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Online Proceedings

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ECOLOGY FROM MICROBES TO BIRDS

Session Moderator: Frieda B. Taub, Aquatic & Fishery Science

JHN 111

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Development of Sulfide Depends on Type of Organic Material and Sediment Grain Size

Annalee Joy (Annalee) Cappellano, Senior, Environmental Studies
Mary Gates Scholar
Kaylie Elizabeth Bazzano Carr, Senior, Aquatic & Fishery Sciences
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R (Rachel) Scott, Junior, Oceanography
Mentor: Sylvia Yang, SEA Discovery Center, Western Washington University
Mentor: William King, Biology

Organic matter, such as detritus, occurs naturally in marine sediments. However, anthropogenic activities, such as historical timber industry practices and nutrient enrichment (eutrophication) leading to algal blooms, have enriched organic matter in marine sediments, compromising the stability of benthic communities. Added organic material can facilitate microorganisms, which alter the chemistry of the water in marine sediment. This study focused on factors associated with the success of benthic anaerobic bacteria that reduce sulfate into sulfide, which can be detrimental to organisms living in and on the sediment. We investigated if wood or algae would be a more productive carbon source for sulfate reducing bacteria and if grain size, fine versus coarse, would affect the amount of sulfide produced by anaerobic bacteria. Sediment microbial communities were cultivated in a four-week long mesocosm experiment in which wood or algae carbon sources were mixed in fine or coarse sediment. We measured sulfide levels throughout the experiment to determine which treatments were most productive. We found that algae led to earlier and higher sulfide levels within four weeks, as compared to wood. Furthermore, fine grained sediment produced higher concentrations of sulfide, particularly in the presence of algae. Our findings suggest organic material in the form of algae, such as from algal blooms, is a more readily available source of carbon for sulfate reducing bacteria. Future research could extend the timeline of an experiment to investigate what sulfide levels may be produced with wood in sediment.

Mesograzer Density Reveals that Eelgrass (*Zostera marina L*) Grows More When Covered in Epiphytes

Hyejoo Ro, Sophomore, Aquatic & Fishery Sciences
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Abigail Andrea (Abby) Von Hagel, Junior, Pre-Sciences
UW Honors Program
Mentor: Sylvia Yang, SEA Discovery Center, Western Washington University
Mentor: William King, Biology

Eelgrass beds in the Salish Sea provide habitat for various organisms, including algal epiphytes and invertebrate grazers. The relationships amongst eelgrass, epiphytes, and grazers are highly complex. Epiphytes have been shown to have a negative effect on eelgrass growth, and epiphyte removal by grazers has been shown to have a positive effect on eelgrass fitness. In some experiments, epiphyte and grazer presence has been shown to have a neutral effect on eelgrass. Therefore, in this study we examined the interactions between *Zostera marina L*, epiphytes, and a native marine invertebrate gastropod *Haminoea vesicula* to measure how these relationships impacted eelgrass growth as a proxy for performance. We collected specimens from two different locations with contrasting gastropod and epiphyte presence- Padilla Bay and Ship Harbor, Washington. We then conducted a series of density gradient experiments measuring dry epiphytic biomass loss under varying mesograzer densities to test whether mesograzers consumed epiphytes, and a follow-up mesocosm experiment to observe eelgrass performance among differing snail density treatments. Our results came to the surprising conclusion that mesograzer biomass and fecal deposits had no effect on eelgrass performance. Additionally, rather than negatively impacting eelgrass performance, the amount of epiphytic cover present on the eelgrass collected in the winter from Ship Harbor, Washington was associated with increased eelgrass growth. This suggests that in some situations epi-

phytes may not have a negative impact on eelgrass performance. This may have significant implications for eelgrass restoration and monitoring efforts in the Salish Sea.

How Do Variations in Air Exposure Affect the Desiccation of *Z. marina* Gathered from Different Tidal Zones?

Elizabeth Marina (Liz) Allyn, Senior, Aquatic & Fishery Sciences
Mary Gates Scholar, UW Honors Program
Jennifer D. (Jenn) Gonzaga, Senior, Envir Sci: Conserv Biol & Ecol (Tacoma)
Mary Gates Scholar, Undergraduate Research Conference Travel Awardee
Mentor: Sylvia Yang, SEA Discovery Center, Western Washington University
Mentor: Megan Dethier, Biology
Mentor: William King, Biology

Eelgrass (*Zostera marina*) are important ecosystem engineers that provide food and habitat to diverse organisms. Some eelgrass beds are declining in locations around the Salish Sea, leading to a subsequent decline in biodiversity and productivity. One proposed restoration strategy is to transplant shoots from healthy to declining sites. Transplantation efforts, however, should consider the effects of desiccation on eelgrass during extreme low tides. Desiccation can decrease transplant success by decreasing photosynthetic rates and causing tissue damage in transplanted shoots. To understand how desiccation affects transplanted eelgrass performance, we conducted a mesocosm experiment that manipulated air exposure durations to simulate eelgrass transplantation between tidal elevations. Plants collected from three tidal heights in Ship Harbor, WA were randomly placed in tide tanks that mimicked the emersion periods of three different tidal elevations. We measured changes in eelgrass morphology, growth, and tissue damage throughout the experiment. We predicted that shoots in treatments with similar air exposure durations as their original locations would exhibit the highest growth rates and the least amount of damage. We found that eelgrass originating from a high intertidal zone that were exposed to a low intertidal treatment exhibited the least amount of bleaching damage. Neither origin nor treatment, however, affected eelgrass growth rates. Our findings suggest that transplanting shoots from the high to low intertidal zone is a useful strategy for eelgrass restoration.

Eelgrass Origin Affects Performance in Warm Water

Malise Ching Yun, Senior, Pre-Sciences
Mary Gates Scholar
Josephine M (Gigi) Gaultier, Junior, Aquatic & Fishery Sciences
Mentor: Sylvia Yang, SEA Discovery Center, Western Washington University
Mentor: William King, Biology

Eelgrass (*Zostera marina*) meadows provide important habitat to waterfowl, invertebrates, and fishes and are the focus of restoration efforts in Washington State. Given the variation in water temperatures of different Pacific Northwest eelgrass habitats, we investigated how water temperature of source locations could affect how the eelgrass could perform as potential donor candidates. In our study, the sites designated for eelgrass shoot donation differed in water temperature; Padilla Bay was generally warmer than Ship Harbor. We hypothesized that plants from the warm site would perform better in warmer temperatures and handle warm temperature extremes. We conducted a mesocosm experiment in which we manipulated temperature and measured eelgrass growth, morphology, and decay. Eelgrass in the warmed treatment decreased in length compared to plants reared at the ambient seawater temperature (control), with Ship Harbor eelgrass decreasing in shoot length more than Padilla Bay eelgrass. The eelgrass from Ship Harbor started to decrease in length at 21 days, compared to 28 days for Padilla Bay. Furthermore, the warmed treatment had more decay after 28 days than the control treatment and eelgrass from Ship Harbor decayed more severely than those from Padilla Bay. Surprisingly, new growth from Ship Harbor was greater than that from Padilla Bay. Our results suggest that Padilla Bay eelgrass could have been better acclimated to warmer temperatures, but the increased temperature still lead to a decrease in performance. The implication for eelgrass restoration is that the temperatures of donor and receiving sites should be similar to improve eelgrass transplant success.

Skin Lipids of the Striped Plateau Lizard (*Sceloporus virgatus*): Oleic and Stearic Acids as Potential Indicators of Mate Quality

Tiare Elaine (Tiare) Gill, Junior, Biology , University of Puget Sound
Mentor: Stacey Weiss, Biology, University of Puget Sound
Mentor: Jay Goldberg, Biology, Indiana University - Bloomington

Chemical signaling, in the form of pheromones, is an important mechanism of sexual selection in reptiles, as it provides a means of communicating mate receptivity and quality during the mating season. Previous research on the chemical profile of Striped Plateau Lizard (*Sceloporus virgatus*) skin lipids found that lower levels of oleic and stearic acid in female skin lipids correlate with larger egg clutch sizes, suggesting

that low levels of the fatty acids might be an attractive mating cue for males. The purpose of this research was therefore focused around two aims: 1) Determine if male lizards respond to manipulation of oleic and stearic acid ratios, as well as between presence and absence of the fatty acids when presented as an isolated cue; 2) Investigate how altering the levels of the two fatty acids in the skin lipids of female lizards affects male courting behavior. To address these aims we recorded male chemosensory behaviors (nose taps, tongue flicks, and air tasting), as well as escape behaviors (scurrying and jumping) during 40 minute behavioral trials. Although there was no significant difference in male chemosensory behavior between low and high lipid ratio treatments when the cues were isolated, results from the manipulated female trials show that male lizards demonstrated significantly more escape behaviors when presented with cues from a fatty acid spiked female than from an un-manipulated female. This suggests that male lizards were less interested in fatty acid spiked females—possibly due to the unattractive nature of a high lipid ratio cue.

Genetic and Phenotypic Study of the *Agama picticauda* Population in Ghana

Sneha Krishnan, Senior, Biology (Ecology, Evolution & Conservation)

Mary Gates Scholar, UW Honors Program

Mentor: Adam Leache, Biology

West Africa is a region characterized by high species diversity and endemism, making it an ideal region to study the mechanisms of speciation and the evolution of genetic and phenotypic differences. Species in these regions often vary in morphology, genetics, and other aspects of their population structure, however the specific drivers of these differences have not been clearly identified. This project uses landscape genetics to test for correlations between geographic distances, genetics, phenotypes, and ecology in rainbow lizards (*Agama picticauda*) in West Africa. Genetic data were collected from 90 specimens using the ddRADseq protocol, and the final data matrix included 2,614 single nucleotide polymorphisms (SNPs). To analyze the phenotypes, 10 morphological traits were measured from 45 specimens obtained from the UW Burke Museum, the LSU Museum of Natural Sciences, and the UCB Museum of Vertebrate Zoology. Phenotypic, geographic, and genetic data were used in the principal component analyses that generated plots showing the distribution of diversity. The preliminary results support four distinct groups with little overlap. Further research will be conducted to include environmental and landscape variables in the study. The results of this study will identify the factors that generate diversity in West Africa. Issues such as climate change and species degradation are becoming more prevalent, therefore an understanding of these factors is necessary for conservation efforts in ecologically diverse regions.

Vertical Distribution of Understory Avian Population in the Peruvian Rainforest

Wenyi (Luke) Zhou, Junior, Environmental Science & Resource Management

Benjamin David (Benjamin) Haagen, Senior, Biology (Molecular, Cellular & Developmental)

Mentor: Ursula Valdez, IAS, UW Bothell

Cocha Cashu Biological Station in the Amazonian rainforest of Southeastern Peru hosts a myriad of plants and animals, with one study reporting 230 avian species found in 80-100 ha study plots. Such incredible species diversity may be attributed to the adaptation of specialized hunting behavior and morphological traits allowing for habitat partitioning of forest strata. In our study we hypothesized that we would find differences in wing and tarsus morphology in birds living at different forest strata. Over a five-day period, twenty birds were captured by mist nets and used for data collection. From these individuals, wing length to weight and tarsus length to weight ratios were explored to seek a correlation between them and the heights at which different avian species were observed. We predicted birds with lower wing length to weight ratios, and thus more compact morphology, specialized for flight at lower strata. Furthermore, ground-dwelling birds tend to have a longer tarsi for efficient bipedal locomotion on the forest floor, leading us to predict that birds with lower tarsus length to weight ratios would be observed at higher strata. We found that individuals with shorter tarsi and longer wings relative to body mass tended to be found in higher strata. Our results supported our hypothesis, suggesting adaptations in wing and tarsus morphology facilitate partitioning of forest strata. Morphological analysis of avian populations foraging at different heights is critical for developing an understanding of the evolutionary processes underlying these specializations, and for effective conservation management. Although our predictions regarding correlations between morphology and vertical distribution were confirmed in this study, a larger dataset is necessary to better support our findings. Continued research will allow for accurate predictions to be made concerning how avian populations will respond to fluctuating environmental conditions such as altered migration patterns, climate change, and deforestation.

Is Age in the Feet and Eyes of a Penguin?

Pearl Wellington, Senior, Biology (General)

Mentor: Dee Boersma, Biology

Mentor: Katie Holt, Biology

Knowing the age structure of a population improves demographic models, but birds lack many structures, such as teeth and otoliths, used to age other animals. Marking and following large numbers of individuals is required to know the age structure of a penguin population beyond the distinction between juvenile and adult plumage. In a large population of Magellanic penguins (*Spheniscus magellanicus*) at Punta

Tombo, Argentina, we coded eye and foot color. The penguins ranged from less than one year to more than 28 years of age. We examined iris pattern and color, defining "distinct" eyes as reddish-colored irises with concentric red and pink rings and "indistinct" eyes as dark-brown irises. More than 75% of 2-3 year-old Magellanic penguins had distinct eyes, compared to 50-75% of 4-6 year-olds, 25-50% of 7-20 year olds, 10-25% of 21-24 year olds, and $<$10% of 25+ year olds (n=3262). Foot color progressed from mostly white to mottled to mostly black. We also examined foot color in a small known-age zoo population of Humboldt penguins (*Spheniscus humboldti*). In Humboldt penguins, feet became mostly black within a year of hatching, but continued to darken slowly with age (n=44, maximum age=25 years). In Magellanic penguins, feet took several years to become mostly black (n=190). Nestlings had mostly white feet with small specks of black (n=16). About 88% of adults 3-11 years old had mottled or mostly black feet, while the remaining 12% had white or fully black feet (n=90). 24 of 25 adults 23 years or older had black or almost black feet. Individual variation in both eyes and feet prevents aging an individual with a high degree of certainty, but a population may be split into broad adult age classes based on eye and foot color.