South Sound Science Symposium

Taking the Pulse of South Sound

October 23, 2014

This event is a unique opportunity for scientists to explore how we can work together and identify and relate changes in the health of the South Puget Sound ecosystem. Scientists and technical staff from educational institutions, tribal natural resource agencies, government, non-profit groups, and the private sector were invited to contribute their knowledge and expertise to this event in the form of general session presentations, technical posters, and research abstracts.

All submitted abstracts are compiled below. Underlined type indicates the presenting authors for the poster session. Watch for these and archived abstracts from past conferences at the South Sound Science Symposium website: www.sciencesymposium.org.

Thanks to all of the partners that have made this event possible!

South Puget Sound

***Indicates Student Posters**

Anthropogenic Dissolved Oxygen Impacts in Budd Inlet: Comparing Influences from a Lake or Estuary

Anise Ahmed, Greg Pelletier, Mindy Roberts – Washington State Department of Ecology

Portions of Budd Inlet do not meet Washington State water quality standards and are on the federal Clean Water Act Section 303(d) list for dissolved oxygen (DO). The Budd Inlet, Capitol Lake, and Deschutes River Total Maximum Daily Load Study involved (1) data collection to characterize the sources and processes relevant to the impairments and (2) development of a calibrated computer model to predict circulation and water quality characteristics. Major processes included in the model were DO depletions due to decay of algal blooms (previously mediated by anthropogenic nutrient loading) and steady-state oxygen depletion in the sediment. DO concentrations under natural conditions were predicted using the calibrated computer model. Natural conditions means no human sources of nutrients and no Capitol Lake dam. Finally, predicted DO concentrations under existing conditions were compared with natural conditions to assess temporal and spatial violations of the standard. The combined effects of nonpoint and point sources currently do not meet the pollutant loading capacity of Budd Inlet and Capitol Lake for nutrients in southern Budd Inlet. Pollutant load reductions are required to meet State water quality standards for DO. The effects of Capitol Lake dam, even with only natural nutrient loads, also do not meet DO standards in Budd Inlet. Areas not meeting standards extend from southern to central Budd Inlet. There is a critical area in East Bay of Budd inlet where the magnitude of the DO violation is the largest. At this location Capitol Lake dam causes a DO depletion of about 2 mg/l compared with natural conditions. The rest of the depletion (approximately 1 mg/L) is caused by the combined effects of anthropogenic nutrient loads from the open boundary (external sources) and local point and nonpoint sources.

What Early Life History Tells Us about Restoration Success in Olympia Oysters

Bonnie J. Becker[1], Michael D. Behrens[2], Brian Allen[3], Brent Vadopalas[4], Megan Hintz[1], Hannah Parker[1] – Interdisciplinary Arts and Sciences, University of Washington Tacoma[1], Pacific Lutheran University[2], Puget Sound Restoration Fund[3], School of Aquatic and Fishery Sciences, University of Washington[4]

Native Olympia oysters have been the subject of widespread restoration efforts across the west coast, including in the South Sound. The ultimate goal of restoration is to establish populations that are self-sustaining or even exporting new offspring to other appropriate habitats. It is difficult to study the early life history of marine invertebrates, which have a microscopic and planktonic larval form and often episodic settlement pulses. However, being able to predict larval behaviors and settlement preferences can allow practitioners to design habitats, choose sites, and distribute restoration networks more effectively. The purpose of this study, a collaboration among academic and non-profit organizations, was to map the spatial and temporal distribution of oyster larvae and settlers in Fidalgo Bay. This bay has been the subject of restoration work over the past decade and has experienced high levels of settlement since the project began. From April through July 2013, we monitored the reproductive state of adults and the relative abundance and distribution of larvae and spatfall. Larvae were collected in larval tube traps and using a plankton pump; the number of larvae were quantified using real-time quantitative PCR. Settlers were sampled using shell strings made of adult Pacific oyster shells that were examined visually. Analyses are ongoing, although studies of adults show low reproductive synchrony, even during peak spawning. Settler data revealed that juvenile oysters settled preferentially near adult oysters rather than across depths and locations as previous studies have indicated. We will compare larval distribution data to determine if larvae are distributed throughout the area and are preferentially settling in optimal habitat, or if they remain in specific areas throughout the dispersal period. These results will be used to improve restoration efforts and to inform our upcoming studies of larval dispersal of this important ecosystem engineer throughout Puget Sound.

Assessing Post-Restoration Changes in Opportunity and Capacity on the Nisqually River Delta

Melanie Davis[1], Isa Woo[1], Susan De La Cruz[1], Chris Ellings[2], Eric Grossman[3], Steve Rubin[4], Glynnis Nakai[5] – USGS Western Ecological Research Center[1], Nisqually Indian Tribe Natural Resources Department[2], USGS Washington Water Science Center[3], USGS Western Fisheries Research Center[4], Nisqually National Wildlife Refuge[5]

The Nisqually River Delta represents the single largest estuary restoration project in the Pacific Northwest. The ultimate goal of the restoration was to increase the capacity of the estuary to support wildlife such as waterbirds and native fish. Removal of the outer dikes in 2009 increased potential tidal marsh habitat in southern Puget Sound by 50%, restored more than 35 km of tidal sloughs and channels, and re-established tidal flow to 360 ha of historic floodplain and delta. To assess changes in habitat availability (restoration opportunity), we have collected ongoing pre- and post-restoration data on hydrology, elevation, sedimentation, channel morphology, and vegetation at five sampling units on Nisqually National Wildlife Refuge, as well as on previous phased restoration sites conducted by the Nisqually Indian Tribe on the east side of the Nisqually River. We have monitored invertebrate prey resources annually at these sites to assess changes in the Delta's capacity to support waterbird and salmonid species. Post-restoration monitoring suggests initial sediment changes at some sites with the potential for slow deposition through time – particularly on the west side of the refuge. Furthermore, we observed shifts in invertebrate communities associated with biophysical variables. There were marked increases in arthropod population densities and, at some sampling units, decreases in polychaete densities. While monitoring across the Nisqually River Delta continues, our monitoring results from the last five years suggest the potential for broad-scale, positive ecological effects.

Streamflow Analysis for the Rivers and Streams of South Pierce County, WA

Shuhui Dun, Tom Kantz – Pierce County Surface Water Management

Recent studies have shown a correlation between the biological integrity of river systems and streamflow quantity and timing. Washington State NPDES Phase I Municipal Stormwater Permit (2013–2018) requires Pierce County to examine watershed-scale stormwater management strategies, with a goal of maintaining intact hydrologic, biologic, and water quality conditions that fully support existing and designated uses. The Permit requires future biologic conditions, as represented by the Benthic Index of Biotic Integrity (BIBI) scores, to be estimated using a correlation of hydrologic metrics with BIBI scores for Puget Sound Lowland Streams, as described in DeGasperi, et al. (2009). The purpose of this study was to investigate the feasibility of applying the methodology of DeGasperi, et al. (2009) to the Spanaway Lake Watershed in Pierce County. In our study, long term USGS gauging station data for streams and rivers around the Spanaway Lake Watershed were used to calculate hydraulic metrics (Low Pulse Duration, High Pulse Duration, Flow Reversals, Richards-Baker Index, Low Pulse Count, High Pulse Count, High Pulse Range, and T_{Qmean}). The parameter values were used to examine the streamflow changes over time. Results from sites of different watershed size and development level were compared. We discuss how the specific conditions of the Spanaway Lake Watershed present challenges for developing correlations of hydrologic metrics with BIBI scores similar to DeGasperi, et al. (2009).

Choices for Clean Water Evaluation: McAllister Park Pet Waste Survey

Sadie Gilliom[1], Sarah Moorehead[1], Jennifer Johnson[2] – Thurston Conservation District[1], Thurston County Environmental Health[2]

This survey evaluates the effectiveness of incentive based behavioral change through the Clear Choices for Clean Water (Clear Choices) program to promote positive behavior change within community members by promoting the behavior of picking up pet waste in McAllister Park residents to aid in improvement of the health of their watershed. A single day's waste from one large dog can contain up to 7.8 billion fecal coliform bacteria; enough to close 15 acres of shellfish beds. A green space in the McAllister Park neighborhood was chosen due to its high amount of waste and its location on a wetland within the Henderson shellfish protection area. The 59.7 acre green space was surveyed along the trails for pet waste weekly for fifteen weeks. We provided reached out to the community through mailings, events and pet waste flagging to measure the effect each method had on the amount of pet waste found in the park. Soon after the flags were placed, the community had a strong reaction. One resident was inspired to actively participate by installing a trash can, posting pet waste signs, weighing the waste, and installing 'poop pots'. As a result, the pet waste decreased from 48 piles per week to an average of less than seven piles per week. In addition, these actions resulted in the enrollment of 12 new Clear Choices program participants. Although this is a significant decrease in pet waste, it is unclear whether there is a direct correlation between Clear Choices and the decrease due to the complexity added to the study by the community. We plan to replicate this evaluation in another park to further evaluate the effectiveness of the Clear Choices for Clean Water program.

***Nocturnal Marine Habitat Selection of Surf Scoters**

Lindsey Hamilton[1], Joe Evenson[2] – The Evergreen State College[1], Washington Department of Fish and Wildlife[2]

Surf scoters have recently been observed to be distributed more widely and close to shore for foraging during the day, and then congregated in more open and exposed waters at night. This is important because management and current emergency response plans for events such as oil spills are based off of diurnal distributions and behaviors only. This is common for all waterfowl species and populations. The objectives for my thesis project will be to determine habitat characteristics of nocturnal use areas, what factors influence the selection of those locations, daily timing of movements between nocturnal and diurnal use areas, and to evaluate changes in all of the above between the spring, winter and fall seasons for pacific flyway scoter populations. This will be accomplished by analyzing satellite telemetry data provided by the Alaska Department of Fish and Game (ADFG), the Canadian Wildlife Service (CWS), the Washington Department of Fish and Wildlife (WDFW), and the United States Geological Survey (USGS). In a preliminary review of the WDFW data, it was apparent that areas of high nocturnal use may be located in habitats that see little to no use during the diurnal periods. This research will contribute to the knowledge of scoter ecology and behavior which influences management and conservation practices in the Puget Sound. The results of this study will be published in June of 2015 as a Masters thesis at The Evergreen State College.

***Assessing the Recontamination of the Thea Foss Superfund Site by Phthalates from Urban Stormwater using Positive Matrix Factorization**

Daniel Alejandro Haskell, Joel Baker – University of Washington, Center for Urban Waters

As part of the Stormwater Management Plan outlined in NPDES Municipal Stormwater permits, the City of Tacoma is required to collect and analyze stormwater quality monitoring data since 2001. The plan provides long-term protection of sediment quality for the Thea Foss Waterway Superfund site from a variety of pollutants. However, phthalate esters have become an emerging organic contaminant due to their ubiquitous presence in the environment, and

were identified to be one of the greatest threats to re-contaminate sediment following cleanup actions under CERCLA. One technique that can be used to identify sources of phthalate esters is Positive Matrix Factorization (PMF). Using EPA PMF 4.1 model, six phthalate esters measured in sediment were analyzed from 2006 to 2013 in proximity to seven municipal stormwater outlets in the Thea Foss waterway. PMF analysis attributed stormwater as the primary source (92.3%) of total phthalates in sediment based on two distinct stormwater sources; 1) a 17.6% contribution of predominately Butyl Benzyl (90.9% by mass) north of the 520 bridge, and 2) a 74.6% contribution of predominately Bis(2-ethylhexyl) (88% by mass) throughout the Thea Foss Waterway, especially south of the 520 bridge. A third contribution of 7.7% of Dimethyl, Diethly, Di-n-butyl, and Di-n-octly could not be inferred due to these phthalates falling below the minimum detection limit for analysis. Total phthalate concentrations measured in baseflow and stormwater samples from the seven localized stormwater outlets supported the two distinct stormwater sources to sediments. Therefore, PMF can serve as a promising technique for understanding the contribution of multiple sources of stormwater to a waterbody, if sediment samples are collected and measured for hydrophobic contaminants in tandem.

Delta and Nearshore Habitat Use by Juvenile Salmon and Forage Fish in the Nisqually Reach in Relation to Restoration and Other Factors

Michael Hayes[1], Stephen Rubin[1], Christopher Ellings[2], Sayre Hodgson[2], Walker Duval[2], Eric Grossman[1] – U.S. Geological Survey[1], Nisqually Indian Tribe[2]

The Nisqually Reach Aquatic Reserve extends from the Nisqually river delta to public lands surrounding nearby islands. The river delta has been the site of a major estuary restoration, most recently dike removal in fall 2009 to restore tidal inundation to 750 acres of wetlands. Since 2010 we have used a lampara net to conduct sampling (bimonthly in May-August, monthly in April and September) at delta and nearshore sites in the Nisqually Reach to assess juvenile salmon and forage fish habitat use and the response to restoration. Monitoring has also been conducted for benthic habitats (bathymetry, sediment characteristics, macroinvertebrates, eelgrass extent) and physical processes (hydrodynamics, sediment transport/deposition). We will highlight our results to date with an emphasis on salmon and forage fish spatial and temporal distributions, including: 1) Effect of benthic habitats and physical processes on fish distributions; 2) Fish distributions in response to restoration; and 3) Salmon migration pathways in the Nisqually Reach together with data on stock composition inferred from coded wire tag recoveries of Chinook salmon.

***Native Oyster Stocks for Restoration: Does Local Adaptation Affect Outplanting?**

Jake Heare[1], Joth Davis[2], Brent Vadopalas[1], Steven Roberts[1] – University of Washington[1], Puget Sound Restoration Fund[2]

Olympia oysters, Ostrea lurida, in Puget Sound, Washington are known to initiate reproduction at a specific temperature threshold. Bays along a latitudinal gradient within the Sound exhibit temporal variation in attaining this temperature. This gradient of habitat types has been shown in recent studies to induce the phenomena of local adaptation within semi sessile and sessile native organisms. Since O. lurida is native to the west coast, it is hypothesized that populations along a latitudinal gradient have become locally adapted to their environment. This adaptation would have important ramifications for conservation and restoration projects within the Puget Sound. To test these differences we set up a reciprocal transplant experiment among three populations from Fidalgo (Northern), Dabob (Central), and Oyster (Southern) bays along a latitudinal axis as well as a fourth bay (Manchester NOAA facility) as a control repository. We monitored growth, survival, and fecundity from August 2013 to August 2014. We observed only minor growth and survival differences among populations. Throughout the spawning season, Southern oyster population produced significantly more brooding oysters at two of the three sites compared to the other two populations. Oyster populations native to these diverse bays may have genetically diverged their spawn timing to conform to environmental conditions within each bay, or the Southern population may simply have greater fitness. Through our ongoing research, we intend to determine whether Olympia oyster populations exhibit local adaptation within Puget Sound.

The Use of Juvenile Chinook Otoliths Related to Restoration Efforts on the Nisqually River

Angie Lind-Null[1], Kim Larsen[1], Karl Stenberg[1], Lisa Wetzel[1], Christopher Ellings[2], Sayre Hodgson[2] – U.S. Geological Survey, Western Fisheries Research Center[1], Nisqually Indian Tribe[2]

The Nisqually Fall Chinook salmon population is one of 27 stocks in the Puget Sound evolutionary significant unit (ESU) listed as threatened under the Endangered Species Act (ESA). Preservation and extensive restoration of the Nisqually delta ecosystem has taken place to assist in recovery of the stock as juvenile Fall Chinook salmon are dependent upon the estuary. Furthermore, a Chinook salmon recovery priority of the Nisqually Indian Tribe is to develop a self-sustaining, naturally spawning population. Currently, this population consists of offspring from both hatchery and natural spawners. Baseline information that includes characterization of life history types, estuary residence times, growth rates, and habitat use is essential to evaluating the potential response of hatchery and natural origin Chinook salmon to restoration efforts and in determining restoration success. Otolith analysis was selected as a means to examine Chinook salmon life history, growth, and residence in the Nisqually Estuary pre- and post-restoration. This research has developed into a collaborative effort with the Nisqually Indian Tribe and other U.S. Geological Survey (USGS) researchers involving extensive post-restoration monitoring of the Nisqually delta as related to the response of the delta in support of Chinook salmon. We will report on differential usage of the Nisqually estuary and the expression of life history diversity by natural and hatchery reared juvenile Chinook salmon preceding and following restoration efforts.

South Sound Cutthroat Trout (Oncorhynchus clarkii clarkii) Research and Monitoring

James P. Losee, Larry Phillips – Washington Department of Fish and Wildlife

While it is known that Coastal Cutthroat Trout (Oncorhynchus clarkii clarkia) exhibit a diverse life history, definitive information on spawn timing and distribution in the marine environment is limited to counts of adult fish at upstream traps and tagging studies containing few samples. To gain a better understanding of the status of coastal cutthroat trout and the factors affecting their abundance and spawn timing in South Puget Sound, regional fish biologists have developed a series of studies in coastal tributaries of Eld, Totten and Skookum inlets. Using data collected from 2008-2013 goals of this work include 1) describing the time of redd construction (spawning) 2) describe the morphology of cutthroat trout redds 3) identify local environmental variables affecting the timing of spawning and 4) describe the distribution of adults in the marine environment. Updates from this work, and their relationship to broader patterns of cutthroat trout abundance and management will be presented and discussed.

Reclaimed Water Infiltration Study

Ben McConkey[1], Karla Fowler[1], Lisa Dennis-Perez[1], Jeff Hansen[2] – LOTT[1], HDR Engineering, Inc.[2]

The LOTT Clean Water Alliance is conducting a multi-year scientific study to evaluate unregulated and regulated chemicals left in reclaimed water after physical and biological treatment and when the water is reintroduced to the environment. The past two years LOTT and the Study Team have been developing a detailed scope of work for the study, getting feedback and input from the public, an Independent Peer Review Panel, LOTT's Community Advisory Groups, the LOTT Technical Sub-Committee, the study's Science Task Force and LOTT's Board of Directors. This poster covers in large part the on-going work for the next 2-3 years.

Puget Sound Pressures Assessment: South Puget Sound Results

Elizabeth McManus[1], Karen Jenni[2], Scott Redman[3], Ken Currens[4], Bill Labiosa[5] – Ross Strategic[1], Insight Decisions, LLC[2], Puget Sound Partnership[3], Northwest Indian Fisheries Council[4], U.S. Geological Survey[5]

The Puget Sound Pressures Assessment (PSPA) is an effort to better understand the pressures on the Sound's freshwater, marine-nearshore, and terrestrial resources. The assessment relied on (1) expert judgment to evaluate the intrinsic vulnerability of 47 stressors to 61 endpoints and (2) analysis of geographic information to describe the intensity of stressor expression and the occurrence of endpoints in geographic assessment units. PSPA assessment units include the seven marine basins and 16 watershed areas that comprise the Puget Sound ecosystem (i.e., the U.S. portion of the Salish Sea). PSPA results describe critical vulnerabilities for the South Puget Sound marine basin and for the Nisqually watershed and other watershed areas of the South Sound. This characterization of the South Sound is used to generate Sound-wide results. Results for the South Sound marine basin illustrate some variations in key vulnerabilities relative to other parts of the Sound: e.g., spread of disease to native species is a greater concern in South Sound than elsewhere; changing ocean condition poses less concern in South Sound than elsewhere. Likewise, results for the Nisqually and South Sound watersheds illustrate differences between these areas and similarities and differences with other parts of the Sound. For example, the Nisqually watershed is rated as much less vulnerable to land conversion for transportation and utilities and residential, commercial, and industrial development compared to the South Sound watershed (based on current expression of these stressors). Also, terrestrial habitat fragmentation is a higher concern in the South Sound watersheds than in any other part of the basin. These results may be used with other information to support South Sound decisions about priority pressures to be addressed to ensure long-term protection and recovery.

Cumulative Impacts Review for Burley Lagoon Aquaculture

Marlene Meaders, Ruth Park, Chris Cziesla, Paul Schlenger – Confluence Environmental Company

Confluence Environmental Company (Confluence) is conducting a cumulative impacts review to address the conversion of 25.5 acres of existing shellfish beds from cultivation of Pacific oysters (Crassostrea gigas), Manila clams (Venerupis philippinarum), and scatter-planted geoduck clams (Panopea generosa) to geoduck clams planted in culture tubes in Burley Lagoon, Pierce County, Washington. The goal of this document is to analyze how the proposed geoduck aquaculture operation in Burley Lagoon may contribute to cumulative effects (whether positive or negative) within the Burley Lagoon nearshore and aquatic environment, and if the project would result in a "no net loss" of ecological and social functions. The review is using methods similar to those used for the

Puget Sound Nearshore Ecosystem Restoration Project when analyzing net changes to nearshore ecosystems of Puget Sound. These methods utilize conceptual models, which are based on current scientific understanding of the relationship among nearshore ecosystem processes. Where available, data specific to Burley Lagoon was used to define the net contribution of the various parameters of a specific environmental element (e.g., water plants, animals). If an environmental element did not require a detailed conceptual model, a review of the relevant literature was used to understand the historic and current conditions and the potential for cumulative impacts with the addition of geoduck aquaculture. The review is not finished. However, early results indicate that shoreline development has much larger implications to potential changes to the aquatic environment compared to a change in aquaculture operations in an estuary with an 80-year culture history. A cumulative impacts review is instrumental in understanding the primary influences on ecological and social functions. The review for Burley Lagoon will provide information for a dialog with resource agencies associated with the potential threshold of development in the project region.

SoundToxins

Jennifer Runyan[1], Teri King[1], Dr. Vera Trainer[2], Brian Bill[2] – Washington Sea Grant[1], NOAA Fisheries[2]

SoundToxins, a diverse partnership of Washington state shellfish and finfish growers, environmental learning centers, Native American tribes, and Puget Sound volunteers, is a monitoring program designed to provide early warning of harmful algal bloom events in order to minimize both human health risks and economic losses to Puget Sound fisheries. The overall goal of this cooperative partnership is to establish a cost-effective monitoring program that will be led by state managers, environmental learning centers, tribal harvesters, and commercial fish and shellfish farmers. The objectives of the SoundToxins program are to determine which environmental conditions promote the onset and flourishing of HAB events or unusual bloom events, to determine which combination of environmental factors can be used for early warning of these events and to document unusual bloom events and new species entering the Salish Sea. To accomplish this, seawater samples are collected weekly by the participants at 31 different sites throughout Puget Sound. These are analyzed for salinity, temperature, nutrients, chlorophyll, phytoplankton species, and marine biotoxins. Phytoplankton species diversity is described and the four target HAB species are specifically identified and enumerated. These target species are Pseudo-nitzschia species, Alexandrium catenella, Dinophysis species, and Heterosigma akashiwo. The program is jointly administered by NOAA Fisheries and Washington Sea Grant in partnership with the Washington State Department of Health. For more information, go to www.soundtoxins.org.

A Landscape Based Strategy for Grouping Projects and Prioritizing Drainage Catchments along the Shorelines of South Puget Sound

Scott Steltzner[1], Brian McTeague[1], Kyle Brakensiek[2] – Squaxin Island Tribe[1], Private Consultant[2]

Effective implementation of shoreline restoration and conservation projects requires that the association between nearshore, shorelines and associated uplands and surrounding areas be considered. We used drainage catchments generated by Northwest Indian Fisheries Commissions (NWIFC) Salmon and Steelhead Habitat Inventory and Assessment Program (SSHIAP) to devise a landscape based prioritization methodology for the South Salish Sea nearshore environment. This consisted of (1) the formation of a science advisory panel to review methodology, (2) a literature search for conceptual or proposed projects, and (3) a landscape analysis. Catchments were designated as either nearshore, associated with the shoreline, or upland, one and two catchments landward of the nearshore catchments. A nearshore zone encompassing areas 200 meters from the shoreline was also designated. Delineation of these three geographic strata allowed for us to examine and compare attribute data at varying scales. Although our focus for this exercise foremost concerned nearshore environments, the three strata delineations allowed for consideration of the marine nearshore environment and potential relationships to the upland

terrestrial environment. The three strata were then rated by their level of disturbance for a suite of human induced stressors and also for ecological functions & conditions. Individual catchments and groups of catchments were designated for the management strategies of: conservation, enhancement, restoration or creation.

"Shore Friendly Mason:" A Social Marketing Initiative to Reduce Shoreline Armoring (2014-16)

Karin Strelioff[1], Rich Geiger[1], Jen Thurman-Williams[1], Wendy Gerstel[2], Brandy Reed[3] , Kate Riley[4] – Mason Conservation District [1], Qwg Applied Geology[2], King Conservation District[3], Snohomish Conservation District[4], with partners at Mason County Department of Community Development and WSU Extension, (funded by the Washington Department of Fish and Wildlife and the Washington State Department of Natural Resources)

Extensive shoreline armoring (bulkheads, revetments, seawalls etc.) is recognized as a serious threat to the ecological function of Puget Sound's nearshore environment. The majority of shoreline armor in Mason County, WA is found on residential properties where private landowners installed bulkheads or revetments as a commonly-accepted erosion management practice. To address the adverse impacts of armoring in Mason County, the "Shore Friendly Mason" initiative is designed to achieve the following project goals: (1) facilitating the bulkhead removal process where feasible, (2) encouraging the use of soft shore protection alternatives when conditions warrant intervention, and (3) stopping the use of hard armor as an erosion mitigation technique. Mason Conservation District and its partners will implement the "Shore Friendly Mason" initiative beginning in the winter of 2014. This project will use social marketing tools to reach specific subsets of Mason County shoreline homeowners. Targeted information will be supported by web resources and a nearshore technical team available to visit properties and conduct site-specific erosion-risk and shoreline-management assessments. Our intention is for this focused social marketing/direct technical assistance program to reach those landowners willing to remove armor and those with erosion problems who seek unbiased technical advice regarding the causes, risks, and methods for addressing erosion (thus avoiding installation of new hard armor wherever possible). In cases with a reasonable feasibility of armor removal, the technical team will offer guidance to achieve that goal as well. The program will be tested and refined by Mason Conservation District with the ultimate goal of providing an effective model for others, including the eleven other Puget Sound Conservation Districts.

South Sound Monitoring & Adaptive Management Project

Stephanie Suter[1], Laura Blackmore[2] – Puget Sound Partnership[1], Cascadia Consulting Group[2]

The South Sound Monitoring & Adaptive Management project created a framework for synthesizing monitoring results so that they can be more easily used to inform salmon recovery policy and management decisions. The project geography covered the South Sound nearshore from Point Defiance south to Olympia and north to Shelton, including the Nisqually River estuary. Project team members translated the South Sound multi-species salmon recovery plan into the Puget Sound Recovery Implementation Technical Team's Common Framework, created results chains (logic models) to explicitly describe recovery strategies and assumptions, and selected and prioritized indicators for status and trend, implementation, and effectiveness monitoring. The project team used the existing multi-species salmon recovery plan, guidance from the Recovery Implementation Technical Team, knowledge of existing data sets, and best professional judgment to select indicators. The result is a framework to help recovery partners understand whether their chosen strategies and actions will help address high priority pressures to achieve recovery. The project team also identified gaps in the existing plan and local processes to implement it, and described the current adaptive management process used in South Sound. The most important gap to fill first is the lack of a single, structured technical and policy process accountable for implementation of the entire South Sound multi-species salmon recovery plan. The framework will help guide salmon recovery

organizations – from project sponsors to policy makers – as they select and implement projects, track project results, and improve the multi-species recovery plan over time.

***Narrowing the Search for European Green Crab in Washington's Inland Waters**

Chris Tran[1], Jeffrey Woo[1], Jeff Adams[2], Sean McDonald[1] – University of Washington[1], Washington Sea Grant[2]

The invasive, fist-sized European green crab was first found in waters adjacent to the Salish Sea in 1998 after warm El Nino currents spread larvae of California populations up the Eastern Pacific coast to estuaries as far north as Vancouver Island. Most outer coast populations had limited establishment success, persisting as either small or geographically constrained populations. Because of the potential risk the invasive crab posed to coastal resources, it was designated a deleterious species in Washington State, placing strict constraints on possession and transport of the species and giving the Washington Department of Fish and Wildlife authority to monitor and control the crabs. The Salish Sea appeared to be green crab-free until Fisheries and Oceans Canada staff discovered a thriving population in 2012 in Sooke Inlet near Victoria, British Columbia. To help inform monitoring and public outreach efforts, students from the University of Washington worked with staff from Washington Sea Grant and the UW School of Aquatic and Fishery Sciences to identify, map and prioritize suitable green crab habitat using course physical, biological and access characteristics that could be observed in satellite imagery. Nearly 100 locations appear to have high likelihood of being suitable for European green crab establishment. In August 2013, the authors surveyed for crab molts at select high priority locations on the Strait of Juan de Fuca and around Hood Canal and found no green crab molts. The surveys will be repeated in 2014 with outreach to coastal communities around selected priority locations.