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Online Proceedings

2D

BIOLOGICAL RESPONSES TO ENVIRONMENTAL FACTORS

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

MGH 234

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Measuring Microplastic Abundance in Pacific Sand Lance (*Ammodytes personatus*) Habitat on San Juan Island

Kaitlyn Conway, Senior, Envir Sustainability: Envir Comm (Tac)

Mary Gates Scholar

Mentor: Jan Newton, Applied Physics Laboratory, Schools of Oceanography and Marine Affairs

Mentor: Julie Masura, Environmental Science, Interdisciplinary Arts & Sciences

Pacific sand lance (*Ammodytes personatus*) are important to the diets of sea birds, other predatory fish, as well as mammals. Microplastics (plastics $<$ 5 mm) have been found in spawning and deep-water habitats for these organisms. This project explored if microplastics are found on beaches near Friday Harbor Labs on San Juan Island, WA., and if so, to determine their concentration and distribution. Nine sediment samples were collected from two beaches (Jackson and South) and a wave field known to be Pacific sand lance habitat in this area. Samples were processed according to NOAA's Microplastics Methods Manual. Presence, abundance, type (fiber, fragment, film, pellets) and size class ($<$ 0.5 mm, 1-5mm, 6-10mm, $>$ 10mm) of microplastics were determined from sediment samples collected. Microplastics were found in all samples. Microfibers were the most abundant microplastic type (86%), and Jackson beach had the highest concentration of microplastics (17 microplastics/m2). On average the sizes were between 1-5 mm, and the number were 13 microplastics/m2 in the study area. Larger pieces (5-10 mm) were not present at the wave field located on the seafloor, although found at both beaches. This research helps connect microplastic presence to Pacific sand lance habitat. Considering the main prey type of Pacific sand lance and microplastics found in their environment overlap in size classes, it is highly likely that Pacific sand lance are consuming microplastics.

Interactions Of Heavy Metals, Water Chemistry, And Anthropogenic Activity With Marine Mammal Populations In The Snohomish River Estuary: A Study Of The Whidbey Basin

Elizabeth Lee, Sophomore, Environmental Studies, Everett Community College

Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College

Mentor: Katherine Dye, Everett Community College

Mentor: Robin Araniva, Life Sciences, Everett Community College

The Snohomish River estuary serves as a conjoined and biodiverse body of water in Everett, WA, with influence from the freshwater Snohomish River and saltwater from the Pacific Ocean flowing through the Strait of Juan de Fuca into the Possession Sound. Factors of water chemistry and heavy metals, residing in sediment and influenced by surrounding anthropogenic activity, contribute to the estuary ecosystem and support various trophic levels of marine life. This study observes temperature, salinity, pH, and chlorophyll in the water column, and lead, copper, zinc, and mercury in sediment from 2009 to 2018 at three sites with differing proximity to the Snohomish River: MBT, Buoy, and Everett Marina. The parameters were analyzed through boat-based research and Sea-Bird CTD data collected by the Ocean Research College Academy (ORCA) with funding from the National Science Foundation and in partnership with the University of Washington, Gravity Marine Consulting, and the State Department of Ecology. Longitudinal research at ORCA allows students to monitor marine mammal abundance, including sightings of harbor seals, California sea lions, gray whales and harbor porpoise. This investigation is motivated by potential connections between water quality parameters and the abundance of marine mammals. Results indicate heavy metal levels at Buoy reached a maximum in 2011 with mercury, copper, lead and zinc metals averaging 0.05 mg/kg, 29.73 mg/kg, 7.03 mg/kg, and 54.33 mg/kg, respectively; however, average zinc levels were highest at approximately 55.60 mg/kg in

2016. Comparably, MBT heavy metal concentrations were lower and demonstrated greater variability. In 2018, Everett Marina salinity levels show more fluctuation than MBT, while chlorophyll had a max of approximately 46.4 ug/L at MBT. Gray whales that return to Possession Sound to feed on benthic organisms are potentially impacted by these conditions.

The Role of Eelgrass in Heavy Metal Cycling within Possession Sound

Hannah Weinrich, Sophomore, Undeclared, Everett Community College
Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College
Mentor: Katherine Dye, Everett Community College
Mentor: Robin Araniva, Life Sciences, Everett Community College

Eelgrass (*Zostera marina*) is an ecologically important species of marine angiosperm that inhabits sublittoral sediments in the northern hemisphere. Eelgrass beds provide critical food and habitat for many species of fish, invertebrates, and birds. Its root system has the capacity to interact with both the water column and sediment, making it uniquely poised to influence metal cycles within the ecosystem, including those affected by anthropogenic activity. Eelgrass, sediment, and water samples were collected from three sites in Possession Sound, a part of Puget Sound that borders the City of Everett and contains the Snohomish River Estuary. Samples were processed in the University of Washington Isotope Geochemistry Lab before being analyzed for trace metal concentrations using an ICP-MS. In addition, two-meter long sediment cores were taken from three sites in the Possession Sound and the bottom 5cm were analyzed, allowing the researcher to quantify the anthropogenic influence on metal concentrations within sediment. It was hypothesized that the roots, shoots and blades of the eelgrass would exhibit differing concentrations of heavy metals, and that sediment collected within eelgrass beds would contain higher concentrations of metals than sediment collected outside eelgrass beds. Additionally, samples from sites closer to human activity would contain higher concentrations of metals and a greater proportion of metals from anthropogenic sources. Preliminary results of the ongoing study show that concentrations of arsenic, copper, and zinc were higher in eelgrass blades than roots, and eelgrass tissue had higher metal concentrations than the surrounding sediment. These results suggest that eelgrass uptakes metals from its environment, accumulating as well as translocating them in its tissues. Additionally, study locations nearer to the mouth of the Snohomish River and human activity had higher concentrations of heavy metals overall in both sediment and eelgrass.

Investigating Trends in the Possession Sound

Kara Anderson, Sophomore, Undeclared, Everett Community College
Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College
Mentor: Robin Araniva, Life Sciences, Everett Community College
Mentor: Katherine Dye, Everett Community College

Students of the Ocean Research College Academy (ORCA), an early college program through Everett Community College, have monitored bacteria data near Everett, Washington where the Snohomish River meets the Possession Sound since 2004. Used as an indicator of fecal contamination, *Escherichia coli (E. coli)* are found in the intestinal tract of humans and other homeothermic animals. This study investigates the spatial and temporal trends of *E. coli* levels at three sites within the Possession Sound between 2014-2019 in order to better elucidate the ecosystem's health and potentially negative anthropogenic influences. Variation in coliform levels were analyzed with regard to physical and chemical factors such as tidal stage, depth, the Snohomish River discharge, salinity, temperature, dissolved oxygen, pH, and point sources including combined sewer outflows and storm drains. Water samples were collected with a Niskin bottle while a YSI 650 CTD or a YSI EXO Sonde was utilized to measure salinity, temperature, dissolved oxygen, and pH for each of the samples. ORCA students followed the Coliscan®Easygel®Protocol for inoculation, incubation and quantification. Data were reported as colonies of *E. coli* per 100 mL of water. Preliminary results show that *E. coli* levels have a seasonal correlation with river discharge, increasing in the fall, winter, and spring months when river discharge spikes. Coliform levels are higher at the halocline than at the surface or near-deep. Further sampling at additional upriver sites will demonstrate more sources of *E. coli* data. The results of this study will provide a foundation for understanding the fluctuations in the spatial and temporal trends of *E. coli* levels within the Possession Sound in order to better assess threats to the ecosystem health.

Characterization of Benthic Habitat in the San Juan Archipelago and Divergence in Settling Mechanics for Shell Hash

Elisa Nicole Aitoro, Senior, Oceanography
Mary Gates Scholar
Mentor: Matthew Baker, Aquatic & Fishery Sciences

Pacific sand lance (*Ammodytes personatus*) are an important forage fish in the Salish Sea that spend large portions of their time buried in sediment. Five important *A. personatus* habitats, including San Juan Channel (SJC), Sucia Island (SI), North Peapod Island (NPI), Salmon Bank (SBnk), and Iceberg Point (IP), have been documented by students in the Pelagic Ecosystem Function apprenticeship at Friday Harbor

Labs since 2010. Continued sampling efforts have led to extension of an important time series at these sand wave fields throughout the San Juan Archipelago, as well as three new sites. New sites include Hein Bank (HB), North Waldron Island (NWI), and Puffin Island (PI). Both HB and NWI had *A. personatus* present, while PI did not. A synthesis of data from previous years showed sediment type at Sucia Island and North Peapod Island are most similar to each other, while San Juan Channel and Salmon Bank both have a large variation in sediment type. Shell hash is a prominent portion of many *A. personatus* habitats. Previous studies of these wave fields have treated shell hash as analogous to typical geologic sediments, however this study aimed to examine the divergence of shell hash physical dynamics from what is generally expected. The irregular shape of these biologically-derived sediments leads to a relationship between diameter and minimum settling velocity that is the opposite of what is expected for geologically-derived sediment particles. Of the shell hash tested (n=70), the maximum velocity was relatively consistent, and differences in settling velocity between diameters was seen in minimum velocities. These results have implications for understanding net transport throughout the system where different sediment types are present, understanding how sorting and packing of shell hash impact the habitat quality for *A. personatus*, and how differing amounts of these materials may distinguish these important benthic habitats.

The Influence of Chlorophyll-A and Sea Surface Temperature on Magellanic Penguin Reproductive Success

Anna Sulc, Senior, French, Oceanography
UW Honors Program
Mentor: Dee Boersma, Biology

Organisms in the ocean depend ultimately on phytoplankton as it is the base of the marine food web. Through the use of satellite imaging, indicators of photosynthesis such as chlorophyll-A are used as an index of primary production in the ocean over large areas and variable time scales. Phytoplankton is dependent on large-scale ocean processes such as water temperature and water column mixing. Such estimates might provide insights in food availability for larger predators that eat plankton eating fish such as the Magellanic penguin. Located on the southeast coast of Argentina, Punta Tombo is among the largest breeding colonies for Magellanic penguins. The Boersma Lab at the University of Washington has studied the colony since 1982 and have determined reproductive success for 35 years. Although many factors influence the overall success of the colony, starvation of chicks is responsible for 40% of chick deaths. Through the use of spatial analysis tools, we have looked at chlorophyll-A patterns and seasonal water temperature variation around Punta Tombo and compared these two variables with reproductive success of Magellanic penguins. We expect a strong positive relationship between the two datasets: water temperature and chlorophyll-A. Further we expect that when values are higher closer to the colony, reproductive success of birds is higher, and parents forage closer to the colony.

Melastomataceae Diversity and Abundance along an Elevational Gradient of an Andean Ecological Corridor

Grant Gallaher, Junior, Environmental Studies, Biology, Whitman College
Mentor: Lou Jost

I present a baseline assessment of the plant family Melastomataceae along an elevational gradient of the Llanganates-Sangay ecological corridor in central Ecuador. Conservation efforts within this corridor aim to preserve the high levels of diversity and endemism present in the region. Melastomataceae, as the third most diverse plant family in Ecuador, contributes valuable biodiversity, biomass, and ecological services to the ecosystems of this corridor. On Cerro Mayordomo (max elevation: 3,383 m), 300 m transects were established at four different elevations, and six 5x5 m plots were assessed along each transect (600 m^2 assessed total). All melastome species encountered in plots were grouped and counted based on morphological characteristics. My findings reveal a positive correlation of melastome diversity and abundance with elevation up to 2,500 meters. At 3,000 meters, species diversity decreases sharply, but total abundance remains high. Jaccard, Sorenson, and Morisita-Horn similarity indices indicate dramatic changes in melastome community composition over even slight differences in elevation. Eighteen species of flowering melastomes belonging to four genera were found, revealing a subset of the family's astounding diversity in this region. The results of my study will be used to inform future conservation efforts and ecological studies in this incredibly unique and important Andean corridor.