

## Undergraduate Research Symposium May 20, 2016 Mary Gates Hall

### Online Proceedings

---

1P

#### PAST, PRESENT, AND FUTURE: MEASUREMENTS TO UNDERSTAND EVOLUTION AND CLIMATE CHANGE

Session Moderator: Bonnie Becker, Environmental Science (Tacoma)

JHN 111

12:30 PM to 2:15 PM

\* Note: Titles in order of presentation.

##### Using Real-Time Polymerase Chain Reaction to Determine Spatial Distribution of Multiple Species of Shellfish

Brenda Smithhisler (Brenda) Tran, Senior, Envir Sci: Conserv Biol & Ecol (Tacoma)

Mentor: Bonnie Becker

The success of both wild and cultured shellfish populations is dependent upon recruitment of planktonic larvae. Due to issues of cost, time, expertise and inaccuracy associated with bivalve identification using microscopy, quantitative polymerase chain reaction (qPCR) is being employed to identify and quantify larvae using DNA technology. We are quantifying species-specific abundance and distribution of four commercially important species using novel approaches. Environmental samples were collected via two rounds of in-situ pumping at four locations in intertidal waters in Washington State. Pumping was performed at two depths: near the water surface and above the sea floor and at two times: before sunrise and sunset, in order to determine the spatial and temporal distribution of bivalve larvae. Genetic assays for the Pacific geoduck clam (*Panopea generosa*), Olympia oyster (*Ostrea lurida*), Pacific oyster (*Crassostrea gigas*) and Manila clam (*Venerupis philippinarum*) have been designed. The collected field samples are currently undergoing qPCR quantification using these assays. Results will be analyzed to determine cross-species patterns or species-specific behavior in larval distribution throughout Washington State. This information will provide a comprehensive snapshot of the larvae of multiple shellfish species in Washington. Additionally, this information may further be utilized by hatcheries by providing the best times and locations to plant cultured seeds and substrate and by researchers studying the effects of localized ocean acidification.

##### Bite for Your Life: A Comparison of Mandibular Bending Strength between Extinct and Extant Metatherian Mammals

Nicole Rebecca (Nicole) Aqua, Senior, Anthropology: Archaeological Sciences

Mary Gates Scholar

Mentor: Gregory Wilson Mantilla, Biology

Mentor: Brody Hovatter, Biology

In order to understand the paleoecology of extinct animals, it is useful to look at extant species for comparison. Due to the shared ancestry between the modern opossum, *Didelphis virginiana*, and the extinct marsupialiform, *Didelphodon vorax*, the opossum is often used as an analog for understanding the life history of *D. vorax*. *Didelphodon vorax*, which was the largest mammal from the latest Cretaceous of North America (~66 million years ago), is thought to have had an ovivorous (egg eating) or durophagous (hard-shelled eating) diet; however, little is known about its ontogenetic patterns and ecology. Therefore, we aim to construct an age series of *D. vorax* to gain insight into diet changes throughout its life. A mandibular bending strength analysis investigates the level of force the mandible is capable of withstanding during biting in both dorsoventral and labiolingual directions. Additionally, we can use it to determine variation in bending strength along the body of the jaw, which allows us to further explore feeding behavior. Here, we illuminate cranial ontogenetic patterns in *D. vorax* by examining different development stages to determine diet variation based on mandibular strength profiles. We analyzed mandibular cross-sectional properties and applied beam theory to 15 *D. virginiana* and seven *D. vorax* specimens. Each individual used in the study resulted with a relative force greater than one, which is indicative of an adaptation toward exerting forces directly on prey, whereas a ratio less than one would indicate an adaptation toward withstanding struggling motions or transverse stresses. Finally, we find similar patterns of ontogeny for both species at different tooth positions, which supports the notion

that diet changes throughout ontogeny of these marsupials. Thus, comparison of mandibular bending strength between extinct and extant mammals has the ability to gain insight into their feeding behavior and morphological adaptations.

**Quantitative Dental Ecomorphology of Arctocyoniid and Periptychid "Archaic Ungulates" from the Earliest Paleogene of North America**

*Gianni Russell Aranoff, Senior, Biology (Ecology, Evolution & Conservation)*

*Mary Gates Scholar, UW Honors Program*

*Mentor: Stephanie Smith, Biology*

*Mentor: Gregory Wilson Mantilla, Biology*

The Cretaceous-Paleogene (K-Pg) mass extinction and resulting biotic recovery mark a pivotal moment in mammal evolution. The recovery period, which spanned about 1 million years from the Puercan North American Land Mammal Age (NALMA) to the Torrejonian NALMA, represents a transition from species-poor "disaster" faunas directly following the extinction event to species-rich "recovery" faunas. Though previous research has broadly studied the faunal dynamics of the early Paleogene, the exact mode and tempo of the biotic recovery has not been well examined. To investigate the ecological trends of the "disaster" to "recovery" faunal transition, specifically changes in diet, we analyzed dental evolution within the periptychid and arctocyoniid "archaic ungulate" lineages over a time period that spans from the Puercan NALMA to the Torrejonian NALMA. We measured relief index (RFI), a metric that determines the ratio between the 2D and 3D area of mammal teeth, on both the "archaic ungulates" and a set of ecologically diverse extant mammals to identify the dietary ecologies of the extinct mammals. Previous research has demonstrated a correlation between RFI and diet in extant mammals; high RFI values correspond to herbivory and insectivory, while low RFI values correspond to omnivory and frugivory. Our preliminary results suggest an increase in dietary diversity and an overall decrease in RFI during the biotic recovery. This reduction in RFI reflects a trend in "archaic ungulate" dietary preference from insectivory in the Puercan NALMA to omnivory and frugivory in the Torrejonian NALMA. The results of our study will help scientists understand how ecosystems recover from catastrophic events, such as mass extinctions, on large timescales.

**Degree of Cranial Elevation and the Location of Axial Rotation during Suction Feeding in Striped Surfperch, Largemouth Bass, and Pacific Staghorn Sculpin**

*Jonathan David (Jono) Grindall, Senior, Aquatic & Fishery Sciences*

*Mary Gates Scholar*

*Mentor: Elizabeth Brainerd, Ecology & Evolutionary Biology, Brown University*

*Mentor: Megan Dethier, Biology*

Suction feeding is a valuable process to study since most aquatic vertebrates, which make up nearly half of all vertebrates, eat this way. Having a better understanding of this may give important insight into the evolution of vertebrates as a whole. During suction feeding the cranium elevates, causing bending in the vertebral column, resulting in a rotation of the cranium and body plane about an axis of rotation located on the vertebral column. We hypothesized that the vertebral column behaves like a flexible rod and accordingly asked if axial rotation is located more posteriorly with larger degrees of cranial elevation. Using video reconstruction of moving morphology and joint coordinate systems, which use coordinates to measure the 3D motions of bones in an anatomically meaningful coordinate space, we compared movement of the cranium in relation to the body in striped surfperch, largemouth bass, and Pacific staghorn sculpin. We found no significant correlation between degree of cranial elevation and location of axial rotation. However, the degree of cranial elevation and location of axial rotation varied among these species in a consistent way. These species' unique ways of performing these movements could be related to their differences in morphologies.

**Using a Sterol Produced by Microalgae to Reconstruct Rainfall Patterns in the Solomon Islands**

*Amanda Elisabeth (Amanda) Witt, Senior, Biology (General), Spanish*

*Mary Gates Scholar*

*Mentor: Julian Sachs, Oceanography*

*Mentor: Ashley Maloney, Oceanography*

The South Pacific Convergence Zone (SPCZ) is the most prominent rain feature of the Southern Hemisphere, but is a very understudied region. Changes in the SPCZ can affect freshwater availability to people living on the islands in the South Pacific. The satellite record shows precipitation patterns from the past 37 years; in the tropics the best way to investigate rainfall before 1979 is to examine lake sediment. We used sediment cores with age models from Barora Lake, a shallow freshwater lake in the Solomon Islands, to obtain a detailed view of past rainfall patterns. This lake's lack of oxygen one meter below the water's surface has left its sediment in a uniquely undisturbed state. Because of this, and a high accumulation rate, the sediment provides a record of the rainfall in the Solomon Islands over the last millennium. Lipids

are well-preserved in sediment over geologic time, making them an ideal proxy for reconstructing tropical paleoclimate. The lipid dinosterol is produced primarily by a limited group of dinoflagellate microalgae and acts as a “molecular fossil”. The isotopic ratio of deuterium to hydrogen (2H/1H) found in dinosterol reflects the 2H/1H ratio in the lake water, which is dictated by changes in precipitation and evaporation. In the tropics, more rain results in 2H-depleted rain and lake water. After purifying dinosterol from the sediment with column chromatography and high-performance liquid chromatography, we found minor fluctuations in the dinosterol 2H/1H ratios, which implies a fairly stable rainfall pattern at this location during the past millennium.

### **Thermal Infrared Remote Sensing of Snow Surface Temperature: Quantifying Snow’s Energy Budget**

*Eric Michael Keenan, Senior, Civil Engineering, Earth & Space Sciences (Physics)*

*Mary Gates Scholar*

*Mentor: Jessica Lundquist, Civil And Environmental Engineering*

Over one sixth of the world’s population relies on seasonal snowmelt and glacial runoff for their water resources. With measurable decreases in snow packs and accelerating warming predicted for the next century, quantifying the underlying physical processes describing snow accumulation and melt is critical to making informed water resources decisions. Here we present thermal infrared (TIR) measurements of snow surface temperature collected on the ground and by a small airplane flying over the Tuolumne watershed in Yosemite National Park in February 2016. The plane captured spatial and temporal variations in the temperature of the snow’s surface, while ground measurements provided a reference point to evaluate the aerial measurements’ accuracy. TIR measurements provide a diagnostic tool used to assess model representation of many key processes, including snowmelt rates, sensible and latent heat fluxes, and longwave radiation. Moving forward we plan to incorporate our findings into snow models in order to better represent snow pack dynamics. Initial comparisons between airborne observations and ground based measurements indicate the airborne observations reliably describe snow surface temperature to within two degrees Celsius. This difference indicates a considerable reduction in uncertainty when compared to modeled snow surface temperature.

### **Island Pollinators of Indonesia and the San Juan Islands**

*Ashley Mocorro Powell, Senior, Biology (Ecology, Evolution & Conservation)*

*Mentor: Randall Kyes, Psychology*

*Mentor: Richard Olmstead, Biology, Burke Museum*

Islands are home to some of the world’s most unique and rare species but often are heavily underfunded for scientific mon-

itoring and conservation efforts. In light of a changing climate, it is important to catalogue the diverse species in island environments to estimate current distribution and abundance to establish baseline data records. Historically, smaller organisms like insects are overlooked. However, native pollinators are an integral component of ecosystem functioning and health. In summer of 2015, I surveyed a small island in the middle of the Indian Ocean off the western coast of Java, Indonesia for native bee and wasp species. Utilizing hand held GPS, insect net collection techniques, and colored bowl traps, I was able to conduct the first pollinator survey on Tinjil Island getting a glimpse of the myriad of pollinators inhabiting the area. Transition from my Indonesian field research experience, beginning in March 2016, I am now surveying the coastal meadows and endemic wildflowers of the San Juan Islands for native bee species. By photographing pollinator visitation of wildflowers in San Juan Island National Historical Park, I am contributing to the creation of a citizen scientist species identification catalogue for the region. In celebration of the National Park Service centennial, I am collaborating with a small team of regional pollinator experts to help identify native bee species of Washington’s most iconic islands through a rapid 24-hour survey known as a BioBlitz (May 21-22). In addition, I share with you how you can contribute to local citizen science initiatives and entomology-based educational experiences from your own backyard.

### **Vulnerability and Climate Change-Induced Human Displacement**

*Shweta Jayawardhan, Senior, Political Science, Law, Societies, & Justice*

*Mary Gates Scholar, UW Honors Program*

*Mentor: Arzoo Osanloo, Law, Societies, and Justice*

This project addresses the relationship between vulnerability and climate change induced human population displacement. Anthropogenic climate change is increasingly altering the way people live. A significant consequence of the effects of climate change is human displacement due to climate effects such as hurricanes, sea level rise, and drought. People displaced by the effects of climate change suffer from a legal protection gap. Increasing global attention is being addressed at closing this gap. My research explores the relationship between vulnerability and climate change induced displacement by analyzing case studies of hurricane induced displacement in the U.S. Gulf Coast, cyclone induced displacement in Bangladesh, and drought induced displacement in Somalia. Analysis of these case studies demonstrates that there is a relationship between socioeconomically vulnerable populations and displaced populations. Both in developed and developing countries, environmental displacement affects vulnerable populations disproportionately. Policy aimed at closing the legal protection gap for environmentally displaced persons should address the socioeconomic in-

equalities that make marginalized groups more vulnerable to climate change.

**Power of Expertise: The Effect of Expert Knowledge on the Promotion of Education and Attitude Change**

*Hyojung (Halie) Kim, Senior, Community, Environment, & Planning*

*Mentor: Keith Harris, Built Environments*

*Mentor: Christopher Campbell, Urban Design And Planning Group*

The scope of this project is to invite an expert to make a speech focused on water mismanagement and global climate change and to conduct pre-speech and post-speech surveys to explore the effects of the speech on knowledge and attitude change regarding these two issues. One common assumption among those combating climate change is that providing the public with expert knowledge on the subject will change their opinions and behaviors. This project tests whether that assumption is correct by measuring the impact of a single speech on the knowledge and attitudes of college-aged students. For the application of my research, I planned and organized the event inviting 300 students to listen to a 1-hour speech delivered live by a Senior member of the United Nations on climate change and global water issues, and conduct pre-speech and post-speech surveys that were administered to determine what effect, if any, the speech had on the students' knowledge and attitudes about the topics. 197 pre-surveys were completed while 130 attendees were present at the event and 60 attendees completed the post-survey. The post-survey results are in the process of cross comparison with the initial pre-survey. I hypothesized that the results speech measured by the pre-surveys and post-surveys will show significant positive change in both knowledge and attitude change. The implications of my research results will be used to suggest broader implications for scientific and policy communication to a lay audience in order to continuously educate and successfully convey knowledge and information while advocating for positive change in attitude to further advance our efforts in solving the global threat of climate change and water management.