Title of Project: **Diversity and Systematics** **of Eocene alligator-like crocodylians from the Green**

**River Basin, Wyoming**

I propose to study the wide variety of fossil alligator-like crocodylians that have been recovered from the Green River Basin in Wyoming by Dr. Bartels. These animals lived in the area around 50 million years ago when the Rockies were surrounded by lowlands with a subtropical climate. The objective of my study is to identify the species present and determine their evolutionary relationships in the light of recent taxonomic revisions suggested by Brochu (2010). The project will involve the preparation (cleaning, preserving and assembly), description, and analysis of several new specimens that have not been studied before

This project is an examination all Eocene alligator-like crocodylians from Wyoming A study of one included genus (*Procaimanoidea*) from the same area was the Senior Thesis and FURSCA project of Melissa Light (AC ’10). This study will include additional genera and a reevaluation of her work based on several new specimens and recent systematic revisions of alligators.

# Diversity and Systematics of Eocene alligator-like crocodylians from the Green River

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## Proposed Work

This study will be an analysis of the fossil alligator and alligator-like crocodylians (hereafter referred to as “alligatoroids”) from the early and middle Eocene of Wyoming. Morphological differences between specimens will be used to determine the number of discrete taxa (genera and species) present in the area through a five million year interval. This will include the cleaning and reconstruction of several partial skulls and other skeletal fragments from the collection, extensive literature review, and detailed description and measurement of the specimens. This will culminate in the preparation of a preliminary report that will form the basis for my Senior Thesis. The results will also be disseminated on campus and at professional meetings.

My reconstructions of the fossil specimens will be compared to previously published descriptions (Mook, 1921, 1941, 1961; Gilmore, 1946; Brochu, 2010) and more recent systematic revisions (Brochu, 1999. 2004, 2010) by comparing the systematics and ecological niches of the two to four species of alligatoroids that existed within the ecosystem. I have begun working on the preparation these specimens and have been conducting the literature review since last summer.

## Background Information

The fossils in this study were collected by Dr. Bartels (Geological Sciences), and his colleagues and students from 53-48 million year old (Ma) Eocene deposits of southwestern Wyoming (Gunnell and Bartels, 1994, 2001; Zonneveld et al., 2001; Gunnell et al., 2009).

The specimens relevant to this study were recovered from deposits dating to the Eocene

Epoch, which occurred from between 56 and 33 Ma. During this geological interval, the Green River Basin of southwestern Wyoming had a wet subtropical climate and sat at least 5000’ closer to sea-level than today. The variety of river and lake systems in the area present deposited sediments shed from the still-young Rockies and are seen today the Green River (lake), Wasatch, and Bridger formations. These formations preserve a wide range of fossil vertebrates that lived there at the time (Gunnell and Bartels, 1994, 2001; Zonneveld, et al., 2001). This proposal seeks to describe and better understand the small broad-snouted crocodylian predators of this ecosystem.

Alligators and caimans are two groups of broad snouted crocodylians that have been historically viewed as either very closely related or examples of convergence between two distantly related groups (Brochu, 1999. 2004, 2010; Greg and Kirshner, 2015). There are two species of living true alligators (Family Alligatoridae): the Chinese Alligator (*Alligator sinensis*) and the American Alligator (*A. mississippiensis*). These members are the extant examples of a larger group that once had a much wider geographic range and date back to the Cretaceous Period (100 Ma) when dinosaurs still lived (Greg and Kirshner, 2015). They are represented in the Eocene by one or more species traditionally assigned to the genus *Allognathosuchus* (Brochu, 2004). One focus of this study will be to determine the number of species present and if the assignment to this genus is valid or not.

Caimans (Family Caimanidae) are similar in appearance to alligators, but have a more problematic fossil record and taxonomic history. They are represented today by several genera and species in South America (Greg and Kirshner, 2015). One example of this problematic fossil record is the genus *Procaminoidea*, which is represented by two species in the Eocene which may or may not belong to either the Caimanidae or the Alligatoridae (Brochu 1999, 2004, 2010). A second main objective of the proposed study will be to test hypotheses regarding their taxonomic position.

The animals in this study represent a time when alligatoroids experienced a significant chapter in their history after the extinction of dinosaurs at the end of the Cretaceous (65 Ma). The Paleocene and Eocene epochs were marked by the explosive adaptive radiation of new, generally very small mammalian life. At this time, several alligatoroids evolved smaller body size and specialized dentition in order to exploit these new mammalian prey (Bartels 1984, 1993). This reduced body size (1.5-2.5 meters in length) also correspond with a newly evolved carnivore-like dentition with incisors, canines, shearing premolar-like teeth, and crushing molariform rear teeth. Later in the Cenozoic, alligatoroids re-evolved as generalists with decreased dental specialization and resumed the more typical crocodylian lifestyle of being large, piscivorous to omnivorous predators (Bartels, 1984, 1993). These distinctions and their relevance to this explosive radiation allow these taxon to be differentiated by their ecological significance within their ecosystems.

## Methodology

Preparation and methodology for this project has been based in several Albion College courses, including GEOL/BIOL 309: Vertebrate Paleontology (osteology, crocodylian biology and anatomy, evolution and systematics) and Vascular Plants BIOL 216 (evolution and systematics). I have also worked for two years in Dr. Bartels’ lab learning a variety of paleontological techniques and studying different fossils. Beginning last fall I have been reading papers on extinct crocodylians, organizing and examining the fossil alligator specimens, and preparing additional specimens that I will use this summer and into next year.

My focus for the first five weeks of my summer FURSCA project will be to first finish preparation on the new skulls and postcrania in the collection. Preparation involves the cleaning of the fossils with a variety of tools (dental picks, pneumatic scribes, and an air abrasive machine), the stabilization of the bone with penetrating glue, and the assembly of fossil fragments into more complete skulls, jaws, and postcranial elements. As I work on the preparation, I will continue to describe and identify each specimen to the species level, starting with the most complete ones. From these, I intend to develop criteria for recognizing each species from even fragmentary remains. As I proceed, I will develop species lists from each time interval and area in the Green River Basin in order to provide as complete a record of these animals as possible.

At the end of five weeks, I will depart for a month to attend Albion Geology Summer Field Camp in Wyoming.

After returning to campus, I will spend the last two weeks analyzing shared derived characteristics for each species and begin the process of testing the validity of: the assignment of the true alligators to the genus *Allognathosuchus* (questioned by Brochu, 2004); whether or not a new genus *Tsoabichi* (Brochu, 2010) is distinct from *Procaimanoidea*; and the relationship of *Tsoabichi* and/or *Procaimanoidea* to true caimanids (proposed by Brochu, 2010). These analyses will continue into the Fall as the focus of my Senior Thesis research.

## Proposed Outcomes

Major outcomes of this study will include a deeper understanding of the diversity and classification of alligator-like crocodylians in the Eocene, and additionally will include the information needed to complete my Honors Program Senior Thesis and research requirement for my Paleontology Minor.

I plan to present my findings at the Geology Department Colloquium, at the Fall GSA Annual Meeting in Phoenix, Arizona, and during the Elkin Issac Student Symposium.

All of this will serve as a valuable opportunity to continue to pursue my ambition to become a paleontologist, and will aid in my admission to graduate schools. This project will allow me to further develop and demonstrate my research skills, and provide an opportunity to produce publishable results.