The Evolution of Camelids in the Pacific Northwest in Response to the Grassland Expansion

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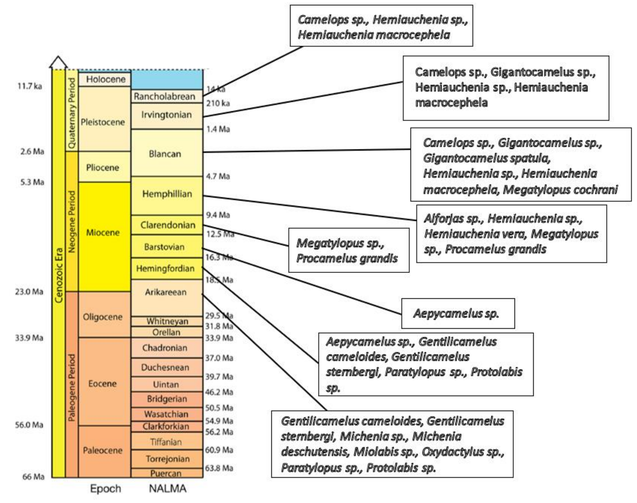
Introduction

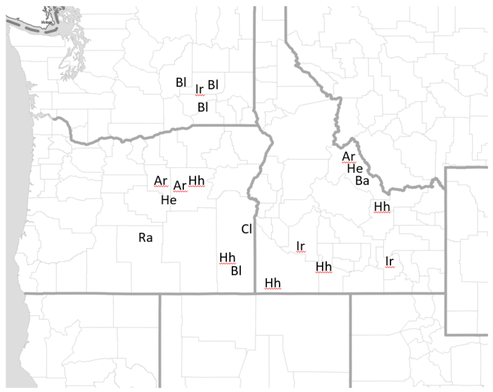
Camelids, the artiodactyl group including camels, llamas, and alpacas, evolved in North America during the Eocene. The first camelids were smaller than a goat; however, some extinct genera were giraffe sized. Most studies of North American camelids focus on fossils found in the Great Plains and as a result little is known about how camelid diversity responded to climate and vegetation changes in the Pacific Northwest. Horses are a well-studied example of ungulate responses to climactic changes and grassland expansion. They show a general increase in body size that is concurrent with their switch from browsing to mixed feeding and eventually to the grazing we see in modern examples. I suspect that as the environment in the Pacific Northwest dried out, camelids also increased in size due to the grassland expansion. I also believe that camelids incorporated more grasses into their diet. I tested this by documenting camelid diversity in the Pacific Northwest, specifically the states of Idaho, Oregon, and Washington, using the published fossil occurrences on the Paleobiology Database. Body size data was estimated using tooth measurements collected on the Fossilworks database. Camelid species were categorized according to two ecological parameters, body size and diet. I used these to track camelid evolution through time. I found that although body mass does increase there were still small browsing lineages late into the Miocene. This study provides a broader biogeographical picture of how grassland expansion influenced camelid evolution and ecology.



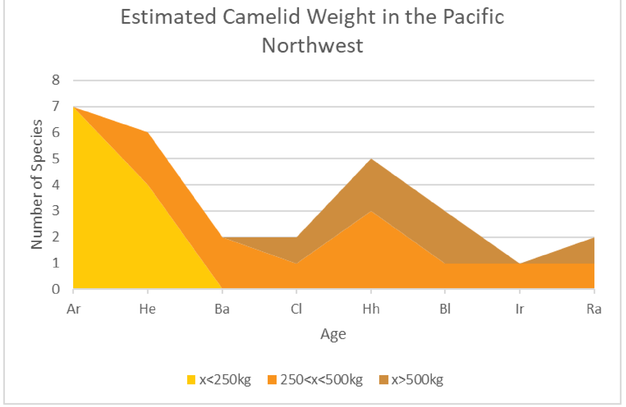
Methods

- Downloaded data on camelid occurrences and tooth size in the Pacific Northwest from the Paleobiology Database and the Fossilworks database.
- Estimated body size by using equations from Damuth 1990.
- Downloaded hypsodonty information from Jardine et al 2012.
- Compared and analyzed body size and hypsodonty information between the Pacific Northwest and the rest of North America.

Geographic Distribution of camelid localities by NALMA



Key NALMA
Ra = Rancholabrean
Ir = Irvingtonian
Bl = Blancan
Hh = Hemphillian
Cl = Clarendonian
Ba = Barstovian
He = Hemingfordian
Ar = Arikareean



Discussion

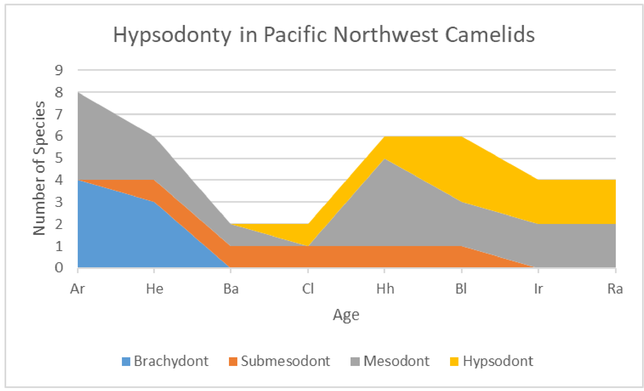
• There is an increase in body size in the Pacific Northwest that could be due to the grassland expansion.

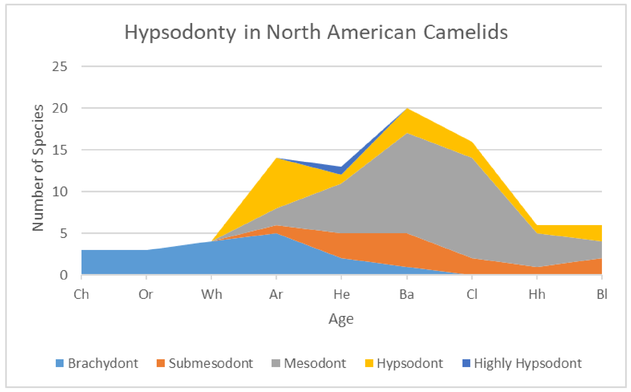
• Brachydont and mesodont teeth appear at the same time.

• Camelids seem to evolve in North America significantly earlier than in the Pacific Northwest. This could be due to sampling issues surrounding the fossilization process.

• There is a lack of data in the Barstovian and Clarendonian making it difficult to discuss over all trends in camel body size and diet.

When comparing patterns in hypsodonty between the Pacific Northwest and North America I noted that the appearance of different types of hypsodonty do not match. Broadly speaking, camelids seem to originally evolve with brachyodont teeth and submesodont, mesodont, and hypsodont teeth only appear in the Arikareean. In the Pacific Northwest, fossiliferous sites earlier than the Arikareean are not present. But, the sites in the Arikareean include both brachyodont and mesodont teeth. Submesodont teeth are not present in the Pacific Northwest until the Hemingfordian, and hypsodont teeth are not present until the Clarendonian. When looking at the data for the entirety of North America, a peak in camelid diversity takes place in the Barstovian. This includes a large percentage of taxa with mesodont teeth. However, this is missing in the Pacific Northwest potentially because of a lack of sampling. It could also imply that there was a greater drying out in the Pacific Northwest than there was in other portions of North America. We can also see that taxa with brachyodont teeth appear to disappear in the Pacific Northwest by the Barstovian while in the rest of North America, they have disappeared by the Clarendonian. This could be because submesodont teeth replaced them in effectiveness.





Results

• Camelid body size increased over time which could be due to the grassland expansion.
• The grassland expansion into the Pacific Northwest probably takes places later than in the Great Plains.
• A diversity peak in camelids takes place in a sampling gap in the Pacific Northwest.
• There is a large sampling issue in the Barstovian and Clarendonian ages.

Conclusions

Camels in the Pacific Northwest start small and increase in size. It is likely that camelids evolved elsewhere in North America and spread into the Pacific Northwest due to their appearance with only two hypsodonty classes, while in the rest of North America full tooth diversity was present. Also, it is likely that the grassland expansion into the Pacific Northwest took place after the spread in the Great Plains region as tooth types that were likely favorable to eating grasses do not appear until later. Additionally, in North America there appears to be a peak in camelid diversity during the Barstovian that is absent in the Pacific Northwest. This could be due to a sampling issue, as there seem to be few localities producing material of that age.
A more detailed analysis would require additional research into the taxa themselves. There is material that should be reexamined as our understanding of camelid evolution has changed since the 1800's and there are many specimens that could and should have their identifications reevaluated. This would allow me to clarify occurrences in the Pacific Northwest and our understanding of which camelids were present. Additionally, there are very few camelid specimens in the Pacific Northwest in general that are logged in the databases I used. By analyzing the actual fossils I could potentially gain a greater number of specimens to analyze. Another way to gain data about camelid diet is by adding more variables to my study include postcranial analysis, mesowear, microwear, or isotopic studies to identify what they were eating. It would also be intriguing to see if there is a crash in camel diversity in North America between the Clarendonian and Hemphilian and whether or not that corresponds to the spread of C4 grasslands.

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