

Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

Balcony, Easel 121

11:00 AM to 1:00 PM

Microbial Respiratory Processes in the Oxygen Deficient Zone of the Eastern Tropical North Pacific Determined Using Targeted Proteomics

Jamee Christensen (Jamee) Adams, Senior, Oceanography

Mentor: Rick Keil, Oceanography

The majority of the ocean contains sufficient oxygen to support aerobic respiration, however some locations are oxygen-stressed. When oxygen concentrations fall to undetectable levels, microorganisms turn to alternative electron acceptors such as nitrogen and sulfur during respiration. Regions of the ocean where this occurs are called Oxygen Deficient Zones (ODZ). ODZs are growing in size due to anthropogenic climate change, and understanding how they operate is important for predicting how the ocean may change in the future. Bacteria play a pivotal role in cycling nutrients through such anaerobic pathways as denitrification, and the sulfur cycle, as well as through the chemoautotrophic process, anammox, which is an important component of the energy web in ODZs. Bacterial enzyme abundances are a good representation for how much of each process may be occurring in low oxygen environments. Specific enzymes are known to be involved in key energy transfer reactions during each of these processes, and peptides within these enzymes can be detected using targeted proteomics. The hypothesis of this research is that there will be vertical zonation between denitrification, anammox, and sulfur cycling within the oxygen deficient waters of the Eastern Tropical North Pacific (ETNP). During this research, bacterial samples from the ETNP, off the coast of Manzanillo, Colima, Mexico, were collected using McLane *in situ* pumps from December 29th, 2016 to January 15th, 2017 aboard the R/V Sikuliaq. Targeted proteomics were applied to six samples from different depths using a list of predetermined peptides involved in denitrification, anammox, and sulfur cycling in order to assess relative enzyme abundance in each sample. Successful completion of sample analysis resulted in a vertical zonation of denitrification, anammox, and sulfur cycling with relative abundance included across the depth profile.

SESSION 1B

TECHNIQUES FOR IMPROVING QUALITY OF MEDICAL CARE

Session Moderator: Eric Seibel, Mechanical Engineering
MGH 228

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Decision Regret in Patients with Durable Ventricular Assist Devices

Cole Evans (Cole) Hansell, Senior, Biology (Physiology)

Undergraduate Research Conference Travel Awardee

Mentor: Stephanie Cooper, Medicine/Cardiology

Mentor: James Kirkpatrick, cardiology, ethics

Patients undergoing ventricular assist device (VAD) therapy are by definition very sick and typically told that they have a high likelihood of dying in the next year without VAD therapy. Though most patients have improved functional status and quality of life, repeated hospitalizations and potentially catastrophic complications post implant can be burdensome. The research aims to assess for decisional regret or ambivalence about VAD implant. During a 3 year program all post VAD implant patients were referred to palliative care. Patients were administered a 5 question decision regret survey that correlates well with decision satisfaction and decisional conflict. On a scale of 0-100, scores >25 were considered to reflect significant ambivalence, and scores between 10-25 were defined as mild ambivalence. Patients were also administered the PHQ-9, a tool for depression inventory. The results found that 102/129 (79%) patients completed decision regret surveys. 64/102 (63%) scored 0, 7/102 (7%) scored >25, and 29/102 (28%) scored between 10-25. The average age of the patients scoring >25 was 44, compared to 55 of the whole cohort. Of those that expressed some degree of ambivalence (n=36), 11/36 (31%) met criteria for at least moderate depression, compared with 18% for the whole cohort. 26% of the total cohort had VADs as bridge to transplant (BTT), while 13/29 (44%) ambivalent patients and 4/7 (57%) very ambivalent patients were living with their VAD as BTT. A majority of patients do not regret their decision; however, a significant minority expressed mild ambivalence, and a small number expressed significant ambivalence. Ambivalence was more common in those who are younger, those with VAD as

BTT, and in patients with depression. It is important to recognize pre-implant that patients have different decision-making needs, and that managing their expectations may be a key component of helping them to adjust post VAD.

SESSION 1D

ECOLOGY AND EVOLUTION

Session Moderator: Bonnie Becker, Interdisciplinary Arts & Sciences (Tacoma Campus)

MGH 234

12:30 PM to 2:15 PM

* Note: Titles in order of presentation.

Influence of El Niño on Nutrients and Anaerobic Processes in the Eastern Tropical North Pacific

*Anna Cassandra (Anna) Bakker, Senior, Oceanography
Mary Gates Scholar*

Mentor: Rick Keil, Oceanography

Mentor: Jacob Cram, Oceanography

El Niño and La Niña are large-scale ocean-atmosphere phenomena that originate in the equatorial Pacific Ocean and last on scales of months to years. In addition to driving the global climate, the El Niño-Southern Oscillation (ENSO) also influences local-scale activities such as oceanic nutrient concentrations and microbial processes. The location where ENSO temperature oscillations originates is upstream of the world's largest, naturally occurring oxygen deficient zone (ODZ), implying that ENSO temporal variations could impact ODZ dynamics. With very little to no oxygen in these waters, microbes use nitrogen species for anaerobic processes, denitrification and anaerobic ammonium oxidation (anammox), in lieu of oxygen. These microbial processes identify by their chemical markers: nitrate, nitrite, and ammonium. This project was to examine ENSO-driven changes in both the vertical extent of oxygen deficient waters and nutrient concentrations in the Eastern Tropical North Pacific (ETNP) off the coast of Manzanillo, Colima, Mexico. In addition to data from 1965, 1969, 1972, 1994, 2007 and 2012 to the ETNP, I collected seawater samples from December 2016 to January 2017 aboard the R/V Sikuliaq to compare oxygen and nutrient profiles over the past 50 years. I hypothesized that ENSO influences fluctuations in oxygen, nutrient, and microbial process regimes. Nutrient data was compared to the global ENSO and oceanographic state during the preceding and following years of each cruise to examine possible relationships between the variables. Rates of denitrification and anammox were also calculated to see if anaerobic processes also correspond with the ENSO cycle. This project provides insight on the microbial and oceanographic response to ENSO dynamics in an economically and ecologically critical part of the ocean. El Niño and La Niña are modules of

the global climate, which are becoming stronger and more frequent in response to anthropogenic climate forcing.

SESSION 2A

POWER MADE VISIBLE: IMAGE, IDENTITY, NARRATIVE ACTIVISM

Session Moderator: Julie Villegas, English

MGH 171

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Graffiti of Innocence in the Syrian Refugee Crisis: Use of Children to Manufacture an Alternative Image

Hannah Lehman, Senior, Art History, Politics and Government, University of Puget Sound

Mentor: Kriszta Kotsis, Art and Art History, University of Puget Sound

Mentor: Patrick O'Neil, University of Puget Sound

Amongst the graffiti blanketing the cities of Athens and Berlin, depictions of children stand out as a solemn reminder of the dire nature of the current refugee crisis in Europe. Due to the large number of refugees passing through, or settling, in various European states, governments have reduced individuals to statistics. This data-driven approach, focused on the number of people and the cost of providing basic resources, dominates the news and international discourse. Combating this statistical discussion, artists have created works that demonstrate the humanity of the crisis. Because paint and printers are easily accessible, street art portrays a broader public sentiment towards the crisis, countering the governmental narrative. This project examines graffiti in Athens and Berlin, and the insights it provides on the refugee crisis that cannot be derived from the official discourse. Using images of children, artists in both cities have manufactured an alternative narrative articulating the challenges facing the individuals involved in the crisis and highlighting their struggle in Europe. Because Athens and Berlin function as endpoints of the refugees' journey, as many enter through Greece before traveling northwest to Germany, a study of the graffiti responding to the migration in these cities is of particular importance. After collecting hundreds of images in-situ during July of 2016, using geo-tagged web-based content and information from locals on hubs of graffiti, several themes emerged, the most prevalent being representations of children. The lack of scholarship on graffiti pertaining to this refugee crisis necessitated the use of art historical images of children in conjunction with current graffiti scholarship to create a methodological framework. Employing the iconographic, semiotic and socio-economic methodologies, I conclude that the works promote the humanization of the crisis and force recognition of the refugees as individuals, thereby opposing the govern-

mental narrative.

SESSION 2B

CHEMISTRY, BIOCHEMISTRY, AND MATERIALS SCIENCE

*Session Moderator: Sharona Gordon, Physiology and
Biophysics*
MGH 228

3:30 PM to 5:15 PM

* Note: Titles in order of presentation.

Development of a Nanofiber Micronization Process for Water-Soluble Drug Delivery

Christina Nhan, Senior, Bioengineering

Mary Gates Scholar, NASA Space Grant Scholar

Mentor: Kim A. Woodrow, Bioengineering

Mentor: Rick Edmark, Bioengineering

Current approaches to deliver prophylactic drugs against HIV are ineffective for many reasons, including drug leakage, low drug loading, and lack of drug release tunability. To protect against HIV infection, a versatile prophylactic drug delivery platform that offers flexible dosing schedules would be an attractive and empowering option for many women. In the Woodrow Research Group, we have developed a fiber-in-fiber (FIF) drug delivery platform that addresses these requirements. The primary benefit of FIF is that it provides both immediate and prolonged drug release to protect against HIV acquisition. To fabricate the FIF platform, two nanofibers are used: a rapidly dissolving burst release fiber with encapsulated, slowly-degrading sustained release nanofibers. To preserve the release properties of the sustained release nanofibers and to ensure that they are of an imperceptible size to the user, we micronize the sustained release nanofiber in a blender. While this process is effective for water-insoluble drugs, water-soluble drugs like tenofovir leak out during micronization. Thus, improving the encapsulation of water-soluble drugs in the sustained release nanofiber component is needed to expand the functionality of FIF. I have developed a new strategy using dry micronization to improve the encapsulation of water-soluble drugs, allowing the FIF system to deliver diverse classes of drugs to protect against HIV acquisition. Retention of water-soluble drug drastically increased from 0% using previous strategies to 90% with dry micronization. Current experiments are assessing the drug release profiles of the dry micronized fibers compared to those intact nanofibers. SEM images of dry micronized fibers show that nanofiber architecture still exists, meaning that the benefits of nanofiber technology apply to dry micronized fibers. Therefore, dry micronized fibers have the potential to be their own drug delivery platform that can be delivered orally, intravenously, as well as intravaginally as a part of the FIF system.

POSTER SESSION 3

Commons West, Easel 6

2:30 PM to 4:00 PM

Communicating Across Borders in a World of Environmental Change

Tiffany Swaw, Senior, International Studies

Alex Hardison, Senior, International Studies

Nathan Aberg, Senior, International Studies

*Eve Ellen Rose Garrigan, Senior, International Studies, Law,
Societies, & Justice*

Mentor: Patrick Christie, JSIS and SMEA

For our Jackson School of International Studies capstone class, Task Force, we created a strategic communications plan tied with a digital story to create a social media campaign. The goal of this campaign is to communicate Tribal Treaty Rights between tribal and non-tribal millennials in the Puget Sound area. The Treaty Rights target issues in the Puget Sound caused by climate change, including decreasing salmon populations and managing non-tribal fishing rights around the region. Most millennials are unaware of these rights, or these issues in general, despite living in the Puget Sound. Our research, primarily self-hosted surveys and focus groups, show a trend in millennials to be sensitive to cultural diversity and climate change acceptance, making them a prime demographic for a marketing campaign. After data collection, we created social media groups, including Facebook, Instagram, and a digital story for potential use in the Tulalip Tribes website. We worked closely with the Tulalip Tribes in Marysville, and visited their location, supervised by Tulalip Tribes' Public Affairs Coordinator Francesca Hillery. UW campus resources will be invaluable in our pursuits; we will contact the school newspaper "The Daily", as well as collaborate with various departments, such as the Intellectual House, to spread awareness and to set up relevant lectures. Millennials are apt to be interested in this topic, therefore, one of our main campaign goals is to create the knowledge in the first place. If successful, our social media campaign will grow towards increasing implementation on campus and for the tribes themselves. Overall, this can lead to future, independent student involvement and efforts to make a change for themselves, for the tribes, and for all in the Salish Sea region.

POSTER SESSION 3

Balcony, Easel 86

2:30 PM to 4:00 PM

The Effects of Ocean Tides on Suspended Surface Sediments in the Amazon River Using Satellite Imaging and Ground Truth Sampling

Caitlin Fisher, Senior, Biology (Molecular, Cellular & Developmental), Oceanography

Mentor: Andrea Ogston, Oceanography

Mentor: Aaron Fricke, Oceanography

The Amazon tidal river consists of the lowermost 800 km of the Amazon River that is affected by tides. The effect of tides on surface suspended sediment concentration (SSC) in the Amazon has not yet been characterized, and may impact estimates of surface SSC as monitored through remote sensing. To assess potential tidal influence on surface SSC, water samples were collected and filtered in field; published remote sensing maps were also collected and compared to field measurements. Thus far, this project has identified discrepancies between *in situ* and remotely-sensed estimates of surface SSC, and constrained the influence of tides on the observed signals. *In situ* surface SSCs more accurately matched with remote sensing maps on sites located directly in the Amazon mainstem, while tributaries showed exaggerated differences in surface SSC. Field surface SSCs in the Amazon mainstem also did not vary significantly with tidal seasons, suggesting that ocean tides play a smaller role in surface sediment transport than originally hypothesized. Further conclusions will look into the role that tides play on total bedload, especially at sites close to the river mouth where tidal influence is strongest. Explanations for surface SSC discrepancies will also be included in the paper's conclusions; since many of the discrepancies occur in freshwater tributaries, the seasonality of phytoplankton blooms will be cross-linked to satellite SSCs. Finally, suggestions for future usage of remote sensing in strong tidal areas of the Amazon River will be given and the success rate/percentage of correlation of satellite surface SSC with field SSCs will be assessed. With a better understanding of the effects of tides on surface SSC and how well remote sensing captures variability, we can better monitor sediment discharge into the tropical Atlantic Ocean as well as sediment delivery to the floodplain of the Amazon River during seasonal floods.

POSTER SESSION 3

Balcony, Easel 100

2:30 PM to 4:00 PM

NDVI Imaging of Submerged Aquatic Vegetation

Carter Kraus, Junior, Aeronautics & Astronautics

Orion Mackenzie (Orion) Black Brown, Junior, Mechanical Engineering

Mentor: Rick Rupan, Oceanography

Mentor: Fritz Stahr

Chlorophyll concentration is an indicator of plant health, but is challenging to quantify. As a result, normalized differ-

ence vegetation index (NDVI) imaging was developed to help solve this problem by making use of chlorophyll's varying reflectance of light waves. This is a proven and powerful tool for observing terrestrial vegetation, allowing for efficient monitoring of living plant populations worldwide. However, no research had been published regarding the use of NDVI for submerged aquatic vegetation, thus our team sought to apply the technique to an aquatic environment, specifically seagrass beds in Queensland, Australia. Seagrass provides both nutrition and habitat for marine life, as well as carbon dioxide storage. The ability to monitor seagrass ecosystems is essential to understand and, in turn, preserve them. We saw NDVI imaging as a potential improvement to current seagrass monitoring methods and conducted experiments to find what issues this technique has in the underwater environment. After testing many aspects of NDVI imaging on in-situ seagrass beds and other test environments, we ultimately found it was not a viable option. This is largely due to basic optical transmission characteristics of water.

POSTER SESSION 4

Commons West, Easel 28

4:00 PM to 6:00 PM

Hyaluronic Acid Coated Polyblend Nanofibers for Promotion of Glioblastoma Migration

Jialu Sun, Senior, Mat Sci & Engr: Nanosci & Molecular Engr

Mary Gates Scholar, UW Honors Program

Mentor: Miqin Zhang, Materials Science & Engineering

Mentor: Ariane Erickson, Material Science and Engineering

Complications and mortality from glioblastoma multiforme (GBM) are often the result of tumor metastasis and thus, understanding the underlying mechanisms in glioma cell migration to help minimize tumor diffusion is of vital importance. Previously in our lab, aligned co-polymer blend chitosan-polycaprolactone (C-PCL) nanofibers have been shown to promote a migratory phenotype and an upregulation of invasion-related genes in GBM cells after 24 hours of culture. Here, we aim to further investigate the effects of nanofiber chemistry on the migratory and invasive character of GBM cells by coating C-PCL nanofibers with hyaluronic acid (HA), a major component of the brain extracellular matrix (ECM). Human U-87 MG GBM cells, a model glioma cell line, were used to study the GBM behavior on the nanofibers. Proliferation assays to determine the biocompatibility of the nanofiber platforms with and without HA were evaluated followed by cell morphology analysis to evaluate elongation and alignment. Overnight migration studies were conducted to determine if migration profiles on the nanofiber platforms were similar to those reported *in vivo*. Drug resistance and invasion-related genes were assessed to determine if culture on HA-coated C-PCL nanofibers could increase malignancy

in GBM. Finally, flow cytometry was used to pinpoint the population of cells expressing a more invasive phenotype and thus provide an idea if HA-coated C-PCL nanofibers were a suitable *in vitro* platform for developing high-throughput anti-invasion cancer therapies.

POSTER SESSION 4

Commons East, Easel 78

4:00 PM to 6:00 PM

The Accuracy of Dead Reckoning Method Used in Ecomapper Tracking

Jingyang Wu, Sophomore, Aeronautics & Astronautics

Mentor: Fritz Stahr

Mentor: Rick Rupan, Oceanography

Dead reckoning is the process of calculating one's current position by using a previously determined position, or fix, and advancing that position based upon known or estimated speeds over elapsed time. It is typically used when external systems, such as GPS satellites or acoustic tracking, are unavailable to track a vehicle relative to earth-fixed coordinates. When used on an autonomous underwater vehicle (AUV) it cannot account for the influence of tidal currents changing the vehicle's displacement without influencing internal speed and heading data. My research experiments with an Ecomapper AUV in Australia in September 2016 illustrate the influence of such tidal currents on dead-reckoning AUV tracks. The experiment was completed at the Morton Bay Research Center of Queensland University and the research data were collected by Ecomapper AUV from designed runs. As a result, the comparison of actual AUV track with the predicted one that was calculated by Matlab with the application of Dead reckoning method showed how much the tidal current influenced the predicted track, and how to reduce this difference by setting the AUV's heading with the tidal current in particular angles. The results are useful for planning new AUV missions in similar tidal currents for reducing position errors generated by this technique.

equator. We have used a simple energy balance model for investigating the orbital, atmospheric, and obliquity parameters that allow for the formation of permanent ice at the equator. We find there is a narrow range of semi-major axis and obliquity values that allow for such "ice-belts". First, we experimented with the range of stability of ice-belt formation by increasing the semi-major axis to the edge of the habitable zone, increasing CO₂ levels to counteract the decrease in solar flux. This led to a very small range of conditions that allow for stable ice-belts. To further investigate the cause of this, we decreased the luminosity of the host star while increasing CO₂ levels (to simulate the control temperatures). This stabilizes the otherwise unstable system, although the range of ice-belt formation is still narrow. Further, we find that this equatorial ice formation often leads to instability due to the ice-albedo feedback. This work suggests that it should not be common for Earth-like worlds at high obliquity to maintain large ice sheets.

POSTER SESSION 4

Commons West, Easel 36

4:00 PM to 6:00 PM

Ice Belt Formation on High Obliquity Planets

Caitlyn Wilhelm, Freshman, Pre-Sciences

Mentor: Russell Deitrick, Astronomy

Mentor: Rory Barnes, Astronomy

At low obliquity, planets like Earth will tend to form permanent ice sheets at the poles, if anywhere. However, at high obliquity, the poles receive more sunlight on average than the tropics, and so ice sheets might be expected to form at the