MUSÉE REDPATH MUSEUM

Volume 4 | Issue 1

Summer 2021

Student Research Spotlight

The Redpath Museum's website is proud to present the Spotlight on graduate student research each month. Starting in June 2020, once a month, a student will be featured on the website's Research tab under *Student Research at the Museum*.

June 2021

Grant Haines
Ph.D. candidate
Hendry Lab

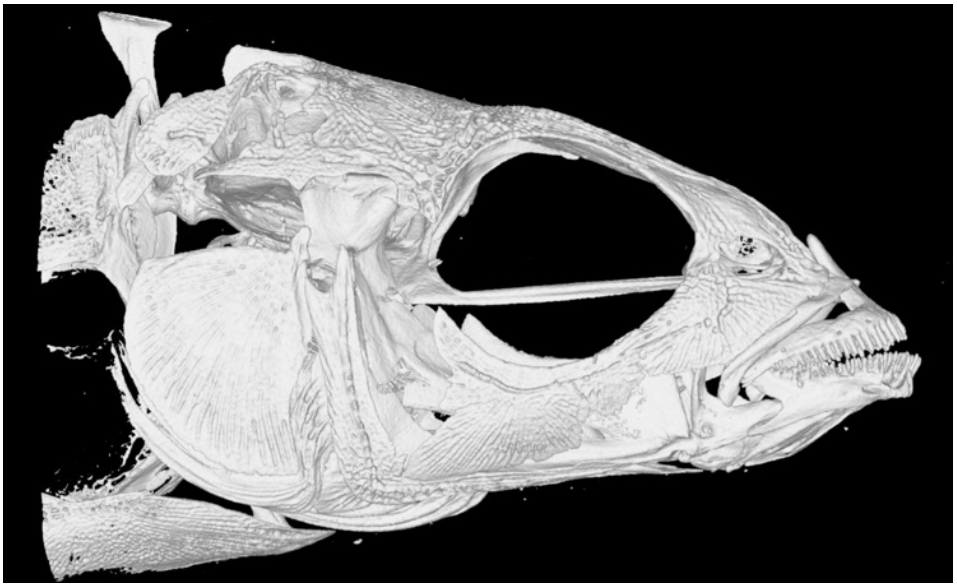
I am Grant Haines, a Ph.D. student in Andrew Hendry's lab studying adaptive divergence and intraspecific evolution in threespine stickleback. I have been fascinated with animals and nature since I was a toddler from spending time outside fishing and camping with my parents, and then later on as a boy scout and then summer camp counselor.

I started out in biology working in an ecology lab at my undergraduate institution, Colgate University, collecting water chemistry data and identifying insects to determine the effects of lime treatments on acidified streams. As I finished my degree there, I decided to pursue biology with a particular interest in the relationships between animals and their environments, and continued on to a master's degree program at the College of William & Mary. There I studied how the lateral motion associated with swimming facilitates filter feeding in paddlefish, ultimately determining that this motion was crucial to the collection and transport of food particles.

"In particular, I often study differences and changes in shape using a variety of techniques known collectively as geometric morphometrics"

During my Ph.D. at McGill, I have focused on stickleback evolution, especially over much shorter timescales than most people think about when discussing natural selection. Stickleback fish are a particularly good study species for fast evolutionary processes, partly due to their life histories. Most populations spend most of their lives in the ocean, but interestingly adult fish migrate to freshwater to spawn, much like salmon. Sometimes offspring are unable to get back to the ocean and instead establish new, freshwater populations. Because of this, there are now thousands of exclusively freshwater populations of stickleback around the world, all diverging more or less independently of one another. While not particularly flashy, they have a number of traits for defending themselves against predators, for seeing in low-visibility environments, and for feeding, among others, that can evolve very rapidly in response to their environments.

I study how traits that interact with the environment – known as phenotypes – differ between populations, and vary as a result of habitat changes. In particular, I often study differences and changes in shape using a variety of techniques known collectively as geometric morphometrics. These techniques allow me to quantify shape data that I collect from computerized tomography (CT) scans, which are generally too complex to be handled with more conventional statistics. A reconstruction of a stickleback skull from one of these scans is pictured. By studying the evolution of parts of the body directly implicated in interacting with the environment, such as feeding, I hope to contribute to our knowledge of fundamental evolutionary processes, and in the future, inform practices for managing native fish populations.



Reconstruction of a stickleback skull from a CT scan

I have been fortunate enough to go to some incredible field sites in Vancouver Island (Misty Lake pictured) and Haida Gwaii in the course of this work, and I hope to continue working in these systems in the future. Thanks to the Haida nation for permitting ongoing research in Haida Gwaii.

Researchgate
Twitter: @GrantEHaines

Grant Haines and colleagues doing fieldwork in Misty Lake, located on Vancouver Island, British Columbia

Volume 4 | Issue 2 **July 2021**

Summer 2021

Dirley Cortés
Ph.D. student
Larsson Lab

Credit: Dr.Hans Larsson

My name is Dirley Cortés, and I am a PhD candidate at the Redpath Museum of McGill University. I was born and raised in one of the most fossiliferous places in Colombia: Villa de Leyva. From a very young age, I had a particular taste for rocks and fossils. In high school, I prepared a pliosaur jaw, which led me to choose natural sciences as my profession. Unfortunately, there are no universities in Colombia that offer a bachelor of science in Palaeontology, and so for this reason, I chose to study biology as my bachelor's degree. In recent years, paleontological sciences have begun to gain more attention in my country, and thus this has created more opportunities for local students to follow a path in this field. Several members of my family have been involved in fossil collection and preparation over many years, but due to a lack of formal education in geosciences, they could not pursue it further. The scientific activities of my relatives laid the foundation for me to start fossil prospecting and gain a genuine interest in natural sciences during my childhood.

At the Centro de Investigaciones Paleontológicas (Paleontological Research Center), Villa de Leyva, Colombia, I learned to prepare fossils and participated in field expeditions. At this time, I met my now doctoral supervisors, Dr. Carlos Jaramillo, and Dr. Hans Larsson. In Dr. Jaramillo's lab, I did a two-year internship at Smithsonian Tropical Research Institute, Panama where I gained experience in field logistics, fossil collecting, and laboratory handling. This gave me enough tools to decide to do a PhD in Dr. Larsson's lab at the Redpath Museum. My PhD supervisors have been enormously influential in my training as a scientist, through museum work, field expeditions, first-hand contact with fossils, understanding data, thinking about big questions, and most of all, in valuing the privilege of being able to do good science in a Latin American country.

In fact, being trained as a scientist and contributing to Paleontology does not feel like a regular job, but rather like an opportunity to pursue my passion and think broadly about the natural world change.

Credit*: Centro de Investigaciones Paleontológicas, Colombia*

I have been taught that there is no a better job than being a scientist, and a paleontologist in particular. In fact, being trained as a scientist and contributing to Paleontology does not feel like a regular job, but rather like an opportunity to pursue my passion and think broadly about the natural world. Everything is exciting in this profession. From learning a second language, interacting with great scientists, and traveling to multiple places, to collecting fossils, answering questions about the Earth, and its ancient life, and on top of that, understanding our minute place as a species in the exuberant and extremely diverse great-tree-of-life!

Some of the major findings I been involved in so far are as follows. In 2013, I did an internship at the Museo Paleontológico Egidio Feruglio in Trelew, Argentina, where I had the opportunity to participate in the excavation of the *Patagotitan mayorum*, biggest animal ever to walk Earth, in Patagonia. Later between 2013-2015, for my undergraduate thesis at the Universidad Pedagógica y Tecnológica de Colombia (Tunja, Colombia) I described the appendicular remains of a 130-million-year-old ophthalmosaurid from Colombia. An opthalmosaurid is a tuna-shaped marine reptile. Since 2016 I have been a fellow at the Smithsonian Tropical Research Institute (STRI) where I have had the opportunity to gain geological fieldwork experience in Panama (Eocene to Pliocene) and Colombia (Pleistocene). At the STRI I have been able to share ideas with many scientists and learn from their research in tropical sciences across a wide variety of topics. Also, at STRI I had the chance to describe amazing shark bite marks preserved in a whale fossil from the late Pliocene of Panama (see Gizmodo story here). In 2017, I did a short-term visit to the paleontological collection of Staatliches Museum für Naturkunde Stuttgart (Germany) under the supervision of Dr. Erin Maxwell, which turned into the publication of a new marine reptile from the Posidonia Shale (Early Jurassic) for the first time in nearly 90 years since the most recent discovery! We named it *Hauffiopteryx altera* (see video on YouTube).

My PhD project, which examines how biodiversity of ancient marine ecosystems responded to large-scale climate and geographical changes through time, has direct implications for palaeontological development and fossil heritage in Colombia and the Neotropics, a field that is still emerging compared to developed countries. I see my future linked to a new generation of Latin American scientists, where students are being trained to start fostering projects with an impact on local and regional development. This, in the long run may help to conserve both biological and paleontological heritage, and through science and education, build the foundations for a more equitable, inclusive, and supportive society.

Research - Evolution of marine ecosystems: an examination on how biodiversity of ancient marine ecosystems responded to large scale climate and geographical changes through time

My PhD research investigates how the ancient marine ecosystems spanning the establishment of the Hispanic Corridor (a seaway linking the eastern Pacific and western Tethyan oceans) evolved. The Hispanic Corridor also represents a comprehensive dataset from multiple diverse fossil localities that temporally and spatially span a time of large-scale global sea level rise, temperature rise, and tectonic rifting that connected the Atlantic and Pacific Oceans during the Early Cretaceous, over 130 million years ago. These data will be used to estimate the aspects of these ecosystems that were most stable and which evolved during this dramatic environmental event. Emphasis is placed on high ecological trophic levels, because as we know from the modern world, predators offer the most robust signals of ecosystem complexity and food web interactions. To address how marine reptiles responded to biogeographic changes (opening of the Hispanic corridor), climate (temperature), and sea-level changes, the marine fauna from the Paja Formation (Hauterivian-Barremian) of Colombia is being used as a model system to investigate evolutionary patterns of top predators (i.e., origin, extinction, anatomical rates) using accurate time-calibrated phylogenies. We hypothesize that biotic factors will show significant signatures to support a hotspot of high origination rates, low extinction rates, high morphological rates of evolution, and high endemism.

Ichthyosaur3D – Credit: Dirley Cortés

Preliminary results present remarkable insights. First, the occurrence of a Colombian Barremian teleosauroid (related to modern-day crocodiles) demonstrates that the thalattosuchian teleosauroid lineage, which was thought to be extinct actually survived the Jurassic / Cretaceous extinction. With a body length of 9.6 m, this specimen is one of the largest known teleosauroids and the youngest known for the lineage (Cortés et al., 2019, see story here). Second, the descriptions of ichthyosaur material reveal the first hypercarnivore ichthyosaur from the Cretaceous, which opens up questions about food web structures for Jurassic-Cretaceous ecosystems (Cortés et al., *In review*). Finally, a 3D surface scan of a pliosaur from the Paja Formation reveals numerous cranial autapomorphies, which provide distinguishable information to place this new genus in a taxonomic and systematic context and to evaluate its phylogenetic and paleobiogeographic relevance (*In prep*.). This project will set the stage for continued explorations of large-scale patterns in species diversity for other taxonomic levels for a better understanding of the consequences of the Jurassic-Cretaceous extinction on marine vertebrate faunas, and ultimately of the advent of today's marine ecosystems (modified from CSVP 2021).

Peer-reviewed publications

- *Cortés, D*., Larsson, H. C. E., Maxwell, E. E., Ruge, M. L. P., Patarroyo, P., & Wilson, J. A. (2019). An Early Cretaceous teleosauroid (Crocodylomorpha: Thalattosuchia) from Colombia. *Ameghiniana*, 56, 365-379.
- *Cortés, D*., De Gracia, C., Carrillo-Briceño, J. D., Aguirre-Fernández, G., Jaramillo, C., Benites-Palomino, A., & Atencio-Araúz, J. E. (2019). Shark-cetacean trophic interactions during the late Pliocene in the Central Eastern Pacific (Panama). *Palaeontologia Electronica*, 22(2).
- *Cortés, D*., & Páramo-Fonseca, M. E. (2018). Restos apendiculares de un ictiosaurio oftalmosáurido del Barremiano inferior de Villa de Leiva, Colombia. Boletín de Geología, 40(1), 15–30.
- Luque, J., *Cortés, D*., Rodriguez-Abaunza, A., Cárdenas, D., & de Dios Parra, J. (2020). Orithopsid crabs from the Lower Cretaceous Paja Formation in Boyacá (Colombia), and the earliest record of parasitic isopod traces in Raninoida. *Cretaceous Research*, 116, 104602.
- Maxwell, E. E., & *Cortés, D.* (2020). A revision of the Early Jurassic ichthyosaur *Hauffiopteryx* (Reptilia: Ichthyosauria), and description of a new species from southwestern Germany. *Palaeontologia Electronica*, 23, 1–43.
- Maxwell, E. E., *Cortés, D*., Patarroyo, P., & Ruge, M. L. P. (2019). A new specimen of *Platypterygius sachicarum* (Reptilia, Ichthyosauria) from the Early Cretaceous of Colombia and its phylogenetic implications. *Journal of Vertebrate Paleontology*, 39(1), e1577875.

Most recent conference papers

- *Cortés, D*., Larsson H.C.E., Maxwell, E.E., Demers-Potvin A., Bui, HNN., Smith, A., & Parra-Ruge ML. (2021). Evolution of marine ecosystems, a global view from the Early Cretaceous marine tetrapods of Colombia. 9th Annual Meeting Canadian Society of Vertebrate Paleontology. Vertebrate Anatomy Morphology Paleontology 9. 14 p. ISSN 2292-1389
- *Cortés, D., &* Larsson H.C.E. (2020). Cretaceous marine predators from Colombia and their contribution to the understanding of the evolution of South American marine ecosystems. 9th International meeting on the secondary adaptation of tetrapods to life in water.
- *Cortés, D*., Maxwel, E.E., & Larsson, H.C.E. (2020). Redescription and phylogenetic position of *P. sachicarum* from the Early Cretaceous of Colombia. 8th Annual Meeting Canadian Society of Vertebrate Paleontology. Vertebrate Anatomy Morphology Paleontology 8. 26-28 p. ISSN 2292-1389.

Media

- New species of 'fish lizard,' a reptile dating back to the dinosaurs, discovered by McGill student https://www.cbc.ca/news/canada/montreal/redpath-mcgill-researchers-germany-identify-ichthyosaurs-1.5653369
- New species of Ichthyosaur discovered in museum collection https://phys.org/news/2020-07-species-ichthyosaur-museum.html
- Fossil hunters found bones from an ancient whale... and then they saw the bite marks https://gizmodo.com/fossil-hunters-found-bones-from-an-ancient-whale-and-1837442417
- Enormous Crocodylomorph Discovered in Colombia https://mostlymammoths.wordpress.com/2020/03/01/enormous-crocodylomorph-discovered-in-colombia-dirley-cortes/
- Ichthyosaurs, an international collaboration https://mostlymammoths.wordpress.com/2021/05/31/ichthyosaurs-an-international-collaboration/

You can find more of my work on ResearchNet:
https://www.researchgate.net/profile/Dirley-Cortes

Volume 4 | Issue 3 **August 2021**

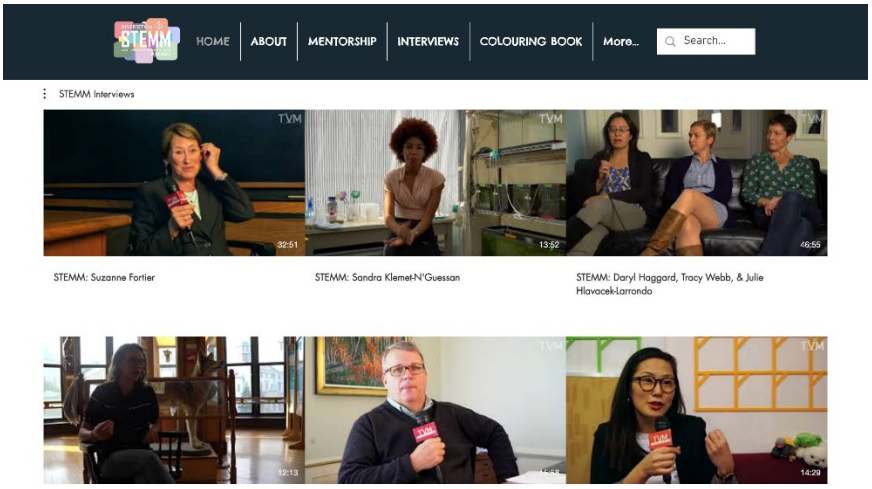
STEMM Diversity McGill

Summer 2021

Oftentimes, we see scientists portrayed as stoic, objective, emotionless creatures, but in reality, scientists are people. Our identities and sensibilities are not in opposition with our role as scientists, but in fact makes us better scientists.

We are STEMM Diversity @ McGill, a student-run initiative that promotes underrepresented groups in STEMM (science, technology, engineering, math, and medicine). We do this through 4 main portions of our initiative:

1. A website that features video interviews with unrepresented groups: https://www.stemmdiversity.com/



2. A colouring and activity book featuring “draw yourself as a scientist” activities, and activities about the research of underrepresented people in STEMM, which you can request a free copy of here: https://www.stemmdiversity.com/colouring-book

3. A lesson plan to accompany this colouring book about the diversity of science and scientists

4. A mentorship program that pairs graduate students with undergraduate students from underrepresented groups, which McGill students in Biology can sign up for here: https://www.stemmdiversity.com/mentorship

STEMM DIVERSITY AT MCGILL
mentorship program

STEMM Diversity is run entirely by graduate students in the Redpath Museum. All of us are scientists, and our involvement in STEMM Diversity stems from our own experiences. Below are the stories of some of our members:

"I authored and illustrated the STEMM Diversity @ McGill colouring book, and am the current Chair and co-founder of STEMM Diversity. When we were founding STEMM Diversity, it was very important to me that there was a part of the initiative that kids could connect with. I've always been interested in science, I grew up flipping over rocks and logs in the mud to see what I could find, but to many I wasn't what a scientist should be. I'm a bright and bubbly woman, and people were quick to tell me that I don't belong. I wanted something that could counter that for kids that were in the position I once was. I've seen the positive impact that the colouring book, and STEMM Diversity as a whole, has had. We've been told that the colouring book finally let kids see someone who was like them in science, and that the passion for science that kids see in the lesson plan made them realize that science could be their passion, too".

- *Jessica Ford, Chair of STEMM Diversity, PhD candidate in Biology*

"Although universities are made up of diverse communities, it's initiatives like STEMM Diversity that help tackle barriers for the inclusion of its diverse individuals. Through this initiative, I have become a better ally and continue to learn how to better serve as an EDI advocate".

- *Nathalie Jreidini, STEMM Diversity volunteer, PhD student in Biology*

"One of the main reasons I am in STEMM is because I had a fantastic undergraduate research mentor. She was the first woman I encountered during my bachelor's that I could relate to within a lab environment, and this experience ultimately defined my future academic and career choices. Because of this, within STEMM Diversity I am one of the coordinators of the mentorship program. My goal is for our undergraduate mentees to see themselves reflected and supported throughout their degrees by others who may have once been in their shoes, and for the graduate students involved to likewise grow in the process by reflecting on their own experiences within STEMM."

- *Victoria Marie Glynn, STEMM Diversity volunteer, PhD candidate in Biology*

We have loved seeing STEMM Diversity grow. It has been such a rewarding part of our time at McGill. To date, we have distributed over 1,800 free STEMM Diversity colouring books, showcased 15 interviews, grown our team, expanded our offerings, and continued to learn and build community. We are excited to see where this journey takes us next.

You can read more about us on our website, in our upcoming Cell Mentor Blog Post, upcoming Voices article in *Trends in Ecology & Evolution*, or by following us on our social media. You are also welcome to contact us via email at stemmdiversityatmcgill@gmail.com.

Learn more about STEMM Diversity through the following videos

SciPEP (**Sci**ence **P**ublic **E**ngagement **P**artnership) **2021 Conference Splash Talk:** https://www.youtube.com/watch?v=e9JVvHuFjcg

Virtual Eurêka! 2021 Science Festival (English): https://www.youtube.com/watch?v=aO9jJxbzKAU

Virtual Eurêka! 2021 Science Festival (French): https://www.youtube.com/watch?v=1vcH_OuHREk