**2019 SAMURS**

**Capstone Awards and Honors**

*2019 Mary Cline Undergraduate Research Awardees*

- Baer, Margaret
  - Amount Awarded $500.00
  - Project Title: Microplastics Analysis and Quantification in Bed Sediments in the Puget Sound
- Burkart, Kenneth
  - Amount Awarded $570.0
  - Project Title: Examining arsenic transfer from water to periphyton and grazers in contaminated urban lakes

2019 Mathematics Awards

- Exceptional Capstone Paper Award: Elizabeth Andreas
- Exceptional Capstone Presentation Award: Kimberly Cote
- Interdisciplinary Award: Arashk Afshar
- Math Community Award: Addie Jacobsen
- Mathematical Growth Award: Eric Wiseman and Charlotte Yan
- Math Ambassador Award: Addie Jacobsen and Madison Phelps
- Outstanding Senior Award: Chris Preuss
- Outstanding Junior Award: Madison Phelps
- Outstanding Sophomore Award: Kaitlyn Jones

2019 Science Awards

- Best Poster
  - Tracie Barry
- Biomedical Sciences Poster 1st Place (tied):
  - Elizabeth Kubay
  - Angela Mitchell and Miranda Makalena
- Biomedical Sciences Poster 2nd Place (tied):
  - Jocelynn Burt
  - Brendy Fountaine
- Environmental Sciences Poster 1st Place (tied):
  - Timothy Lane
  - David Mullins
- Environmental Sciences Poster 2nd Place:
  - Risa Hess
- Environmental Sustainability Poster 1st Place:
  - Jessi McDonald
- Environmental Sustainability Poster 2nd Place:
  - Francesca Marvin

- Mathematics Poster 1st Place:
    - Elizabeth Andreas

**Research Talks**

- **Seeding STEM Growth: Relatable Early Learning Tools For Diverse Caregivers**

  *Risa Hess*

  *Capstone Advisor: Peter Selkin*

  STEM fields have underrepresentation from people of color, people with a background of poverty, or LGBTQ affiliation. A lack of diverse thought hinders innovation in solving the global problems that our children will inherit. A majority of Tacoma families are in a socioeconomic category that has historically suffered from scholastic disparity gaps. A phenomenal amount of brain growth occurs before age 5, and students who start behind, tend to stay behind. In the longitudinal Ready, Set, Read-Tacoma study, I've coordinated efforts with several non-profit partners, providing more culturally responsive lending libraries with STEM discussion guides to over 900 Tacoma preschooler's families. Participant's Kindergarten intake assessment scores are significantly higher in all 7 categories, compared to peers whose families did not use the program tools before starting school. Continuing on this model and now empowering caregivers to engage in short, frequent STEM-based conversations is leading to a cohort of small children already identifying themselves as scientists, engineers and mathematicians. Inclusive early learning activities for disadvantaged families levels the playing field when starting school, reducing demographic gaps and allowing greater learning to occur overall. These seeds can grow to expand a more proportionate diversity in STEM careers for a new generation.

- **Mutational Analysis of Potential Phosphorylation Sites on the Kinetochore-Associated Protein Stu2**

  *Angela Mitchell and Miranda Makalena*

  *Capstone Advisor: Jack Vincent*

  The kinetochore plays a key role in aligning chromosomes during mitosis and helps ensure proper separation of duplicated DNA molecules into daughter cells. Some proteins that associate with the kinetochore regulate attachment to microtubules by destabilizing weak attachments and stabilizing strong attachments. In the model organism *Saccharomyces cerevisiae*, the Ipl1 kinase and Stu2 protein have similar effects on regulating kinetochore tension. Since Ipl1 is a kinase, and Stu2 is phosphorylated, we believe Stu2 function may be regulated by Ipl1. To test if Stu2 function is dependent on phosphorylation by Ipl1, we mutated possible Ipl1 phosphorylation sites and observed its

effects on Stu2 function. Four Ipl1 target consensus sites within the Stu2 protein were selected for this study. We used site-directed mutagenesis techniques to alter these potential Ipl1 phosphorylation sites on Stu2 by mutating serine codons to alanine codons. We successfully constructed S40A and S430A/S593A mutations in Stu2 using the megaprimer whole plasmid (MEGAWHOP) cloning technique. We then introduced the mutated version of *stu2* into yeast and conducted phenotype tests to determine if inactivating these putative phosphorylation sites affected its function. Our initial results indicated that phosphorylation at sites S430 and S593 may not be required for proper Stu2 function. We suggest that further testing of Ipl1 phosphorylation sites could reveal possible mutations that lead to malfunction of Stu2 that then affect the kinetochores ability to release improper attachments to microtubules. This would give insight into how signaling between kinetochore proteins can help to ensure proper chromosome segregation and avoid aneuploidy.

- **Impact of Wildfire-Associated High Atmospheric Pollutants on Local Emergency Medical Services**

  *Heather St. John*

  *Capstone Advisor: Maureen Kennedy*

  Wildfires are increasingly prevalent in the Northwest region of the United States in the last twenty years, with a corresponding increase in many air pollutants including carbon monoxide (CO), particulate matter 2.5 (PM2.5), nitrogen dioxide ($NO_2$), and ozone ($O_3$). Many of these pollutants can be dangerous to human health, especially PM2.5, a tiny particle that can easily embed in the lung tissue and decrease one's ability to breathe. Numerous studies have shown a correlation between increased wildfire activity and increased visits to emergency departments for both cardiac and respiratory events.

  The aim of my research was to see if a correlation exists between prehospital emergency medical services (EMS) and increased wildfire activity. I used data from the Tacoma Fire Department, and Pierce County pollutant readings to determine if there was any statistical relationship between EMS calls and worsening air quality. I focused on cardiac and respiratory related calls from June-September between 2013-2018, as this is well documented as the wildfire season.

  We noted an increase in calls in 2018 relative to the other years, which was a summer with record high air quality readings. Additionally, there was an increase in AQI (air quality index; a standardized index of pollution levels) readings in July and August indicating poorer air quality and suggesting a possible correlation to increased wildfires at that time. However, data suggests there was no statistically significant correlation between increasing AQI's and EMS call volume across Tacoma. Future research may involve increasing sample sizes to improve statistical power.

## Abstracts

- **Discerning the biochemical function for the catalytic domain of *Plasmodium* BEM46-like protein (PBLP)**

  ***Koryn Aguon*** *and Misaki Seto*

  *Capstone Advisor: Anna Groat-Carmona*

  Malaria is a mosquito-borne disease caused by the *Plasmodium* parasite, which infects approximately 216 million people worldwide and kills an estimated 445,000 people each year. Although malaria can be treated, the rise in drug resistance has created a need for new intervention strategies, including the identification of new drug targets like the *Plasmodium* BEM46-like protein (PBLP). PBLP is a highly conserved, uncharacterized α/β-hydrolase that plays an important role in modulating the formation of invasive-stage parasites and is expressed throughout the parasite life cycle. PBLP shares structural homology and amino acid identity with other BEM46-like proteins in the α/β-hydrolase superfamily. Previously, a cDNA copy of the *pblp* coding sequence was amplified and then mutated using overlap-extension PCR to disrupt the putative catalytic active site (Ser153, Asp229, and His258), which was predicted using bioinformatic analyses. PBLP is membrane bound in liver-stage and blood-stage parasites so the hydrophobic transmembrane domain within the PBLP protein sequence was excluded during cloning so that subsequent protein purification procedures could be done in solution. Ultimately, our goal is to express this parasitic protein in a bacterial system by successfully ligating the wild-type and mutant *pblp* sequences into a bacterial protein expression vector so that it can be purified and its catalytic activity can be characterized using functional enzymatic assays. These results will enable a better characterization of PBLP and potentially lead to the development of novel drug targets for the prevention and treatment of malaria.

- **Growing Our Forests: Managing Forests to Determine How to Improve Productivity and Sustainability**

  *Lillian Allred*

  *Capstone Advisor: Courtney Bobsin*

  Life as we know it would not be the same without the forests that provide our timber resources. Therefore, the management practices that affect the productivity of these forest ecosystems will affect us. Many studies that test the results of different practices have lasted a few decades, however, the results of these studies cannot be appropriately used to determine what will happen over centuries. The Long Term Ecosystem Productivity study was started in 1995 by Dr. Bernard Borman, Dr. Richard Bigley, and many others. Projected to last 200 years, it encompasses four replicate sites across Washington and

Oregon. This will allow us to compare the effects of various forest management techniques on ecosystem productivity, soil systems, and biodiversity in different ecosystems over the long term.
The focus of my internship was to collect data for this study by characterizing understory plants and trees in the Siuslaw National Forest site in coastal Oregon. We collected tree plot and understory plot composition data. We observed sword fern and salal as dominant understory vegetation, which may have implications for wildlife food sources. Data shows that, while seedling counts per hectare have decreased in all of the different treatments in the Olympic site, there were increases in the number of seedlings in both the late and mid treatment plots of the Siuslaw site. This, and other aspects of our data, suggest that there are still significant openings in the canopy, possibly due to lost needles from Douglas fir impacted by Swiss needle cast.

- **LOOKS DO MATTER: How beauty and community involvement assist in the long-term success of an urban park restoration**

  *Megan Mae Ancheta*

  *Faculty Mentor: Cynthia Updegrave*

  Many, if not all, restorations face anthropocentric challenges. However, urban park restorations may be more susceptible to such challenges, more specifically littering, due to their high accessibility in the community. At Titlow Beach Park, we restored 0.15 acres of land located south of a gravel parking lot. A significant amount of evidence found on our site suggests that the restoration site is a prominent illegal dumping ground. However, by installing thoroughly researched and aesthetically pleasing native species, our restoration site has become more resistant to littering. Although the plant choices and designs will carry out the success of our restoration site, inviting the locals to our planting parties and volunteer events has allowed us to train future stewards and educate young adults about the importance of restoration. The act of being proactive in the community has also significantly assisted the long-term success of our restoration.

- **Mathematical Analysis of Neuron Propagation**

  *Elizabeth Andreas*

  *Capstone Advisor: Rita Than*

  Hodgkin and Huxley created a mathematical model for the signals generated by an axon of a giant squid axon. This model is a system of four differential equations that are difficult to solve analytically. Thus, many simpler methods have been developed to study the model. Here we cover a two-dimensional reduction of the Hodgkin-Huxley model and analysis it using phase plane analysis.

- **Sustainability on Campus: The UWT Farmers Market**

*Ashley Arakaki*

*Capstone Advisor: Jim Gawel*

The University of Washington Tacoma is located downtown where grocery stores within walking distance are lacking, therefore limiting student access to fresh produce and nutritious foods on campus. In a survey conducted across the university, students showed interested in having access to more fresh produce due to the limited dining options available and expressed interest in a farmers market. For this project, we met with various stakeholders across campus to lay the groundwork for the UW Tacoma farmers market project in assessing costs and benefits to the university. Having a farmers market on campus would make UW Tacoma more sustainable by providing students with fresh, local produce while also addressing issues of food insecurity amongst college students.

- **Blooms & Plumes: Obtaining Estuarine Water Characteristics from Highly Oblique Aerial Imagery**

  *Brandon Voekler and **Tracie Barry***

  *Capstone Advisor: Cheryl Greengrove*

  Harmful algal bloom (HAB) events and associated eutrophication have been increasing in duration and frequency in recent years. Satellite detection has increased the ability to monitor and predict HABs, however accuracy within estuaries is limited due to optical complexity. Frame camera imagery taken at low altitudes may overcome this obstacle, allowing managers to expand aerial observation capacities. Utilizing Washington State Department of Ecology (WA DOE) Eyes over Puget Sound (EOPS) Monitoring Program imagery, this study attempted to rectify highly oblique imagery and obtain estuarine water characteristics including the spatial distribution of algal blooms utilizing two methods. Method one included MATLAB homographic angle correction, georeferencing and manual digitization. Method two utilized Geographic Information Systems (GIS) software to rectify and georeference images, and algal bloom and sediment plume coverage was identified through support vector machine image classification. Both methods successfully transformed highly oblique aerial imagery into usable spatial data for future comparison with the spatial distribution of eutrophication factors to aid in monitoring and early detection of HABs and eutrophication events. This project illustrates additional value of incorporating photographic surveys into monitoring efforts and demonstrates the integration of highly oblique frame camera imagery into estuarine research.

- **Temporal and Spatial Variability of Phytoplankton Assemblages in Clayoquot Sound, BC, Canada**

  *Tracie Barry*

*Capstone Advisor: Cheryl Greengrove*

Clayoquot Sound is a fjordic estuary on the west coast of Vancouver Island, BC, Canada. Given the complex topography and bathymetry of this region, many of the inlets are susceptible to periodic hypoxia/anoxia, as well as dramatic spatial and temporal fluctuations in oceanographic properties which influence local primary productivity and phytoplankton abundance. The University of Washington Tacoma has been collecting water property data, phytoplankton, sediment and plastics samples in Barkley and Clayoquot Sounds since 2001. In the fall of 2014, Pacific Northwest estuaries experienced an anomalously warm intrusion of water ("the blob") from the upper eastern Pacific Ocean. For this presentation annual pre- and post "blob" time series of autumnal phytoplankton assemblages for Tofino Inlet within Clayoquot Sound were compared for 2013, 2014, 2016 and 2017. A seasonal comparison of autumn and spring 2017 phytoplankton communities will also be presented. Evidence of increased water temperature and decreased dissolved oxygen were found within the inlet. Changes in phytoplankton group composition were also apparent, with an increased prevalence of dinoflagellate genera, of which most harmful species are comprised. Phytoplankton total abundance, as well as the presence harmful algal species, may have long term impacts on local aquaculture. This study may allow aquaculture managers to better predict and mitigate the effects of future warm water influences.

- **Analysis of spinule prevalence at synapses in early postnatal ferret visual cortex**

*Sarah Jane Biddlecome*

*Capstone Advisor: Marc Nahmani*

Communication between two neurons occurs at the synapse, a minute gap between a presynaptic delivering neuron to a postsynaptic receiving neuron. This communication may be solidified by invaginating projections called spinules, from the postsynaptic neuron to the presynaptic neuron. The exact functionality of spinules is under development as several studies provide insight to their possible mechanisms. We present in this research the possibility of neural activity being the driving force to spinule formation. Analysis of tissue sections from the visual cortex of ferrets at postnatal day (p) 21 and p28 were obtained through the use of electron microscopy. If activity drives spinule formation, we would expect to see few spinules present due their eyes remaining closed in these age groups. In contrast, if spinules were prevalent during the creation of circuitry we may expect a high presence of spinules in the presynaptic neuron in these age groups. At p21, the beginning of synaptic plasticity, about 11% of presynaptic excitatory terminals contained a spinule, whereas in p28 there was about 5% prevalence of spinules in the excitatory terminals. Further analysis determined that spinules in p21 and p28 were found to occupy a relatively small area (~1%) in the presynaptic terminal. This data suggests that spinule prevalence may indeed be activity driven and would expect to see an increase of spinules present in the presynaptic terminals as the ferret ages (i.e. p46, p60, adult).

- **Effects of Sialic Acid Enrichment on the Glycan Profile of IgG Antibodies**

  *Olga Bozin*

  *Capstone Advisor: John Finke*

  Alzheimer's disease (AD) is a neurodegenerative disorder that affects more than 5.5 million adults in the United States. Immunoglobulin G (IgG) antibodies are an immunotherapy drug class that are used in clinical trials of AD. These antibodies are typically targeted to specific forms of the β-amyloid peptide found in the brain of AD patients. The major problem with IgG and other protein drugs is their lack of blood-brain barrier permeability.

  Sialic acids are sugars that are attached to the ends of oligosaccharides linked to antibodies. Prior studies show these sialylated glycans alter permeability of their host-antibody through the blood-brain barrier. However, these studies used 12-14% sialylated antibodies and it is important to show that the effect will increase when 100% sialylated antibodies are tested. In pursuit of this research, my lab is currently enriching sialylated antibodies using lectin affinity chromatography. However, it is unclear whether enrichment of sialic acid alters the different types of sialic acid present in the enriched antibody product. To measure the change in this profile, the fragment antigen binding and fragment crystallizable (Fab/Fc) regions of glycans were selectively cleaved, isolated, and tagged with a fluorescence label 2-aminobenzamide via reductive amination. Fab and Fc glycans from normal and sialic-acid-enriched antibodies were analyzed via high performance liquid chromatography (HPLC) and the glycan profiles were compared.

- **Beach Please: A Study On The Effects of Logmats On The Invertebrate Species Inhabiting Spirit Lake At Mt. St. Helens**

  *Ashley Brier*

  *Capstone Advisor: Jeremy Davis*

  This was study conducted in order to test the effects of the leftover debris on various invertebrate species that inhabit Spirit lake, located near Mount St. Helens, after the major eruption in 1980. Results of this study could potentially beg the question as to whether it is advisable to leave debris after a major natural disaster, further, if that debris could possibly hold healthy levels of biodiversity. Traps were set up in three major habitats: the shallow shore, in the open water, and on logmats. Insects were collected in bottles of ethanol, and later sorted in the lab. Results indicated that logmats were just as diverse as the more "original" habitats, such as the shallow shore. The same number of species were found in both the shallow shore habitats and the logmat habitat. Further, an interesting trend was found with mayflies (baetidae) inhabiting mostly the logmat habitat, and the damselflies (coenagrionidae) mostly inhabiting the shallow shore, pointing to an interesting possible refuge, and pushes for further study. While these results are simply a starting point, they suggest that logmats could serve as important sites for diversity, and

that future clean up efforts may want to consider leaving similar sites be after a major disturbance.

- **Repeated Thermal Stress could play a larger role than anticipated in the Future health of Soft Coral Assemblages**

  *Keefe Brockman*

  *Capstone Advisor: Jeremy Davis*

  It is projected that increasing ocean surface temperatures and a decrease in pH will have extremely detrimental impacts on hard coral assemblages, however there is little to no data on short term impacts of both of these stressors on soft corals. In this study the stress tolerance of soft corals was assessed in a laboratory setting with *Heteroxenia sp.*, stress was assessed by monitoring the pulsing rate of the coral as pH was held as consistently as possible (7.6-7.8) in treatment tanks via $CO_2$ diffusion and temperature were monitored and increased across all tanks. The data showed a somewhat higher stress response in the lower pH tanks, when compared to the temperature adjusted only aquaria. While these data do show that forecasted ocean pH levels (7.6-7.8) and ocean surface temperature increases could affect *Heteroxenia sp.* due to a lack of replicates due to unforeseen bacterial colony crashes, further analysis needs to be conducted to find the breadth of just how great the impact could be.

- **The Sharing Revolution**

  *Lauren Browning*

  It is well understood that the pursuit of higher education is detrimentally expensive, and the cost of tuition and materials continues to rise steadily. As we all know, college is not just tuition; students need books and supplies in addition to tuition and regular living expenses. In addition to high costs, much of what students are purchasing for college ends up in landfills. By establishing a network for students, faculty, and staff to share goods and services with one another, both individual and institutional waste footprints can be reduced drastically. When necessities can be obtained with little financial stress, students can spend more time on their schoolwork, and may be less likely to divert time to a job to meet their needs. Sharing economies on campus make resources available to those who need them in a dignified and fun way, while also deepening the sense of community on campus by making people and planet the cornerstone of the economy. Student support for this project is wide and diverse. Our survey of 125 students showed that 80% of respondents are willing or very willing to exchange goods or services with others on the UWT campus. 94% of the respondents claimed that they donate their belongings when they no longer want or need them, indicating a supply of items for physical exchange events that occur on campus. We then met with stakeholders including, Elizabeth Hyun, the campus space planning manager of Campus Planning and Retail Services. Ryan Moriarty, the Multimedia Content Specialist, and Tina Snyder, the CEO of mycampuswall.com. These stakeholders gave us the information needed to

construct a plan for space and advertisement for the swap meets. Tina Snyder was able to help us create and activate a unique UWT portal on the mycampuswall website. We were able to have that portal go live and available for student use by the end of March 2019. The physical swap meet was taken on by faculty and the first UWT swap meet was held on Earth Day of 2019.

- **Global health experience in India: An observation of private and public healthcare sectors**

  *Jocelynn Burt*

  *Capstone Advisor: Karen Cowgill*

  Through the program Child Family Health International (CFHI), I participated in the program Hospital Medicine and Infectious Diseases which allowed me to travel to India. This trip provided the opportunity to experience healthcare and the medical field from a different perspective. We observed India's healthcare systems via experiential learning by visiting various clinics and hospitals, by attending small lectures given by local medical professionals, and by conducting a literature review on the topic of India's healthcare system. During my visit, the most noticeable factor of India's healthcare is that of the differences between private and public healthcare sectors. It is known that India's healthcare system is greatly overburdened due to the high population to doctor ratio. Therefore, public healthcare is often forced to be as quick and efficient as possible while private clinics offer more time spent with each patient. Although public healthcare is accessible to all citizens, people still choose to pay higher fees out of pocket to receive treatment from private health clinics. This could implicate that the quality of care a patient receives possibly outweighs the increased cost of that care. The doctor to patient relationship is an important aspect of healthcare, the patient-centered mentality I observed is something I hope to bring with me through my academic and professional career.

- **Mammalian Species Diversity is Positively Influenced by Tree Cover in Pierce County**

  *Amanda Campos*

  *Capstone Advisor: Chris Schell*

  The expansion of urban environments has pervasive and long-term implications for biodiversity worldwide. As a result, it is important to understand the factors in urban areas that contribute to bolstering species richness. Terrestrial vertebrates are particularly sensitive to urban ecological change, as many species face physical anthropogenic barriers that hinder their ability to navigate the landscape. In this study we sought to determine what anthropogenic factors influence species richness in cities. Motion-triggered cameras (n=38) were placed along two transects extending from Point Defiance

Park to Eatonville, WA. Photo data was collected for the Spring Season of 2019 for approximately 30 days. Many of our variables strongly correlated, so we combined them all in a principal component analysis (PCA) to get a single score that represented degree of urbanization (General linear model: $z = -1.933$, $p=0.046$). In addition, tree cover negatively correlated with road density and impervious surface cover. Our Data suggest that the interaction among human structures and tree cover may play an important role in influencing species richness. Further, these data may help inform scientists and urban planners to develop strategies that seek for planting more trees in cities.

- **The early detection of Porphyromonas gingivalis using quantitative polymerase chain reaction (qPCR)**

  *Sutantra Chailitilerd*

  *Capstone Advisor: David Hirschberg*

  Gingivitis is a form of gum inflammation caused by the bacteria *Porphyromonas gingivalis. P. gingivalis* builds up in plaques and produces hydrolytic, proteolytic, and lipolytic enzymes along with toxic metabolites that cause the tooth-supporting tissues to be destroyed. Furthermore, *P. gingivalis* produces metabolites that cause damage to the host by manipulating the host immune system through its virulence factors like Lipopolysaccharide that affect the host immune signaling. *P. gingivalis* is hard to detect among the more than 500 bacterial species residing in our mouth flora. Thus, the research focused on determining the threshold of pre-gingivitis by calculating the accumulation percentage of *P. gingivalis* in the periodontal pocket. We designed *P. gingivalis* primers to amplify a region of a conserved gene called 16S rRNA and then cloned the DNA into *Escherichia coli* cells. After the successful transformation of *E. coli,* colonies were picked to see which had been successfully transformed. The plasmid wil serve as a positive control to compare against environmental samples taken from the human mouth. Identifying the abundance of *P. gingivalis* in human mouths allows us to determine a threshold for pre-gingivitis and gingivitis diagnoses.

- **Pre-Spawn Mortility (PSM) rates in Coho Salmon, Puget Sound WA**

  *Drew Clement*

  *Capstone Advisor: Erik McDonald*

  Oncorhynchus kisutch (Coho salmon) have a profound ecological, cultural, and economical significance in Washington State's Puget Sound region. Their population levels are at an all-time low due to Pre-spawn Mortality syndrome (Fiest. et. al, 2011) and other factors such as habitat loss, degradation, and poor ocean conditions. Pre-Spawn Mortality syndrome (PSM) occurs when salmon experience disorientation, oxygen loss, and ultimately death once they reach freshwater streams before they can mate and bury their eggs. The cause has been linked to excessive urban stormwater runoff, but the exact toxin(s) is still unknown and most of the research on PSM rates have been conducted

primarily in King, Thurston, and Kitsap County. To better assess the extent of this issue in the Puget Sound, we surveyed Swan Creek in Puyallup in Pierce County during their spawning season by counting and dissecting dead female Coho salmon to determine if they contained eggs or not. The fish that contained over 50% of their eggs succumbed to PSM, and the fish that contained less than 50% of their eggs were able to spawn before dying. The assessment took place from early October of 2018 to mid-December of 2018. The calculated escapement, or return of Coho to Swan Creek to spawn, was only 12. The calculated PSM rate was 0.

- **The Heart of the Landscape: The Ecological Impacts of Urban Runoff on Salmon in the Pacific Northwest, A Geospatial Analysis**

  *Sayla Comer*

  *Capstone Advisor: Matt Kelley*

  Salmon in the Pacific Northwest have an intimate role with the landscape and those who inhabit the region. Salmon are deeply ingrained within the culture and heritage of Salish First Nations. So much that these people are referred to as the Salmon People. The role of salmon in the landscape ecology of the region has been long-documented to be a powerful one. The marine nutrients that are brought back with spawning seasons nourish all trophic levels of the landscape, a cycle that has existed in the region for a millennia. In the wettest region in the contiguous United States, salmon is threatened by the ongoing presences of vehicle-derived contaminants within urban runoff, among other factors of land development and a history of overfishing. Many populations of salmon have been listed as endangered species and population numbers continue to dwindle. Coho salmon, in particular are susceptible urban runoff pollution which contains a cocktail of chemical compounds. Urban runoff presence in streams and rivers has been documented to induce prespawn mortality in returning coho populations, where over 90% mortality has been shown. This syndrome, referred to as urban runoff mortality syndrome (URMS), which has been found to specifically induce prespawn mortality in coho salmon has been studied since the physical remediation of streams and rivers in the region in the mid-1990s. The specific chemical compounds responsible for the phenomenon have remained elusive until recently where a study conducted by the Center for Urban Waters in Tacoma, WA found strong evidence linking URMS to tire wear particle (TWP) leachates.

  Feist et al. (2011) chronicled prespawn mortality events and percent mortality within streams on a map of the Puget Sound evolutionary significant unit (ESU), showing the coincidence of a variety of paved surfaces with prespawn mortality events. Similarly, I have conducted a spatial analysis on paved surfaces within the Puget Sound ESU for coho salmon. Taking a watershed-by-watershed approach, with ArcMap I have theoretically defined the sub-basins within each watershed (WRIAs 1-18) and then classified the sub-basins based upon various amounts of impervious surface (total). Each WRIA has also been classified based upon the density of roads, state highways, and urban land use. The output is an a collection of maps showing sub-basins and water

resource inventory areas containing paved sources as well as the highlighting which coho populations whether natural or hatchery are potentially affected.

It is the hope that this output may have implications for where the most protection is needed and for which coho populations within the Puget Sound ESU. Limitations of the study consist of the neglect of stormwater treatment/catchment areas/soil bioretention infrastructure within these areas and of course the age of the data used. Overall, this does well for generalizing which watersheds and locations contain high levels of paved sources which can act as transporters for tire wear particle leachates and ultimately lead to the continued prespawn mortality events of coho salmon and the extinction of local, isolated populations.

- **Protecting Puget Sound by Inspecting private stormwater systems and educating business owners and homeowners of their stormwater systems in Olympia WA**

  *Allan Cortina*

  Stormwater systems are usually the only treatment that urban runoff encounters before it re-enters receiving waters. Municipalities are required to build and maintain stormwater treatment systems to minimize pollution and flooding from urban runoff. However, most private stormwater systems are not regulated by municipal codes and suffer from neglect. These neglected systems can contribute to flooding or major water quality contamination events. In the city of Olympia, I helped to develop and implement a program to require business owners and homeowner associations (HOA's) to inspect their private stormwater treatment systems for code compliance. Subsequently, the city of Olympia would audit the inspection for compliance. If there were any issues in the system, the private owners had up to a year to get their system back into compliance. Out of 150 private stormwater systems that were audited in the city of Olympia, over 40 of those systems were found non-compliant and were then fixed to meet code. Only 2 systems were still considered non-compliant by the end of 2018. Although the city of Olympia has over 1300 private stormwater systems, implementing this program by including a few dozen new sites every year will eventually bring all the private stormwater systems into compliance and improve water quality.

- **QuEChERS method development for identifying toxic organic compounds in salmon tissue exposed to stormwater runoff**

  *Allen Cortina*

  *Capstone Advisor: Ed Kolodziej*

  It is well known that stormwater can have adverse effects on aquatic species if exposed. By identifying compounds that cause these ill effects to aquatic species, then there can be action to limit or ban these compounds in industrial applications. By developing an optimized method using the QuEChERS (quick, easy, cheap, rugged and safe) method, we can extract environmental contaminants in biological tissue to analyze and identify the compounds that are causing the adverse effects on aquatic life. Research into different

QuEChERS methods was used and then testing each method to see which method was the best candidate to recover known environmental contaminants in salmon tissue. It was determined that a modified QuEChERS method was successful in recovering 16 out the 22 compounds of internal standard. This method had about an 50-60% recovery rate. By trial and error, we were able to optimize the QuEChERS method to recover a satisfactory range of compounds. This method will be used in future research to identify toxic organic contaminants from stormwater in biological samples of salmon and other fish species.

- **Global Health Experiential Learning in Tarija, Bolivia**

  *Melani Cruz*

  *Capstone Advisor: Karen Cowgill*

  Child Family Health International (CFHI) is a nonprofit organization that encourages individuals to learn about global health through cultural immersion. Working with CFHI for two weeks in August 2018 allowed me to shadow doctors, see the poverty present, and find a place I could call home in Tarija, Bolivia.

  Staying in a foreign country was intimidating and I faced many challenges with Spanish being the main language spoken in Tarija. I found myself feeling lost and sometimes frustrated at the dinner table when I had to converse with my host family. I had a few mishaps with the doctors where there was some miscommunication as I shadowed in both rural and city settings. Throughout the weeks, I learned more Spanish and was able to communicate more confidently. I learned the importance of body language and being aware of my surroundings.

  My experience of travelling to a foreign country and viewing the healthcare, lifestyle, and social constructs in both rural and city environments in Tarija, Bolivia was not just a check off my travel list. My stay taught me about another culture but also helped me to appreciate being able to communicate with ease and the importance of cleanliness in healthcare facilities in the U.S. I am grateful for the opportunities available to me as I further my education and understanding of healthcare in my community as well as throughout the globe.

- **Detecting Chytrid Fungus Using Aptamer-based Biosensors**

  ***Ryan Culbert*** *and Shah Khan*

  *Capstone Advisor: David Hirschberg*

  Chytridiomycosis infections, caused by *Batrachochytrium dendrobatidis (Bd)* and *Batrachochytrium salamandrivorans (Bsal),* are responsible for the decline of 501 amphibian species, 90 of which have been eradicated (Parris and Beaudoin, 2004). The pathogens that cause this infection are invisible to the naked eye and kill the host in the span of days; for that reason, detection is crucial (Michigan Frog Survey, 2003). The

objective is to devise a rapid, cost effective, and accurate detection method, while also abiding by specific criteria. Criteria include: (a) no harm to live animals or subjection to long quarantine periods, (b) low volume water samples should be used for detection, and (c) method must have the ability to identify contaminated shipping materials. Electrochemical aptamer-based biosensors (EABs) are proposed as a new method of chytrid detection. EABs rely on an oligonucleotide conformational change that results from a specific analyte binding, generating an electrochemical signal (Somerson and Plaxco, 2018). Quantitative data will be collected, allowing for infection load analysis. Data from the biosensors will match and/or exceed the *Bd* qPCR sensitivity of 72.9% and specificity of 94.2%. EABs provide an instant, accurate detection method that can be used easily and performed on site. Potential applications of such a system would not only be for chytrid detection, but real time monitoring or even as biorecognition elements.

- **Construction of a Single-Integration Vector for Genetic Analysis of the Mif2 Kinetochore Protein in Saccharomyces cerevisiae**

  *Annalacia Glossen and* ***Huyen Dang***

  *Capstone Advisor: Jack Vincent*

  The propagation of all organisms depends on the accurate and orderly segregation of chromosomes. In eukaryotes proper chromosome segregation requires the combined effort of centromeres, spindle microtubules, and the kinetochore protein structure. When chromosomes are improperly segregated it results in aneuploidy and can cause diseases such as cancer. The inner kinetochore contains a protein called Mif2. Mif2 is a protein that associates with a centromeric region on the chromosome and forms a DNA-protein complex with the microtubules. The phosphorylation of proteins in the kinetochore can aid in the correction of error connections between the kinetochore and the microtubules. Mif2 is thought to be phosphorylated by the Ipl1 kinase as it contains many stretches containing the consensus sequence for Ipl1 kinase, which aids in the proper segregation of chromosomes. We aimed to determine if these possible phosphorylation sites are important for the function of Mif2. To do this, we used versions of the Mif2 gene that contained mutated codons for either serine or threonine. We begin experiments to transfer the mutated Mif2 sequence into a single integration vector to ensure only one copy of the Mif2 sequence is inserted and transformed in yeast. We made progress on several approaches including Gibson assembly to accomplish this task. After successful transformation into yeast, heat stabilization and growth pattern phenotypic testing will be used to analyze the effects that the mutations had on protein expression and function.

- **Analysis of Canopy Cover and Organic Carbon at Mount St. Helens Hummocks Ponds**

  ***Eric De Start*** *and Brandon Voelker*

  *Faculty Mentor: James Gawel*

The Hummocks Ponds Complex at Mount St. Helens resulted a debris avalanche. This unique environment offers the opportunity to study the limnological aspects of newly formed ponds in a natural and protected environment. Organic carbon within sediment and pondside canopy cover were the basis for our investigation. Organic carbon and canopy cover were not strongly correlated with each other, however, evidence suggests that hydroperiod effects both canopy cover and carbon content. This could be due to the increased opportunity of growth for terrestrial plants. Further sampling of these ponds for organic carbon and more data from other ponds may help to corroborate these patterns.

- **Wind Blown Loess Deposits**

  *Eric De Start*

  *Capstone Advisor: Peter Selkin*

  Loess is a windblown dust or silt that has been deposited and accumulated in an area. Windblown silt, or loess, provides information about the wind direction as well as wind speed, higher winds will have a larger particle size. Palouse loess demonstrates the importance of being able to categorize soil formation with the aid of magnetic separation. By taking samples of the Palouse loess along the Columbia River, in southeastern Washington State, we can examine and process the samples using a Scanning Electron Microscope (SEM) to sort by particle size and elemental composition. By tracking and then mapping out the sample locations will give us a better understanding of the environmental conditions in which the loess was deposited. By focusing on the trends of particle size and composition, we will be able to tell the importance of the locations of the greater loess deposits. It is widely accepted that the Palouse loess comes from the Eureka Flats, by observing the distance away, along with particle size, we will be able to determine wind speed and direction.

- **Insect Diversity and Shade Cover at Mount St. Helens Hummocks Ponds**

  ***Mae Fosnick**, Jake Nyiri, and Andrew Paquin*

  *Faculty Advisor: James Gawel*

  The hummocks ponds created in the aftermath of the Mt. St. Helens eruption offer a unique opportunity to observe freshwater insect populations in some of the youngest lakes on the planet. We studied the effect of shoreline shading on insect diversity. Insect samples were collected from a wide variety of ponds. It was observed that overall diversity was low and the samples were all dominated by Diptera spp. This indicates that while Diptera can easily colonize catastrophically-created lakes, other species have had a harder time. A correlation between lack of shade cover and increase in predatory species (and corresponding drop in total insect number) was also observed, indicating that the freshwater predators which most quickly colonized the disturbed area prefer to hunt in lit areas.

- **Islet Amyloid Deposition In A Novel Mouse Model Of Cystic Fibrosis**

  *Brendy Fountaine*

  *Faculty Mentor: Rebecca Hull*

  Treatments for cystic fibrosis (CF) have extended patients' lifespan, resulting in CF-related diabetes (CFRD) as a major CF complication affecting 30-50% of adults. A key pathological feature of CFRD is the deposition of islet amyloid polypeptide (IAPP) as amyloid in pancreatic islets. In type 2 diabetes, Islet amyloid is associated with decreased beta-cell mass and function. Current mouse models of CFRD do not develop all the pathological features observed in human CFRD, including islet amyloid. To generate a mouse model of CFRD which exhibits islet amyloid deposition, we crossbred a CF mouse ($Cftr^{F508del}$) and a human IAPP (hIAPP) transgenic mouse and compared amyloid deposition in cultured islets from the resulting offspring. Islets from each of the mice genotypes (NT.$Cftr^{del/del}$ (n=2), NT.$Cftr^{+/del}$ (n=4), NT.$Cftr^{+/+}$ (n=5), hIAPP.$Cftr^{del/del}$ (n=2), hIAPP.$Cftr^{+/del}$ (n=5), hIAPP.$Cftr^{+/+}$ (n=3)) were isolated and cultured for 7 days in high (16.7 mM) glucose to induce amyloid formation. Islets were fixed in neutral-buffered formalin, paraffin-embedded and sectioned. Sections were stained with thioflavin S (for amyloid) after which amyloid prevalence (% islets with amyloid), amyloid severity (% islet area occupied by amyloid) were quantified. Islets from hIAPP transgenic mice developed islet amyloid when cultured *in vitro*, while islets from non-transgenic mice did not. Among hIAPP transgenic mice with different CF genotypes (hIAPP.$Cftr^{del/del}$, hIAPP.$Cftr^{+/del}$, hIAPP.$Cftr^{+/+}$, respectively), islet amyloid prevalence (74±13%, 73±11%, 81±5 %; p=0.89 by ANOVA)[NE2] or severity (3.4 ± 1.7%, 2.0 ± 1.1%, 3.57 ± 0.4%; p=0.64 by ANOVA) did not differ. The presence of amyloid in islets of mice expressing hIAPP genotypes supports the utility of this new mouse model to study this aspect of islet pathology as seen in human CFRD.

- **The effects of cytochalasin B on the localization of the Plasmodium BEM46-like protein (PBLP) to determine the role of translocated proteins during malarial infection**

  ***Armann Gill*** *and Tracy Mwangi*

  *Capstone Advisor: Anna Groat-Carmona*

  Prior research identified the *Plasmodium* BEM46-like protein (PBLP), which is expressed throughout the malaria life cycle and previously found to be important in the development of all invasive stages. PBLP is located on the parasite plasma membrane (PPM), however, it is relegated to an unknown intracellular vesicular structure within sporozoites. Thus, PBLP is translocated from an intracellular compartment to the PPM of the sporozoite. It is unknown how the translocation occurs. Prior research has shown parasite secretory organelles may not be responsible for the translocation of PBLP[1]. In cells, vesicles containing cellular components, including proteins, are transported via intercellular trafficking system called the cytoskeleton. Extracted salivary gland

sporozoites were treated with mycotoxins, like cytochalasin B (CB), to inhibit formation of actin and test the role of actin cytoskeletal rearrangements in the translocation of PBLP. Immunofluorescence assays were performed on CB-treated and untreated samples to examine the effect of CB on PBLP localization in salivary gland sporozoites and during early LS differentiation. Motility assays were carried out on CB treated sporozoites to observe its effects on sporozoite locomotion. The objective of this study was to determine how PBLP moves to the PPM after actin filaments are interrupted by CB toxin. However, while sporozoites were successfully used to infect Hepa 1-6 cells, the effect of CB on the translocation of PBLP was not determined. In the future, we hope to repeat these studies using CB as well as include use of other mycotoxins to disrupt additional intracellular trafficking structures such as microtubules.

- **Plastic is Everywhere: Microplastics in The Pugest Sound**

  *Mandeep Gill*

  *Capstone Advisor:*

  The emergence of industry and urban development has had an impact on the environment. This progress of human development has created new variables, such as plastic. The negative effects of plastic are due to its chemical resiliency resulting in a long residence time. In this study the amount of microplastics (plastics < 5mm) were measured in the Puget Sound on the northwestern coast of the U.S, an inlet of the Pacific Ocean. To know exactly where and how much microplastics make its way into the water, sediment samples from different locations in Budd Inlet were gathered. The samples were collected using a van Veen to randomly scoop the first 1-2 cm of sediment, which was then stored in glass jars. After the samples were collected they were filtered through a series of sieves. Potassium metaphosphate was initially used to separate the clay particles. Lithium metatungstate solution was then used to separate the less dense particles, followed by filtering through a 0.3mm sieve and dried. The use of a wet peroxide oxidation then degraded the natural organic matter, before a density separator was used. The sample was filtered through a 0.3mm sieve and the plastics were removed with forceps using a dissecting microscope. The plastics were measured for length and categorized as either film, nurdle,fiber or fragment. Out of the 10 samples that were processed, 8 showed the presence of microplastics in them. Therefore the results support other findings that plastics are ubiquitous in the environment.

- **Construction of a Single-Integration Vector for Genetic Analysis of the Mif2 Kinetochore Protein in Saccharomyces cerevisiae**

  ***Annalacia Glossen*** *and Huyen Dang*

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  The propagation of all organisms depends on the accurate and orderly segregation of chromosomes. In eukaryotes proper chromosome segregation requires the combined

effort of centromeres, spindle microtubules, and the kinetochore protein structure. When chromosomes are improperly segregated it results in aneuploidy and can cause diseases such as cancer. The inner kinetochore contains a protein called Mif2. Mif2 is a protein that associates with a centromeric region on the chromosome and forms a DNA-protein complex with the microtubules. The phosphorylation of proteins in the kinetochore can aid in the correction of error connections between the kinetochore and the microtubules. Mif2 is thought to be phosphorylated by the Ipl1 kinase as it contains many stretches containing the consensus sequence for Ipl1 kinase, which aids in the proper segregation of chromosomes. We aimed to determine if these possible phosphorylation sites are important for the function of Mif2. To do this, we used versions of the Mif2 gene that contained mutated codons for either serine or threonine. We begin experiments to transfer the mutated Mif2 sequence into a single integration vector to ensure only one copy of the Mif2 sequence is inserted and transformed in yeast. We made progress on several approaches including Gibson assembly to accomplish this task. After successful transformation into yeast, heat stabilization and growth pattern phenotypic testing will be used to analyze the effects that the mutations had on protein expression and function.

- **Bioaccumulation: microplastics & chinook salmon**

  *Nathan Godfrey*

  *Capstone Advisor: Julie Masura*

  Plastics have become an increasing problem in marine and freshwater systems because the impacts on both animals and the environment are unknown. Plastics are divided into two categories based on size: macroplastics greater than 5 millimeters, and microplastics smaller than 5 millimeters. Accumulation of plastics in the environment is an increasingly persistent problem and long-term effects are unknown, there is a need for further investigation into whether or not microplastics are bioaccumulating within fish and other organisms. The purpose of this experiment was to investigate if microplastics would accumulate in juvenile Chinook salmon, which could cause residual problems in these populations. Salmon were exposed to microplastics through food pellets with 20 red plastic fibers in the pellets. The salmon were euthanized at day zero, three, five, seven, and ten. Once they were euthanized, they were dissected to collect their gastrointestinal tract, the tracts were digested with potassium hydroxide, and the remaining fibers were counted via dissecting microscope. Initial data showed a decrease in fibers in the samples over time, suggesting that the microplastics are able to pass through the gastrointestinal tracts.

- **Restoration of Titlow Beach Park in Tacoma, WA**

  *Melissa Gonzalez*

  *Capstone Advisor: Cynthia Updegrave*

Titlow Beach Park in Tacoma, Wa is a Metro Park Tacoma owned park which is predominantly forest that meets the sound. This park has become overgrown with invasive species and littered with debris. Invasive species become introduced to areas where they thrive better than the native plants. The invasive species are more productive in the non-native areas due to the environmental conditions, they becoming overgrown, outcompete and suppress the growth of native species. This results in the decrease of biodiversity which can reduce gene flow and eventually cause the extinction of native plants. Restoring the site to its native ecosystem involves removing the invasive species and the planting native plants allowing the site to eventually sustain itself. This project was done in a group of six students for the Restoration Ecology program at the University of Washington as a tri-campus project. To conduct this project we did an site assessment of the area, created a budget, a proposal, a work plan, planting plan, and a stewardship plan. After carrying out our plans, through volunteer work parties, we created monitoring and maintenance plans for MPT to take over when we are done to minimize invasive plant growth. At the conclusion of our project we have removed almost all of the invasive species and planted over 200 natives plants.

- **Black-tailed deer occupancy is influenced by urbanization and predator presence in Pierce County, WA**

  *Ariel Greenheck*

  *Capstone Advisor: Chris Schell*

  Deer have become hyper-abundant across urban landscapes in America with the reduction of predators and massive landscape changes that come with urbanization. Therefore, understanding the factors that contribute to deer abundance and occupancy can help us understand how deer have become so successful in cities. In this study, we investigated the influence of several anthropogenic factors on black-tailed deer (*Odocoiles hemionus*) occupancy across Pierce County. We set up 39 motion-triggered cameras extending from Point Defiance Park to Northwest Trek in Eatonville, WA in the Spring of 2019 in order to estimate deer occupancy. The several anthropogenic factors we observed (i.e., impervious surface, tree canopy, road distance, road detection, building detection, green space, habitat area) were combined into a single covariate that we labeled as “urbanization” to maximize our statistical power. We additionally investigated whether coyote presence at a site explained deer occupancy. We ran a single-season occupancy model in R (version 3.6.0). We found that sites that are more urbanized were less occupied ($z = -2.66$; $P = 0.00771$). Paradoxically, sites with greater coyote presence also had a positive relationship to higher deer occupancy ($z=2.27$; $P=0.02323$). In sum, these results suggest that the urbanization and coyote presence affect deer presence at various locations across Pierce County. This research could also aid our understanding of how prey species respond to anthropogenic factors in cities.

- **Noisy City, Wily Coyotes: The influence of ambient noise and urbanization on coyote occupancy in Tacoma, WA**

  *Riley Haizlip*

  *Capstone Advisor: Chris Schell*

  Human disturbance across the globe are becoming more prevalent as urbanization dramatically impacts local ecosystems. Anthropogenic noise is particularly salient in shaping community dynamics of urban fauna, as well as dictating what species may or may not be present. The combination of natural and anthropogenic factors can consequently influence whether a species occupies urban habitats. More specifically, as the Tacoma population grows and more developments and construction projects encroach on rural regions, there is a necessity to understand the consequences of increased development. This project evaluated the occurrence of coyotes (*Canis latrans*) in Pierce County, WA. We set motion-triggered camera traps (n = 39) along two transects that extended from Point Defiance Park to Eatonville, WA, to collect photo data from April 3rd to May 10th. In addition, we recorded ambient environmental noise using sound level meters to determine the decibel range of each site. Photo tagging was completed for all trail cams in order to identify all present species, their occurrence, and other important components of community dynamics. Using a single-season occupancy model, we found that there is a 48.6% rate of occupancy (psi) with road distance and road density having the largest influence on occupancy. The rate of detection (p) was found to be much lower at 15.4%, with building density, impervious surface area, and road density having the largest impact on p. We then combined all of the anthropogenic landscape factors into a single factor we called 'Urbanization'. The overall rate of urbanization did not influence whether or not a coyote was detected at a site, but ambient noise negatively influenced whether a coyote was present. These data suggest that secondary factors of the urban environment (i.e., ambient anthropogenic noise), may be an influential factor for coyote populations in Pierce County.

- **Seeding STEM Growth: Relatable Early Learning Tools For Diverse Caregivers**

  *Risa Hess*

  *Capstone Advisor: Peter Selkin*

  STEM fields have underrepresentation from people of color, people with a background of poverty, or LGBTQ affiliation. A lack of diverse thought hinders innovation in solving the global problems that our children will inherit. A majority of Tacoma families are in a socioeconomic category that has historically suffered from scholastic disparity gaps. A phenomenal amount of brain growth occurs before age 5, and students who start behind, tend to stay behind. In the longitudinal Ready, Set, Read-Tacoma study, I've coordinated efforts with several non-profit partners, providing more culturally responsive lending

libraries with STEM discussion guides to over 900 Tacoma preschooler's families. Participant's Kindergarten intake assessment scores are significantly higher in all 7 categories, compared to peers whose families did not use the program tools before starting school. Continuing on this model and now empowering caregivers to engage in short, frequent STEM-based conversations is leading to a cohort of small children already identifying themselves as scientists, engineers and mathematicians. Inclusive early learning activities for disadvantaged families levels the playing field when starting school, reducing demographic gaps and allowing greater learning to occur overall. These seeds can grow to expand a more proportionate diversity in STEM careers for a new generation.

- **Correlates of Bedside Manner of Oncology/HIV and Nephrology Departments at Swedish Medical Hospital**

  *Brian Huynh*

  *Capstone Advisor: Heather Heinz*

  Healthcare providers' approach and handling of a patient affects the likelihood that the patient will elect to return to the same hospital. Medical personnel may increase this election by being attentive, thorough, and timely in their patients' care. This is known as bedside manner. Bedside manner is regulated through the use of protocols to remind medical personnel of certain actions to be performed during patient care, such as AIDET (Acknowledge, Introduce, Duration, Explanation, and Thank You). Even with AIDET to remind personnel of what is expected, the quality of patient care is also dependent upon the patients' conditions and how well the department utilizes its resources (such as personnel, locators, track boards, and call lights) to serve those patients. Medical departments decide how to utilize resources based on acuity level, the measure of the intensity of care that is required of medical personnel towards a patient.
  By comparing resource utilization and bedside manner (as measured by AIDET compliance) across low and high acuity departments (Nephrology vs Oncology/HIV), we can improve patient satisfaction and election of return for different medical departments. To achieve this, we propose our comparative observation methodology in the form of an IRB application through the University of Washington Human Subjects Division in coordination with Swedish Medical Hospital, Seattle, WA.

- **A Narrative Literature Review of Infant Feeding Practices in Sub-Saharan Africa**

  *Sara Jensen*

  *Faculty Advisor: Karen Cowgill*

  This study is based on 1000 surveys, regarding infant feeding habits, done in Lubumbashi, Democratic Republic of the Congo (DRC). Ideal breastfeeding habits are that breastfeeding should be implemented within the first hour after birth and be

continued for the first six months of the infant's life exclusively. After the first six months it is recommended to change to partial breast feeding with some solid foods making up the rest of the diet until the infant is 24 months in age. My job initially was to clean the data that was entered into EpiInfo (free epidemiology software from the CDC) and exported to Excel in preparation for analysis. On beginning to clean the database it was clear there was an error in the data exportation, but it was unclear where this error occurred. To identify the source of the error I went through all the surveys, one by one, and checked them against the Excel database for accuracy. In order to retain data accuracy, one must export from EpiInfo to Stata directly. In the remaining time we shifted focus to do a narrative literature review. The narrative literature review revealed that there are gaps in the existing knowledge on infant feeding practices in Sub-Saharan Africa, including DRC. The infant feeding survey will contribute to closing this gap. There is still more work to be done however on the analysis from Lubumbashi, DRC before any conclusions can be drawn from that data.

- **Optimization of the Purification of Sialylated Intravenous Immunoglobulin (IVIG)**

  *Tiffany Jones*

  *Capstone Advisor: John Finke*

  Recent studies on beta-Amyloid-targeting antibody treatments have the potential to treat patients with Alzheimer's disease. Antibody therapy would benefit from improved delivery of these antibodies through the Blood Brain Barrier (BBB) and reach the beta-amyloid plaques in the brain. Sialylated antibodies have shown to decrease the efflux through the BBB but sialylation is low (14%) in natural antibody populations. The present research identifies a method that isolates 100% sialylated antibodies from pooled human blood (IVIG) at a minimum concentration of 100uM.

  Different combinations of agarose-linked Erythrina cristagalli lectin (ECL) and Sambucus nigra agglutinin lectin (SNA) columns purify sialylated antibodies using affinity chromatography. The first method had the antibodies go through the spin columns in the following order: ECL cleanup then SNA to capture, with lactose buffer to elute. The second method followed the order: ECL cleanup with lactose, SNA cleanup with lactose, ECL cleanup in the absence of lactose, and SNA capture in the absence of lactose to capture, then collection with lactose. The third method was a streamlined version of Method 1. A primary analysis checked antibody concentrations by measuring fluorescence intensity at 280nm. Quantitative surface plasmon resonance (SPR), neuraminidase treatments, and various calculations measured more precise concentrations of sialylated antibodies, and the absence of non-sialylated antibodies that bind non-specifically to the SNA column.

  While both the first and third purification methods yielded sufficient concentrations for further studies, the third method has less non-specific antibody contaminants. The third purification method is preferable when purifying for sialylated IVIG antibodies.

- **Research, Design and Implementation of Patient Education and Perioperative Materials In a General Surgery Internship**

  *Michelle Jorgenson*

  *Capstone Advisor: Marc Nahmani*

  In order to gain experience in an operating room and emergency room setting I created an internship in the general surgery department of a rural hospital in Ketchikan, Alaska. During the internship I shadowed general surgeons for 150 hours and attended pre and post- operative clinic visits. During clinic visits I observed a variety of different surgeries ranging from colonoscopies and other endoscopic procedures to appendectomies, cholecystectomies, bowel resections and more. Based on the needs of the community and general surgery department at Peach Health General Hospital, I decided to create a patient informative pamphlet and perioperative medications table for the use in the implementation of the Fast Track Colonoscopy program at the facility. To this end I conducted a literature review on the best practices in creating these materials. The final materials were presented to the medical staff I was working under, Dr. Julie A. Conyers MD and Dr. Matthew A. Bzdega MD. Through this experience I acquired knowledge on a broad range of surgeries, procedures, techniques and anesthesia. Working in a rural location I developed a deeper understanding of patient selection and resources availability in a rural facility. Additionally, I gained experience with pathophysiology- the disease process and when physiology goes wrong, which is the scope of a lot of medicine. This internship was a rewarding experience which has strengthened my drive to continue my education into medicine.

- **Detecting Chytrid Fungus Using Aptamer-based Biosensors**

  *Ryan Culbert and* ***Shah Khan***

  *Capstone Advisor: David Hirschberg*

  Chytridiomycosis infections, caused by *Batrachochytrium dendrobatidis (Bd)* and *Batrachochytrium salamandrivorans (Bsal),* are responsible for the decline of 501 amphibian species, 90 of which have been eradicated (Parris and Beaudoin, 2004). The pathogens that cause this infection are invisible to the naked eye and kill the host in the span of days; for that reason, detection is crucial (Michigan Frog Survey, 2003). The objective is to devise a rapid, cost effective, and accurate detection method, while also abiding by specific criteria. Criteria include: (a) no harm to live animals or subjection to long quarantine periods, (b) low volume water samples should be used for detection, and (c) method must have the ability to identify contaminated shipping materials. Electrochemical aptamer-based biosensors (EABs) are proposed as a new method of chytrid detection. EABs rely on an oligonucleotide conformational change that results from a specific analyte binding, generating an electrochemical signal (Somerson and Plaxco, 2018). Quantitative data will be collected, allowing for infection load analysis.

Data from the biosensors will match and/or exceed the *Bd* qPCR sensitivity of 72.9% and specificity of 94.2%. EABs provide an instant, accurate detection method that can be used easily and performed on site. Potential applications of such a system would not only be for chytrid detection, but real time monitoring or even as biorecognition elements.

- **3-Dimensional Analysis of Spinule Bearing Excitatory Presynaptic Terminals in the Visual Cortex**

  *Madleine Kimani*

  *Capstone Advisor: Marc Nahmani*

  Spinules are invaginations that project and get enveloped into the presynaptic terminal. They are usually less than 100nm in length and under 1µm long. Although their function is still unclear, previous studies have hypothesized that they appear to increase stability of synaptic function. In addition, at regions where there are active synapses, a high number of spinules are frequent than in regions that do not have high activity. In this study, I analyzed transmission electron microscopy images taken from previous studies that focused on the anatomy and physiology of the visual cortex. Our focus was to examine the percentage of cortical excitatory presynaptic terminals that contain spinules in adult mouse. We used image processing programs; Fiji to analyze excitatory presynaptic terminals and identify which ones were bearing spinules and Reconstruct to construct a 3D image of spinule bearing terminals. In the 96 synaptic terminals I analyzed, 28% contained either one or two spinules. The spinules were originating from adjacent axons, adjacent dendrites, adjacent spines, postsynaptic spines, and others from unknown neuronal cell structures. My data showed that among these origins, the highest numbers of these invaginations came from the adjacent axon and postsynaptic spine; approximately 44% and 30% respectively. In addition, spinules from the adjacent axon protruded into the presynaptic terminal bringing in their vesicles. These data and observations indicate therefore that spinules may be important to reinforce the synaptic function.

- **Puyallup Cultural Garden**

  *Seth Kincl*

  *Capstone Advisor: Jim Gawel*

  Our project was a proposal for an on-campus garden that honors the indigenous people whose land that University of Tacoma has been built upon. The main objective is to spread cultural awareness and to acknowledge the Puyallup tribe's history of the area. It is also our goal to utilize this space as a classroom to teach sustainability, botany, Native American studies, urban planning, and other related subjects in conjunction with a course. The space also serves students as a means of relaxation as being additional green-space added to the campus. So far we have reached out to multiple individuals within the university and the Puyallup tribe with positive interest. We have continued forward in

securing funds needed to implement the garden through the Campus Event Fund. We are still awaiting approval from the board directors.

- **Using Stratigraphic Diatom Deposits as a Proxy of Present-day Lake Productivity**

  ***Klevemann, Caroline****, Francesca Marvin, Grace McKenney, Kavi Rana, and Erica Webb*

  *Faculty Mentor: Jim Gawel*

  The purpose of this study was to use diatomic taxa abundance and organic carbon as indicators of productivity over time in ponds within the Hummocks Pond Complex, which was created in the 1980 eruption of Mount St. Helens. Sediment core samples were taken from two separate ponds and were analyzed for both diatom taxa abundance and organic carbon percentage. Through TSI calculations the trophic status for two specific ponds, H-16 and H-10, were found to be eutrophic and meso-eutrophic, respectively. Using araphid diatom percent abundance as a proxy for pond productivity over time within sediments, H-16 showed a decrease in diatom deposits, however, H-10 showed a consistent percentage abundance of araphid diatoms. Overall, this may indicate that H-16 became more eutrophic over time, whilst H-10 has stayed more mesotrophic since they were created 39 years ago. The organic carbon percentages validate this idea through their steady decrease going back in time for both ponds. Using TSI calculations, diatom taxa abundance, and the organic carbon measurements, we determined the trophic status and productivity in these two ponds. This is important to geologists and ecologists as ongoing studies analyze how succession occurs in freshwater ecosystems following volcanic eruptions in the Pacific Northwest. Future research on these ponds will determine if these productivity trends continue or change over time, and can explore how this will affect the greater Mount St. Helens ecosystem.

- **3D analysis of spinule bearing excitatory presynaptic terminal prevalence in adult mouse visual cortex**

  *Elizabeth Kubay*

  *Capstone Advisor: Marc Nahmani*

  Neuronal communication allows for the rapid transmission of neuro-sensory information from one neuron to another. Spinules are fine processes that invaginate presynaptic terminals. These structures have been identified within electron microscopic images, however the function and prevalence of these thin projections remains unclear. In this experiment we used image processing programs, Fiji and Reconstruct to analyze 3D electron microscopy image volumes of adult mouse visual cortex brain tissue to determine the prevalence of spinules within the adult brain. In analysis of 99 synaptic terminals, I found that 62% of presynaptic terminals in the adult cortex were spinule bearing terminals (SBTs). Approximately 45% of SBTs contained spinules from adjacent axons. Within these visual cortex synaptic terminals, the post synaptic densities were often perforated, suggesting these perforation may serve as an entrance point for spinules

invaginating into presynaptic terminals. My data implicates postsynaptic spines and adjacent axons as the primary 'spinule' protrusions into presynaptic terminals, followed by adjacent spines (~ 39%), and adjacent dendrites (~17%). The data suggests that spinules are a common feature of cortical synapses and may create anchoring points that strengthen synaptic terminal to postsynaptic spine connections.

- **Mapping Underwater Cover & Structure: Habitat Analysis of Bass Location in Alder Lake**

  *Timothy Lane*

  *Capstone Advisor:*

  Competition fuels many motivations in life, and bass fishing is no different. Competition anglers are always looking for the next best thing to give them an edge. The edge provided in this capstone is revealed cover and structure within the bottom of Alder Lake (Pierce County, WA). The resulting sidescan mosaic will fill a niche in underwater mapping. The problem with most graphing units is that they don't employ sidescan-capable transducers, but rather 83/200 kHz transducers limited to 2D sonar only. The higher end units that support sidescan mapping do allow logging of data to save tracks within the unit but are limited in the sense of the creation of mosaic sidescan into a single map. The question proposed in this capstone is "where do I begin looking to find bass?" The approach was to collect field data using a Lowrance Elite 7ti graphing unit with TotalScan transducer to map the bottom of Alder Lake. The resulting data is then processed through ReefMaster software and analyzed through Arcmap 10.6.1. The result is a complete image of the bottom of the lake, including features such as stumps, old roadbeds, and creek channels. This data is crucial in understanding where bass might relate to and therefore provide data for anglers looking to capitalize during tournaments.

- **Searching for Spinules: Analyzing Critical-Period Plasticity in Visual Cortex Images**

  *Sarah Lindhartsen*

  *Capstone Advisor: Marc Nahmani*

  Motivation

  Animal development and behavior is dependent on synaptic connections in the brain. Synapse structures called spinules have been found throughout the brain, but their purpose and function is not well understood. Many spinules form when when a dendritic spine invaginates a membrane bound projection into an axon terminal or bouton.

  Problem Statement

  We wanted to know whether spinule formation is associated with critical period plasticity in mammalian visual cortex development, a developmental time-window of robust

change in synaptic anatomy and physiology. The midpoint of visual cortex plasticity in the visual development of ferrets is 46-47 days postnatal (p). Since spinules have been hypothesized to function as units of neuronal circuit remodeling, we predicted that the appearance of spinules in excitatory presynaptic terminals would be higher during the midpoint of the critical period (high plasticity) and lower during the non-critical periods (lower plasticity).

Approach/Methods

Excitatory synapses in Transmission Electron Microscope images from ferret p46 -p47 visual cortex were analyzed for the presence of spinules using FIJI software.

Results

Compared to the images of the other developmental ages, the appearance of spinules in visual cortex excitatory synapses at the critical period midpoint (spinule prevalence: 6.133%) did not show the predicted increase. Rather, spinule prevalence in excitatory synapses increased from birth to adulthood, suggesting that spinule formation may be related to the maturation and strength of developing synapses.

Conclusion

Spinule development and function in ferret visual cortex does not appear to be correlated to critical period plasticity.

- **Assesing Microplastic Concentrations in Sand Samples from a Remote Atoll in South Pacific: A Pilot Study**

  *Amelia Lingle*

  *Capstone Advisor: Julie Masura*

  Plastic debris in large water bodies such as oceans and seas has become a prominent issue. Microplastics (polymers less than five mm) can be primary, manufactured (i.e. microbeads from facial exfoliants), entering water bodies through runoff / drainage systems, or secondary (i.e. clothing fibers or fragments) and overtime undergo weathering and breakdown. These microplastics are often small enough to pass through water treatment filters, thus ending up in watersheds. Aquatic organisms are known to ingest microplastics, and while the impacts are currently unknown, interest in the matter is growing. Contaminants in microplastics are also a concern and could have harmful effects on the environment and the organisms that ingest them as well. This study evaluated the concentration and distribution of microplastics collected from sandy beaches on islets (motus) of Tetiaroa, an atoll located in the Pacific Ocean. Thirty-six samples were collected from eight of the islets. The analysis included density separation using a high-density fluid, filtration to .3-mm, examination under a microscope, and gravimetric analysis to determine concentration and type of microplastics in each sample. Thirty-nine percent of the samples processed contained microplastics including fibers, netting, and a fragment. This preliminary study shows that microplastics continue to be

ubiquitous in the natural environment, and continues to heighten the need for disposal management throughout the world.

- **Mutational Analysis of Potential Phosphorylation Sites on the Kinetochore-Associated Protein Stu2**

  *Angela Mitchell and* ***Miranda Makalena***

  *Capstone Advisor: Jack Vincent*

  The kinetochore plays a key role in aligning chromosomes during mitosis and helps ensure proper separation of duplicated DNA molecules into daughter cells. Some proteins that associate with the kinetochore regulate attachment to microtubules by destabilizing weak attachments and stabilizing strong attachments. In the model organism *Saccharomyces cerevisiae*, the Ipl1 kinase and Stu2 protein have similar effects on regulating kinetochore tension. Since Ipl1 is a kinase, and Stu2 is phosphorylated, we believe Stu2 function may be regulated by Ipl1. To test if Stu2 function is dependent on phosphorylation by Ipl1, we mutated possible Ipl1 phosphorylation sites and observed its effects on Stu2 function. Four Ipl1 target consensus sites within the Stu2 protein were selected for this study. We used site-directed mutagenesis techniques to alter these potential Ipl1 phosphorylation sites on Stu2 by mutating serine codons to alanine codons. We successfully constructed S40A and S430A/S593A mutations in Stu2 using the megaprimer whole plasmid (MEGAWHOP) cloning technique. We then introduced the mutated version of *stu2* into yeast and conducted phenotype tests to determine if inactivating these putative phosphorylation sites affected its function. Our initial results indicated that phosphorylation at sites S430 and S593 may not be required for proper Stu2 function. We suggest that further testing of Ipl1 phosphorylation sites could reveal possible mutations that lead to malfunction of Stu2 that then affect the kinetochores ability to release improper attachments to microtubules. This would give insight into how signaling between kinetochore proteins can help to ensure proper chromosome segregation and avoid aneuploidy.

- **An Overview of the Jellyfish Aquaculture Process**

  *Francesca Marvin*

  *Faculty Mentor: Rus Higley*

  This study is conducted in order to create a baseline of knowledge for jellyfish including aquaculture while increasing public knowledge and connecting citizens to the natural world. How can Jellyfish be aquacultured, in an open water system with the Puget Sound? The process of jellyfish aquaculture for the purpose of creating a baseline of knowledge and education will be explained. The aquaculture process followed was created and took place at the Marine Science and Technology Center (MAST) through

Highline College. All tanks are run through an open water system with the Puget Sound, with the only water difference being UV sterilization for the Jellyfish due to damaging organisms that could get through, if it wasn't sterilized. There are three different types of Jellyfish aquacultured; Moon Jellyfish, Egg Yolk Jellyfish and the Lion's Mane Jellyfish. Daily there are water changes and feeding of brine shrimp. Once the jellyfish are out of polyp stage and onto their ephyra stage they are moved to a glass bowl, with other of the same species ephyra. Once the Jellyfish start to turn to the Adolescent Medusa they are moved to larger tanks for the public to view. Additional steps are taken for injured or hula hooping jellyfish, feeding directly into their mouth a variety of foods blended up. Brine shrimp are harvested and restocked daily in lab. Brine shrimp eggs are decaped in lab for ease of consumption for the jellyfish. Jellyfish can be aquacultured up to Medusa phase in an opened water system with the Puget Sound if certain upkeep steps are taken.

- **Using Stratigraphic Diatom Deposits as a Proxy of Present-day Lake Productivity**

  *Klevemann, Caroline, **Francesca Marvin**, Grace McKenney, Kavi Rana, and Erica Webb*

  *Faculty Mentor: Jim Gawel*

  The purpose of this study was to use diatomic taxa abundance and organic carbon as indicators of productivity over time in ponds within the Hummocks Pond Complex, which was created in the 1980 eruption of Mount St. Helens. Sediment core samples were taken from two separate ponds and were analyzed for both diatom taxa abundance and organic carbon percentage. Through TSI calculations the trophic status for two specific ponds, H-16 and H-10, were found to be eutrophic and meso-eutrophic, respectively. Using araphid diatom percent abundance as a proxy for pond productivity over time within sediments, H-16 showed a decrease in diatom deposits, however, H-10 showed a consistent percentage abundance of araphid diatoms. Overall, this may indicate that H-16 became more eutrophic over time, whilst H-10 has stayed more mesotrophic since they were created 39 years ago. The organic carbon percentages validate this idea through their steady decrease going back in time for both ponds. Using TSI calculations, diatom taxa abundance, and the organic carbon measurements, we determined the trophic status and productivity in these two ponds. This is important to geologists and ecologists as ongoing studies analyze how succession occurs in freshwater ecosystems following volcanic eruptions in the Pacific Northwest. Future research on these ponds will determine if these productivity trends continue or change over time, and can explore how this will affect the greater Mount St. Helens ecosystem.

- **For the Love of Bees: The Potential Use of Green Roofs as Forage Area In Urban Environments**

  *Jessi McDonald*

  *Capstone Advisor: Matt Kelley*

Bees and other pollinators are always in need of forage area. Pollinator decline has been linked in part to habitat loss, where they lose not just food but nesting sites from a lack of landscape connectivity. When we think of urban environments we do not think of the plants and trees that dot their landscape, they are often referred to as concrete jungles. Obviously, there is some foraging for pollinators in cities especially in Tacoma. Many homes have flowers in pots or gardens, and flowering trees and flowers can be found all over the city. But the amount and connectivity of these areas can be lacking and is hardly conducive to providing enough forage area as cities expand. If green roofs are built to hold flowering plants in specific places, they can provide connectivity needed to support the world's pollinator populations and bring more nature back into urban environments. This work focuses on bees in cities where foraging choices are limited and where environmental traps and sinks are found. I use GIS to spatially analyze Tacoma choosing buildings and homes in between areas where bees can be found foraging where green roofs would be best placed to create a connective forage area across the city.

- **Using DNA Barcoding to Improve Identification of Bivalve Larvae from Western Washington**

  *Grace McKenney*

  *Capstone Advisor: Bonnie Becker*

  Bivalves (i.e. clams, oysters, and mussels) play critical roles in the marine ecosystem and economy of Western Washington, which means they are a vital group of animals to study and monitor. To ensure the sustainability of these species, it is crucial for scientists to study all life stages. One of the least understood is the larval stage, especially the distribution and behavioral differences among species. Light microscopy is traditionally used to identify bivalve larvae in environmental plankton samples, and is based on morphological discrimination between taxonomic groups. However, differing identifications amongst scientists, morphological changes due to environmental factors, and larval stage similarities between taxonomic groups can lead to differing identifications. These misidentifications can be minimized through the use of DNA barcoding. In this study, we used previously collected environmental water samples containing larvae, EZNA Mollusc kits, polymerase chain reactions (PCR), DNA sequencing, and comparisons to online gene databases to determine better taxonomic specificity of individually sorted bivalves within 5 groups of interest: Olympic oysters (*Ostrea lurida*), Pacific oysters (*Crassostrea gigas*), small clams, large clams, and mussels. Information from DNA barcoding will help scientists both verify light microscopy classifications and clarify the identities of planktonic bivalve larvae. This will provide a vital tool for further bivalve studies, such as determining morphological changes during growth and species abundance in the water column. Therefore, looking at

bivalve larvae as a community of multiple species will allow us to have a more complete understanding of the dynamics of bivalve populations over different life stages.

- **Using Stratigraphic Diatom Deposits as a Proxy of Present-day Lake Productivity**

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- **Magnetic Properties in Puget Lowland Lahars**

  *Thomas Melot*

  *Capstone Advisor: Peter Selkin*

  The Osceola Mudflow is one of the largest historic lahars, or volcanic mudflows, from Mount Rainier discovered to date. It flowed from Mount Rainier to the Puget Sound through the White River valley about 5,600 years ago. Measurement of the vertical variations in magnetic properties of lahar deposits is expected to allow for better predictions about the flow characteristics of future lahars with implications for hazard mitigation. For this study, samples of the Osceola Mudflow deposit were taken from a vertical profile on an outcrop along the White River and were analyzed for bulk magnetic properties. This study found that concentrations of magnetic minerals are highest at the bottom of the mudflow deposit at this site, something that remains unexplained.

- **Chemical composition of sediment contributions from floating logs on Spirit Lake**

  *Joseph Meyer*

  *Capstone Advisor: Jim Gawel*

  As a result of the 1980 eruption of Mount St. Helens, a large number of trees and a mountain of debris were deposited in Spirit Lake at the base of this volcano. The maximum depth of the lake was drastically reduced, and floating logs continue today to cover approximately 20% of the lake surface area. These logs, also known as floating woody debris, provide substrate for periphyton and aquatic insects, which in turn provide a source of nutrients and trace elements to this oligotrophic (nutrient poor) lake. Thus floating woody debris may play an important role in the ecology of lakes, and yet they are relatively unstudied. Our project examines the quantity and composition of the sediment generated from the floating logs. In the summer of 2018 we deployed sediment traps in open water and below duplicate experimental log mats tethered in a small bay in Spirit Lake away from the larger destructive log mat. We also collected sediment cores from the area to compare eruption debris contributions to post-eruption additions. Sediment trap samples were filtered, and along with sediment core samples dried and digested by microwave-assisted acid digestion. Carbon, nitrogen, phosphorus, and other trace elements will be analyzed by CHN analysis and ICP-MS. Our results will improve our understanding of the role floating woody debris may play in the post-disturbance ecology of lakes, and will inform lake management in the future.

- **Mutational Analysis of Potential Phosphorylation Sites on the Kinetochore-Associated Protein Stu2**

  ***Angela Mitchell*** *and Miranda Makalena*

  *Capstone Advisor: Jack Vincent*

  The kinetochore plays a key role in aligning chromosomes during mitosis and helps ensure proper separation of duplicated DNA molecules into daughter cells. Some proteins that associate with the kinetochore regulate attachment to microtubules by destabilizing weak attachments and stabilizing strong attachments. In the model organism *Saccharomyces cerevisiae*, the Ipl1 kinase and Stu2 protein have similar effects on regulating kinetochore tension. Since Ipl1 is a kinase, and Stu2 is phosphorylated, we believe Stu2 function may be regulated by Ipl1. To test if Stu2 function is dependent on phosphorylation by Ipl1, we mutated possible Ipl1 phosphorylation sites and observed its effects on Stu2 function. Four Ipl1 target consensus sites within the Stu2 protein were selected for this study. We used site-directed mutagenesis techniques to alter these potential Ipl1 phosphorylation sites on Stu2 by mutating serine codons to alanine codons. We successfully constructed S40A and S430A/S593A mutations in Stu2 using the megaprimer whole plasmid (MEGAWHOP) cloning technique. We then introduced the mutated version of *stu2* into yeast and conducted phenotype tests to determine if inactivating these putative phosphorylation sites affected its function. Our initial results

indicated that phosphorylation at sites S430 and S593 may not be required for proper Stu2 function. We suggest that further testing of Ipl1 phosphorylation sites could reveal possible mutations that lead to malfunction of Stu2 that then affect the kinetochores ability to release improper attachments to microtubules. This would give insight into how signaling between kinetochore proteins can help to ensure proper chromosome segregation and avoid aneuploidy.

- **Generating a cell free system using perfringolysin O (PFO) to study *Plasmodium yoelii* late liver-stages**

  *Amy Morris*

  *Capstone Advisor: Anna Groat-Carmona*

  Malaria is caused by a vector-born parasite that infects millions of people worldwide, yet has little national attention (CDC, 2019). Due to the high fatality, an increase of resources have tried to control this disease (CDC, 2019). However, monitoring this disease has resulted in complications due to the hemocytes rapidly decay overtime and interfere with studying the late replication cycle of malaria. The goal of this project is to create a cell freeze system by using *Plasmodium yoelii* mouse malaria infected mosquitoes with perfringolysin O (PFO) infected Hepa1- 6 cells in order to observed if the parasitophorous vacuole can grow independently *in vitro*. We obtained a transgenic *Escherichia coli* strain that was previously used for the expression of PFO using standard protein purification techniques. A plasmid map was reconstructed from a combination of bioinformatics, plasmid editing software, and using PFO from previous studies to genotype the transgenic *E. coli* strain. However, we have neither been able to confirm the identity of the transgenic *E. coli* strain nor been able to purify PFO. In the future, our objective is to treat malaria infected Hepa1-6 cells with purified PFO and use temperature changes to control PFO-mediated lysis of the host cell membrane to separate out the parasitophorous vacuole. Developing this cell free culturing system could improve our ability to study late liver-stage development *in vitro*, which would be a vital step towards the generation of new malaria vaccines.

- **Is Ocean Acidification Changing Bivalve Behavior?**

  *David Mullins*

  *Capstone Advisor: Bonnie Becker*

  Studies show that ocean acidification has great impacts on bivalves, corals, and other organisms with shells, but does it also affect the behavior of these organisms? Bivalve species are filter feeders, which provide an important ecosystem service, they are also preyed on by many species. The purpose of our research is to help survey bivalve populations around Puget Sound and to better understand the behavior and movement of different bivalve species. This collaborative project with the Washington Department of Natural Resources has been working to learn where bivalves are going during the day and

at night. The bivalves of interest are Olympia oysters, Pacific oysters, clams, mussels, d-hinge larvae, and unknown bivalve larvae. Sample collection took place in Fidalgo Bay, Willipa Bay, Case Inlet, and Port Gamble in 2015. Statistical analysis of the final counts is still underway, but the final data has been compiled and organized. Willipa Bay showed a significantly greater amount of Pacific Oyster larvae than any of the other 3 sites, however, mussels were much more abundant in Port Gamble and Case Inlet. Port Gamble also had a large population of d-hinge larvae. Olympia Oyster counts were the lowest among the bivalves of interest, as hypothesized. Collections took place at night and daytime, in deep and shallow traps, and on bare substrate and in eelgrass. Our hypothesis is that bivalves may be actively seeking eelgrass to swim down to during the day light in order to take advantage of the photosynthesis occurring. During photosynthesis, the eelgrass would be removing CO2 from the water, creating a less acidic environment. Our initial data also shows that there may not be a significant difference in bivalves found in bare substrates, no matter the time of day or depth. Conversely, light seems to have a significant difference on bivalves in eelgrass, many more bivalves were found around the eelgrass during the day than at night. This supports our hypothesis. Future analysis may show more trends and teach us more about bivalves and if ocean acidification plays a possible role in their behavior.

- **The Use of Science in Puget Sound's Ecosystem Recovery Plans**

  *Joshua Murray*

  *Capstone Advisor: Tom Koontz*

  Science has the benefit of providing vital information in ecosystem recovery planning. Ecosystem recovery planning is done around the world as a collaborative effort and often aims to be informed by science. Because of the difficulty of incorporating science into planning, especially when it's done by non-scientists we thought it important to explore. We as a team wanted to look further at this idea and explore what kind of science was used. We began by learning about social science qualitative methods by analyzing documents. We looked at 12 local plans for salmon recovery around the Puget Sound area and used a coding system to identify the sources of information that were referenced in those plans. Coding consisted of dissecting each source into year, consultant, type of source from a list of 20, natural/social science and vertical/horizontal authority. From there we were able to break down the science and resources that were used when establishing these plans to gain a better idea about how they were developed. We were able to break down the plans and get an overall picture of how they are developed. Results show differences across the 12 plans as well as some common features amongst those plans giving us insight into the planning process.

- **The effects of cytochalasin B on the localization of the Plasmodium BEM46-like protein (PBLP) to determine the role of translocated proteins during malarial infection**

*Armann Gill and **Tracy Mwangi***

*Capstone Advisor: Anna Groat-Carmona*

Prior research identified the *Plasmodium* BEM46-like protein (PBLP), which is expressed throughout the malaria life cycle and previously found to be important in the development of all invasive stages. PBLP is located on the parasite plasma membrane (PPM), however, it is relegated to an unknown intracellular vesicular structure within sporozoites. Thus, PBLP is translocated from an intracellular compartment to the PPM of the sporozoite. It is unknown how the translocation occurs. Prior research has shown parasite secretory organelles may not be responsible for the translocation of PBLP[1]. In cells, vesicles containing cellular components, including proteins, are transported via intercellular trafficking system called the cytoskeleton. Extracted salivary gland sporozoites were treated with mycotoxins, like cytochalasin B (CB), to inhibit formation of actin and test the role of actin cytoskeletal rearrangements in the translocation of PBLP. Immunofluorescence assays were performed on CB-treated and untreated samples to examine the effect of CB on PBLP localization in salivary gland sporozoites and during early LS differentiation. Motility assays were carried out on CB treated sporozoites to observe its effects on sporozoite locomotion. The objective of this study was to determine how PBLP moves to the PPM after actin filaments are interrupted by CB toxin. However, while sporozoites were successfully used to infect Hepa 1-6 cells, the effect of CB on the translocation of PBLP was not determined. In the future, we hope to repeat these studies using CB as well as include use of other mycotoxins to disrupt additional intracellular trafficking structures such as microtubules.

- **Insect Diversity and Shade Cover at Mount St. Helens Hummocks Ponds**

*Mae Fosnick**, Jake Nyiri**, and Andrew Paquin*

*Faculty Advisor: James Gawel*

The hummocks ponds created in the aftermath of the Mt. St. Helens eruption offer a unique opportunity to observe freshwater insect populations in some of the youngest lakes on the planet. We studied the effect of shoreline shading on insect diversity. Insect samples were collected from a wide variety of ponds. It was observed that overall diversity was low and the samples were all dominated by Diptera spp. This indicates that while Diptera can easily colonize catastrophically-created lakes, other species have had a harder time. A correlation between lack of shade cover and increase in predatory species (and corresponding drop in total insect number) was also observed, indicating that the freshwater predators which most quickly colonized the disturbed area prefer to hunt in lit areas.

- **Synthesis of a novel amide for antileishmanial activity testing**

*Tomas Oliverez*

*Capstone Advisor: Meg Henderson*

Nearly one million new cases of leishmaniasis are estimated to occur each year. Visceral leishmaniasis is a fatal manifestation of the disease, killing upwards of 65,000 people a year worldwide. The Drugs for Neglected Disease initiative (DNDi) partnered with the University of Washington in order to further the research and development of novel compounds with possible antileishmanial activity. DNDi suggested coupling a predetermined carboxylic acid compound and aminopyrazole compound to synthesize a novel amide. To accomplish this synthesis, use of the amide coupling agent HBTU and triethylamine was chosen. This chosen pathway was favored due to its ease of setup in a single solution with dimethyl sulfoxide (DMSO), as well as the ability to perform the reaction at room temperature and atmospheric conditions for improved manufacturability. A successful synthesis of the target compound was suggested by infrared spectra and proton NMR. The PMB protecting group still needs to be removed, and other teams working on this project have been struggling with this. The sample will then be sent to DNDi for efficacy testing. While the chosen pathway may have yielded the targeted amide compound, there remains a wealth of possible alternative synthetic pathways and other suggested target compounds to attempt to synthesize. These alternatives should be explored and cataloged to expand the basic research surrounding the challenge of developing better treatments for visceral leishmaniasis.

- **The Effects of Socioeconomic Status on Healthcare Accessibility in Buenos Aires**

  *Miriam Otieno*

  *Capstone Advisor: Joan Bleecker*

  In the journal article by Ramos et al. found that, the risk of infant mortality for Argentina was alarmingly high compared to both developing nations and western countries. (Ramos et al. 2007). Among c-section complications, slow response time and barriers to communication, infrastructure and accessibility to healthcare are some of the causes that affect the maternal health care rates in Argentina. (Karolinski,2010) For my research I observed how accessible healthcare facilities were for women in 4 neighborhoods of different socioeconomic levels in Buenos Aires, Argentina. I observed the density of women's healthcare facilities and the accessibility of public transport I measured the accessibility of clinics by looking at the distance from public transport such as subte (subway) stations and bus stations and clinics. I then evaluated the data using graphs and other analysis methods to see which neighborhoods more clinics and which neighborhood had had clinics that were closest to public transport. I looked at the infrastructure such as the availability of waiting rooms and how accessible it is to those with disabilities and examined the disparity between neighborhoods. Though public transportation might play a role in the availability of healthcare services between neighborhoods but other factors such as wait times and infrastructure might be a stronger determinant on the accessibility of healthcare. There was a disparity in the distance from the clinics and hospitals to the public transportation. Affluent neighborhoods were closer to subte stations than bus

stations and poorer neighborhoods had equal distance from the subte stations and the bus stations.

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- **Analyzing Levels of Perfluorinated Compounds in Mytilus trossulus Utilizing Chemical Analysis and Mass Spectrometry**

  *Gabe Peretz*

  *Capstone Advisor: Joyce Dinglasan-Panlilio*

  Perfluorinated Alkyl Substance (PFAS) have become very prevalent in ocean waters and have been detected in sea mussel tissues, such as *Mytilus trossulus*. The overall goals of this large study is twofold: First, to determine whether mussels, which are filter feeders, can be used to assess water concentration of PFAS. Second, to assess potential human exposure to these contaminants from shellfish consumption. This portion of the investigation focused on measuring the levels of PFAS in mussel tissues from different sites in Washington State. A spike and recovery method was performed to validate published extraction method of PFAS in mussel tissues as well as to assess the baseline levels of PFAS in test mussel samples. The samples were spiked with known amounts of PFAS commonly detected in the environment. The samples were prepared for analysis via liquid chromatograph equipped with a tandem mass spectrometer (LCMSMS). Concentrations will be reported and compared to previous studies. Masses of native PFAS were calculated with baseline mass added of 0.025 micrograms. This provided yield data that showed that the native compounds, such as PFDA and PFNA, were present before the laboratory spike-and-recovery. There are global health concerns for this research, the relative health risks of PFAS to humans are unknown at this time, but they can be passed down from mother to child through breast feeds or unborn children through the placenta, and there has already been levels of different PFAS found in human blood samples

- **Using GIS to Create a Habitat Suitability Index for Chinook Salmon Bearing Streams and Rivers in the Puget Sound**

  *Andrew Potter Maul*

  *Capstone Advisor: Matt Kelley*

  Chinook Salmon, an endangered keystone species in the Pacific Northwest, have dwindling populations. The loss of healthy Chinook populations can have detrimental effects on the ecosystem. These effects include the loss of historically vital nutrients for forests lining the streams and rivers where salmon spawn, or the loss of a food source for other animals, such as starving Puget Sound Resident Killer Whales. The purpose of this experiment was to develop a habitat suitability index for Chinook spawning rivers and streams flowing in to the Puget Sound, and create visual representations for the index values. Using spatial and tabular data, Chinook bearing streams in the Puget Sound were were analyzed for multiple ecological factors that affect the success of spawning and survival of Chinook salmon. Two analyses were created, a detailed index featuring fewer streams, and more broad index including the majority of Chinook bearing streams in Puget Sound. Streams and rivers closer to the Puget Sound, and nearer to more populated cities, were found to have the less suitable habitats than those further away.

- **Plant Selection and Site Design to Deter Encroachment of Invasive Species in Urban Restoration**

  *Victoria Prideaux*

  *Faculty Mentor: Cynthia Updegrave*

  The natural environment at Titlow Beach Park provides services that benefit the surrounding community via a properly functioning ecosystem; however, anthropogenic activities often negatively impact the surrounding environment and can introduce invasive species to already sensitive urban habitats. Restoration ecology assists the recovery of these degraded habitats to a more natural state and restores the natural processes that benefit humans. The removal of invasive species, such as Himalayan blackberry and English ivy, opens space for native vegetation. Through plant selection and site design we can work to naturally deter and suppress these invasive species. This will not only benefit the natural habitat, but it also will improve Titlow Beach Park's aesthetic presentation and further encourage the community's recreational use.

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- **Youth Gone Wild: Where Does Tacoma's Youth Avoid**

*Christopher Roberson*

*Capstone Advisor: Matt Kelley*

The Youth Gone Wild (YGW) project is working closely with the Action Mapping Project (AMP) to improve the overall quality of life for the residents of Tacoma, Washington. Urban development and understanding where to prioritize funding are important to help improve quality of life. This study is analyzing what areas Tacoma's youth are actively avoiding, identifying which areas need priority. For this research project I used data collected from the Action Mapping Project (AMP) that was digitized hand drawn maps into ArcGIS, making heat maps of where Tacoma's youth are spending their time outside of school. This data was used to isolate the areas that are more frequently avoided and visited by Tacoma's Youth. Comparing these datasets by several variables: Trails, Bikeways, Dominant Land Use, and nearby Parks. Kids are avoiding areas dominantly within residential areas, with 67% being Single Family Dwellings. These identified locations will be used in future studies conducted by the AMP program with the University of Washington Tacoma.

- **Geothermal Energy to Combat Coal Use in Washington State**

*Cassidy Sawyer*

*Capstone Advisor: Matt Kelley*

Electricity is one of the main sectors that emit carbon dioxide. Washington has many renewable energy sources including geothermal energy which could help supply the state with electricity and using this energy would help reduce the states carbon emissions. Figuring out which public utility district in Washington is using the most coal for electricity generation would show where a geothermal power plant would be most beneficial in cutting down carbon emissions. Then, the question is where within this service area could a geothermal power plant be placed? ArcMap and collected data on the public utility services in Washington will be used to map and locate where coal generated electricity is the most prevalent and site selection will take place within the service area for a suitable land parcel to place a geothermal power plant. The public utility district #2 of Grant County was identified for using a high percentage of coal generated electricity. Within Grant county a suitable site is on undeveloped land, accessible by roads, away from high density populations, and has geothermal potential. This is a targeted approach to lowering Washington states carbon emissions by using ArcMap to locate trouble areas and analyze them to implement a renewable solution.

- **Discerning the biochemical function for the catalytic domain of *Plasmodium* BEM46-like protein (PBLP)**

*Koryn Aguon and **Misaki Seto***

*Capstone Advisor: Anna Groat-Carmono*

Malaria is a mosquito-borne disease caused by the *Plasmodium* parasite, which infects approximately 216 million people worldwide and kills an estimated 445,000 people each year. Although malaria can be treated, the rise in drug resistance has created a need for new intervention strategies, including the identification of new drug targets like the *Plasmodium* BEM46-like protein (PBLP). PBLP is a highly conserved, uncharacterized α/β-hydrolase that plays an important role in modulating the formation of invasive-stage parasites and is expressed throughout the parasite life cycle. PBLP shares structural homology and amino acid identity with other BEM46-like proteins in the α/β-hydrolase superfamily. Previously, a cDNA copy of the *pblp* coding sequence was amplified and then mutated using overlap-extension PCR to disrupt the putative catalytic active site (Ser153, Asp229, and His258), which was predicted using bioinformatic analyses. PBLP is membrane bound in liver-stage and blood-stage parasites so the hydrophobic transmembrane domain within the PBLP protein sequence was excluded during cloning so that subsequent protein purification procedures could be done in solution. Ultimately,

our goal is to express this parasitic protein in a bacterial system by successfully ligating the wild-type and mutant *pblp* sequences into a bacterial protein expression vector so that it can be purified and its catalytic activity can be characterized using functional enzymatic assays. These results will enable a better characterization of PBLP and potentially lead to the development of novel drug targets for the prevention and treatment of malaria.

- **Equine Pathogen Detection through Loop-Mediated Isothermal Amplification**

  *Krithika Shanmugam*

  *Capstone Advisor: David Hirschberg*

  Currently, pathogen detection requires at least one to two days and specialized instruments that are burdensome and impractical to use in resource-deficient areas. Development of rapid detection tools can improve health significantly, as early detection could allow for prompt quarantine, preventing the transmission of disease. An accepted practice for pathogen detection is endpoint PCR, a DNA amplification technique that requires a thermocycler. In this experiment, loop-mediated isothermal amplification (LAMP) was used to detect equine pathogens in place of endpoint PCR. Equine was used as the animal model due to similarities present in equine and human physiological systems. LAMP can amplify a particular segment of a pathogen, indicating the presence of the target pathogen with just one temperature. Synthetic DNA of pathogens were used to validate the assay and LAMP was able to detect *S. zoo*, *S. equi*, *EHV1*, *EHV4*, and *E. flu*, which are common equine pathogens. The detection of target pathogens through LAMP in a controlled laboratory setting suggests the experiment is ready to be scaled down to smaller devices, such as a microfluidic chip. Further research will include developing an internal control, introducing DNA extracted from pathogens rather than synthetic DNA, and troubleshooting the microfluidic chip component. After the reaction is demonstrated to work successfully on a portable device, it can be used in the field to assess equine health rapidly and apply quarantine methods to prevent the transmission of disease. This research can eventually be used to improve diagnostics for human health in resource-deficient areas.

- **Impact of Wildfire-Associated High Atmospheric Pollutants on Local Emergency Medical Services**

  *Heather St. John*

  *Capstone Advisor: Maureen Kennedy*

  Wildfires are increasingly prevalent in the Northwest region of the United States in the last twenty years, with a corresponding increase in many air pollutants including carbon monoxide (CO), particulate matter 2.5 (PM2.5), nitrogen dioxide ($NO_2$), and ozone ($O_3$).

Many of these pollutants can be dangerous to human health, especially PM2.5, a tiny particle that can easily embed in the lung tissue and decrease one's ability to breathe. Numerous studies have shown a correlation between increased wildfire activity and increased visits to emergency departments for both cardiac and respiratory events.

The aim of my research was to see if a correlation exists between prehospital emergency medical services (EMS) and increased wildfire activity. I used data from the Tacoma Fire Department, and Pierce County pollutant readings to determine if there was any statistical relationship between EMS calls and worsening air quality. I focused on cardiac and respiratory related calls from June-September between 2013-2018, as this is well documented as the wildfire season.

We noted an increase in calls in 2018 relative to the other years, which was a summer with record high air quality readings. Additionally, there was an increase in AQI (air quality index; a standardized index of pollution levels) readings in July and August indicating poorer air quality and suggesting a possible correlation to increased wildfires at that time. However, data suggests there was no statistically significant correlation between increasing AQI's and EMS call volume across Tacoma. Future research may involve increasing sample sizes to improve statistical power.

- **Farm or Bacteria: Development of DNA Assay for the Detection of Virginiamycin Antibiotic Transcripts in Mussel Tissue**

  *Brendan Studebaker*

  *Capstone Advisor: David Hirschberg*

  Recently, an antibiotic called virginiamycin was detected in mussel tissue collected at various locations in the Puget Sound. The health of Puget Sound waterways are routinely monitored and researchers at the Center for Urban Waters want to know if this virginiamycin was produced naturally by a bacterial species that may be residing inside the mussel tissue called *Streptomyces virginiae* or if the antibiotic was leached into the bay from farm runoff. The reason that this is cause for concern is that the presence of antibiotic in the environment may lead to environmental bacteria developing a resistance to antibiotics over time. It has been shown that when under selective pressure by low levels of antibiotic, bacteria undergo a selection process for resistance genes against antibiotics and then potentially transfer those genes to pathogens that affect humans (Gunnarsson et. al. 2017). To identify if the cause of the antibiotic contamination is coming from the bacteria *S. virginiae*, a qRT-PCR assay was proposed. A sensitive reverse transcriptase qPCR (qRT-PCR) assay is currently being developed and made specific for two genes in the virginiamycin synthesis pathway, VmsT and VirN, a post-modification enzyme and a response regulator protein respectively. To develop the assay, an RNA extraction kit and a reverse transcriptase enzyme would be used to reverse transcribe RNA transcripts relevant to virginiamycin synthesis. This process generates DNA sequences needed as a target for qPCR. As a further confirmation of target

detection, gel electrophoresis is completed on our amplification product after every run to ensure that the DNA length matches what we would expect. Testing of the qPCR protocol has demonstrated that the current sensitivity of the primers to the synthetic template is $10^4$ DNA copies for the VmsT gene and $10^3$ DNA copies for the VirN gene. The sensitivity of the assay will most likely be limited due to high G-C content in both genes, and particularly high within VmsT. After the qPCR conditions are demonstrated to be reproducible, an extraction and reverse transcriptase protocol will be developed for the mussel tissue. By testing sample material collected from the Puget Sound, we will be able to determine whether bacteria are causing the presence of virginiamycin in mussels.

- **Finding Forests Fit for a Fisher**

  *Angela Suffia*

  *Capstone Advisor: Matt Kelley*

  In Washington State, the fisher (*Martes pennanti*) was extirpated in the 1930's due to over trapping and habitat loss. The species is being slowly by reestablished through the release of fishers in the Olympic and Cascade mountain ranges. Finding the right location for introductions can be one of the toughest aspects because fishers are one of the most specialized mammals in North America (Zielinski et el. 2004). To locate sites in the Olympic Peninsula that satisfy fisher habitat requirements, ArcGIS software was used to create a habitat index considering factors such as land cover, hydrography, elevation, forest type, canopy cover, slope, and roads. Each dataset was reclassified to reflect the suitability parameters gathered from the literature. Rasters were added together using the Raster Calculator; creating a final suitability score for each raster cell in the extent. The result shows that ideal habitat for the fisher can be found in the Eastern side of the extent, in the dark green areas of the map. Selecting the most suitable habitat for a reintroduction is important in determining where we can set a species up for long term success.

- **Hospital Health Experiential Learning in rural Mumbai - India**

  *Ussi, Zeynab*

  *Capstone Advisor: Karen Cowgill*

  Growing up in Zanzibar city, Tanzania, I was always curious to know what brought people to the hospital and why some diseases were more common than others. My aim was to observe the healthcare system of a developmental country similar to which I grew up in. What I was able to obtain in the short two weeks stay in rural Mumbai is that the majority are malnourished, either due to their diet or accessibility to food, leading to bone disorders like osteoporosis at a young age as well as other health issues. I also visited a

leprosy clinic where I got insights to the some of the achievements Mumbai (and India as a whole) has made to eradicate such diseases.

- **Analysis of Canopy Cover and Organic Carbon at Mount St. Helens Hummocks Ponds**

  *Eric De Start and* ***Voelker, Brandon***

  *Faculty Mentor: James Gawel*

  The Hummocks Ponds Complex at Mount St. Helens resulted a debris avalanche. This unique environment offers the opportunity to study the limnological aspects of newly formed ponds in a natural and protected environment. Organic carbon within sediment and pondside canopy cover were the basis for our investigation. Organic carbon and canopy cover were not strongly correlated with each other, however, evidence suggests that hydroperiod effects both canopy cover and carbon content. This could be due to the increased opportunity of growth for terrestrial plants. Further sampling of these ponds for organic carbon and more data from other ponds may help to corroborate these patterns.

- **Blooms & Plumes: Obtaining Estuarine Water Characteristics from Highly Oblique Aerial Imagery**

  ***Brandon Voekler*** *and Tracie Barry*

  *Capstone Advisor: Cheryl Greengrove*

  Harmful algal bloom (HAB) events and associated eutrophication have been increasing in duration and frequency in recent years. Satellite detection has increased the ability to monitor and predict HABs, however accuracy within estuaries is limited due to optical complexity. Frame camera imagery taken at low altitudes may overcome this obstacle, allowing managers to expand aerial observation capacities. Utilizing Washington State Department of Ecology (WA DOE) Eyes over Puget Sound (EOPS) Monitoring Program imagery, this study attempted to rectify highly oblique imagery and obtain estuarine water characteristics including the spatial distribution of algal blooms utilizing two methods. Method one included MATLAB homographic angle correction, georeferencing and manual digitization. Method two utilized Geographic Information Systems (GIS) software to rectify and georeference images, and algal bloom and sediment plume coverage was identified through support vector machine image classification. Both methods successfully transformed highly oblique aerial imagery into usable spatial data for future comparison with the spatial distribution of eutrophication factors to aid in monitoring and early detection of HABs and eutrophication events. This project illustrates additional value of incorporating photographic surveys into monitoring efforts and demonstrates the integration of highly oblique frame camera imagery into estuarine research.

- **Mapping the susceptibility of alders to Phytophthora alni in Western Washington**

*Brandon Voelker*

*Capstone Advisor: Matt Kelley*

Phytophthora alni is a species complex of pathogenic oomycetes (water molds) that can cause lethal disease in alder trees, Alnus. In Europe, it has been devastating stands of alder since the 1990s. One subspecies, Phytophthora alni subsp. uniformis, has already been found in the wild in Alaska and Oregon, but not in Washington State. Recently, it has been detected in potted alders in nurseries in Pierce County. It is currently unknown whether it is in the wild in Washington, either naturally or through introduction from nursery plants. To begin efforts to detect Phytophthora alni in Washington State, a risk assessment map will be created using Geographic Information System (GIS) techniques. The spatial analysis will involve examining the environmental factors that increase infection susceptibility, such as slope, soil grain size, and flooding, and correlating with the distribution of alders. Important data that could be revealed are where high risk areas are located and what types of land cover are correlated with risk. A web map will be published online to aid detection efforts. The risk assessment will provide a starting point for choosing sampling sites, which is the next step in detecting the existence of P. alni. Additionally, the final analysis will inform forest management practices, as the highest risk areas could be inspected for symptomatic alders and mitigation measures could be enacted if any are found. The assessment could also have implications for restoration sites where native trees such as alder are planted from nursery stock.

- **Using Stratigraphic Diatom Deposits as a Proxy of Present-day Lake Productivity**

*Klevemann, Caroline, Francesca Marvin, Grace McKenney, Kavi Rana, and* ***Erica Webb***

*Faculty Mentor: Jim Gawel*

The purpose of this study was to use diatomic taxa abundance and organic carbon as indicators of productivity over time in ponds within the Hummocks Pond Complex, which was created in the 1980 eruption of Mount St. Helens. Sediment core samples were taken from two separate ponds and were analyzed for both diatom taxa abundance and organic carbon percentage. Through TSI calculations the trophic status for two specific ponds, H-16 and H-10, were found to be eutrophic and meso-eutrophic, respectively. Using araphid diatom percent abundance as a proxy for pond productivity over time within sediments, H-16 showed a decrease in diatom deposits, however, H-10 showed a consistent percentage abundance of araphid diatoms. Overall, this may indicate that H-16 became more eutrophic over time, whilst H-10 has stayed more mesotrophic since they were created 39 years ago. The organic carbon percentages validate this idea through their steady decrease going back in time for both ponds. Using TSI calculations, diatom taxa abundance, and the organic carbon measurements, we determined the trophic status

and productivity in these two ponds. This is important to geologists and ecologists as ongoing studies analyze how succession occurs in freshwater ecosystems following volcanic eruptions in the Pacific Northwest. Future research on these ponds will determine if these productivity trends continue or change over time, and can explore how this will affect the greater Mount St. Helens ecosystem.

- **Three-dimensional Analysis Indicates Percentage of Spinule-Bearing Presynaptic Cortical Terminals May Increase Dramatically Following Visual Training**

  *Chris Yuen*

  *Faculty Mentor: Jim Gawel*

  Spinules are protrusions into presynaptic terminals and may represent a common component of neuronal synapses. Spinules may act as specialized structures that mediate neuronal communication, plasticity, and/or maintenance of synaptic strength. While percentages of spinule projections are known for some areas of the brain, the percentages of cortical presynaptic terminals that envelop these structures is unclear. Understanding the percentage of these spinule-bearing terminals and their origins would provide insight about their importance and potential function. Hence, the goal of this study was to determine the percentage of spinule-bearing excitatory terminals and to identify the origin of these spinules. We analyzed published 3D transmission electron microscopy image stacks of the primary visual cortex (V1) from one untrained mouse and compared our data to a similar analysis of a V1 image stack from a visually trained mouse. Whereas our analysis revealed that ~26.2% of terminals contained a spinule, in the trained mouse ~62.7% of terminals contained a spinule. Interestingly, the majority of spinules within spinule-bearing terminals from both the trained and untrained mouse originated from adjacent axons and postsynaptic spines. Therefore spinule function likely involves interaxonal and presynaptic to postsynaptic dynamics. Overall, the proportion of spinule-bearing terminals in V1 of the trained mouse was ~2.4-fold greater than that in the untrained mouse. Since training paradigms are known to strengthen underlying neuronal synapses, the observed increase in Spinule bearing terminals in the trained mouse may reflect a direct effect of training.