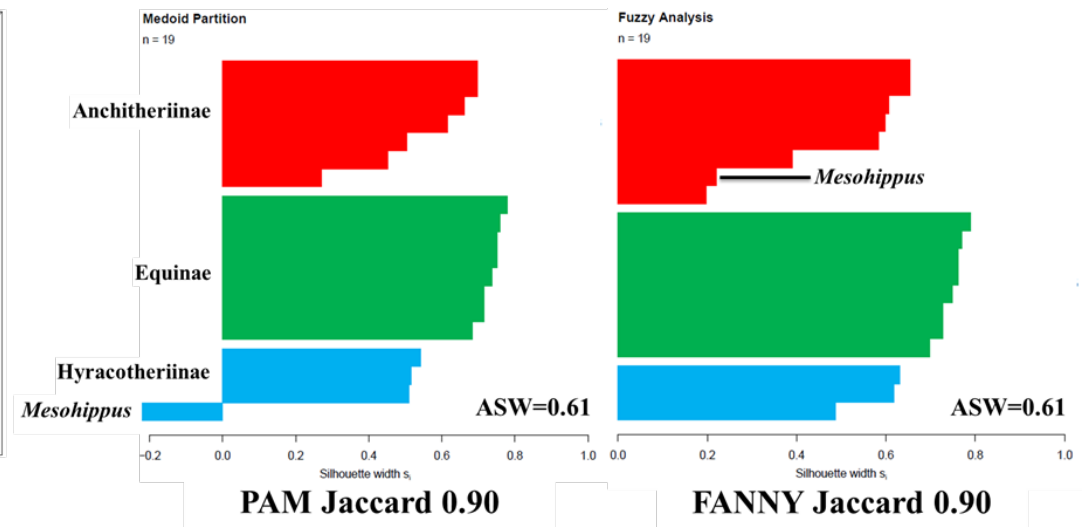
BDC-Simple/Pearson 0.95

ORIGINAL
(Cavanaugh et al. 2003)



DCA-Jaccard/Spearman 0.90

BEST COMBINATION OF NEW TECHNIQUES
(Gregory et al. 2022)

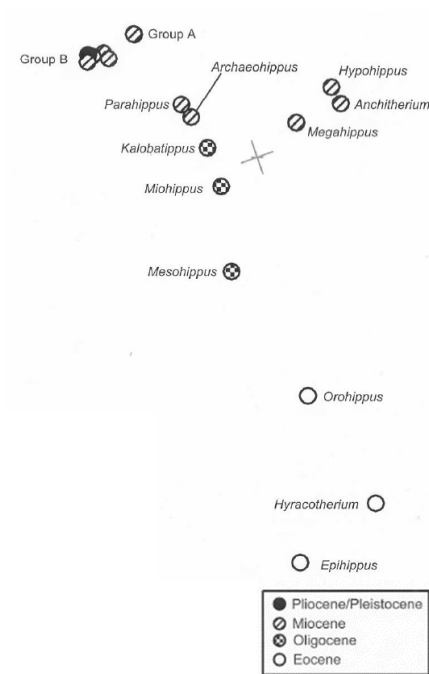


PAM Jaccard 0.90

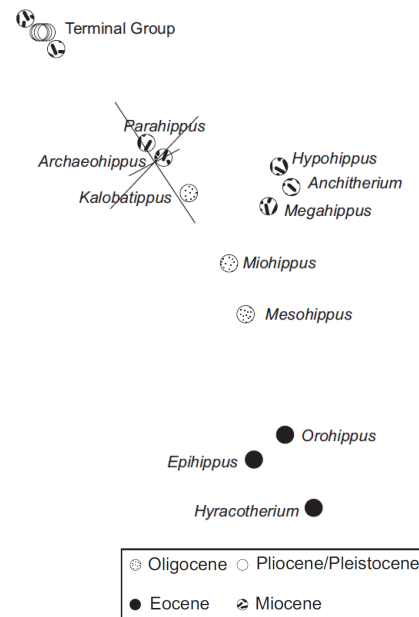
FANNY Jaccard 0.90

Our Previous Research

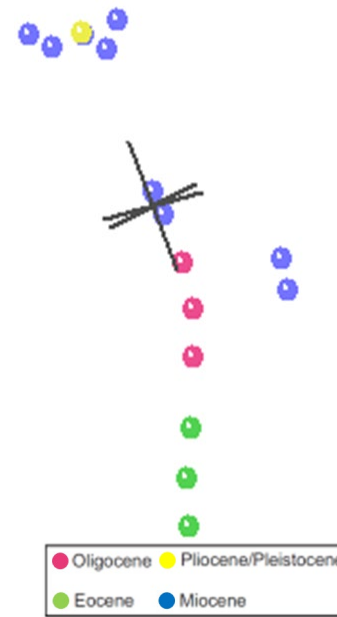
- We also confirmed that horses form a stratomorphic series, further confirming their status as a monobaramin (Gregory et al. 2022)



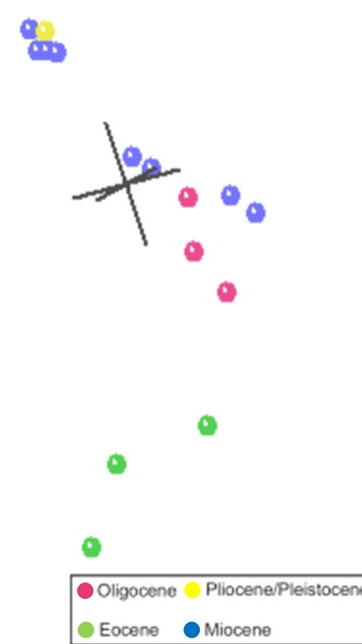
ORIGINAL
3D ANOVA Simple 0.95
Cavanaugh et al. 2003



ORIGINAL
MDS Simple 0.95
Wood 2005



NEW ANALYSIS
MDS Simple 0.95
Gregory et al. 2022



NEW ANALYSIS
MDS Jaccard 0.90
Gregory et al. 2022

Goal of Present Study

- The goal of the present study is to investigate potential discontinuity and holobaraminic status of horses and other similar taxa using new datasets and baraminological techniques
 - 1) Froelich (2002): Statistical Baraminology of extinct horses (and outgroups) skeletal morphology
 - 2) Rose et al. (2014): Statistical Baraminology of extinct horses (and outgroups) skeletal morphology

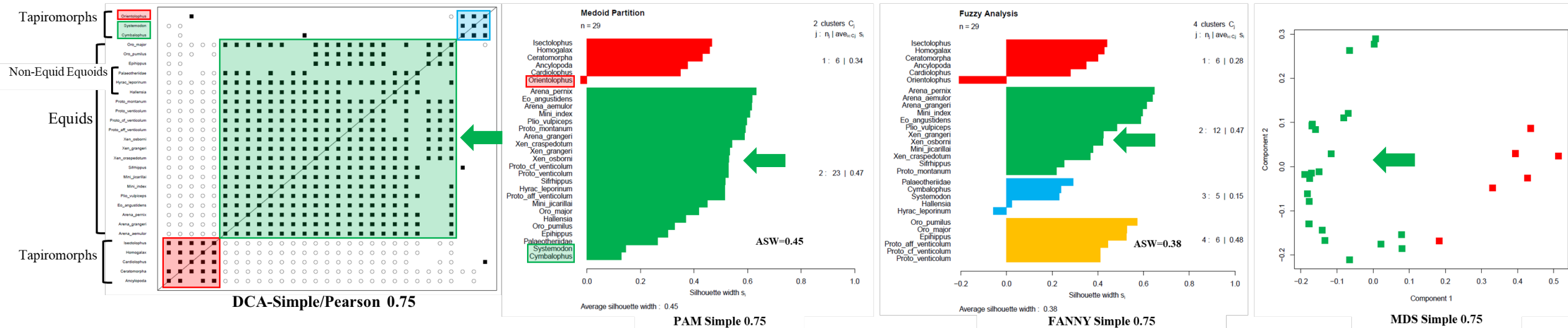
Statistical Baraminology Methods

- Two equid datasets (complete and various subsets) analyzed using new baraminological methods (BARCLAY–Wood 2020, 2021):
 - Distance Correlation Analysis (DCA) with Pearson & Spearman correlations
 - Classic Multidimensional Scaling (MDS)
 - Medoid Partitioning (PAM) and Fuzzy Analysis (FANNY)
 - Both Simple Matching and Jaccard distances as well as character relevances of 0.0 and 0.75 were utilized for all analyses
 - Average silhouette widths calculated for PAM & FANNY
 - Froelich (2002): 125 cranial, postcranial & dental characters for 48 taxa
 - Rose et al. (2014): 208 cranial, postcranial & dental characters for 53 taxa
 - Various outgroup taxa included

Statistical Baraminology Results

- Equids shared continuity with one another and sometimes with other perissodactyls (especially non-equid equoids)

Equids vs. All Other Perissodactyls



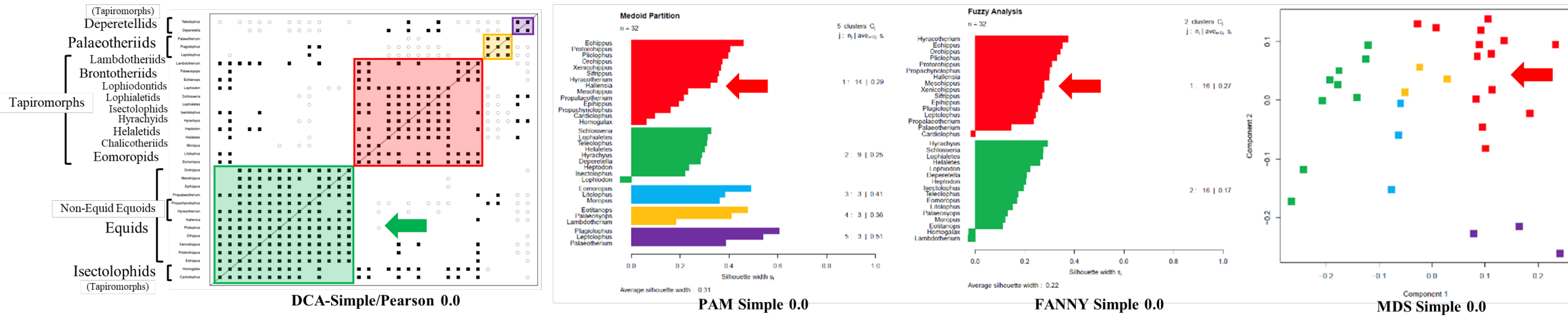
Froelich 2002

*Jaccard/Spearman and 0.0 character relevance analyses (some not shown) very similar to Simple/Pearson and 0.75

Statistical Baraminology Results

- Equids shared continuity with one another and sometimes with other perissodactyls (especially non-equid equoids)

Equids vs. All Other Perissodactyls



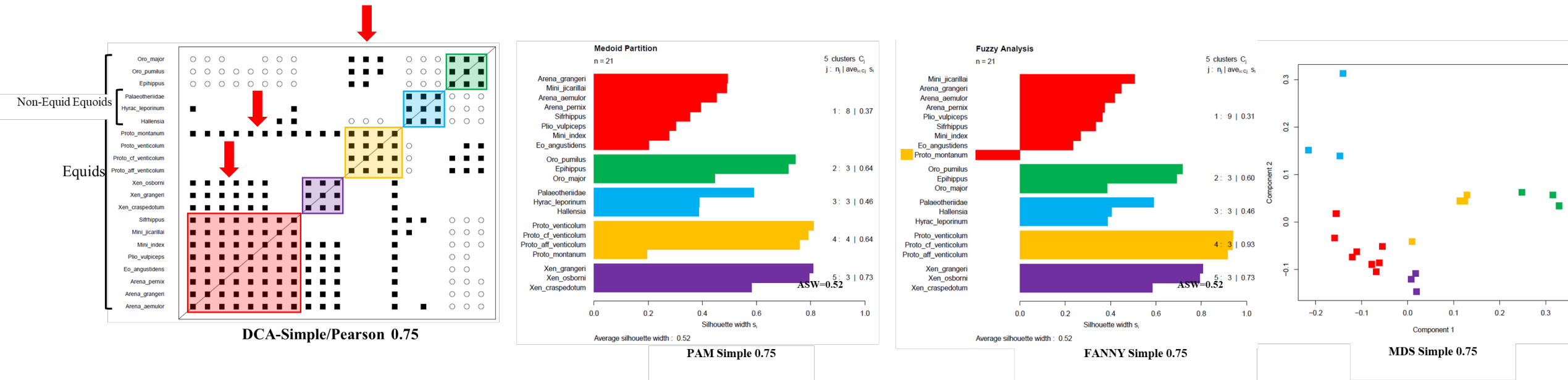
Rose et al. 2014

*Jaccard/Spearman and 0.75 character relevance analyses (some not shown) very similar to Simple/Pearson and 0.0

Statistical Baraminology Results

- Equids shared continuity with one another and sometimes with other perissodactyls (especially non-equid equoids)

Equids vs. Non-Equid Equoids

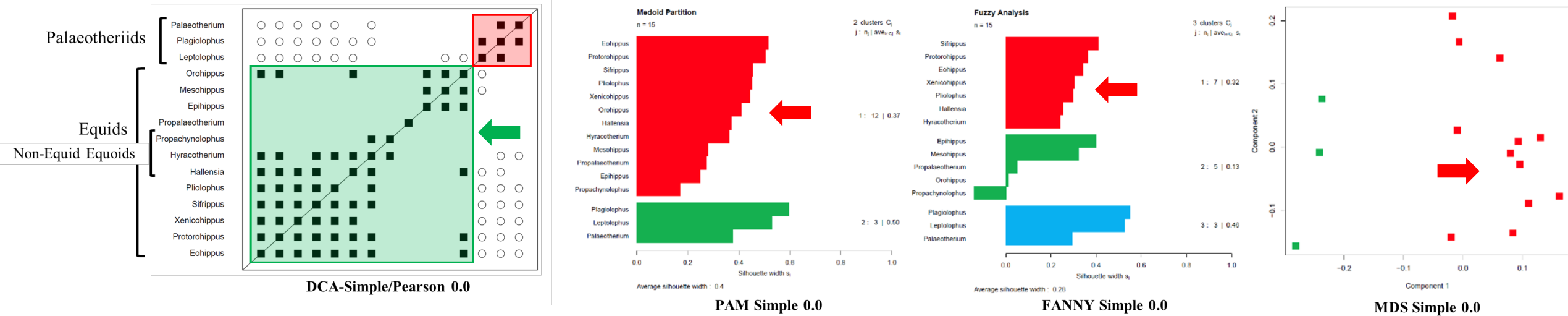


Froelich 2002

Statistical Baraminology Results

- Equids shared continuity with one another and sometimes with other perissodactyls (especially non-equid equoids)

Equids vs. Non-Equid Equoids

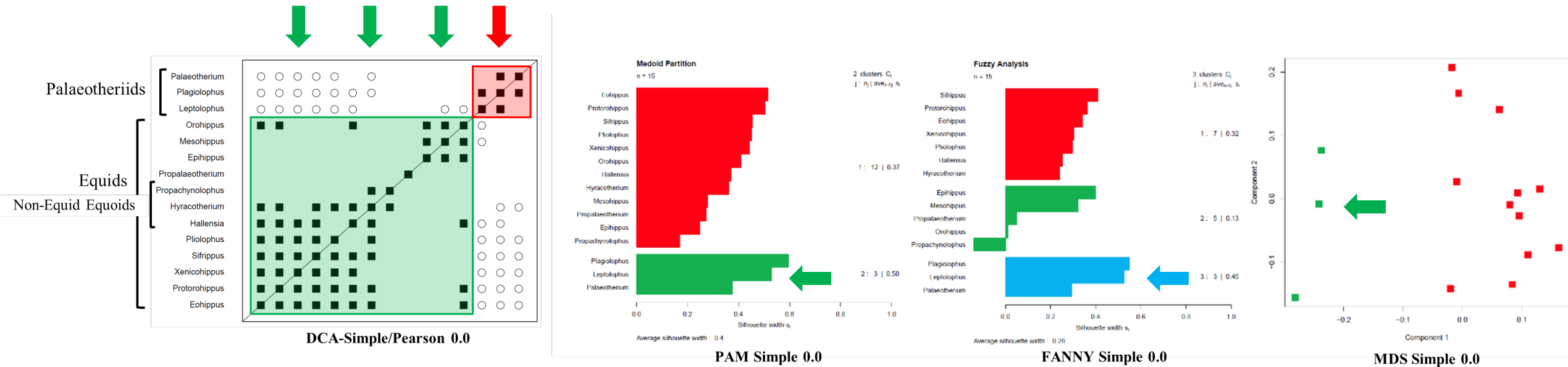


Rose et al. 2014

Statistical Baraminology Results

- It is worth noting that, in several analyses, members of Paleotheriidae (Equoidea) were not continuous with the equids but were, in fact, discontinuous with them

Equids vs. Non-Equid Equoids

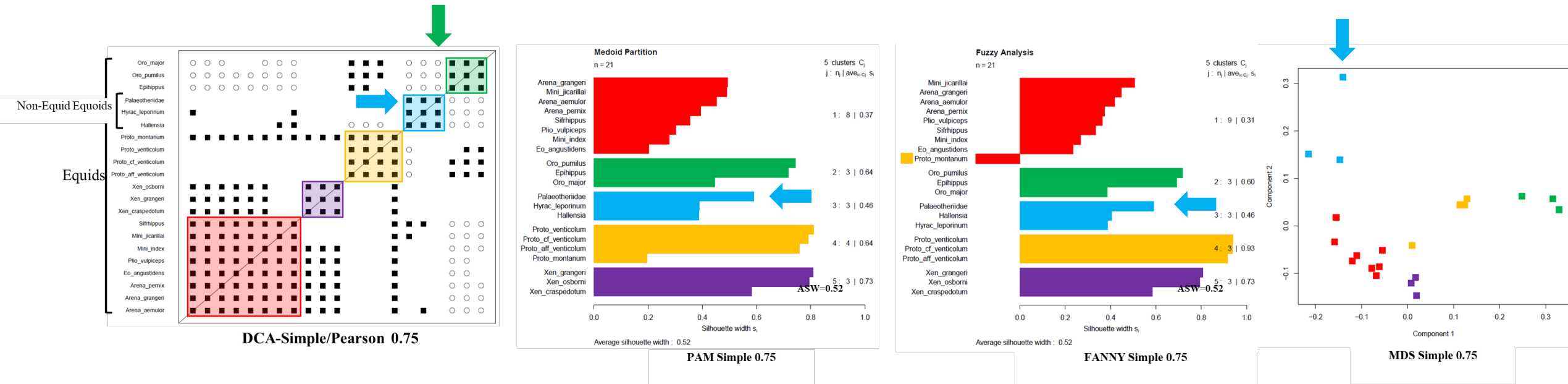


Rose et al. 2014

Statistical Baraminology Results

- It is worth noting that, in several analyses, members of Paleotheriidae (Equoidea) were not continuous with the equids but were, in fact, discontinuous with them

Equids vs. Non-Equid Equoids

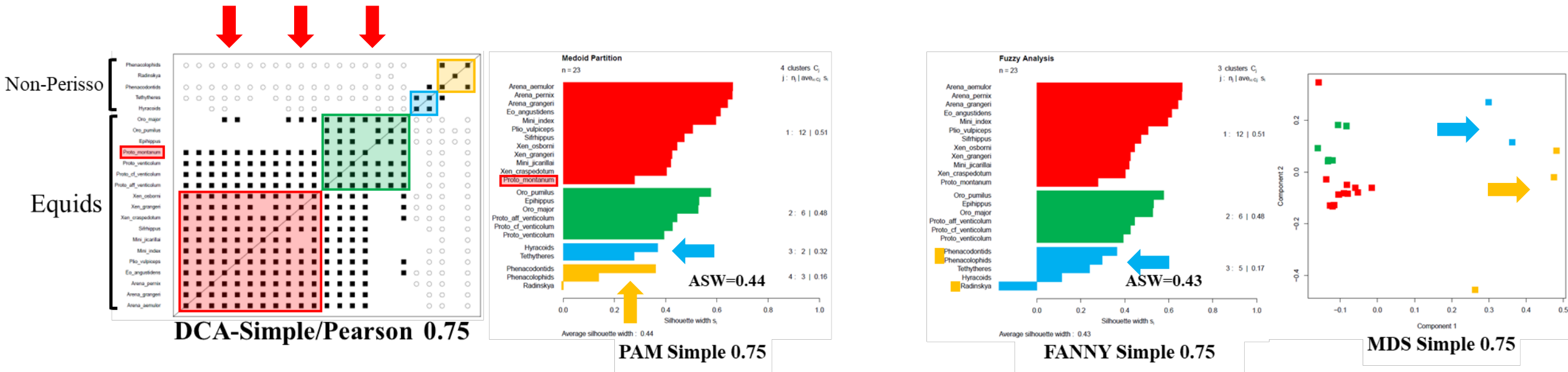


Froelich 2002

Statistical Baraminology Results

- And finally, equids displayed discontinuity with many non-perissodactyl outgroups across relevant analyses

Equids vs. Non-Perissodactyls

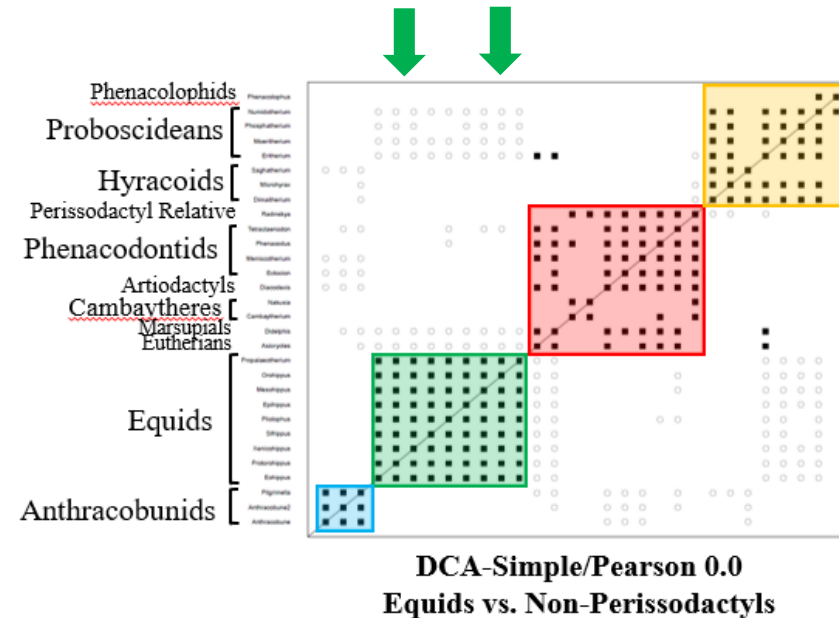


Froelich 2002

Statistical Baraminology Results

- And finally, equids displayed discontinuity with many non-perissodactyl outgroups across relevant analyses

Equids vs. Non-Perissodactyls



Rose et al. 2014

Statistical Baraminology Discussion

- Wood et al. (2003) define a “holobaramin as a group of known organisms that share continuity...and are bounded by discontinuity.”
- Based on the evidence presented here, we conclude that the equids, or perhaps some larger equoid group (excluding paleotheriids), form a single holobaramin



Harder, Heinrich, *Hipparion*, ca. 1920, Tiere der Urwelt: Series III, Hamburg. Accessed March 19, 2023 from: <https://commons.wikimedia.org/wiki/File:Hipparion3.jpg>



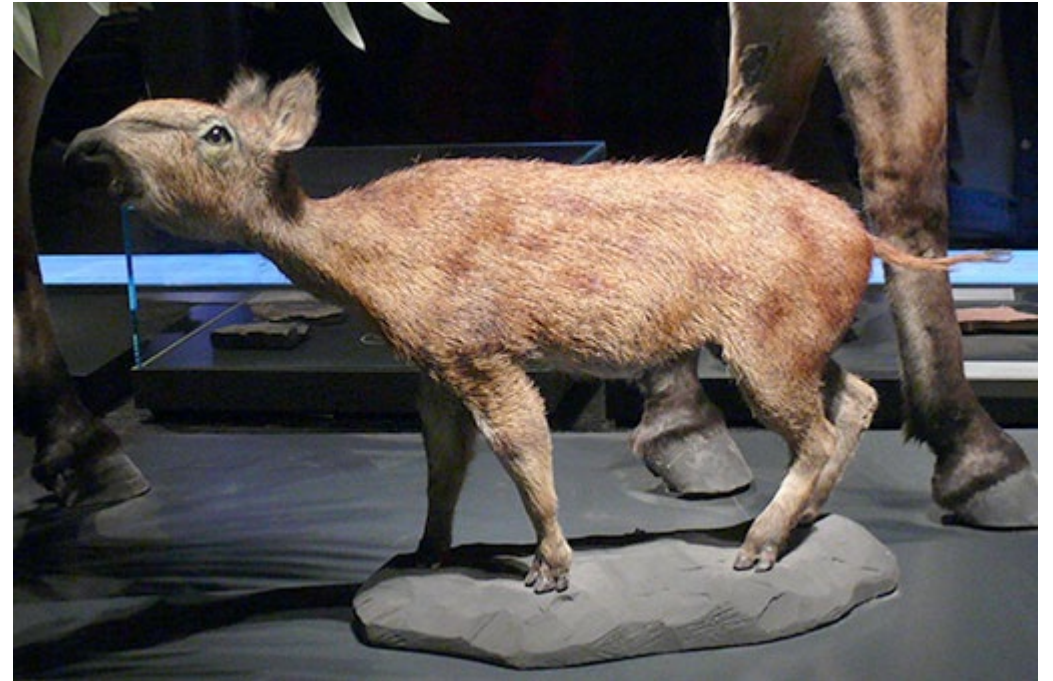
Harder, Heinrich, *Przewalski Horse*, ca. 1920, Tiere der Urwelt: Series III, Hamburg. Accessed March 19, 2023 from: https://commons.wikimedia.org/wiki/File:Przewalski_horse.jpg



Harder, Heinrich, *Mesohippus*, ca. 1920, Tiere der Urwelt: Series III, Hamburg. Accessed March 19, 2023 from: <https://commons.wikimedia.org/wiki/File:Mesohippus.jpg>

Overall Conclusions

- These results, which are consistent with previous studies, including our own (Gregory et al. 2022), directly impact creationist perspectives on speciation after the flood and how diversification of the horses should be understood
- If we assume an end-Cretaceous Flood terminus, a single horse baramin serves as an example of rapid, post-Flood intrabaraminic diversification in the YEC model



Restoration of *Eurohippus parvulus* on display in the Museum für Naturkunde, Berlin, Germany. Photo courtesy Haplochromis (Wikipedia).

Acknowledgments

- Many thanks to the Center for Research & Scholarship and Center for Creation Studies at Liberty University for providing conference & travel funds
- Thanks also to Kara Ray, Liz Tallman, and Luke Ragan who all helped with this project along the way



References

- Cavanaugh, D.P., T.C. Wood, and K.P. Wise. 2003. Fossil Equidae: a monobaraminic, stratomorphic series. In *Proceedings of the Fifth International Conference on Creationism*, ed. R.L. Ivey, pp. 143-153. Pittsburgh, Pennsylvania: Creation Science Fellowship.
- Danilo, L., J.A. Remy, M. Vianey-Liaud, B. Marandat, J. Sudre, and F. Lihoreau. 2013. A new Eocene locality in southern France sheds light on the basal radiation of Palaeotheriidae (Mammalia, Perissodactyla, Equoidea). *Journal of Vertebrate Paleontology* 33:195-215.
- Evander, R. 1989. Phylogeny of the family Equidae. In *The Evolution of Perissodactyls*, eds. D.R. Prothero and R.M. Schoch, pp. 109-127. New York: Oxford University Press.
- Froelich, D.J. 2002. Quo vadis eohippus? The systematics and taxonomy of the early Eocene equids (Perissodactyla). *Zoological Journal of the Linnean Society* 134:141-256.
- Gregory, J., K. Ray, M. Tallman, L. Ragan, and T.R. Brophy. 2022. New Baraminological Methods Confirm Monobaraminic Status of the Horses (Perissodactyla: Equidae) and Preliminary Analyses of New Datasets Suggest the Possibility of Discontinuity between Horses and Various Outgroup Taxa. *Journal of Creation Theology and Science Series B: Life Sciences* 12:5-6.

References

- Hooker, J.J. 1994. The beginning of the equoid radiation. *Zoological Journal of the Linnaean Society* 112:29-63.
- MacFadden, B.J. 1992. *Horses: Systematics, Paleobiology, and Evolution of the Family Equidae*. Cambridge University Press, New York.
- Rose, K.D., L.T. Holbrook, R.S. Rana, K. Kumar, K.E. Jones, H.E. Ahrens, P. Missiaen, A.Sahni, and T. Smith. 2014. Early Eocene fossils suggest that the mammalian order Perissodactyla originated in India. *Nature Communications* 5:5570.
- Wood, T.C. 2005. Visualizing baraminic distances using classical multidimensional scaling. *Origins (GRI)* 57:9-29.
- Wood, T.C. 2020. *BARCLAY software, v. 1.0*. Core Academy of Science, Distributed online at coresci.org/barclay.
- Wood, T.C. 2021. Baraminology by Cluster Analysis: A Response to Reeves. *Answers Research Journal* 14:283-302.
- Wood, T.C., K.P. Wise, R. Sanders, and N. Doran. 2003. A Refined Baramin Concept. *Occasional Papers of the Baraminology Study Group* 3:1-14.