Pacific Estuarine Research Society

2012

Historic Depot Arts Building

611 R Avenue

Thank You

Shannon Point Marine Center for hosting the Social Thursday Night

Gere-a-Deli our caterer and facility for our banquet

City of Anacortes, Parks and Recreation for going out of their way to help us host the meeting.

The Planning committee

Gary Williams – Program Chair

Jeannie Gilbert - registrar, co-chair

Steve Sulkin co-chair

Jude Apple

PERS 35TH ANNUAL MEETING PROGRAM SCHEDULE

Thursday, 12 April 2012		
6:30 – 8:30 pm		**Opening Mixer & Registration - Shannon Point Marine Center**
Friday, 13, April 2012		**Science Sessions at the Historic Arts Building**
7:30 - 8:30		**Registration**
8:30 - 8:45		**PERS Welcome -** *Steve Rumrill, President*
8:45 - 9:00		**CERF Welcome -** *Mark Wolf-Armstrong, Executive Director*
9:00 - 9:15		**Program & Logistics –** *Gary Williams & Jeannie Gilbert*
9:15 -10:15		**Oral Session 1 - Mollusk Ecology/Biology**
9:15		**O1-1. Predicting domoic acid concentrations in Hood Canal and Washington outer coast intertidal bivalves using integrated oceanographic and food web models.** *Eva Dusek-Jennings* and Charles Simenstad, University of Washington.*
9:30		**O1-2. Physiological and feeding adaptations of the invasive purple varnish clam, *Nuttallia obscurata*.** *Leesa Sorber* and Deborah Donovan, Western Washington University.*
9:45		**O1-3. Population recovery, habitat enhancement, and reproductive ecology of Olympia oysters in Coos Bay, Oregon.** *Steve Rumrill* and Scott Groth, Oregon Department of Fish and Wildlife.*
10:00		**O1-4. The effects of tidal height and immersion time on predator-induced shell plasticity in three members of the genus *Nucella.*** *Caitlin O'Brien, Western Washington University.*
10:15		**O1-5. Key habitat factors structuring clam communities in Tillamook Bay, Oregon, USA.** *Anthony F. D'Andrea, Stacy Galleher*,Eva Riedlecker, Kelsey Adkisson, Natalie Amoroso, and Jennifer Boyer, Oregon Department of Fish and Wildlife.*
10:30 - 11:15		***Coffee Break & Poster Session I***
11:15-11.45		**Oral Session 2 – Benthic & Algal Processes**
11:15		**O2-1. Rocky intertidal benthos in Iniskin/Iliamna Bay: a 33-year baseline and hints of climate change?** *Jon Houghton, Jason Stutes*, Adrienne Stutes*Pentec Environmental/Hart Crowser, Inc.; Dennis Lees, Littoral Environmental and Ecological Services; Sandra Lindstrom, University of British Columbia.*
11:30		**O2-2. Don't judge an alga by its morphology: biochemical and ecological differences between two ulvoid algal species.** *Kathy Van Alstyne*, Sue-Ann Gifford, and Monica Moritsch, Western Washington University.*
11:45		**O2-3. You are what you eat? Testing assumptions in isotopically-based food web models.** *Beth Sosik* and Charles Simenstad, University of Washington.*
12:00 - 1:30		Lunch

PERS 35TH ANNUAL MEETING PROGRAM SCHEDULE (cont'd.)

1:30 - 2:15		**Oral Session 3 – Climate Change**
1:30		**O3-1. Marsh accretion in Oregon estuaries using the marker horizon method and implications of sea level rise.** *Chris Mochon Collura* and Cheryl Brown,ad Rachel King, US Environmental Protection Agency.*
1:45		**O3-2. Consequences of increased temperature and ocean acidity on heterotrophic bacterioplankton composition and metabolism.** *Nam Siu*, Jude Apple, and C.L. Moyer, Western Washington University*
2:00		**O3-3.. Spatial patterns of composition in tidal wetland plant and algal assemblages in Oregon: implications for wetland vulnerability to future sea-level rise.** *Christopher Janousek, US Environmental Protection Agency.*
2:15 - 3:30		***Coffee Break and Poster Session II***
3:30 - 4:30		**Oral Session 4 - Vegetation Monitoring & Modeling**
3:30		**O4-1. Fidalgo Bay soft shore bank stabilization for forage fish habitat restoration and protection of cultural resources.** *Christine Woodward, Samish Indian Nation.*
3:45		**O4-2. Evaluating vegetation response to estuary restoration: Nisqually River delta case study.** *Lisa Belleveau*,Kelley Turner, and Isa Woo, US Geological Survey; Jesse Barham and Jean Takekawa, US Fish and Wildlife Service; Christopher Ellings, Nisqually Indian Tribe; Gerardo Chin-Leo, The Evergreen State College.*
4:00		**O4-3. Tidalmarshmonitoring.org - introducing an online monitoring handbook.** *Kelley Turner*,John Takekawa, and Isa Woo, US Geological Survey; Christopher Ellings, Nisqually Indian Tribe; Brian Root and Jean Takekawa, US Fish and Wildlife Service.*
4:15		**O4-4. Applying and testing a predictive vegetation model to management of the invasive cattail, *Typha angustifolia*, in an oligohaline tidal marsh reveals priority effects caused by non-stationarity.** *Gregory Hood, Skagit River System Cooperative.*
4:30 - 5:30		**PERS Business Meeting**
6:30 - 8:30 pm		**Banquet at Gere-A Deli** **Keynote Address: The engineer, Tinkerbell and dukwibəłš: historic and future transformations of the Puget Sound nearshore ecoscape.** *Charles "Si" Simenstad, University of Washington.*

PERS 35TH ANNUAL MEETING PROGRAM SCHEDULE (cont'd.)

Saturday, 14 April 2012		Science Sessions at the Historic Depot Arts Building (cont'd.)
8:15 - 8:30		**Welcome and Notices**
8:30 - 9:45		**Oral Session 5 - Sediment, Shorelines & Salmonids**
8:30		**O5-1. Assessing the effects of urban infrastructure on the nearshore foraging performance of juvenile Pacific salmon in Elliott Bay, Washington.** *Stuart Munsch, University of Washington.*
8:45		**O5-2. Microtopography mediates competition between a native and an introduced seagrass.** *Michael Hannam* and Sandy Wyllie-Echeverria, University of Washington.*
9:00		**O5-3. Port Susan Bay restoration: developing a monitoring framework.** *Peter Markos*,Kelley Turner, and John Takekawa, US Geological Survey; Donald Crump and Roger Fuller, The Nature Conservancy..*
9:15		**O5-4. Restoration of private shorelands in the Salish Sea: results and lessons learned.** *Jim Brennan, Washington Sea Grant, University of Washington.*
9:30		**O5-5. Relationships between watershed alterations and sediment accretion rates in Willapa Bay, Washington and Yaquina Bay, Oregon.** *David Young*, Patrick Clinton, and Robert Ozretich, US Environmental Protection Agency.*
9:45 - 10:15		***Coffee Break & Poster Session III***
10:15 - 11:30		**Oral Session 6 - Estuarine Processes**
10:15		**O6-1. Carbon and nitrogen sequestration by eelgrass along an estuarine gradient.** *Jennifer Ruesink*, S.X. Yang, and A.C. Trimble, University of Washington.*
10:30		**O6-2. Mass-balance approach for assessing nitrate flux in tidal wetlands - lessons learned.** *Hilmar Stecher*,Cheryl Brown, James Kaldy, Theodore DeWitt, and Caitlin White, US Environmental Protection Agency.*
10:45		**O6-3. Inter-annual variation in eelgrass (*Zostera marina*) distribution and productivity on a large tidal flat in southern British Columbia.** *Cynthia Durance, Precision Identification.*
11:00		**O6-4. The value of peer-to-peer knowledge transfer for engaging Pacific Northwest Tribes in stem education and oceanographic studies and use of the NANOOS data visualization system for San Juan Island pelagic data.** *Jan Newton*, University of Washington; Jude Apple, Western Washington University and Northwest Indian College.*
11:15		**O6-5. Application of a landscape ecology approach to habitat banking in the Fraser River estuary, BC, Canada.** *Gary Williams*, GL Williams & Associates Ltd; Dan Buffett, Ducks Unlimited Canada.*

PERS 35TH ANNUAL MEETING PROGRAM SCHEDULE (cont'd.)

Saturday, 14 April 2012		Science Sessions at the Historic Depot Arts Building (cont'd.)
11:30 - 12:15		**Student Awards, Acknowledgements, & Closing Remarks**

Abstracts –Oral Talks

Evaluating vegetation response to estuary restoration: Nisqually River delta case study. *Lisa Belleveau*,Kelley Turner, and Isa Woo, US Geological Survey; Jesse Barham and Jean Takekawa, US Fish and Wildlife Service; Christopher Ellings, Nisqually Indian Tribe; Gerardo Chin-Leo, The Evergreen State College.*

The Nisqually River Delta is an estuary that has been modified by restricting tidal flow to reclaim lands for agriculture. Recently, the Nisqually National Wildlife Refuge, working in collaboration with the Nisqually Indian Tribe and Ducks Unlimited, restored a large amount of the tidal flows as part of the largest estuary tidal marsh restoration project in the Pacific Northwest. Early restoration monitoring focuses on vegetation, pore-water salinity, and RTK GPS elevation data collected throughout the Nisqually Delta in 2010. Additional parameters collected in point intercept and quadrat surveys include species composition, percent cover, stem density, and maximum height of each species. Analyses were conducted on nine dominant species exploring relationships between biological (species richness, percent cover, height, and density) and physical parameters (salinity and elevation). Overall, pore-water salinity and elevation both appeared to have a positive influence on the salt marsh vegetation species studied. These species can tolerate high salinities, but submergence time (i.e. elevation) may be the limiting factor explaining differences in growth and distribution. Sedimentation, subsidence related to past diking and drainage, and sea-level rise are other processes that drive elevation changes and influence vegetation colonization. Long-term monitoring of sedimentation, elevation, and vegetation surveys will help to identify variation in colonization. Monitoring in the Nisqually Delta provides baseline data to increase our understanding of these complex ecosystems that is essential for supporting adaptive management.

Restoration of private shorelands in the Salish Sea: results and lessons learned. *Jim Brennan, Washington Sea Grant, University of Washington.*

Shorelines throughout the Salish Sea have been subjected to a variety of development pressures, and most have been altered from their historic conditions. With approximately 90 percent of Puget Sound shorelands designated for residential development, the types and extent of development that have occurred, and continue to occur, have a significant effect on the health and integrity of nearshore marine habitats. Shoreline armor and alterations of riparian areas have been identified as two of the major modifications, which result in the loss and degradation of nearshore habitats. This presentation will provide an overview of the process, players, challenges, and lessons learned from the design and implementation of a nearshore restoration project on privately owned, residential property in Port Madison, Bainbridge Island, Washington. Once completed (2012), the proposed restoration will result in a return of the natural character and ecological attributes of the shoreline to allow for natural nearshore processes, enhanced habitat functions and values, and provide for a more resilient shoreline. This project will also serve as a good demonstration of how such actions may be taken on privately owned shorelands.

Inter-annual variation in eelgrass (*Zostera marina*) distribution and productivity on a large tidal flat in southern British Columbia. *Cynthia Durance, Precision Identification.*

The effects of climate change and other anthropogenic stressors on eelgrass can not be accurately assessed without an understanding of the natural variability within these habitats.
Natural and anthropogenic factors have greatly modified the habitat within the study area over the past 40 years. A review of historical air photographs, orthophotographs, and satellite imagery estimated that the area colonized by *Z. marina* increased from 310 ha in 1967 to 724 ha in 2003. The section of the meadow that is located between two causeways was filmed (digital orthophotos) and ground-truthed in 2003 and annually between 2007 and 2011 to assess inter-annual changes in distribution. The short and long term changes and the various factors that may have contributed to these changes will be discussed. The inter-annual productivity of *Z. marina* in the inter-causeway eelgrass meadow was estimated in 2003 and annually between 2007 and 2011 at four reference stations in the inter-causey and compared with data from two stations west of the causeways, and two stations in a meadow approximately 26 km to the southeast. Large variations in inter-annual productivity were detected at all sites and trends were generally consistent between locations. Research has shown that eelgrass productivity may be influenced by many large scale environmental factors and near shore oceanic conditions. The inter-annual variation in productivity at the study sites was compared with the Pacific Decadal Oscillation (PDO), sea surface temperature, and the onset of daytime spring low tides. The relationship between eelgrass productivity and these large scale physical influences will be discussed.

Predicting domoic acid concentrations in Hood Canal and Washington outer coast intertidal bivalves using integrated oceanographic and food web models. *Eva Dusek-Jennings* and Charles Simenstad, University of Washington.*

The cosmopolitan diatom genus *Pseudo-nitzschia* includes a number of species that are capable of producing the neurotoxin domoic acid (DA). When blooms of toxin-producing *Pseudo-nitzschia* are advected over intertidal shellfish beds, suspension-feeding bivalves feed on the diatom and bio-accumulate DA in their soft tissues. This results in a potential threat for humans, marine mammals, and sea birds that consume DA-tainted shellfish. On the outer coast of Washington state, DA has been responsible for numerous harvest closures for razor clams. In Puget Sound, however, only three harvest closures have occurred because of DA. This disparity raises the question: Why has *Pseudo-nitzschia* only caused three harvest closures in Puget Sound, while the coastal razor clam fishery has been plagued by frequent closures? Using integrated oceanographic and food web models, we explore some of the factors that affect DA concentrations in clams after a *Pseudo-nitzschia* bloom has already been established. Inputs to our models include: clam community composition and abundance, beach slope profiles, tidal advection, suspension-feeding rates, and domoic acid uptake and depuration rates. Preliminary data indicate that clam community composition and abundance, along with inter-species variability in domoic acid uptake and depuration rates, play major roles in regulating DA concentrations in clams, and thus affecting harvest closure regimes on the outer Washington coast and in Puget Sound.

Key habitat factors structuring clam communities in Tillamook Bay, Oregon, USA. *Anthony F. D'Andrea, Stacy Galleher*,Eva Riedlecker, Kelsey Adkisson, Natalie Amoroso, and Jennifer Boyer,Oregon Department of Fish and Wildlife.*

The Shellfish and Estuarine Habitat Assessment of Coastal Oregon (SEACOR) project conducted a comprehensive study of bay clam populations using a stratified-random design on major tide flats in Tillamook Bay, OR. On each flat, we collected clam population data along with habitat characteristics (tide flat, tidal strata, sediment type, and eelgrass *Zostera marina* parameters) to identify patterns in bay clam species composition, abundance, biomass, size, and spatial distribution. Standard parametric and non-parametric statistical analyses combined with non-metric multidimensional scaling and spatial analysis show that there are distinct differences in abundance and biomass between tide flats for the four most abundant species studied (*Clinocardium nuttallii*, *Tresus capax*, *Macoma nasuta*, *M. inquinata*). However, habitat characteristics such as eelgrass parameters (e.g. % cover, shoot density, presence) and sediment type were key environmental factors affecting bay clam species composition, abundance, and biomass on some flats. Several species (*C. nuttallii*, *T. capax*, *M. nasuta*) had significantly higher densities and biomass in eelgrass beds relative to unvegetated areas of the tideflats. Two species *(Leukoma staminea* and *Saxidomus giantea*) had significantly higher densities and biomass in cobble/gravel sediment than sand/mud habitat. These relationships highlight the need to better understand the interactions between bivalve populations and habitat characteristics in Pacific Northwest (PNW) estuaries.

Microtopography mediates competition between a native and an introduced seagrass. *Michael Hannam* and Sandy Wyllie-Echeverria, University of Washington.*

The Asian seagrass *Zostera japonica* was likely introduced to the Pacific Coast of North America near the beginning of the 20th century, and now ranges from British Columbia to Humboldt Bay, California. In its introduced range, *Z. japonica* sometimes co-occurs with native *Z. marina* in a patch mosaic in conjunction with intertidal microtopography. At such sites, *Z. marina* often inhabits depressions that retain water through a low tide, and *Z. japonica* often inhabits mounds that are fully exposed during low tides. Topographic surveys indicated that an index of topographic position is a significant predictor of species presence at one such site in Padilla Bay, WA. To elucidate the roles of abiotic limitations and biotic interactions in this pattern, we experimentally transplanted each species, in monospecific and mixed patches, to intertidal mounds and pools. *Z. japonica* shoot densities and standing crop were depressed in the presence of *Z. marina*, regardless of topographic position and *Z. marina* shoot densities and standing crop were depressed on mounds regardless of *Z. japonica* presence. In a second experiment, we transplanted *Z. marina* into a range of densities of *Z. japonica* on pools and in mounds. Again, *Z. marina* performance was consistently depressed on mounds, but no effect of *Z. japonica* density as detected in our analysis. These results suggest that the introduced *Z. japonica* is competitively excluded from pools and the native *Z. marina* is physiologically restricted from mounds.

Applying and testing a predictive vegetation model to management of the invasive cattail, *Typha angustifolia*, in an oligohaline tidal marsh reveals priority effects caused by non-stationarity. *Gregory Hood, Skagit River System Cooperative.*

Effective tidal marsh restoration requires predictive models that can serve as planning and design tools. To develop such a tool, a predictive model of oligohaline tidal marsh vegetation was developed from reference marshes in the Skagit Delta (Washington, USA) and applied to a 1.1-ha experimental treatment site. RTK-GPS was used to sample the reference marsh and develop probability curves for the elevational distributions of common marsh species. The probability curves were applied to a LIDAR-derived digital elevation model to generate maps predicting the probability of occurrence of each species within the treatment and control sites. The treatment and control sites, located within a recently restored area that had been diked but never completely drained, were covered by a mono-culture of non-native *Typha angustifolia* (narrow-leaf cattail) growing 40 to 60 cm lower in elevation than in the reference marsh. The *T. angustifolia* was mowed repeatedly in the treatment site to allow colonization by predicted native marsh species. Four years after mowing, *T. angustifolia* was replaced over much of the treatment site by native sedges, consistent with the predictive vegetation model; the control site remained covered by *T. angustifolia*. The mowing experiment confirmed that pre-emptive competition from *T. angustifolia* was preventing vegetation recovery in the restoration site following dike removal, and implied that some vegetation species may be refractory to environmental change, such as dike removal or sea-level rise, because of differences in recruitment and adult niches.

Spatial patterns of composition in tidal wetland plant and algal assemblages in Oregon: implications for wetland vulnerability to future sea-level rise. *Christopher Janousek, US Environmental Protection Agency.*

Plants and algae mediate important ecosystem processes in coastal marshes and swamps. These assemblages are structured in part by estuarine environmental gradients such as tidal elevation and salinity. Such gradients are likely to change with sea-level rise (SLR) due to global climate change. We used data from four Oregon estuaries to (1) quantify vascular plant and algal variation within and between estuaries, (2) determine the distribution of plants and algae along elevation and salinity gradients, and (3) assess potential vulnerabilities of wetland vegetation to SLR. We found that plant assemblages tended to vary more within individual estuaries than among them. Plant composition differed especially between low estuarine marsh and palustrine tidal marsh. Tidal elevation strongly affected macroalgal abundance, sediment chlorophyll a, plant composition, and plant diversity; salinity also appeared to structure wetland primary producers. Our preliminary findings suggest that SLR may shift wetlands to more algal-dominated habitats and reduce plant diversity absent sufficient accretion and/or lateral migration of intertidal habitat. If salinity intrusion accompanies SLR, wetland vegetation may be able to tolerate elevated salinity throughout much of the estuary, but species in fresher tidal wetlands may be negatively impacted.

Port Susan Bay restoration: developing a monitoring framework. *Peter Markos*,Kelley Turner, and John Takekawa, US Geological Survey; Donald Crump and Roger Fuller, The Nature Conservancy..*

The Port Susan Bay (PSB) region supports some of the finest estuarine habitats in Puget Sound that are critical to an array of wildlife species including raptors, shorebirds, snow geese, several species of salmon, other fishes, and clams. TNC is initiating a restoration project to restore and reconnect over 60 ha of diked uplands. In addition to restoring habitat, this project will improve connectivity between the Stillaguamish River and hundreds of hectares of tidal marshes in PSB, which will support the long-term vision of the PSB conservation program, which is to restore a functional estuarine ecosystem that is resilient to ongoing threats and adaptable to climate change. The restoration will contribute to the common vision of learning, improving, and sharing to advance the science of estuarine restoration within Puget Sound. The success of restoration actions in PSB depends on developing baseline information and conducting restoration monitoring to inform management decisions, examine restoration outcomes, and allow for adaptive management. We structured the monitoring of performance metrics in a stepwise fashion: the main drivers of the monitoring efforts are overarching restoration objectives, within each objective are detailed hypotheses, and specific predictive or conceptual models are identified. Using this structure, our monitoring framework integrates temporal and spatial scales of biological and physical processes such as hydrology and sediment regimes, channel and marsh topography, vegetation colonization, invertebrate abundances, bird abundance and behavior, and fish use. Here we present the history of the PSB restoration project, our monitoring framework, and our progress on collecting baseline data.

Marsh accretion in Oregon estuaries using the marker horizon method and implications of sea level rise. *Chris Mochon Collura* and Cheryl Brown, and Rachel King, US Environmental Protection Agency.*

Sea level rise and the ability of marshes to keep up with this rise have been extensively studied on the Atlantic and Gulf coasts of the US; however, there is limited information available for marshes in the Pacific Northwest. Our research focuses on measuring marsh sediment accretion using the feldspar clay marker horizon method along with marsh characteristics including plant species community, elevation, sediment carbon and nitrogen content, and bulk density. We have established 125 plots in eight Oregon estuaries from Tillamook to Coquille. On average, we measured accretion rates of 6.9 mm/yr (n = 44 cores, SD 4.59) for low marsh plots and 2.9 mm/yr (n = 21 cores, SD 2.04) for high marsh plots. Maximum accretion rates were measured at the lower end of low marsh habitat adjacent to tidal flats and tidal creeks. Our results suggest that low marsh habitat in Oregon estuaries may be able to keep pace with the current rate of sea level rise. We will also discuss the effects of recent winter storms on accretion rates.

Assessing the effects of urban infrastructure on the nearshore foraging performance of juvenile Pacific salmon in Elliott Bay, Washington. *Stuart Munsch, University of Washington.*

Conversion of natural ecosystems to industrial landscapes is a globally prevalent mode of habitat degradation that is concentrated in coastal areas where the majority of the increasing human population lives. Humans have physically altered coastlines to expand and sustain the residential, commercial, and tourist activities associated with these areas. Two ubiquitous forms of coastal urban infrastructure that alter shallow water habitat are (1) seawalls that modify the composition and slope of nearshore habitat and (2) overwater structures that shade the water below. Shoreline modifications potentially affect the ecology of juvenile Pacific salmon, which follow a “stay shallow” mandate and utilize shallow water estuarine habitat for foraging, predator refuge, salinity acclimatization, and migration. Shoreline armoring and overwater structures can decrease juvenile salmon prey density and diversity in epibenthic habitat. However, the majority of juvenile salmon foraging occurs in the water column above the substrate and the effects of shoreline modifications on depth-specific prey availability and juvenile salmon foraging performance are poorly understood. My M.S. research will elucidate juvenile salmon foraging behavior and depth-specific prey availability in habitats adjacent to seawalls, overwater structures, and unarmored reference shorelines in Elliott Bay, Washington to improve understanding of the effects of these shoreline modifications on juvenile salmon habitat quality. This research will likely provide functional information to the near-term assessment of the effects of the upcoming Elliott Bay Seawall reconstruction and possible implementations of associated juvenile salmon habitat enhancement.

The value of peer-to-peer knowledge transfer for engaging Pacific Northwest Tribes in stem education and oceanographic studies and use of the NANOOS data visualization system for San Juan Island pelagic data. *Jan Newton*, University of Washington; Jude Apple, Western Washington University and Northwest Indian College.*

Students from Native American tribes in the Pacific Northwest United States are under-represented in ocean studies despite tribes’ strong cultural ties to the sea for thousands of years. Tribes with lands bordering seawater and who currently use this environment are numerous in the Puget Sound region.

Yet entrainment of tribal students into ocean sciences higher education is lacking. Through efforts that span and integrate several programs, we have initiated several successful practices to understand and break through some of the barriers to improve this status. Some solutions are quite straightforward, but not obvious if Native American cultural awareness is not appreciated. One highly successful practice has been use of peer-to-peer knowledge transfer. We have also found that including sampling over the full spectrum of the pelagic ecosystem has been successful. Native American students and their communities are attracted to this work because the data are ecosystem inclusive (water to whales), the content is place-based, and the learning environment focuses on an experiential, student-led, inquiry-based approach – all of which resonate with the Native culture. The utility of this perspective as a contribution to STEM research is obvious. We seek to share our lessons learned with the ocean community to foster a wider and more diverse participation in ocean science. Additionally, the Northwest Association of Networked Ocean Observing Systems has developed a data visualization tool for marine water variables. As a pilot, NANOOS has made an integrated database holding not only oceanographic variables but also plankton, marine mammals, and seabird species, abundance and distribution.

The effects of tidal height and immersion time on predator-induced shell plasticity in three members of the genus *Nucella. Caitlin O'Brien, Western Washington University.*

Nucella lamellosa, *N. canaliculata* and *N. ostrina* are intertidal snails that are known to respond plastically to red rock crabs by thickening their shell lip and decreasing somatic growth. Each species' relative degree of response appears to mirror its relative height in the intertidal, with *N. lamellosa* (low and subtidal) showing the greatest response, *N. canaliculata* (mid intertidal) a median level and *N. ostrina* (high intertidal) the least. This pattern is thought to be driven by the relative risk of crab predation inherent to each tidal height: crabs actively seek immersed areas, increasing the predation risk of snails lower in the intertidal. I hypothesized that physical parameters associated with tidal height (immersion time), including temperature gradients, feeding opportunity and the frequency of predator cue detection, also affect the anti-predator response. I conducted an experiment measuring differences in the predator-induced responses of these three species maintained in four immersion times. *Nucella lamellosa* and *N. canaliculata* exhibited a strong gradient of increases in shell mass and length with increasing immersion time, and these increases were only slightly higher in the presence of predator cue, while *Nucella ostrina* exposed to crab cue ceased shell growth. Lip thickness responded plastically in *N. lamellosa*, while *N. canaliculata* thickened regardless of cue treatment, and *N. ostrina* thickened more in the absence of crab cue. Each species thickened most in the immersion treatment which most closely corresponded with its native tidal height. These findings offer insight into an important model system for the study of phenotypic plasticity.

Carbon and nitrogen sequestration by eelgrass along an estuarine gradient. *Jennifer Ruesink*, S.X. Yang, and A.C. Trimble, University of Washington.*

Because of high biological activity in estuaries, organisms both affect and are affected by their nutrient environment. The capacity of organisms to influence carbon and nitrogen has become particularly germane in light of estuarine acidification and eutrophication, respectively. In this study, we examined density, size, growth, and nutrient content of eelgrass *Zostera marina* at 8 sites along a salinity gradient (<20 - >30) in Willapa Bay, Washington. Density and size-corrected shoot growth were depressed at the up-estuary sites, possibly as a consequence of fine-grained, high organic sediment. Shoot size and branching showed unimodal relationships with largest size and lowest branching at intermediate sites. %C varied from 33% up-estuary to 30% near the ocean, whereas %N was more variable (1-3%) and was highest at both ends of the estuarine gradient. Overall estimated C and N uptake depended primarily on eelgrass density across sites, with individual-level traits modifying the relationship.

Population recovery, habitat enhancement, and reproductive ecology of Olympia oysters in Coos Bay, Oregon. *Steve Rumrill* and Scott Groth, Oregon Department of Fish and Wildlife.*

Olympia oysters (*Ostrea lurida*) became locally extinct in Coos Bay (OR) prior to written history in response to a combination of coastal fires, sedimentation, burial, and perhaps a large-scale tsunami. Individuals of *O. lurida* were returned to Coos Bay in the 1950's when they were inadvertently re-introduced as hitch-hikers during commercial mariculture of Pacific oysters (*Crassostrea gigas*), and the population was re-established by the late 1980's. However, it is likely that basin-wide re-colonization of *O. lurida* has been hampered by several limiting factors including habitat loss and alteration, dredging, decreased availability of shell substrata, diminished recruitment, predation, competition, and ecological interactions with native and non-native species. Recent efforts have been initiated to re-establish and enhance populations at several sites in Coos Bay, and local actions have included deployment of larval collector bags, import of Olympia oyster spat, placement of *C. gigas* shell-and-rock rubble, and experimental development of modular OLY-ROCS (cement paving stones with *O. lurida* shell fragments). New research has been initiated to investigate the reproductive biology and ecology of local Olympia oysters as factors that regulate population recovery. The Olympia Oyster Recovery Advisory Committee was established to provide stakeholder input into three research projects undertaken by graduate students, and the findings will be incorporated into development of an Olympia Oyster Conservation and Recovery Strategy for Coos Bay. The conservation strategy will focus on the steps that can be taken to facilitate further recovery of *O. lurida* throughout the polyhaline region of the estuary, and identify gaps for additional research.

The engineer, Tinkerbell and dukwibəłš: historic and future transformations of the Puget Sound nearshore ecoscape. *Charles "Si" Simenstad, University of Washington.*

Since the 1850's, industrial and suburban transformations of the Puget Sound shoreline have altered the structure, and consequently the ecosystem processes and functions of its ~4,000km of beaches, embayments, estuaries and deltas. As captured in recent explorations of the essence and ethics of place, spatially-explicit analysis of these transformations has enlightens us about the enormity of change, but also of the ecological consequences. Initial transformations in the Progressive Era, encompassing massive technocratic engineering, resulted in acute changes to the 'ecoscapes' of the Sound's large river deltas and other estuaries, but even transition to more socially and governmentally engineering has not halted chronic degradation of all nearshore ecosystems, their processes and functions. One of the more comprehensive of these recent analyses, the Puget Sound Nearshore Ecosystem Restoration Project's (PSNERP) Change Analysis, quantifies nearshore transformations along the Sound's entire shoreline at four scales: (1) change and transition of 'shoreforms'; (2) structural alterations to the shoreline; (2) changes to adjacent uplands; and, (4) watershed area changes. While such a historic analysis is inherently confined to physical changes that can be documented between 1850's and early 2000's, their inferred impact to ecosystem processes is demoralizing, to say the least. While the magnitude of the Sound's nearshore transformation varies across the seven, diverse sub-basins, it is readily evident that ecosystem goods and services are cumulatively degraded. Because there is no Tinkerbell, to transport us to "Neverland", we will need to evoke our own Dukwibəłš, the Transformer, to address the challenge of strategic rehabilitation and restoration.

Consequences of increased temperature and ocean acidity on heterotrophic bacterioplankton composition and metabolism. *Nam Siu*, Jude Apple, and C.L. Moyer, Western Washington University.*

Our oceans have absorbed approximately one third of all anthropogenic CO_2 released into the atmosphere, causing seawater to become acidified. By 2100, average sea surface temperatures are expected to increase 4°C, and atmospheric CO_2 concentrations are predicted to triple. These compounding effects will undoubtedly have significant consequences for biological processes in the oceans. Heterotrophic bacterioplankton play an important role in the marine carbon cycle and the oceans' ability to sequester CO_2. There is however limited research on how these important microorganisms will respond to the predicted increases in temperature and ocean acidity. We investigated the consequences of elevated temperature and decreased pH on heterotrophic bacterioplankton composition and metabolism; utilizing manipulative experiments. Terminal-restriction fragment length polymorphism (T-RFLP) found shifts in the community structure of manipulated microbes, and indicated that changes in pH had the greatest effects on these communities. Although experiments on the metabolic response of these communities are still ongoing, the observed shifts in microbial community structure strongly suggest that their overall metabolism would be also affected. This study provides a foundation for future work in this relatively unexplored area of oceanographic and climate research, and will help predict the response of microbial communities to the changing oceans and the implications with respect to microbially-mediated biological processes in those oceans.

Physiological and feeding adaptations of the invasive purple varnish clam, *Nuttallia obscurata*. *Leesa Sorber* and Deborah Donovan, Western Washington University.*

The invasive Purple Varnish Clam (*Nuttallia obscurata*) has steadily increased its range in the Pacific Northwest since its introduction in the late 1980s. *N. obscurata* has the ability to maintain populations in the high intertidal zone where it is subjected to a wide range of environmental conditions such as salinity fluctuations and limited food availability. *N. obscurata* may be successful in the high intertidal due to two methods of feeding; filter and pedal that allow them to collect food regardless of water coverage. I compared the gill-to-palp mass-ratio of *N. obscurata* collected from the mid and high intertidal zones using common dry mass techniques. This allowed me to determine if there was an increase in the ratio of the foraging apparatus due to increased collection of sediment at the higher zones during exposure.
N. obscurata also have a wide tolerance for salinity differences, which are metabolically stressful to organisms in the high intertidal zone. I conducted experiments on the oxygen consumption of excised gill tissue from *N. obscurata* and *P. staminea*. The rate of oxygen consumption was acutely tested in salinities ranging from 5 to 55 ppt. A comparison between the mass-specific metabolic rates of both organisms was compared to determine if *N. obscurata* is better able to deal physiologically with environmental fluctuations. The outcome of these investigations will help to further the understanding *N. obscurata* ability to adapt to the environmentally diverse high intertidal zone and perhaps lead to ways to manage their populations in the Pacific Northwest.

You are what you eat? Testing assumptions in isotopically-based food web models. *Beth Sosik* and Charles Simenstad, University of Washington.*

Multiple stable isotope (MSI) analyses are increasingly popular techniques in the ecologist's toolbox. By harnessing the unique properties of certain isotopes, researchers have developed novel methods to approach otherwise difficult-to-answer inquiries such as ecosystem connectivity. Using MSI analyses, we are investigating the contribution of detrital macroalgae to subtidal benthic food webs. Our isotope data will be used as inputs in a multivariate model to determine the extent to which primary consumers may rely on this organic matter subsidy from shallow, photic ecosystems. However, any conclusions drawn from these results are only as good as the assumptions upon which these food web models are based. I am currently conducting a series of experiments to evaluate the assumption that no biogeochemical changes that could significantly affect our isotope values will occur as macroalgae drift into the aphotic zone and decompose. Specifically, I seek to know: 1) if the isotopic value of drift kelp changes over the course of decomposition; 2) if there is a microbial loop component that must be included in the model as a potential organic matter source or intermediary; and, 3) if these factors significantly alter the expected isotope values of the primary consumers that feed on detrital algae. Failure to account for potential biogeochemical changes caused by detrital decomposition in our data may confound our interpretation of the relative contributions of discrete organic matter sources. Isotopically-based techniques are powerful tools in food web ecology; however, they come with a suite of underlying assumptions that must be addressed.

Mass-balance approach for assessing nitrate flux in tidal wetlands - lessons learned. *Hilmar Stecher*,Cheryl Brown, James Kaldy, Theodore DeWitt, and Caitlin White, US Environmental Protection Agency.*

Field experiments were carried out in 2010 and 2011 to assess the nitrate balance in a small tidal slough located in the Yaquina Estuary, Oregon. In 2010 we used a whole-slough, mass-balance approach, while a smaller scale, flume-like experiment in a tidal channel with a dense *Zostera marina* bed was conducted in July 2011. Although experimental and environmental issues prevented calculation of unambiguous nitrate fluxes, this work yielded valuable insights into the complexity of such field studies and provided qualitative information on nutrient flow. For example, greater removal of nitrate, along with a significant rise in dissolved oxygen and pH, was observed during the day compared to night time during periods of similar flow. The relative merits of each approach are discussed, and this Pacific Northwest tidal wetland system is compared with East Coast marshes.

Tidalmarshmonitoring.org - introducing an online monitoring handbook. *Kelley Turner*,John Takekawa, and Isa Woo, US Geological Survey; Christopher Ellings, Nisqually Indian Tribe; Brian Root and Jean Takekawat, US Fish and Wildlife Service.*

A rapidly growing number of tidal marsh restoration projects are ongoing or in the planning stages throughout the Pacific Northwest. Pre- and post-restoration monitoring are critical components of any tidal marsh restoration project to assess project outcomes, evaluate whether objectives are being achieved, to support adaptive management decisions, and investigate the implications of climate change and sea level rise. In addition, a more standardized approach among restoration projects would be valuable so that project outcomes can be compared across the larger geographic scale. This project, funded by the National Wildlife Refuge System Pacific Region Inventory and Monitoring Program, is directed at providing an online monitoring handbook for tidal marsh restoration practitioners based on existing and past projects. It is meant to be a practical tool for those land managers and scientists "on the ground" conducting tidal marsh restoration monitoring. This website may be used as a guide for selection of appropriate monitoring methods to undertake sampling. Monitoring methods are grouped by three basic metrics: physical, biological, and ecological. Each monitoring group is further broken down into categories and provides information on several methods that can be chosen based on specific project goals and on-site conditions. Tidalmarshmonitoring.org will be a "living" document that incorporates improved and new methods as they are developed by the restoration science community.

Don’t judge an alga by its morphology: biochemical and ecological differences between two ulvoid algal species.
Kathy Van Alstyne, Sue-Ann Gifford, and Monica Moritsch, Western Washington University.*

Species of ulvoid macroalgae often have macroscopically similar morphologies and, as a result, are frequently lumped into an “ulvoid” guild during field surveys or for other work. These morphologically similar species of algae can have different biochemical characteristics, which may result in similar-looking algae having significantly different ecological impacts. For example, *Ulva lactuca* and *Ulvaria obscura* are difficult to distinguish in the field, but can have similar distributions and co-occur with one another. The two species differ in that *Ulvaria* has higher tissue nitrogen concentrations and produces large quantities of dopamine. *Ulva* does not produce measurable amounts of dopamine. *Ulvaria* can release dopamine into the environment when it is desiccated then rehydrated during a tidal cycle. The released dopamine is biologically active and can reduce the growth rates of other macroalgae and microalgae. Thus, morphology in these species is not always a reliable predictor of ecological impacts.

Application of a landscape ecology approach to habitat banking in the Fraser River estuary, BC, Canada. *Gary Williams*, GL Williams & Associates Ltd.; Dan Buffett, Ducks Unlimited Canada.*

In 1993 the first habitat bank in Canada was created in the Fraser North Arm in a cooperative initiative between the Port North Fraser Authority and Fisheries and Oceans Canada. The habitat bank was designed to address the national fish habitat policy guiding principle of "no net loss". In 2011, the Port Metro Vancouver embarked on a program to expand habitat banking to include the entire Fraser estuary and Burrard Inlet, and a landscape ecology approach was adopted to develop a rating system to rank identified habitat banking opportunities. Seven criteria (i.e. habitat area, relative habitat productivity, First Nations support, community support, owner willingness, success certainty, compatibility with physical processes) were rated using a 3-level scoring system and the sum used to rank sites in a pre-screening matrix. To evaluate the pre-screened sites, the Lower Columbia River and estuary habitat restoration prioritization framework (Thom et al. 2011) involving analysis of change in overall function, processes and values of the site, analysis of predicted success of project, analysis of cost, and analysis of change in size of functional area was modified to incorporate specific Fraser estuary criteria.

Fidalgo Bay soft shore bank stabilization for forage fish habitat restoration and protection of cultural resources.
Christine Woodward, Samish Indian Nation.

In 2009, the Samish Indian Nation located in Anacortes Washington networked with a variety of local, state and federal agencies to restore 550 feet of eroding shoreline along Weaverling Spit with an engineered soft shore stabilization project to protect an archeological site that was in danger of eroding onto the beach. This project also provided habitat for forage fish spawning along with shade vegetation; and helped stabilize the shoreline along the popular Tommy Thompson pedestrian trail that was currently being impacted by erosion and in danger of being lost in certain portions. The success of the project has been measured by the following:

Archeological site stabilized
Erosion of the current shore stabilized
Forage fish spawning habitat has been improved along the 550 feet of shoreline

Addition of native plants and grasses along with several large trees are providing overhanging shade which was non-existent this stretch of beach. This project is being used as an educational opportunity on bank stabilization and beach nourishment and focuses on the value of networking a wide variety of partners working together towards the same goal. Phase Two, The Central Weaverling Spit project that is beginning in the spring of 2011 and is located on tribal property, will replenish the lost sediment by rebuilding a natural sloping beach from the edge of the past projects and stretching an additional 500 feet east.

Relationships between watershed alterations and sediment accretion rates in Willapa Bay, Washington and Yaquina Bay, Oregon. *David Young*, Patrick Clinton, and Robert Ozretich, US Environmental Protection Agency.*

This study reports the general lack of change in sedimentation rates for two Pacific Northwest coastal estuaries despite major reductions in old-growth forest stands and increased number of log roads and slash burnings during the mid-1900's. As developments of coastal watersheds increase, corresponding efforts are needed to insure the integrity of nearshore ecosystems. Cores collected from lowland marshes or adjacent mudflats in Willapa Bay, WA and Yaquina Bay, OR were sectioned, and 1-cm thick sediment layers were dated using traditional lead -210 geochronology procedures. Polynuclear aromatic hydrocarbons, total organic carbon, and grain size also were analyzed in some cores to assist in the interpretation. Sediment accretion rates in most lower marsh cores ranged from 0.1 to 0.4 cm/yr, although a higher rate (1.15 cm/yr) was measured in one mudflat core from lower Yaquina estuary. Only one of the ten cores collected showed a clear increase in accretion rate, beginning around 1976.

Rocky intertidal benthos in Iniskin/Iliamna Bay: a 33-year baseline and hints of climate change? *Jon Houghton, Jason Stutes*, Adrienne Stutes*Pentec Environmental/Hart Crowser, Inc.;Dennis Lees, Littoral Environmental and Ecological Services; Sandra Lindstrom, University of British Columbia.*

Littoral habitats in lower Cook Inlet represent important areas of diversity and productivity that are both ecologically and economically important. This study describes benthic marine intertidal biota in Iniskin and Iliamna bays based on work conducted by the authors over the last 33 years. Two stations sampled in recent (2004-2008) work were identical in location to those sampled under other programs during the late 1970s and in 1996, thus providing a substantial historical perspective. A stratified random approach was used to characterize biota at each of three elevations (upper, middle, lower) at seven rocky stations. The area experiences winter icing that severely affects upper and middle intertidal rocky assemblages. Data from 1978 and 1996 showed a high degree of stability in upper and middle intertidal rocky assemblages. Upper zones were dominated by seasonal growths of barnacles with longer-lived species such as rockweed relegated to sheltered crevices. The middle elevation was strongly dominated by red algae that regenerate from holdfasts each spring. However, in 2004 and 2005 there was a remarkable increase in rockweed, a perennial that is much less ice tolerant which correlated with over winter ice minimums for the area. This suggested a reduced ice stress that facilitated increased rockweed coverage. In 2005, 2006, and 2008, the red algae regained dominance while rockweed reduced coverage as ice coverage rebounded. This coupled with other changes or species deletions suggests this area is sensitive to seasonal ice patterns and may exhibit large shifts in the ecology of the intertidal should reduced ice coverage become more frequent.

PERS 35TH ANNUAL MEETING POSTER SESSIONS

Wall 1 – Water Quality	
P-1	**Eyes over Puget Sound: integrating multiple observations to report current conditions of water quality in Puget Sound and the Strait of Juan de Fuca.** *Julia Bos, Mya Keyzers*, Christopher Krembs, Laura Friedenberg, Skip Albertson, Brandon Sackmann, David Mora, Suzan Poole, Carol Maloy, Washington Dept. of Ecology.*
P-2	**Monitoring the oxygen dynamics of a coastal embayment of the Salish Sea (Bellingham Bay).** **Sarah DeLand, Western Washington University; Lance Brockie, Northwest Indian College; Jude Apple, Western Washington University.*
P-3	**Investigating climatic and local factors influencing water quality in the Salish Sea.** *Gabrille Lopez*, Stony Brook University; Jude Apple, Western Washington University.*
P-4	**A comparison of the patterns of pCo_2 variability in local waters with the flowing seawater system at Shannon Point Marine Center.** *Loraine Martell, University of Puerto Rico Humacao; Brooke Love, Western Washington University.*
P-5	**Using a Pacific herring bioassay to assess the toxicity of woodchips and Retene.** *Fernando Vargas*, California State University Fullerton; Paul Dinnel, Shannon Point Marine Center.*
Wall 2 – Invertebrates, Fish, and Food Webs	
P-6	**Declines in US West Coast burrowing shrimp populations are linked to fluctuations in estuarine recruitment.** *Brett Dumbauld*, USDA-ARS; John Chapman and Katelyn Bosley, Oregon State University.*
P-7	**Morphological changes of *Synechococcus* in culture as a result of protist grazer pressure.** *Edna Fernandez*, Eckerd College; Suzanne Strom, Western Washington University.*
P-8	**Marine phytoplankton monitoring in Central Puget Sound: small organisms, big value.** *Gabriela Hannach* and Kimberle Stark, King County.*
P-9	**Estuarine food web connectivity: a trophic comparison of marsh restoration strategies in the Skokomish Estuary.** *Emily Howe* and Charles ("Si") Simenstad, University of Washington.*
P-10	**Manipulating the nutritional and toxic content of rotifers as prey for larval crabs.** *Aliah Irvine*, University of Hawaii at Manoa; Steve Sulkin, Shannon Point Marine Center.*
P-11	**Relationship between host and symbiont cellular growth in *Anthopleura elegantissima* and *Symbiodinium muscatinei*.** *Rea Pineda*, Brian Bingham, and Jay Dimond Western Washington University.*
P-12	**Chinook salmon population diversity and juvenile rearing habitat utilization in the Columbia River estuary: implications for management and restoration.** *Pascale Goertler* and Charles Simenstad University of Washington; Dan Bottom, and David Teel, Northwest Fisheries Science Center.*
P-13	**Occurrence, abundance, and developmental stage of a parasitic nematode in juvenile bluefish (*Pomatomas saltatrix*) inhabiting the Hudson River estuary.** *Jessica Lajoie, University of Massachusetts.*

PERS 35TH ANNUAL MEETING POSTER SESSIONS (cont'd.)

Wall 3 – Climate Change, Eelgrass, and Algae	
P-14	**Effects of ocean acidification on dispersal behavior, feeding rates and growth efficiency in larval crabs.** *Anna-Mai F. Christmas* and Steve Sulkin, Western Washington University.*
P-15	**EstuRe project: US Pacific Coast estuary/watershed data and R tools.** *Melanie Frazier*, Henry Lee, Lee McCoy, Cheryl Brown, and Walter Nelson, US EPA; Deborah Reusser, US Geological Survey.*
P-16	**Ocean acidification: responses of three phytoplankton species.** **Abdiel Laureano-Rosario, University of Puerto Rico, Brady Olson, Western Washington University.*
P17	**Preparing for rising tides: providing sea-level rise tools and guidance to local governments in Washington State.** *Kate Skaggs*, Washington Department of Ecology.*
P-18	**Vancouver Island's Courtenay (K'ómoks) River estuary, restoration and the positive effects on climate change - a blue carbon pilot project.** *Paul Horgen*, University of Toronto, Kayt Chambers; Dan Bowen, Dan Bowen Consulting Services Ltd., Dave Davies, Department of Fisheries and Oceans; Christine Hodgson, North Island College; Michele Jones, Mimulus Biological Consultants; Pam Shaw, K'ómoks First Nations; Lora Tryon; Kathy Campbell and Wayne White, Comox Valley Project Watershed Society.*
P-19	**Seagrassnet: seasonal monitoring of two seagrasses, *Zostera marina* and *Zostera japonica*, at Dumas Bay, Washington.** *Lisa Ferrier* and Jeff Gaeckle, Washington State Department of Natural Resources.*
P-20	**We need 20% more eelgrass (*Zostera marina* L.) - where and how?** *Jeffrey Gaeckle, Washington State Department of Natural Resources; Ronald Thom, Pacific Northwest National Laboratory.*
P-21	**The effects of dopamine on F*ucus distichus*; a marine alga.** *Josh Galvan, Colorado State University.*

Abstracts – Posters

Eyes over Puget Sound: integrating multiple observations to report current conditions of water quality in Puget Sound and the Strait of Juan de Fuca. *Julia Bos, Mya Keyzers*, Christopher Krembs, Laura Friedenberg, Skip Albertson, Brandon Sackmann, David Mora, Suzan Poole, Carol Maloy, Washington Dept. of Ecology.*

The Washington State Department of Ecology (Ecology) Marine Monitoring Unit conducts a variety of marine observations, including routine long-term marine monitoring in Puget Sound and Washington's coastal estuaries. Since the 1970s, we have used a floatplane to collect monthly data from a widely distributed station network. In 2010, we began using the routine transit leg of the monitoring flight between Kenmore (North Seattle) and Olympia to capture repeated aerial observations of surface conditions in Puget Sound at no extra cost. These observations are posted within two days of the marine flight as the foundation of an online report called "Eyes Over Puget Sound" (EOPS). EOPS includes current information and aerial photos on locations of plankton blooms, river plumes, hydrographical features, and accumulations of debris and jellyfish as well as sightings of oil sheens.

EOPS presents multiple scales of observation by combining high-resolution photo observations with satellite images, en route ferry data between Seattle and Victoria BC, measurements from our moored instruments and eventually, water column profiles collected via the floatplane. The scale, unique perspective and rapid turnaround of EOPS generates a unique synopsis of current Puget Sound conditions that can be used for education, field support, science and public awareness, and ultimately improves our knowledge about our part of the Salish Sea ecosystem.

Effects of ocean acidification on dispersal behavior, feeding rates and growth efficiency in larval crabs. *Anna-Mai F. Christmas* and Steve Sulkin, Western Washington University.*

The role of sea water acidification of the world's oceans on populations and communities is a subject of growing concern and attention. In the case of crustaceans, issues such as calcium dynamics of the molting process and direct effects on survival and development rates of larvae have received at most limited attention. There is, however, a variety of potential effects on planktonic larvae relating to their behavior and physiology that can have significant consequences to their distribution, settlement success, and recruitment to the population. The role of larval crabs in the food web as top down regulators of other plankton and bottom up regulators of jellyfish and finfish prey can also influence their impacts on communities. My thesis research will provide evidence for the possible effects of increased ocean acidification on important larval crab processes like dispersal behavior, feeding rates and growth.

Monitoring the oxygen dynamics of a coastal embayment of the Salish Sea (Bellingham Bay). *Sarah DeLand*, Western Washington University; Lance Brockie, Northwest Indian College; Jude Apple, Western Washington University.*

Many marine coastal environments including those in the Salish Sea ecosystem experience hypoxia (critically low dissolved oxygen concentrations) due to both anthropogenic and natural causes. Bellingham Bay, one of the coastal embayments within Salish Sea, is no exception. A preliminary, year-round investigation of oxygen dynamics in Bellingham Bay began in 2006 to follow the trends in dissolved oxygen concentration. During the summer of 2011, dissolved oxygen concentrations were studied more closely in order to map the volume and area of the hypoxic bottom water in Bellingham Bay. By using CTD profiles collected at eight historical stations and eighteen additional stations as part of north-south and east-west transects, we compiled an extensive dataset to better understand the dissolved oxygen dynamics of the bay. The results of the investigation indicate that Bellingham Bay displays hypoxic conditions in the northern deep water during mid to late summer each year. Additionally, repeated mapping of the hypoxic area throughout the summer revealed that it is not a static volume of water; rather it moves through the water column. The conditions seen occurring in Bellingham Bay follow similar patterns and trends to those observed in other coastal ecosystems in the area, including Hood Canal, which is known for hypoxic conditions that have deadly consequences for marine organisms. These results provide a better basis for understanding the patterns of dissolved oxygen concentrations and hypoxic conditions within Bellingham Bay and provide a valuable, quantitative baseline for tracking changes in this ecosystem.

Declines in US West Coast burrowing shrimp populations are linked to fluctuations in estuarine recruitment. *Brett Dumbauld*, USDA-ARS; John Chapman and Katelyn Bosley, Oregon State University.*

We have monitored populations of two species of burrowing thalassinid shrimp, *Neotrypaea californiensis* and *Upogebia pugettensis* in Willapa Bay, Washington for over two decades. These native shrimp are important ecosystem engineers, but also cause significant mortality to shellfish. Densities of both species were either increasing or stable through the mid 1990's and then began to decline. *U. pugettensis* are now almost absent in Willapa Bay and subsequent monitoring and mapping efforts suggests that this decline is broadspread along the U.S. West Coast and due in large part to the introduced parasitic isopod, *Orthione griffenis* which compromises their reproduction. Similar surveys of *N. californiensis* populations however, suggest that they too are declining. Since both shrimp have pelagic larval stages that develop in the coastal ocean, we asked whether interannual fluctuations in larval survival and estuary recruitment influence adult populations. We found a significant relationship between recruitment and the density of 1+ shrimp the following year. By also tracking entrance of postlarvae to Yaquina Bay, Oregon in 2010 and 2011, we demonstrate that the relationship may be more complex with high mortality of either postlarvae or juveniles during the first year.

Morphological changes of *Synechococcus* in culture as a result of protist grazer pressure. *Edna Fernandez*, Eckerd College; Suzanne Strom, Western Washington University.*

Synechococcus, a genus of picocyanobacteria, is one of the most abundant photosynthetic organisms in the world. Their immense productivity and abundance place them in a vital position in the ocean's food web. In culture, *Synechococcus* sp. CC9311 sometimes forms filament structures (i.e. unusually long cells); the reason for their change in morphology is unclear. Changes in morphology could be related to the concentration of nutrients in their growth media, or to the presence of protist grazer. *Synechococcus* CC9311 were grown in different media to evaluate the effect of nutrient concentration on the cyanobacterial growth rate and morphology. Experiments using the mixotrophic flagellate *Ochromonas* sp were conducted to evaluate the effect of the grazer and associated dissolved substances on Synechococcus morphology. Over the 7-d experiment filament structure was not observed; instead a portion of the cyanobacteria arranged into microcolonies. Microcolonies were most abundant in the presence of filtrate from *Ochromonas* culture. A second experiment did not find microcolony formation, most likely due to differences in age of grazer culture or type of experimental container (plastic versus glass). Although *Synechococcus* filament formation was not affected significantly by the media type, presence of grazing flagellates, or grazer-derived dissolved substances, this work has set a basis for future study of predator-prey interactions in the microbial food web and found that SN/50 is a suitable medium for growing *Synechoccocus*.

Seagrassnet: seasonal monitoring of two seagrasses, *Zostera marina* and *Zostera japonica*, at Dumas Bay, Washington. *Lisa Ferrier* and Jeff Gaeckle, Washington State Department of Natural Resources.*

SeagrassNet is a global seagrass monitoring program that is now established in 32 countries with 115 monitoring sites around the world. Standardized protocols for scientific monitoring have been developed and are successfully implemented by trained teams of local scientists and managers. Quarterly fixed-transect sampling is carried out at sites for seagrass species composition, cover, density, biomass, canopy height, and depth distribution, as well as temperature, salinity, light and sediment type. A monitoring team at each site sends data via the internet to an online database and archive at www.SeagrassNet.org. The Washington State Department of Natural Resources' Nearshore Habitat Program, established a SeagrassNet site at Dumas Bay in May 2008. Three years of sampling show seasonal patterns in seagrass species (*Zostera marina and Zostera japonica*) composition, shoot morphology and density, percent cover, and above- and below-ground biomass along transects established at +1 m, 0 m, and -1.6 m MLLW. Declines in *Z. marina* are evident at the highest tidal elevation (+1 m) transect. It is unclear if these changes are related to disturbances and/or displacement by non-native eelgrass, *Z. japonica*. Long-term assessment of seagrass resources elevates the visibility of this important nearshore habitat and provides a barometer of direct anthropogenic and global climate change impacts.

EstuRe project: US Pacific Coast estuary/watershed data and R tools. *Melanie Frazier*, Henry Lee, Lee McCoy, Cheryl Brown, and Walter Nelson, US EPA; Deborah Reusser, US Geological Survey.*

The EstuRe Project is a collaborative effort of the U.S. EPA and USGS to standardize and improve the accessibility of data for U.S. Pacific Coast estuaries and their corresponding watersheds. We are presenting a preview of the datasets and tools that will soon be available from the EPA website for analyzing and visualizing estuarine data. The datasets include geomorphology data for estuaries (derived from geospatial data from the U.S. Fish & Wildlife Service's National Wetlands Inventory Project) and watersheds (based on U.S. EPA's work to delineate watersheds for each estuary), as well as climate data from a variety of sources (PRISM, Daymet, AVHRR satellite data). Geographic coverage includes estuaries and watersheds from northern Washington (Cape Flattery, 48.383°N) to southern California (Tijuana Estuary, 32.557°N), excluding Puget Sound. We have also created tools for the statistical program R to help users extract and summarize these data and view them in Google Earth. These data can be used in many ways including: the development of regional scale benthic indicators; the identification of estuaries at risk of climate change or anthropogenic stressors; the modeling of patterns among and within estuaries of species distributions and richness; and the classification of estuaries based on geomorphology and climate. In the future, we intend to expand the project to include human population and land-use data and point-based data from projects such as EPA's Environmental Monitoring and Assessment Program.

We need 20% more eelgrass (*Zostera marina* L.) - where and how? *Jeffrey Gaeckle, Washington State Department of Natural Resources; Ronald Thom, Pacific Northwest National Laboratory.*

Seagrasses have been declining to a point where it has been deemed a worldwide crisis. In response to regional and global needs, the Puget Sound Partnership's Action Agenda specifically targets an increase of 20% more eelgrass (*Zostera marina* L.) by 2020. Restoring eelgrass will benefit a multitude of species valued in Puget Sound, as well as contribute to water quality improvement, shoreline stabilization, and carbon sequestration. Because of its importance to nearshore food webs and shoreline processes, restoring eelgrass has been a general recommendation made by numerous entities for the entire Salish Sea. To accomplish this, the Marine Sciences Laboratory of the Pacific Northwest National Laboratory in partnership with the Washington Department of Natural Resources will employ numerical and spatial models, field studies, and test plantings to identify areas within Puget Sound that have a high probability of restoration success and resilience to natural and anthropogenic disturbances. Additional prioritization will be assigned for sites that would be conserved and protected through shoreline management actions.

In this poster, we seek your immediate input on three different types of information:
1. Are you aware of any location in Puget Sound where eelgrass used to grow or is still growing but appears under duress?
2. What stressors do you believe caused or is currently causing eelgrass decline?
3. What additional local and regional management actions could be implemented to sustain, restore or protect eelgrass?

We request that you write your input directly onto this poster or otherwise express your comments to us.

The effects of dopamine on *Fucus distichus*; a marine alga. *Josh Galvan, Colorado State University.*

Abstract –Ulvoid algae form green tide blooms that occur worldwide. One bloom-forming species, *Ulvaria obscura* is unique because it is the only alga known to produce dopamine. It can release dopamine into the surrounding water in concentrations that could exceed 500µM. We hypothesized that dopamine has detrimental effects on the development of embryos and growth of a co-occurring brown alga *Fucus distichus*. To test our hypothesis, we measured the effects of dopamine concentrations and the duration of exposure on the percentage of *F. distichus* zygotes that germinated and on embryo length. Our results demonstrate that dopamine reduced the number of zygotes that germinated in concentrations as low as 100µM by almost 10%. At concentrations as high as 500µM, the number of zygotes that did not germinate was as high as 30%. The embryo length was significantly affected by exposure to dopamine. During the first three hours of exposure to dopamine, the embryo length significantly dropped at the higher concentration. It is not clear if these effects are a result of dopamine or the formation of reactive oxygen species (ROS), dopamine quinone, or other compounds resulting in the oxidation of dopamine.

Chinook salmon population diversity and juvenile rearing habitat utilization in the Columbia River estuary: implications for management and restoration. *Pascale Goertler* and Charles Simenstad University of Washington; Dan Bottom, and David Teel, Northwest Fisheries Science Center.*

Population diversity has emerged as an important asset to the expression of adaptation and as a mechanism for resilience in changing environments. For many species a matrix of available habitats are also necessary to ensure population stability and persistence. Access to diverse habitats has promoted population diversity in Pacific salmon through the expression of life history diversity. More specifically, estuarine rearing habitat has been shown to foster dominant life history strategies, enhance within watershed biocomplexity and support smolt growth. Chinook salmon in the Columbia River have potentially undergone major population diversity losses due to anthropogenic reductions in rearing and spawning habitat. This presentation is an evaluation of preliminary data from a Master's study which investigates the distribution of juvenile Chinook population diversity and rearing habitat in the Columbia River estuary. In the proposed study we aim to describe the distribution of juvenile Chinook population diversity within estuarine rearing habitats, and illuminate relationships between estuary use and population diversity. Microsatellite DNA genotyping, otolith microstructure and year-round, estuary-wide habitat sampling will construct a series of associations between habitat utilization and population diversity, which can be used to simulate predictions of habitat use beyond our sampling sites and speculate the effects of future habitat change. This study will also provide comprehensive and convincing evidence for the benefits of salmon estuarine rearing and confirm the breadth of spatial and temporal estuary use by juvenile salmon. Our research is designed to inform habitat and salmon population restoration, address data gaps, and guide future research within the Columbia River.

Marine phytoplankton monitoring in Central Puget Sound: small organisms, big value. *Gabriela Hannach* and Kimberle Stark, King County.*

The King County Marine and Sediment Assessment Group manages a long-term marine monitoring program designed to assess water quality in the Central Puget Sound Basin. Data are collected monthly for physical, chemical, and biological (chlorophyll-a) parameters at 14 locations and depths throughout the Puget Sound Central Basin. The recent addition in 2008 of a long-term phytoplankton species component to this program was deemed necessary to predict how changes in climate and other regional stressors might impact the Sounds' trophic structure.

The goals of the phytoplankton monitoring component are 1) to assess relative abundance of major phytoplankton taxa during the bloom season, 2) to document the timing of seasonal shifts in major taxa, 3) to investigate relationships between physical/chemical parameters and species relative abundance, and 3) to detect long-term changes in community composition.

The current phytoplankton sampling program is limited to three locations within the Central Basin. Point Jefferson and East Passage are long-term ambient monitoring stations representing open north and south areas of the Puget Sound Central Basin. Quartermaster Harbor is a shallow, protected embayment with poor tidal flushing and an in situ mooring is deployed to provide high frequency water quality data from this site. Our long-term goal is to expand the phytoplankton monitoring program and build an extensive database that could help evaluate the effects of environmental and anthropogenic changes on the Puget Sound food web.

Vancouver Island's Courtenay (K'ómoks) River estuary, restoration and the positive effects on climate change - a blue carbon pilot project. *Paul Horgen*, University of Toronto, Kayt Chambers; Dan Bowen, Dan Bowen Consulting Services Ltd., Dave Davies, Department of Fisheries and Oceans; Christine Hodgson, North Island College; Michele Jones, Mimulus Biological Consultants; Pam Shaw, K'ómoks First Nations; Lora Tryon; Kathy Campbell and Wayne White, Comox Valley Project Watershed Society.*

Climate change and global warming are serious concerns that we must understand as we try to work on projects to reduce CO_2 levels in the atmosphere. When trying to establish the criteria for determining a living carbon offset, one has to know how much carbon dioxide is removed from the atmosphere by the vegetation systems providing the carbon offset. For many systems, the calculations are established and the markets are set, even though the green house gas removal is not permanent. A blue carbon offset is one generated in coastal areas, most specifically in the northern hemisphere by estuarine environments. The unique geographical characteristics within estuaries that empty into the Strait of Georgia provide one of the most productive areas in the world for primary photosynthetic activity and carbon dioxide removal. Two vegetation systems, eelgrass meadows and salt marshes, have been established to be as much as 90 times as efficient as a mature conifer forest in removing $CO_2$from the atmosphere. Because of the complexity and changing conditions in estuaries, a protocol does not exist for the evaluation of blue carbon offsets. In our Blue Carbon Pilot Project for the Courtenay River Estuary, we will identify parameters required to establish an industry protocol, propose methods to quantify those parameters and provide the results to offset through the Verified Carbon Standards (VCS) and offset industries for review. We view this as a community effort that will go on for an extended period of time.

Estuarine food web connectivity: a trophic comparison of marsh restoration strategies in the Skokomish Estuary.
Emily Howe and Charles ("Si") Simenstad, University of Washington.*

Due to the importance of estuarine marshes to the marine ecosystem, there has been increasing support for large restoration programs. A few examples from the Pacific Northwest include large-scale levee removal projects in the Nisqually, Skagit, Stilliguamish, and Skokomish estuaries. While most of these projects were initially driven by salmon enhancement objectives, they are also important for detritus-based food webs because they can increase the biomass of available organic matter (OM) to detritivores and increase cross-ecosystem connectivity between the river, marsh, and nearshore marine ecosystems. Both increased OM biomass and transport can increase ecosystem productivity. In this study, we examine patterns in mussel food web support and growth among three marsh types in the Skokomish Estuary: a natural levee-breach (>15yrs old), a new levee-removal project (2 yrs old), and an ancient, natural marsh. Significant differences in food web support were observed across dates, marshes, and locations within marshes. Marsh-derived detritus was surprisingly more prevalent in the new levee-removal restoration site than in the older marsh sites. Significant differences in mussel growth were observed across dates and internal marsh sites, but did not track with patterns associated with food web support. The lack of marsh-based growth differences indicates that, from an energetic standpoint, the three sites function similarly to one another despite disparities in age, hydraulic connectivity, and primary production.

Manipulating the nutritional and toxic content of rotifers as prey for larval crabs.
Aliah Irvine, University of Hawaii at Manoa; Steve Sulkin, Shannon Point Marine Center.*

Experiments were designed to manipulate the nutritional and algal toxin content of rotifers that serve as prey for larval crabs in laboratory tests. Initial experimental design applied treatments that varied in the ratio of toxic (*Alexandriumandersoni*) and non-toxic algal cells and determining the effects over time on egg production in the rotifer *Brachionus plicatilis*. Experiments required that rotifers ingest a non-toxic alga of approximately the same size as *A. andersoni* and no feeding preference by rotifers when presented with mixtures of the two algal types. Using epifuorescence microscopy, we confirmed that rotifers would ingest the non-toxic alga *Prorocentrum micans*. However, rotifers feeding on mixtures of *A. andersoni* and *P. micans* showed preferential ingestion of the former. An alternate design was employed that alternated the days on which either toxic or non-toxic cells were presented to rotifers, using *Isochrysis galbana* as the non-toxic component. The treatments were *I. galbana* (Ig) daily; *A.andersoni* (Aa) daily; repeated one day Ig/two days Aa; repeated one day Ig/one day Aa; repeated two days Ig/one day Aa; and repeated one day Ig/one day unfed. Rotifer egg production over five days was maintained at approximately 0.7 eggs/rotifer on the Ig daily treatment, but dropped to almost zero on the Aa daily treatment. Adding as little as only one day out of three fed on Ig sustained egg production equal to that of daily Ig exposure, suggesting a prominent role of nutritional deficiency in the Aa-fed rotifer diet, although toxicity cannot be ruled out entirely.

Ocean acidification: responses of three phytoplankton species. **Abdiel Laureano-Rosario, University of Puerto Rico, Brady Olson, Western Washington University.*

Atmospheric CO_2 has been increasing at an unprecedented rate since the industrial revolution and is expected to approximate 1000 ppm by the year 2100. This rising partial pressure of atmospheric CO_2 forcibly dissolves CO_2 into the ocean, and through a series of reactions, acidifies the ocean. One group of organisms that may benefit from increased oceanic CO_2 are the phytoplankton, whose carboxylating enzyme RUBISCO is under saturated at present day CO_2 concentrations. To test for phytoplankton sensitivity to rising CO_2 we grew three disparate phytoplankton species (*Prorocentrum micans, Dunaliella tertiolecta* and *Ditylum brightwelli*) in batch culture under three different pCO_2 concentrations (ambient [400 ppmv], 750 ppmv and 1000 ppmv) and measured cell sizes, cellular growth rates, and nutrient uptake rates. We found that *P. micans* and *D. tertiolecta* grew significantly faster under elevated pCO_2, whereas *D. brightwelli* grew equally across CO_2 treatments. *D. tertiolecta* were significantly larger under high CO_2. CO_2 uptake was significantly greater under high pCO2 compared to ambient concentration for all three phytoplankton species, while phosphate and nitrate drawdown remained the same across pCO_2 treatments, suggesting that cells may become carbon-rich in high CO_2 environments. In general, *P. micans* and *D. tertiolecta* appeared more sensitive to elevated pCO_2 than the diatom *D. brightwellii*. We hypothesize this reflects the more recent evolution of diatoms, whose RUBISCO may operate at higher efficiencies at low CO_2 due to its more recent appearance compared to *P. micans* and *D. tertiolecta*, both of which evolved much earlier than diatoms and under a much richer CO_2 environment.

Occurrence, abundance, and developmental stage of a parasitic nematode in juvenile bluefish (*Pomatomas saltatrix*) inhabiting the Hudson River estuary. *Jessica Lajoie, University of Massachusetts.*

Environmental stressors such as pollution and climate change may make fishes highly vulnerable to parasitic infections through immunosuppression. *Philometra saltatrix* is a parasitic nematode that is specific to bluefish (*Pomatomus saltatrix*). The rate of infection, life history, and effects of *Philometra saltatrix* in juvenile bluefish are unclear. Our objectives were to determine the occurrence, abundance, developmental stages, and assess the pathological effects of *Philometra saltatrix* infection in juvenile bluefish inhabiting the Hudson River estuary. *Philometra saltatrix* was found in 50% of the 81 fish examined. Occurrence increased over time and by November, all of the juvenile bluefish processed were infected. Abundance of *Philometra saltatrix* was the greatest in October (5 nematodes/infected fish). Sub-gravid (with eggs), and gravid (with larvae) females were found in the greatest proportion, and 92% of the nematodes were located in the pericardium. Pathological effects included severe pericardial hypertrophy, granulomatous inflammation, fibrosis, and visceral adhesions. The occurrence of *Philometra saltatrix* in juvenile bluefish observed in this study is among the highest reported for philometrids. We provide the first account of reproducing *Philometra saltatrix* in the pericardium of juvenile bluefish, and the pathologies we observed could be severe enough to cause mortality in affected fish.

Investigating climatic and local factors influencing water quality in the Salish Sea. *Gabrille Lopez*, Stony Brook University; Jude Apple, Western Washington University.*

The physical properties of marine ecosystems (e.g. salinity, temperature, dissolved oxygen, nutrient concentration) are affected by local factors such as upwelling and river flow as well as large scale climatic cycles. Pacific Northwest coastal waters in particular are strongly affected by El Niño Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO). In the present study the effect of local and climatic factors on Salish Sea were investigated. A long term data set (i.e. 1985-2010) included water quality from Shannon Point Marine Center (SPMC), upwelling indices reported by NOAA, and Fraser and Nooksack flow data reported by Canada WSC and USGS, respectively. Analyses included calculating monthly and annual means for (temperature, salinity, chlorophyll; and subsequent) regression of these variables with river flow and upwelling data to identify possible relationships. Analyses failed to identify a significant influence of river flow or upwelling on local water quality in this region, leading to the conclusion that factors controlling water quality are very complex. We further explored the influence of climate by investigating the relationship between warm and cool phases of ENSO and PDO and variability in SPMC water temperature.

A comparison of the patterns of pCo_2 variability in local waters with the flowing seawater system at Shannon Point Marine Center. *Loraine Martell, University of Puerto Rico Humacao; Brooke Love, Western Washington University.*

High concentrations of carbon dioxide (CO_2) affect ocean chemistry, making it more acidic. These changes are expected to have impacts on organisms and ecosystems. Shannon Point Marine Center is equipped with sea tables, flushed with flowing seawater, that are used to maintain organisms for research. We compared the partial pressure of carbon dioxide (pCO2) and pH of three areas: sea tables, Shannon Point beach and the seawater intake, to compare the sea table environment to the natural levels and variability of pCO_2. Alkalinity and pH were measured to calculate the pCO_2 on discrete samples collected at each location. We also deployed a data sonde to measure pH, temperature and salinity in situ in the sea tables and the intake. All pCO_2 values measured were greater than equilibrium with the atmosphere. The sea tables had higher pCO_2 and less variability compared with the beach on a weekly time scale. Diurnal variability was also greater on the beach than in the sea tables or the intake. The pH measured by the data sonde showed pH is significantly higher at the intake than in the sea tables, but this difference was small compared to the difference between the beach and the sea tables. The difference in pCO_2 patterns between the sea tables and the beach is probably related to the depth of the intake. The sea tables appear to serve as a good representation of subtidal pCO_2 environment, but do not recreate the levels or variability of pCO_2 seen in intertidal environment.

Relationship between host and symbiont cellular growth in *Anthopleura elegantissima* and *Symbiodinium muscatinei*.
Rea Pineda, Brian Bingham, and Jay Dimond Western Washington University.*

Along the west coast of North America, the temperate anemone *Anthopleura elegantissima* hosts the symbiotic alga *Symbiodinium muscatinei* within its gastrodermal cells. Despite temporally variable environmental conditions, the density of symbionts in the anemone's tissues stays relatively constant. *A. elegantissima* is known to regulate symbiont density by expelling excess algae, but it is unknown whether synchronized growth of the host and its algal population might help keep symbiont densities constant. Gastrodermal cells containing *S. muscatinei* were extracted from tentacles of *A. elegantissima* and cell cycles of host and symbiont cells were analyzed using DNA staining and flow cytometry. The percentage of cells in each cell cycle phase was within 5% for host and symbiont, showing potential coupling of partner cell cycles. The effect of nutrition on the cell cycle synchronization was assessed by selectively feeding the host or the symbiont. Results indicate that, in addition to controlling algal density through expulsion of excess symbionts, *A. elegantissima* and *S. muscatinei* communicate in a way that allows the holobiont to synchronize growth rates. However, selectively feeding one partner can disrupt the synchrony. This decoupling suggests that, while synchrony of cellular growth in the holobiont occurs, it can be influenced by the nutritional status of the individual partners.

Preparing for rising tides: providing sea-level rise tools and guidance to local governments in Washington State.
Kate Skaggs, Washington Department of Ecology.*

In the US Pacific northwest, sea level rise (SLR) projections range from 3" to 22" by 2050 for the Puget Sound, 1" to 18" for the central and southern outer coast, and -5" to 14" for the northwest Olympic Peninsula. This dramatic range in projections highlights one of the many difficulties local governments face when planning for the impacts of, not only sea level rise but also more frequent storm events and heightened storm surges when those events occur. The Washington Department of Ecology (Ecology) is assisting local governments by providing them with information, guidance, and tools they will need to effectively plan for and adapt to sea level rise. A survey was distributed to local governments to gauge the level of concern regarding sea level rise, determine what information planners already possess, and establish what SLR information Ecology could provide that would be most helpful. The results of this survey will be used to inform the development of a guidebook. The guidebook will focus on how to integrate sea level rise planning into local Shoreline Master Programs and other already existing regulation in Washington. The survey information will also be used to prepare outreach and education materials for local planners and the public. Additionally, Ecology is coordinating with NGOs, state agencies, and academic institutions to foster regional collaboration concerning SLR adaptation planning. These actions aim at helping local governments be more prepared for SLR impacts and decrease political, economic, and social costs associated with waiting to adapt.

Using a Pacific herring bioassay to assess the toxicity of woodchips and Retene.
Fernando Vargas, California State University Fullerton; Paul Dinnel, Shannon Point Marine Center.*

The Pacific herring (*Clupea pallasi*) is an important forage fish for marine fish, birds and marine mammals, and an important food and bait source for humans. Early life stages of herring are known to be sensitive to an array of contaminants, including very low concentrations of polycyclic aromatic hydrocarbons (PAHs). One possible source of contamination is from chemicals leached from wood products, including wood chips, sawdust and bark, which sometimes have been discarded into waters near herring spawning grounds. In Port Gamble, WA, it is suspected that benthic wood accumulations may be partially responsible for elevated herring embryo mortalities, either directly (wood derived chemicals) or indirectly via bacterial decomposition of the wood (e.g., ammonia, sulfides, depressed dissolved oxygen). Some of the naturally occurring chemicals in wood are PAHs, including retene. The purpose of this project is to determine the toxicity of four different types of wood leachates and retene by using a seven day Pacific herring larval survival and growth test. Feeding herring larvae are being exposed to five treatments (fir, cedar and hemlock chips, fir bark, and retene) at concentrations of 100%, 50%, 25%, 12.5%, and 6.25%. The 100% concentration of wood leachate is equal to 250 g of wood chips/liter of seawater (soaked for 24 hr) and the 100% concentration of retene is equal to ~20 ug/liter of seawater (saturation in seawater). Test endpoints are 7-day survival and larval growth as measured by the dry weight of survivors.

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PERS President Elect Candidate Statement:
Tony D'Andrea

I am an estuarine ecologist at the Oregon Department of Fish and Wildlife (ODFW), where I run the Shellfish and Estuarine Assessment of Coastal Oregon (SEACOR) project. This project focuses on mapping and quantifying estuarine habitat and biological resources in Oregon estuaries, particularly the four bay clams commonly targeted by recreational and commercial

clammers: gaper, butter, cockle, and native littleneck clams. I have been with ODFW since 2010 after an academic career at both Oregon State University and the University of the Virgin Islands. During my academic career, I taught oceanography and marine biology and headed a research program investigating the population and community ecology of intertidal invertebrate communities in Oregon estuaries. I am a west coast transplant having moved here in 1999 as a National Research Council fellow at the U.S. EPA Pacific Coastal Ecology Branch in Newport with Ted DeWitt (a PERS past president!) after receiving my Ph.D. from the State University of New York at Stony Brook where I was a member of SEERS. I like that CERF has affiliate societies with their blend of regional science, collegiality, and student support. Upon moving to Oregon, I transferred my membership to PERS. One of the things about PERS that made an impression on me was (and is) how diverse our membership is relative to many of the other affiliate societies. It is a rare and valuable opportunity to have academic, government, and private sector researchers all sharing their knowledge of estuaries and PERSians do this every year. My experiences with SEERS and PERS have been formative in the development of my career and I feel a strong call to give back to the society through service and leadership. As president, I would continue to promote the exchange of ideas that is central to the society's purpose by actively engaging our professional and academic members, recruiting and supporting student members, and encouraging member involvement in our activities. Together, we can ensure that PERS continues to stand out as one of the leading CERF affiliate societies.

Schedule at a glance

Thursday Evening April 12

Registration and
Mixer at Shannon Point
6:30pm - 8:30pm

Friday - April 13 – Science Sessions at the Depot Arts Bldg.

7:30 - 8:30 Registration
8:30 - 8:45 am PERS Welcome - *Steve Rumrill*
8:45-9am CERF Welcome- *E.D. Mark Wolf-Armstrong*
9:00 9:15 Logistics- *Gary Williams & Jeannie Gilbert*
9:15 -10:15 am Oral Session 1- Mollusk Ecology/Biology

Dusek-Jennings
Sorber
Rumrill
O'brien
Galleher

10:30 - 11:15 Poster Session I & Coffee Break
11:15 – 12:00pm Oral Session 2 – Benthic & Algal Processes

Stutes
Van Alstyne
Sosik

12:00 - 1:30 Lunch
1:30 - 2:15pm Oral Session 3 Climate Change

Mochon-Collura
Siu
Janousek

2:15 - 3:30pm Coffee Break and Poster session
3:30 - 4:30pm Oral Session 4 Veg. Monitoring & Modeling

Markos
Belleveau
Turner
Hood

4:30 - 5:30 - PERS Business Meeting
6:30 - 8:30 – Banquet at Gere-a-Deli
8:30 - …. Grad student mixer

Saturday - April 14 Science Sessions at the Depot Arts Bldg.

8:15 - 8:30 am Welcome and notes
8:30 - 9:45 am Oral Session 5 – Sediments, Shorelines & Salmonids

Munsch
Hannam
Woodward
Young
Brennan

9:45 - 10:15 am Coffee Break & final Poster session
10:15 - 11:15 Oral Session 6 – Estuarine Processes

Ruesink
Stecher
Durance
Williams
Newton

11:15 - 12:15 Student awards
Thank You's to Organizers & Board members

Closing Remarks