Abstracts

Alphabetical Order by Last Name

COUPLING UAS SURVEYS AND DEPTH MEASUREMENTS TO PREDICT EELGRASS COVER IN PADILLA BAY, WA

Jacqui Bergner*, Western Washington University, jacquelynbergner@gmail.com, **David Wallin**, Western Washington University

Two species are in majority at the Padilla Bay National Estuarine Research Reserve, *Zostera marina*, a native eelgrass, and *Zostera japonica*, a nonnative. Unoccupied Aerial Systems (UAS) have been used more frequently for eelgrass monitoring and mapping, especially for large populations like those in Padilla Bay. UAS imagery have resolutions of 10cm or lower and are much more cost and time effective than aerial surveys that provide similar image resolutions. In this project, multispectral UAS imagery was coupled with a centimeter level Digital Elevation Model, providing depth data, to predict *Z. marina* and *Z. japonica* cover. First, spectral data were used separately to assess the accuracy of eelgrass cover predictions using Random Forest (2,000 trees) classification. Then, spectral and depth data were combined to improve classification accuracy. Optimal imagery was captured when wind speeds were less than 5 m sec-1, sun angles were between 30-52°, tide stage was around -2.5ft, and there was 10% cloud cover. The DEM was created from Real Time Kinematic measurements via regression kriging, yielding a vertical error of 4.3cm. The overall accuracy predicting *Z. japonica* dominant, mixed, and *Z. marina* dominant cover was 71.3% using spectral data, while the accuracy raised to 89.6% when the depth and spectral data were combined. Although depth was a strong predictor for eelgrass cover, spectral data provided insight on seasonal changes among cover types.

Keywords: eelgrass, UAS, *Zostera marina*, *Zostera japonica*, estuary

EUROPEAN GREEN CRAB ZOEAE IDENTIFICATION: THE FIRST STEP IN DEVELOPING A LARVAL DETECTION AND RESEARCH NETWORK

Nicole Burnett*, Padilla Bay National Estuarine Research Reserve, nburnett@padillabay.gov, **Keiley Munsterman**, **Sylvia Yang**, Padilla Bay National Estuarine Research Reserve

European green crab (*Carcinus maenas)* is considered one of the world's worst marine invaders. Introduction to the inland waters of Washington has led to concerted efforts to trap and remove as many adults as possible, and much of the current research on *C. maenas* has focused on the adult stage of their life history. However, *C. maenas* disperses via planktonic larvae, and little is known about the ecology of the species' early life history stages. Such information could aid management of *C. maenas* at its invasion front. Thus, in this study, we sought to develop identification characteristics for *C. maenas* from its invaded range in WA and develop tools to distinguish *C. maenas* larvae from the larvae of native crab species. We successfully reared *C. maenas* larvae through the four zoeal stages to obtain voucher specimens and found that morphological characteristics of *C. maenas* in its invaded range are very similar to that of its native range. A defining characteristic of *C. maenas* zoeae from many regional species is the absence of lateral carapace spines and the identification resources we have created further describe characteristics differentiating *C. maenas* and regional crab zoeae. Given these new resources we hope to form a larvae detection and research network to begin understanding the planktonic stages of European green crab in Washington.

Keywords: *Carcinus maenas*, larvae, identification

USING BAITED REMOTE UNDERWATER VIDEO TO STUDY INTERACTIONS BETWEEN DUNGENESS AND EUROPEAN GREEN CRAB

Annie Cavanaugh*, Makah Tribe, annie.cavanugh@makah.com, **Cole Svec** Makah Tribe, cole.svec@makah.com, Adrianne Akmajian , Makah Tribe, marine.ecologist@makah.com

Dungeness crab (*Metacarcinus magister*) is a species harvested on the US West Coast in recreational, commercial, and tribal fisheries that retains economic and cultural importance, but their interactions with and impacts from invasive European green crab (*Carcinus maenas*; hereafter green crab) are not well understood. In the Wa'atch and Tsoo-Yess River estuaries on the Makah Reservation, subadult Dungeness crabs (40-130 mm) are regularly captured in traps used in green crab removal efforts. Multiple baited remote underwater video (BRUV) were deployed in the two estuaries to study interactions between Dungeness and green crab and evaluate several hypotheses. Individual green crab success at accessing bait, displacement from bait, and whether approach success is affected by the number, species, and size of other crabs nearby were evaluated. Direct interactions between the two species were also analyzed in order to assess whether interactions are primarily agonistic or passive and whether one species tends to be dominant. These evaluations will help us gain insight into how green crab are interacting with native species in the environment and to assess the direct impacts that green crab may have on Dungeness crab that are rearing in coastal estuaries.

Keywords: invasive species, green crab, behavioral interactions

MEASURING THE RATE OF DENITRIFICATION IN HOOD CANAL

Kal DeLong*, Western Washington University, delongk2@wwu.edu, **Riley Heath**, New Mexico Technology, riley.heath@student.nmt.edu, **Sam Kastner**,WWU Department of Environmental Sciences, kastnes@wwu.edu, **David Shull**, WWU Department of Environmental Sciences, shulld@wwu.edu

Denitrification is an important component of the nitrogen cycle and provides a sink for dissolved inorganic nitrogen (DIN). Model calculations predict that reductions in the anthropogenic supply of nitrogen to Hood Canal would reduce the extent and magnitude of bottom water hypoxia. But the rate of loss of nitrogen via denitrification in Hood Canal is unknown. To calculate the rate of denitrification in Hood Canal, water samples were collected at six different depths at four stations in Hood Canal. From these samples, we measured vertical profiles of N_2:Ar gas ratios by MIMS, and concentrations of ammonium, nitrate+nitrite and phosphate. We used the vertical profiles of N_2 gas concentrations and DIN and phosphate concentrations, along with estimates of vertical eddy diffusivity from a numerical model of circulation in Hood Canal to estimate the rate of denitrification. Hood Canal's denitrification rate was found to have an average close to 1 mmol m^{-2} d^{-1}, similar to estimates of denitrification in other coastal estuaries.

Keywords: denitrification, Hood Canal, hypoxia

PHYSIOLOGICAL FACTORS FOR OPTIMUM NATIVE AND NON NATIVE VEGETATIVE EELGRASS GROWTH IN SOUTH SLOUGH ESTUARY, OREGON

Sage A. Enright*, Western Washington University, enrighs2@wwu.edu, **Jillian R. Garsjo**, University of Oregon, jgarsjo@uoregon.edu

Eelgrass (*Zostera sp.*) is a genus of seagrasses found globally in gently sloping, near-shore, protected coastlines and estuaries (Reynolds, 2018). Eelgrass plays an important role in subtidal marine ecosystems by providing habitat and nurseries for invertebrates and fish. It provides food for endangered species and sequesters carbon (Anderson, 2020). In 1931-1933 eelgrass experienced greater than 90% die-off due to eelgrass wasting disease. More recently, prolonged high sea surface temperatures in the northeast Pacific Ocean from 2013-2016, known as

"The Blob", added new stress to the species (Magel et al., 2022). Understanding factors affecting eelgrass growth can help elucidate its path to recovery. This study analyzes vegetative growth progression of native (*Zostera marina*) and non-native (*Zostera japonica*) eelgrass species at seven locations along South Slough Estuary, Oregon, over the past 10 years using National Estuary Research Reserve Systems (NERRS) water quality monitoring station and field data. It relates growth to four physiological stressors that most affect eelgrass: temperature, salinity, sediment and turbidity. We found that estuary environments that are shallower, with warmer temperatures, lower salinity, and finer sediment accumulation (leading to more turbidity) show trends of lower eelgrass abundance. Based on measurements compared to theoretically optimum ranges for eelgrass growth, we conclude that the best habitat is located closer to the mouth of South Slough Estuary rather than inland; also that factors can combine as stressors when not in optimum ranges, and, with other stressors such as macroalgae, can be detrimental to eelgrass survival.

Keywords: Eelgrass, Estuary, Invasive Species

ASSESSING ESTUARY RESILIENCE TO SEA-LEVEL RISE: A COLLABORATIVE STUDY ACROSS COASTAL BC

Steven Henstra*, The Nature Trust of British Columbia, shenstra@naturetrust.bc.ca, **Thomas Reid**, West Coast Conservation Land Management Program

Estuaries and coastal wetlands comprise <3% of BC's coastal landscape, yet they provide critical habitat for many coastal fish and wildlife species. Considerable effort has been made to conserve and protect these unique ecosystems; however, they exist in a narrow band of elevation and may be vulnerable to climate change induced sea-level rise (SLR). As land managers and stewards, decision making and resource allocation needs to be informed by science to best direct management activities.
In 2019, The Nature Trust of British Columbia (NTBC), working with Coastal First Nations and our program partners, secured funding to implement a five-year project to assess estuary resilience to SLR at 15 sites across BC's coast, and to implement several major restoration projects to increase resilience where required.
To assess resilience to SLR, our team has implemented a robust suite of data collection to classify elevation distribution, quantify sediment accretion, and estimate site-specific SLR. These data are used to calculate quantitative metrics that can be viewed as a "stop light diagram" indicating relative vulnerability or resilience to SLR among sites, creating an effective means to communicate results and management outcomes.
The results will provide guidance on the type and priority of management actions to take on lands managed by the NTBC, Coastal First Nations, and our partners (e.g. conservation, restoration, or adjacent securement). The preliminary results of this study have already been used to inform the planning and implementation of ecological restoration projects at three of our study sites.

Keywords: Resilience; Restoration; Sea-Level Rise; Climate Change

WHAT COMES FIRST SEDIMENT REMEDIATION OR ECOSYSTEM RECOVERY? (HINT: THEY SHOULD GO HAND IN HAND!)

Robert K. Johnston*, Applied Ecological Solutions, rkj.johnston@gmail.com, **Jason P. Stutes**, Geoengineers Inc., jstutes@geoengineers.com

Cleanup at many contaminated sediment sites can be very costly, time consuming, and ineffective if larger scale pressures and ecological processes are not adequately addressed by the remedial design. Ideally, a holistic approach is desired for remedies that brings together remediation and reuse (restoration) by exploiting synergies that minimize costs and environmental impacts and achieves whole-system sustainability benefits. Sustainable remediation strategies should be informed not only by considerations of regulatory compliance but also by stakeholder goals, values and expectations. Over the last few decades, remedies selected at contaminated sediment sites have focused on mass removal or the reduction of exposure to sediment-associated contamination

to manage human health and ecological risks. At many contaminated sediment sites, assessing contaminant-focused remedy effectiveness measures has been confounded by the complexity of ecosystem processes, the lack of comprehensive monitoring data sets, and the need to align remediation objectives with ecosystem recovery goals. Additionally, sediments are linked to processes occurring within the watershed making them susceptible to, and potential drivers of, chemical, physical and biological stressors from larger scale social and economic pressures, climate change, and other disturbances associated with the Anthropocene. Drawing on the results of case studies, key concepts and lessons learned to better integrate sediment cleanup and ecosystem recovery goals are discussed and you are cordially invited to join the discussion.

Keywords: Ecological risk assessment, Sediment cleanup, Ecosystem Restoration, climate change

SEDIMENT DYNAMICS AS DRIVERS FOR ECOSYSTEM CHANGE

Molly Keogh, University of Oregon, mkeogh@uoregon.edu; **David Sutherland**, University of Oregon, dsuth@uoregon.edu; **Emily Eidam**, Oregon State University, Emily.Eidam@oregonstate.edu, **Tyler Souza**, UNC Chapel Hill, tsouza@unc.edu, **Jenni Schmitt**, South Slough National Estuarine Research Reserve, Jenni.Schmitt@dsl.oregon.gov, **Ali Helms**, South Slough National Estuarine Research Reserve, Alicia.R.Helms@dsl.oregon.gov, **David Ralston**, Woods Hole Oceanographic Institution, dralston@whoi.edu, **Jennifer Kirkland***, South Slough National Estuarine Research Reserve, Jennifer.Kirkland@dsl.oregon.gov

Like many US Pacific Northwest estuaries, the quality of tidal ecosystems in the Coos estuary in southern Oregon is highly dependent on both anthropogenic and climate-based factors. Since 2015, once-healthy eelgrass (*Zostera marina*) beds have collapsed, particularly in the mid and upper estuary where turbidity and temperature fluctuations are not buffered by stable ocean conditions. During this same time, restoration plots of Olympia oysters (*Ostrea lurida*), a native species once abundant in the Coos estuary, were buried in sediment and failed. Using a combination of field observations and hydrodynamic model results, we examined event- to seasonal-scale sediment dynamics in the Coos estuary. We found that during rainfall events, turbidity spikes are followed by up to 3 cm of mud deposition in the mid and upper estuary. Meanwhile, little or no deposition occurs in the lower estuary. After a storm, newly-deposited sediment is reworked on the scale of weeks to a month. The combination of rapid sedimentation and erosion creates dynamic conditions that are likely stressful to native bed-forming species. As climate change intensifies storms, event-driven spikes in turbidity, bed stress, and sediment deposition will increasingly strain these sensitive estuarine systems, perhaps pushing them to a point of irreversible change.

Keywords: sediment dynamics, climate change, eelgrass

EUROPEAN GREEN CRAB ON THE MAKAH RESERVATION

Dawson Little*, Makah Tribe, dawson.little@makah.com, **Adrianne Akmajian**, Makah Tribe, marine.ecologist@makah.com)

The European green crab (*Carcinus maenas*; hereafter green crab) is listed as one of the worst invasive marine species in the world as it has very few predators, reproduces quickly on a large scale, and can greatly damage local ecosystems and fisheries. First observed in Washington and British Columbia in the late 1990s, the green crab has spread to areas along the outer coast and within the Salish Sea becoming a large-scale concern. Makah Fisheries Management has continued to develop a trapping and monitoring program since green crab were first seen on the reservation in 2017 that seeks to help track and mitigate the spread of this invasive species. We have observed spatial and temporal patterns in the distribution of green crab and found evidence of multiple settlement events of juveniles in our region. As the invasion of green crab continues, it is pertinent to exchange information and ideas to better inform strategies to contribute to a more efficient invasion response.

Keywords: invasive species, green crab, mapping

A STATISTICAL REPRESENTATION OF OIL SPILL FATE IN THE SALISH SEA, USING DATA AND NUMERICAL MODELS

Rachael D. Mueller*, University of British Columbia, rmueller@eoas.ubc.ca, **Susan E. Allen**, University of British Columbia, **Ashutosh Bhudia**, University of British Columbia, **Stephanie Chang**, University of British Columbia, **Vy Do**, University of British Columbia, **Krista Forysinski**, University of British Columbia, **Casey Hilliard**, Dalhousie University, **Doug Latornell**, University of British Columbia, **Shihan Li**, Dalhousie University, **Ben Moore-Maley**, University of British Columbia, **Haibo Niu**, Dalhousie University, **Cam Power**, University of British Columbia

Oil spill response planning requires good information on the spatial distribution of the most likely oil spill scenarios in order to help bequeath to future generations a Salish Sea that is absent of oil spill impacts. We developed a data-informed modeling framework for generating statistical maps of oil spill fate in the Salish Sea to help provide this information. Oil spill location, month and volume are randomly generated from a year's worth of AIS ship track data that was organized into vessel time exposure maps for seven different vessel classifications. For oil cargo vessels, we use AIS ship tracks to create voyages that identify the ship's origin and destination and, where applicable, attribute oil type based on Washington State Department of Ecology oil transfer data. We randomly select a spill day, hour, and year between January 1, 2015 and December 31, 2018 to capture a wide range of spill conditions. Our 7-day spill scenarios use currents, winds, and waves that are predicted by the SalishSeaCast, HRDPS, and WW3 models, respectively. We generated 10,000 random oil spills with our Monte Carlo simulation and predicted oil dispersion, emulsification, dilution, biodegradation, beaching, and advection for these spills using a modified version of the MOHID oil spill model. In this poster, we will detail the design of the Monte Carlo simulation and present maps of the likelihood of oil presence on the water and beaches.

Keywords: oil spill fate, Salish Sea, models, AIS

UNCOVERING THE MOLECULAR MECHANISM OF FLOWERING IN *ZOSTERA MARINA*, A FOUNDATION INTERTIDAL SPECIES

Christine T. Nolan*, University of Washington, ctnolan@uw.edu, **Takato Imaizumi**, University of Washington, takato@uw.edu, **Jennifer Ruesink**, University of Washington, ruesink@uw.edu

Eelgrass (*Zostera marina*) is a foundation species in coastal ecosystems and is threatened by natural and anthropogenic pressures related to climate change. Eelgrass has two methods of propagation: clonal branching and sexual reproduction via flowering. Flowering and seed production in eelgrass is considered important for resilience and contributes broadly to genetic diversity. However, the molecular mechanism of flowering in eelgrass and the environmental factors contributing to flowering are so far unknown. Flowering and seed production in the model plant *Arabidopsis* is achieved by the expression of a specific flowering gene (florigen) which is highly conserved in flowering plants. We have identified several candidate florigen genes in *Z. marina*. In field studies, we observed differing expression levels of these florigen genes in flowering and vegetative tissues collected from populations in Willapa Bay, WA. We hypothesize that one or more of these genes can serve as a molecular marker for flowering, which can be used to predict how climate change will affect sexual reproduction. Improving our understanding of flowering in eelgrass will give insights into how populations will respond to climate change and help inform restoration and management strategy.

Keywords: Eelgrass, Restoration

MARINE CARBON DIOXIDE REMOVAL - WHAT WE NEED TO KNOW ABOUT THESE CLIMATE CHANGE MITIGATION TECHNOLOGIES

Liz Perotti, NOAA OAP, liz.perotti@noaa.gov, **Jessica Cross**, **Gabby Kirch**, **Libby Jewett**

Keywords: Climate Change, Technology

ESTABLISHING MICROBIOME BASELINES OF SEA STARS IN COASTAL BRITISH COLUMBIA WATERS

Carolyn Prentice*, Hakai Institute, carolyn.prentice@hakai.org, **Gillian Sadlier-Brown**, Hakai Institute, **Derek Van Maanen**, Hakai Institute, **Ondine Pontier**, Hakai Institute, **Krystal Bachen**, Hakai Institute, **Kelly Fretwell**, Hakai Institute, **Tyrel Froese**, Hakai Institute, **Kyle Hall**, Hakai Institute, **Zach Monteith**, Hakai Institute, **Angeleen Olson**, Hakai Institute, **Margot Hessing-Lewis**, Hakai Institute, **Alyssa-Lois Gehman**, Hakai Institute, **Colleen Kellogg**, Hakai Institute

On the Pacific coast of North America, populations of at least 20 asteroid species have been impacted by sea star wasting disease (SSWD). Environmental stressors, viral pathogens, and microbiome dysbiosis have all been suggested to play roles in the progression of SSWD but a consistent causative agent or suite of stressors has yet to be identified. While sea star microbiomes have been examined in laboratory settings, much work remains to be done to characterize the wild microbiome of Northeast Pacific sea star species. Here, we characterized the epidermal microbiome of six locally abundant sea star species with varying degrees of susceptibility to SSWD. Dermal swabs were collected from both intertidal and subtidal sites across space and time, and microbiomes were characterized using 16S rRNA gene sequencing. Preliminary observations show that the asteroid species examined here harbor distinct surface microbiomes, with varying relative abundances of the top 10 microbial taxa. Additionally, the microbiome of these sea star species appears to be plastic, changing seasonally. Healthy microbiomes appear to be different from those of individuals with SSWD symptoms, though more data within each sea star species is needed to further investigate these patterns. The existence of a core sea star microbiome remains to be determined but will be essential for establishing relationships between dysbiosis, the rise of opportunistic pathogens, and the etiology of SSWD.

Keywords: sea star; microbiome; 16S sequencing; wasting disease

RESILIENT COASTS FOR SALMON: EMPOWERING COMMUNITIES WITH NATURE-BASED SOLUTIONS TO ADAPT TO CLIMATE CHANGE

Kyla Sheehan*, Pacific Salmon Foundation, ksheehan@psf.ca, **Dr. Isobel Pearsall**, Pacific Salmon Foundation, **Dr. Nicole Christiansen**, Pacific Salmon Foundation, **Maria Catanzaro**, Pacific Salmon Foundation, **DG Blair**, Stewardship Centre for British Columbia, **Kelly Loch** - Stewardship Centre for British Columbia

A 5-year collaborative project led by the Pacific Salmon Foundation and the Stewardship Centre for BC, called Resilient Coasts for Salmon: Nature-based Solutions for Climate Change, is working to raise public awareness about climate change impacts including sea level rise in East Coast Vancouver Island communities, and empower citizens by providing nature-based solutions (NbS) that encourage resiliency for coastal communities and ecosystems.

We have created educational resources like our primer: Impacts of Climate Change on Shorelines, People, and Salmon: Nature-Based Approaches for Ecosystem Health to provide a background on the issues that our coasts are facing, and a Tool Kit of articles that help guide readers through what we can do about those impacts.

We are creating opportunities for communities to see NbS in action through three Green Shores® demonstration sites that are being developed in popular parks in collaboration with local municipal governments, First Nations, and stewardship groups.

Through a mapping initiative, which includes citizen science workshops and boat-based mapping, we are building a valuable dataset of the extent of coastal modification, such as seawalls, along our coastline.

To build capacity for adopting NbS, level 1 and level 2 Green Shores training is being offered free of charge to coastal geomorphologists, landscape architects, municipal and Indigenous government staff, and others who can bring these approaches to their community.

Keywords: climate adaptation, nature-based solutions, coastal education, climate change awareness, restoration

OLYMPIA OYSTER RESTORATION: SURVIVAL AND GROWTH DIFFER BETWEEN CULTURE METHODS IN PADILLA BAY

Cameron Sokoloski*, Padilla Bay NERR, WA Dept of Ecology Washington Conservation Corps, csok461@ecy.wa.gov, **Sylvia Yang**, Padilla Bay NERR, syang@padillabay.gov, **Roger Fuller**, Padilla Bay NERR, rfuller@padillabay.gov, **Paul Dinnel**, Skagit County Marine Resources Committee, padinnel@aol.com

The native Olympia oyster, *Ostrea lurida*, has been reduced to about 1% of its historical population size due to overharvesting, habitat loss, and environmental degradation. Since 1999, restoration efforts within Salish Sea estuaries have had mixed success, and specific restoration methods have been recommended to increase survival under conditions of environmental stress or predation. In this study, we tested two methods for culturing *O. lurida* in Padilla Bay, WA. Specifically, we investigated how bag culture versus ground culture methods affected survival and size of *O. lurida* transplanted into tidal channels. We found that after ~3 summer months, bag culture plots had 1.3 times more live spat per shell than ground culture plots. However, live spat were 1.1 times larger in ground culture plots than bag culture plots. We did not observe any post-larval recruitment during this period. We observed very little predation by oyster drills and that ground culture plots were prone to sedimentation. These results suggest that over short time periods, both culture methods were effective at our test site; bag culture may help spat survive sedimentation, and ground culture may stimulate faster growth. Continued monitoring is necessary to observe whether the two culture methods lead to differential survival across seasons and years.

Keywords: Restoration, *Ostrea lurida,* techniques

IT DOESN'T STOP WHEN THE CONTAMINANTS ARE CLEANED UP: PUTTING HABITAT RESTORATION CONSIDERATIONS INTO ENVIRONMENTAL REMEDIAL PROJECT DESIGN; CASE STUDIES, SUCCESSES, AND LESSONS LEARNED

Jason Stutes PhD*, GeoEngineers, jstutes@geoengineers.com, **Emily Hurn**, GeoEngineers, **Jessica Blanchette**, Hailey Aldrich, **Mike Ehlebracht LHG**, Hailey Aldrich, **Hun Seak Park PhD**, WA Dept. of Ecology, **Iain Wingard**, GeoEngineers, **Fiona McNair**, GeoEngineers, **Lucy McInerney, P.E.**, WA Dept. of Ecology

Meaningful nearshore restoration opportunities in marine systems are often limited by availability of area that is not subject to anthropogenic limitations such as industrial development, habitat impediments such as shoreline armoring, or other degradation OR restoration activities are limited in what can be implemented (e.g. maintaining existing access, preserving shoreline views, maintaining necessary infrastructure, etc.). Environmental cleanup sites represent a unique opportunity where many of the restrictions associated with broad scale ecological restoration are removed and there is an opportunity to implement a "clean slate" approach to restoration design. Despite this potential, there is not a clear requirement to take this approach and there is often a disconnect between remediation goals and restoration of habitat function. Here we present a past and future project where restoration of habitat function was a clear project emphasis along with environmental cleanup goals. What worked and lessons learned from previous project actions along with current considerations for future projects should be incorporated into cleanup action plans moving forward.

Keywords: Remediation, Eelgrass, Forage Fish, Habitat Restoration

LEGACY AND EMERGING CONTAMINANTS IN SEAWEEDS OF INTEREST FOR WASHINGTON STATE AQUACULTURE DEVELOPMENT

Holly L. Suther*, Western Washington University, sutherh2@wwu.edu, **Dr. Ruth Sofield**, Western Washington

University, harperr3@wwu.edu, **Dr. Kathy Van Alstyne**, Western Washington University, kathyva@wwu.edu

Seaweeds are cultivated and harvested around the world for many uses including food, pharmaceuticals, cosmetics, and fuel. The seaweed aquaculture industry has been on the rise globally, and interest has been expressed in the United States in furthering the development of the industry. Because seaweeds can absorb contaminants into their tissues, an understanding of the risks to consumers is important for informing those consumers and maintaining public support for the industry. The goal of this project is to measure concentrations of legacy (PCBs, arsenic, cadmium, lead, and mercury) and emerging (per-and polyfluoroalkyl substances (PFAS)) contaminants in seaweeds that are currently or likely to be grown and harvested in Washington's (US) marine waters for consumption. The project is structured around better understanding the types of contaminants present in seaweeds of the Salish Sea and how they vary among species and over time. Water samples and blades of sugar kelp, *Saccharina latissima*, were collected from Blue Dot Sea Farm (US) during the growing season and post-harvest for analyses of metal content and PFAS. Additionally, five species of seaweed that are either wild-harvested or of interest to aquaculture were collected. These species include *Alaria marginata* (winged kelp), *Gracilaria sp.* (red spaghetti), *Nereocystis luetkeana* (bull kelp), *Palmaria palmata* (dulse), and *Ulva "lactuca"* (sea lettuce). Using ICP-MS and QTOS-MS, concentrations of metals (As, Cd, Pb, Hg), iAS, and PFAS compounds in seaweed tissue were measured, and the results from these preliminary analyses will be presented.

Keywords: Seaweed, Contaminants, Aquaculture

SELF-RECRUITMENT OF THE EUROPEAN GREEN CRAB TO OREGON ESTUARIES

Sylvia Behrens Yamada*, Oregon State University, yamadas@oregonstate.edu, **Shon Schooler**, South Slough National Estuarine Research Reserve, shon.schooler@state.or.us, **Andrea Randall**, jaoskemmer@centurylink.net, **Jennifer Fisher**, NOAA, jennifer.fisher@noaa.gov

European green crabs (*Carcinus maenas*) first arrived in Oregon estuaries during the 1990s. The mechanism for this range expansion was the transport of larvae from established populations in California in the north-flowing Davison Current. Between 1998 and 2015, recruitment of 0-Age crabs in the fall correlated well with surface ocean temperatures and the strength of the Davidson Current during the previous winter. This period was marked by sporadic recruitment, with many years of recruitment failure, suggesting that California was the primary source of larvae. After the 2015-2016 El Niño however, recruitment has been good every year, despite some cold winters. Since green crabs live up to 6 years, their abundance in Oregon estuaries increased to an average of ~7 crabs/trap/day with a maximum of ~30 crabs/trap/day. Size frequency distributions of young crabs after the 2015-2016 El Niño indicate the presence of more than one cohort. These patterns suggest that the breeding populations of green crabs in Oregon estuaries may now be abundant enough to be self-recruiting.

Keywords: invasive species, recruitment, ocean indicators

Poster Abstracts

SEASONAL VARIATION AND THRESHOLDS: RESPONSE OF EELGRASS (*ZOSTERA MARINA*) TO ELEVATED TEMPERATURES

Avia Breiter* (Western Washington University, Shannon Point Marine Center, breitea@wwu.edu) **Cameron Sokoloski** (Padilla Bay National Estuarine Research Reserve, csok461@ecy.wa.gov), **Sylvia Yang** (Padilla Bay National Estuarine Research Reserve, syang@padillabay.gov), **Jeff Gaeckle** (Washington State Department of Natural Resources, jeffrey.gaeckle@dnr.wa.gov)

Seawater temperatures across the Salish Sea vary spatiotemporally, and climate change models predict temperature increases will also vary across the region. In this study, we investigated the response of eelgrass (*Zostera marina*) to prolonged (≥1 year) exposure to two elevated temperatures. Eelgrass from four sites in

Washington, USA, were transplanted into flow-through seawater mesocosms and exposed to ambient and heated (+3°C or +5°C) seawater conditions. Over the course of each experiment, we measured shoot density, morphological traits, photosynthetic efficiency, growth, and wasting disease index. We found that effects of elevated temperature on eelgrass varied by season, donor site, and magnitude of temperature increase (+3°C or +5°C). In summer and fall for both experiments, plants in heated treatments had higher shoot densities and were taller, wider, and had more leaves. However, in winter and spring: shoot density, width, and number of leaves were lower in the +5°C treatment compared to ambient; these characteristics were similar between the +3°C and ambient treatments. These differences suggest that eelgrass response and temperature thresholds vary by season, and eelgrass from Washington State may be more vulnerable to elevated temperature in winter and spring. More research is needed to further explore recovery of eelgrass in heated treatments over successive seasons and potential effects of ecosystem wide changes related to increasing seawater temperatures.

KEYWORDS: Climate change, eelgrass, elevated seawater temperature

INFLUENCE OF A TIDE GATE ON WATER QUALITY AND EELGRASS RESILIENCE IN PADILLA BAY, WA

Alexis Jordan* (Shannon Point Marine Center, Western Washington University, jordan5@wwu.edu) **Heath Bohlmann** (Padilla Bay National Estuarine Research Reserve, hbohlmann@padillabay.gov), **Sylvia Yang** (Padilla Bay National Estuarine Research Reserve, syang@padillabay.gov), **David Shull** (Western Washington University, shulld@wwu.edu)

As tide gates control water flow, there is potential for water quality to be modified as freshwater pools behind a closed gate for hours at a time. In Padilla Bay, WA, tide gates regulate freshwater flowing into the estuary. This study investigated: (a) changes in water quality on both sides of the Joe Leary Slough tide gate, (b) if freshwater from the slough was detectable in the bay, and (c) if variation in eelgrass condition was evident alongside the presence of freshwater from the slough. To characterize variation in water quality, we collected water samples and deployed in situ monitoring instruments logging standard water quality metrics. To quantify eelgrass condition, we adapted established protocols to assess reproductive effort, epiphyte biomass, and wasting disease at two estuarine monitoring sites downstream of the mouth of the slough in the bay. We found that immediately near the tide gate, depth, salinity, turbidity, dissolved oxygen, and water temperature exhibited pulsing patterns that may be related to the opening and closing of the gate, which was also correlated with the diurnal cycle during the sampling period. Phosphate and ammonium concentrations were linked to salinity near the tide gate. Interestingly, the freshwater pulsing signal was not detected at the eelgrass monitoring sites. Wasting disease was low at both eelgrass sites; however, we found more flowering shoots and greater epiphyte biomass at the site closest to the mouth of the slough.