Grant Proposal rough draft

The sauropod hiatus has long perplexed geologists. Sauropods flourished in the Jurassic but diminished in diversity and abundance in the Cretaceous. Gaps in the sauropod record led scientists to believe they had gone extinct in North America and Europe in the Early Cretaceous; it was proposed that they were replaced in the Late Cretaceous by South American sauropods migrating northward. Recent research suggests the hiatus is a product of stratigraphic biases; the Western Interior Seaway expanded in the Cretaceous, flooding previously-prime sauropod habitats and driving them further inland. I will assess the validity of stratigraphic forces on the hiatus by examining range size and distribution changes from the Late Jurassic to the Late Cretaceous in North America using occurrence data in the Paleobiology Database. I will also use morphological and taxonomical data from the Paleobiology Database and landmark analyses from samples to determine sauropod turnover throughout the interval.

For much of the 20th century, sauropods and their nature were poorly understood (Wilson). Their large body sizes made preservation of complete skeletons extremely rare, so paleobiologists had little knowledge of their phylogeny, life habits and stratigraphic duration. Sauropods are most closely associated with the Jurassic period, but they span the complete Mesozoic and persisted until the Maastrichtian extinction (D’Emic et al). Until recently, they were considered Lazarus taxa, as no North American sauropod fossils were known from the Albian/Cenomanian through the Maastrichtian (a span of 25-30 million years)(D’Emic et al). Recent work on Cretaceous sediments in the American Southwest has narrowed the gap, and concurrent work in Gondwanan deposits has revealed a continuous sauropod record (Mannion et al). These findings have led paleontologists to two conclusions: either the hiatus reflects extinction of sauropods in the Northern Hemisphere followed by invasion of southern taxa, or it is an artifact of stratigraphic biases and indicates a shift in deposition away from sauropod ranges (Mannion et al). If our results from landmark analyses and principal component analyses show similarity among North American sauropods across the Late Jurassic-Late Cretaceous interval, then we can conclude that no extinction occurred and that stratigraphic controls are responsible for the hiatus. If our results indicate greater similarity with South American taxa, we can conclude that the sauropod hiatus is indeed due to regional extinction in North America. Changes in range distribution as assessed by the Paleobiology Database and stratigraphic data from MacroStrat will be used to supplement these conclusions.

Dinosaurs are among the most compelling organisms found in the fossil record in the eyes of the general public. The results of this project can be used to educate laypeople about this significant interval of the Mesozoic, thus increasing public interest in paleobiology and geology. Additionally, a cohesive understanding of the history of life is crucial to any society that seeks to live responsibly in our modern world. Extinction, especially of megafauna, poses significant challenges to present-day conservation efforts, and large animals’ responses to changing environmental conditions have long been poorly understood. Though sauropods do not resemble modern mammalian megafauna, their morphological complexity makes them an appropriate analogue for studying biological and behavioral adaptations to changing environmental conditions like rising sea levels. The sauropod hiatus has been recognized for decades, and represents a unique challenge to our understanding of life; in order to fully grasp how they responded to their changing environment, we must first separate trends in their diversity from confounding stratigraphic biases. By assessing changes in both geographic ranges (behavioral) and morphology (biological) across the hiatal interval, we can begin to grasp the relative impact of these two possible causes. Identifying a cause for the hiatus, whether stratigraphic or biological, will direct future efforts in studying sauropod ecology.

I plan to use Paleobiology Database records of sauropod body and trace fossils to track changes in both the geographic ranges and morphological characteristics of North American sauropods spanning a period from the Late Jurassic through the Late Cretaceous. I will use Macrostrat in conjunction with range data to map changes in depositional environments and lithologies. This will help to assess any stratigraphic biases that would interact with changing ranges to create an artificial paucity of sauropod fossils. In addition, I will be comparing morphological similarities via landmark analysis and principal components analysis at the stage level to study possible lineages of North American sauropods into the Cretaceous. Late Cretaceous sauropods show some similarities to South American taxa, which many have interpreted as support of the reinvasion hypothesis—by examining similarities among North American morphologies, this hypothesis can be effectively tested. In order to facilitate effective landmark analysis, visits to collections that include sauropod fossils (especially transitional and rare Early Cretaceous fossils) will be necessary. Travel expenses are expected to include gas for a vehicle, lodging and food during these trips; use of equipment to perform landmark analyses will also require GSA funding.

References:

D’Emic, M., Wilson, J., Thompson, R, 2010. The end of the sauropod dinosaur hiatus in North America.

Mannion, PD and Upchurch, P, 2011. A re-evaluation of the 'mid-Cretaceous sauropod hiatus' and the impact of uneven sampling of the fossil record on patterns of regional dinosaur extinction.

Lucas, S.G.,1989. *Alamosaurus* and the sauropod hiatus in the Cretaceous of the North American Western Interior.

* Wilson, J. Sauropod Phylogeny.