



# *Program Directory*

Research, Outreach and Education

**2010-2012**

Washington Sea Grant | University of Washington





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## About this Directory

This document contains brief descriptions of current Washington Sea Grant (WSG) research, outreach and education projects for the 2007 – 2010 and 2010 – 2012 funding cycles. Through the national and local strategic planning processes, four interrelated topics have emerged as critical program areas: Living Marine Ecosystems; Ocean and Coastal Environmental Health; Changing Oceans and Coastal Communities; and Ocean Literacy and Workforce Capacity. These program areas comprise the headings under which individual projects can be found. Additional information is available through the WSG Web site ([wsg.washington.edu](http://wsg.washington.edu)) or from the project leaders and investigators. Contact information for project leaders and investigators is contained in the back pages of this directory and on the WSG Web site.

## Introducing Washington Sea Grant

For more than 40 years, Washington Sea Grant has served Washington, the Pacific Northwest and the nation by funding marine research and working with communities, managers, businesses and the public to strengthen understanding and sustainable use of ocean and coastal resources.

Based at the University of Washington, WSG is part of a national network of 32 Sea Grant college programs located in every coastal and Great Lakes state and in Puerto Rico. The Sea Grant program is administered by the National Oceanic and Atmospheric Administration (NOAA) and funded through federal-state partnerships.

WSG operates within an extremely diverse and productive ocean and coastal region. Washington's ocean coast is an area of low population densities, tribal lands, small ports and natural resource-based economies. By contrast, larger communities with diversified urban economies rim the densely populated Puget Sound basin. WSG participates in numerous federal, state and local programs pertaining to these marine and coastal environments. It is involved in implementing the Puget Sound Partnership's Action Agenda to restore and protect Puget Sound. WSG is also a member of the State Ocean Caucus, established to implement an action plan for improving protection and management of Washington's ocean and coastal resources. On a larger, regional scale, WSG is actively collaborating with NOAA's Western Region, the six West Coast Sea Grant programs and the West Coast Governors' Agreement on Ocean Health.



## WSG Core Programs

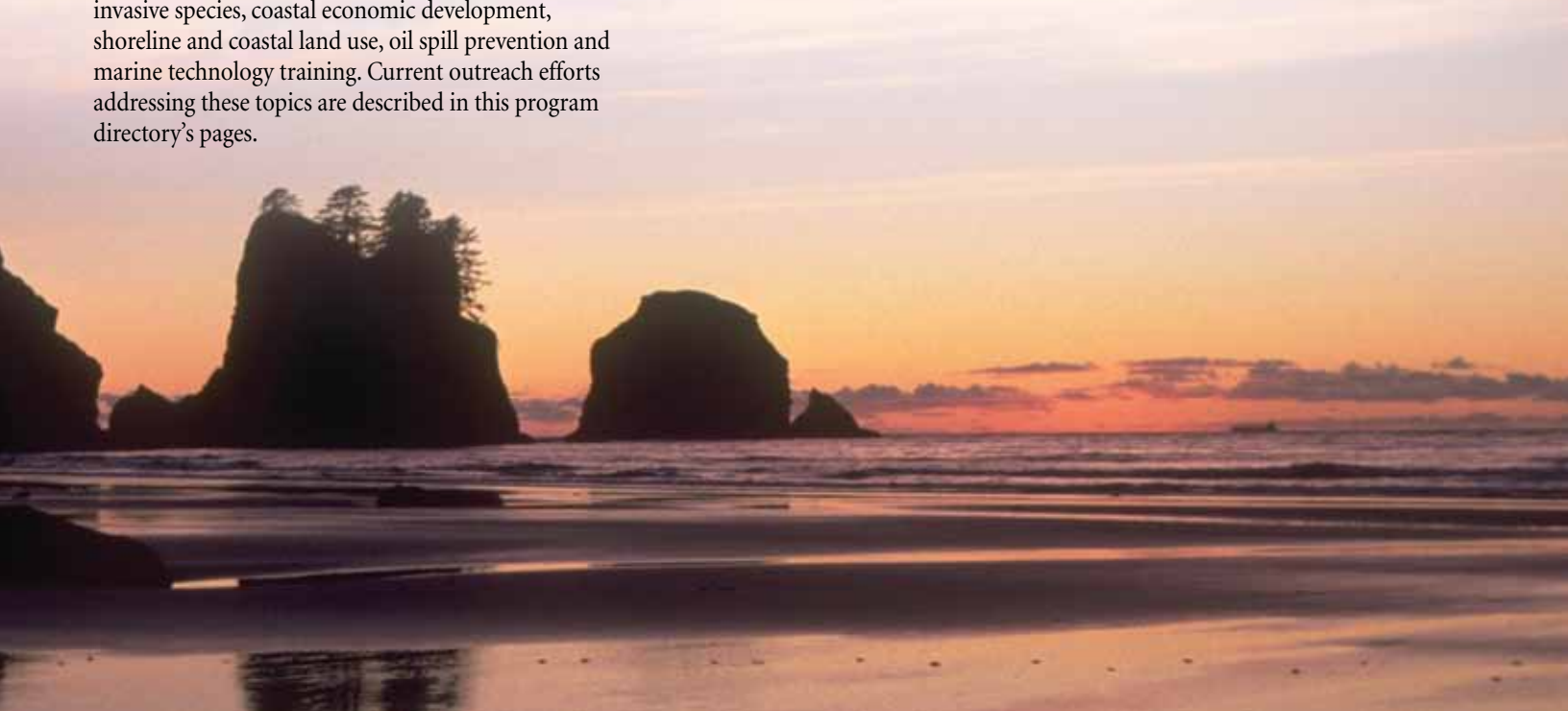
WSG organizes its activities around four core programs: Research, Outreach, Education and Communications. Integration of these four core programs is key to effectively carrying out WSG's mission: "Improving the translation of research and scientific information into knowledge for use in the marine environment."

**Research** sponsored by WSG combines scientific excellence and a focus on problems and opportunities faced by ocean users and managers in Washington and the Pacific Northwest. It maximizes the productive use of marine resources while preserving and, if necessary, helping to restore the essential qualities of a healthy marine environment. From the discovery of rare deep-sea glass sponge reefs off the coast of Washington to the design of habitat-friendly seawalls on Seattle's urban waterfront, WSG's portfolio includes a mix of basic and applied research. WSG selects, funds, oversees and manages marine-related projects carried out by academic and research institutions throughout Washington. While smaller program development projects are funded on a continuing basis, most research projects are funded through a rigorous, competitive process that WSG conducts on a biennial basis.

**Outreach** efforts are a central component of WSG Marine Advisory Services (MAS). Outreach staff works individually and in teams, reaching out to marine and coastal constituents with program-generated information. MAS campus- and community-based specialists conduct research and share university resources and their own expertise with the public and state and local user groups. They work in a broad range of topic areas, including aquaculture, fisheries, water quality, marine operational safety, aquatic invasive species, coastal economic development, shoreline and coastal land use, oil spill prevention and marine technology training. Current outreach efforts addressing these topics are described in this program directory's pages.

**Education** provides learning opportunities for students of all ages to improve ocean literacy and maintain a vibrant marine-related workforce in Washington and the Pacific Northwest. The program presents undergraduate, graduate and postdoctoral students with opportunities to compete for fellowship and internship programs that will expand their horizons and enhance future careers. WSG also supports informal educational programs for K-12 students. It works closely with educators and technical experts to disseminate information on marine resources and the environment. Many WSG research projects involve the training of undergraduate and graduate students, as well as postdoctoral investigators.

**Communications** develops products to help agencies, organizations, businesses, schools and individuals better understand and manage marine resources and the environment. As unbiased brokers of information, WSG Communications keeps the public informed about current research and technology and promotes the understanding of marine issues among industry, educators and marine resource users. The Communications office maintains a publications database, produces and distributes informational brochures, pamphlets and books, creates public exhibits and responds to media inquiries about Sea Grant activities and research. It maintains the WSG Web site and produces publications and other materials in support of all the other WSG program areas — helping translate technical and scientific findings into useful information. Communications has shared its expertise with the Puget Sound Nearshore Partnership, NOAA's Northwest Fisheries Science Center and the University of Washington's College of the Environment, helping them inform their constituents about important marine issues.



# Critical Program Areas

## Living Marine Ecosystems

*Understanding the marine environment and conserving marine resources while providing for sustainable use and ensuring healthy populations in the future.*

### Accounting for Spatial Structure in Stock Assessments: The Case of Pacific Sardine

*Andre Punt, School of Aquatic and Fishery Sciences, University of Washington; Richard Methot, Northwest Fisheries Science Center, NOAA Fisheries Service; and Kevin Hill, Southwest Fisheries Science Center, NOAA Fisheries Service*

R/LME-2

Northern Pacific sardines constitute the second-largest federally managed fishery on the West Coast, but current stock assessment methods do not fully account for where the fish are located (their spatiality). This project will develop a spatially-structured population dynamics model that allows for multiple substocks and regional growth. The model will be used to test alternative stock assessment methods.

### An Individual-Based, Quantitative Genetic Model for Investigating Local Adaptation and Population Viability in Connected Populations of Sockeye Salmon

*Lorenz Hauser, School of Aquatic and Fishery Sciences, University of Washington, in support of Jocelyn Lin, Sea Grant/NOAA Fisheries Fellow in Population Dynamics*

E/I-18

Intraspecific diversity affords species a buffer against environmental disturbance. Population structure is an important determinant of such diversity, and microevolutionary forces (such as selection, migration and inbreeding) will determine the distribution of diversity within and among populations. This project will study how interactions among salmon populations may affect this microevolutionary balance. A model will be developed to determine how microevolutionary changes translate to changes in observable traits and to simulate effects of those changes on reproductive output.



## Climate-Change Effects on Steelhead in North Pacific Marine Ecosystems

*Katherine Myers and Nancy Davis, School of Aquatic and Fishery Sciences, University of Washington; Masa-aki Fukuwaka, Fisheries Research Agency, Hokkaido National Fisheries Research Institute; Nathan Mantua, JISAO/School of Marine Affairs Climate Impacts Group, University of Washington*

R/F-160

Steelhead is a salmonid species on which millions of state and federal dollars are being spent for protection and restoration of stocks in the North Pacific Ocean. How are climate-induced changes in ocean conditions and food webs affecting steelhead growth and survival? Researchers are conducting a retrospective analysis of data extending back to 1955. Coupled with additional field studies, the project is creating a suite of maps and models to clarify the relationships among biological and oceanographic variables on steelhead distributions, migration patterns, bioenergetics and growth.

## Community Engagement for Effective Watershed Stewardship in the Oakland Bay Watershed

*Teri L. King, Washington Sea Grant*

This project seeks to increase levels of voluntary implementation of best management practices on private lands to improve the health of the Oakland Bay watershed. Employing principles of social marketing, it will help the Squaxin Island Tribe identify key issues and obstacles to behavior change, especially among livestock owners and septic system users — the major identified contributors of nonpoint pollution within the watershed. WSG is providing nearshore discovery walks, septic socials and other public venues with teachable moments that will lead to documented behavior change.

## Cultured - Wild Interactions: Disease Prevalence in Wild Geoduck Populations

*Carolyn L. Friedman and Brent Vadopalas, School of Aquatic and Fishery Sciences, University of Washington*

R/GD-2

A lack of baseline information on geoduck health and condition hinders the management of this resource. Without prior knowledge of parasites and disease prevalence, it can be difficult to identify the causative agent of an epidemic. Baseline data provide information of possible pathogens and insight into whether the initial outbreak or re-emergence of a disease is related to an endemic or newly introduced parasite. In this five-year project, funded by the state of Washington, researchers will characterize parasites and other disease organisms associated with geoducks and determine their prevalence in three wild populations representing southern Puget Sound, Hood Canal and the Strait of Juan de Fuca. Animals will be collected during summer and winter to detect both warmwater and coldwater infectious organisms.

## Developing Genomic Biomarkers for Assessing Fish Reproductive Health

*Graham Young and J. Adam Luckenbach, School of Aquatic and Fishery Sciences, University of Washington; Fred Goetz, Great Lakes WATER Institute, University of Wisconsin-Milwaukee; Penny Swanson, Northwest Fisheries Science Center, NOAA Fisheries Service*

R/B-49

While migrating through urban waterways and nearshore environments, salmon are exposed to environmental estrogens, low oxygen concentrations and other contaminants and conditions that can inhibit reproduction. This project is identifying an array of genes in salmon that might serve as markers of such exposures. Fisheries researchers and managers can use the resulting bioassessment tools to evaluate relationships among specific environmental conditions and contaminants and the reproductive health of Puget Sound salmon stocks.



## Educational Activities and Technical Support for Shellfish Growers

*Teri L. King and Steve Harbell,  
Washington Sea Grant*

Washington state's shellfish industry leads the nation in bivalve production and is considered by many to be the most technologically advanced in the world. To deal with increasing environmental, health and regulatory issues, growers need the latest information to remain competitive and economically viable. WSG field agents work in the South Sound, Hood Canal and Grays Harbor areas, in the heart of the shellfish industry. Their activities include hosting an annual conference for shellfish growers, sharing information on aquatic nuisance species and coordinating research on a variety of environmental and water quality issues facing the industry.

## Enhancing Public Understanding of Resource Issues

*Marine Advisory Services staff,  
Washington Sea Grant*

Despite their geographic proximity, coastal residents of all ages often lack fundamental knowledge of ocean and coastal issues. At the same time, University of Washington and other state academic institutions are home to many of the nation's top marine scientists. WSG's Sound Science seminars bring University of Washington scientists to communities to speak about current research related to local resources and economies. MAS also takes advantage of other opportunities to provide balanced information on marine issues for learners of all ages. Activities include marine-related school and library enrichment programs, beach walks, field trips, media interviews, presence at community events and presentations for students, agency personnel, researchers, tribal and coastal residents and low-income and minority audiences.

## Estimating Population Growth and Interspecies Interaction Parameters with Spatial Replication

*Jennifer Ruesink, Department of Biology,  
University of Washington, in support of Kevin See,  
Sea Grant/NOAA Fisheries Fellow in Population  
Dynamics*

E/I-15

Understanding the effects of biotic and abiotic factors on the growth rate of a population of a particular species can help managers make informed decisions to maintain the health and viability of that population. This project will design methods for incorporating spatially replicated data to estimate these factors, enhancing the precision of estimates and potentially accelerating the response time of managers in identifying potential threats. The project will provide researchers and managers with an understanding of the potential benefits of spatial replication and covariance within a larger population and the relative effects of other species on a focal species. The model and methods developed will be used in estimating community population dynamics parameters in West Coast groundfish populations.

## Evaluating Pacific Groundfish Schooling Behavior and Untrawable Refuges Using Multi-Species Mixture Models and Data from Autonomous Underwater Vehicles

*Andre Punt, School of Aquatic and Fishery  
Sciences, University of Washington, in support of  
James Thorson, Sea Grant/NOAA Fisheries Fellow  
in Population Dynamics*

E/I-17

Management of the seven overfished Pacific groundfish stocks is inhibited by difficulties in standard stock assessment methods that may be caused by fish aggregation and habitat-selective behaviors. This project will develop an individual-based model of Pacific groundfish to aid in evaluating future Pacific groundfish management proposals. The model will be used to estimate the precision and accuracy of alternative index standardization methods and autonomous underwater vehicle (AUV) sampling when applied to habitat-selective or schooling species.



## Evaluating Stock Assessment Methods and Management Strategies for Spatially Heterogeneous Fish Stocks

*Ray Hilborn, School of Aquatic and Fishery Sciences, University of Washington, in support of Carey McGilliard, Sea Grant/NOAA Fisheries Fellow in Population Dynamics*

E/I-14

Many fish stocks are patchily distributed in the world's oceans — a fact that is often overlooked by resource managers when setting catch quotas. For this project, methods for assessing and managing patchily distributed fish stocks will be developed and tested. The sensitivity of these models to variables such as marine protected areas and sites unreachable by conventional trawl gear will be evaluated, and the effectiveness of several strategies for managing large-scale and small-scale fisheries will be analyzed.

## Factors Influencing Recruitment Variability in Estuarine Bivalves

*Jennifer Ruesink and Alan Trimble, Department of Biology, University of Washington*

R/LME-3

Washington state, particularly Willapa Bay, has experienced dramatic declines in oyster recruitment for the past four years. Production at commercial bivalve hatcheries has also declined, and harvests continually exceed seed renewal rates. This project will evaluate more than 80 years of historical data on oyster and clam reproduction in Willapa Bay, Puget Sound and British Columbia. Data will be used to guide research directed at determining the key mechanisms controlling reproduction in Washington's cultured bivalves.

## Geochemical and Ecological Consequences of Disturbances Associated with Geoduck Aquaculture Operations in Washington

*Glenn VanBlaricom, David Armstrong and Tim Essington, School of Aquatic and Fishery Sciences, University of Washington (R/GD-1a), and Jeffrey Cornwell and Roger Newell, Horn Point Marine Laboratories, University of Maryland (R/GD-1b)*

R/GD-1a and R/GD-1b

As part of a large-scale multidisciplinary study funded by the state of Washington, researchers will address several of the most pressing issues regarding the effects of geoduck aquaculture on the Puget Sound ecosystem:

the effects of aquaculture structures on communities of plants and animals in or on Puget Sound beaches; the potential of these structures to change the behavior or movements of salmon and other commercially and ecologically important fish and shellfish; whether disturbance during geoduck harvesting affects communities of plants and animals and subsequent recovery of the ecosystem; if such disturbance during harvesting alters the physical and chemical properties of Puget Sound beaches. Researchers will investigate ecosystem-level effects on an array of organisms, throughout the geoduck culture cycle. The project will examine initial conditions and patterns of recovery following culture activities, such as installing structures or harvesting clams, and compare the changes associated with these activities to those of storms and other naturally occurring disturbances. Research findings will provide the scientific foundation for policy decisions that balance the needs and concerns of shellfish growers, environmental groups and property owners.

## Glass Sponge Reef Habitat in the Pacific Northwest

*H. Paul Johnson, School of Oceanography, University of Washington*

R/NP-6

Glass sponge reefs have recently been discovered in deep waters near Grays Canyon off the Washington coast. Little is known of these habitats, long inaccessible to humans. This project is using sophisticated imaging technologies to create maps and oceanographic profiles of the sponge reefs and their inhabitants, which can include commercially important shrimp and rockfish.

## Linking Genetic Variation, Selection and Adaptation in Chinook Salmon: Next Generation Genome Sequencing

*Kerry Naish and Jim Seeb, School of Aquatic and Fishery Sciences, University of Washington*

R/LME-1

One of the key challenges remaining in the conservation and management of fish populations is the ability to anticipate their adaptive response to human activities. Understanding this response will allow researchers to track the impact of these activities, explore alternative management strategies and assess the success of any remedial actions taken. This project will develop powerful tools, based on recent

innovations in DNA sequencing, that can be used to evaluate variation across the Chinook salmon genome, measure changes in population fitness and improve forecasting efforts in species management.

### Non-Invasive Physiological Monitoring of Southern Resident Killer Whales

*Samuel Wasser, Center for Conservation Biology, University of Washington*

R/LME-4

Washington's endangered southern resident killer whale population experienced an unexplained 20-percent decline in the late 1990's. The study will use detection dogs aboard boats to locate fresh orca scat on the surface of the water, facilitating its collection and subsequent analysis. This noninvasive approach will analyze fecal hormone and toxin levels to test three potential population threats: declines in Chinook salmon (a major component of the killer whales' diet), disturbance by vessel traffic and the presence of persistent organic pollutants.

### Pacific Whiting Plant Monitor Training

*Pete Granger, Washington Sea Grant*

In 2008, shoreside processors of Pacific whiting in Washington, Oregon and California were subject to new federal catch reporting requirements. Seasonal observers now are needed to monitor whiting and bycatch landings, correctly identifying bycatch species, monitoring landing weights and ensuring accurate reporting of catch data. Working with NOAA Fisheries' Northwest Regional Office, WSG is coordinating training of observers for the processing plants.

### Populations and Spatial Dynamics of Endangered Baleen Whales in the North Pacific

*Glenn VanBlaricom, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, University of Washington, in support of Amanda Bradford, Sea Grant/NOAA Fisheries Fellow in Population Dynamics*

E/I-13

Baleen whale populations worldwide were dramatically reduced by commercial whaling practices in the 19<sup>th</sup> and 20<sup>th</sup> centuries. This project will examine the dynamics of severely depleted populations of baleen whales in the North Pacific in order to establish a quantitative framework for evaluating the recovery potential of these populations. The frameworks will be applied to data on western gray whales and Sea of Okhotsk bowhead whales, both of which are at high risk of extinction.

### Recolonization of the Upper Cedar River by Anadromous Salmonids

*Thomas Quinn, School of Aquatic and Fishery Sciences, University of Washington*

R/F-159

Recent dam modifications have allowed coho and Chinook salmon to recolonize the upper Cedar River watershed. For the past three years, data have been collected on all salmon entering the watershed. From these and other data, project team members are exploring the origins of the fish that come back to the upper Cedar River — whether they are returning generations or a constant influx of strays from populations below the dams — and how traits such as body size and spawning date affect the reproductive success in this recolonization event. The results will shed light on the factors spelling success or failure in salmon recolonization efforts.



## Recovery and Performance of Complex Marine Exopolymers in the Cold

*Jody Deming, School of Oceanography,  
University of Washington*

R/B-50

Exopolymers are naturally occurring compounds that, at sub-zero temperatures, function as enzyme stabilizers and protect cells against damage from freezing. This project is recovering exopolymers produced by a marine bacterium in sea ice, using innovative techniques that, unlike previous methods, will not alter the structure or properties of these compounds. This technological breakthrough should advance our understanding of sea-ice communities and has considerable potential for applications in the biotechnology field.

## Reducing Seabird Mortality in Fisheries

*Edward F. Melvin and Troy Guy,  
Washington Sea Grant*

Seabird avoidance measures developed and tested by WSG have dramatically reduced seabird mortalities in Alaska longline fisheries. These measures have been incorporated into regulations in the North Pacific. On the West Coast, these measures are studied with cooperation from tribal and non-tribal longline fishermen. On an international level, WSG is promoting a coordinated effort to curb the accidental capture of seabirds. Few countries require seabird avoidance measures and, in the extensive longline and trawl fleets throughout the world's oceans, this continues to threaten far-ranging albatrosses, petrels and other seabird species. Past and current WSG-initiated projects have addressed this issue globally.

## Resilience of Soft-Sediment Communities after Geoduck Harvest in Samish Bay, Washington

*Jennifer Ruesink, Department of Biology,  
University of Washington*

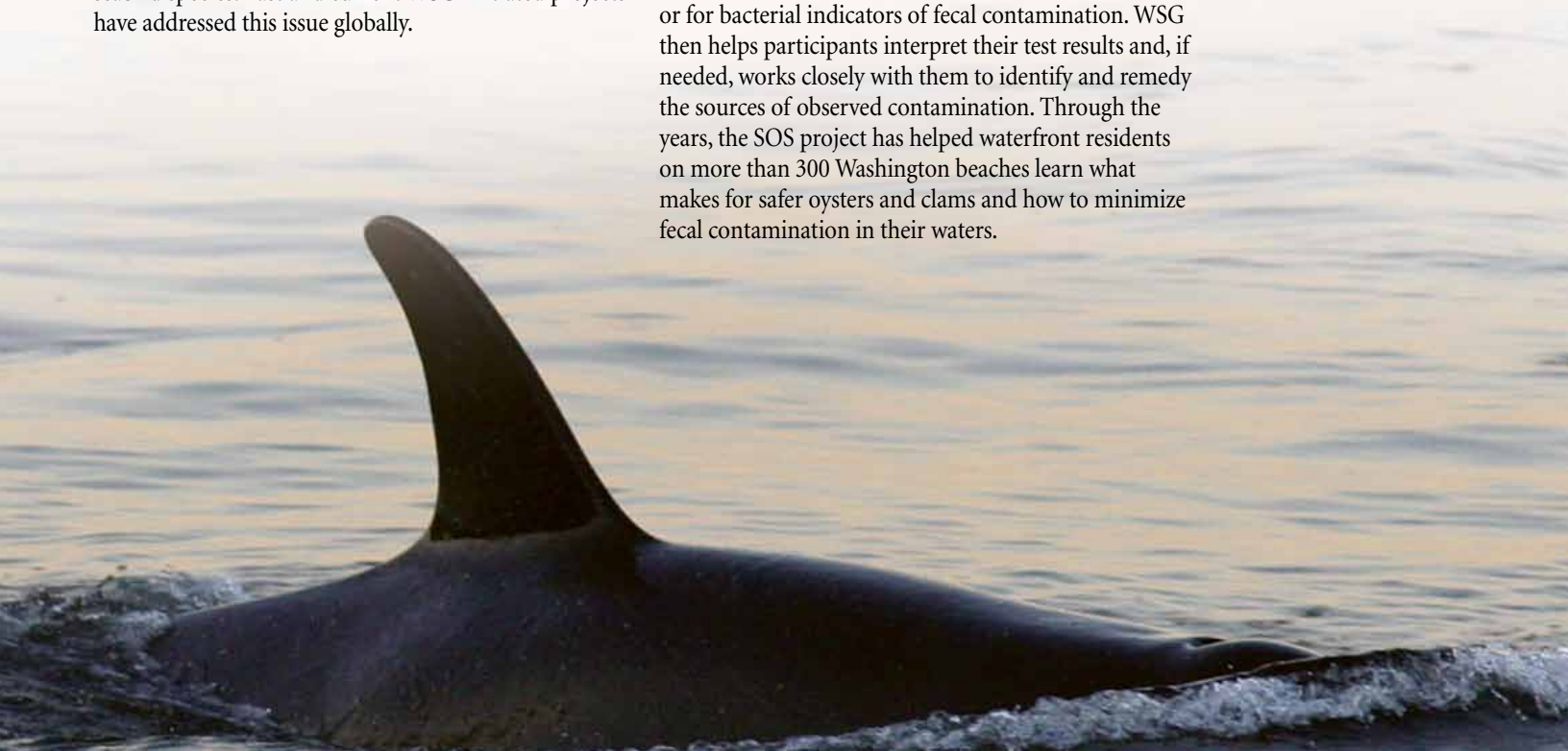
R/GD-3

Commercial geoduck beds share waters with soft-sediment tideflats and eelgrass meadows — two habitat types that host diverse communities of plants and animals. This project, funded by the state of Washington, will explore changes in the habitats within and nearby a commercial geoduck bed during the geoduck aquaculture cycle, from harvesting the clams through the reseeded of a new crop and the removal of protective PVC pipe. Detailed surveys before and after these events, both inside and outside the geoduck bed, will produce data on initial impacts on and rates of recovery for eelgrass meadow and soft-sediment invertebrate communities. The project will offer insights into interactions between commercial geoduck aquaculture practices and local marine habitats.

## State of the Oyster Study

*Teri L. King, Washington Sea Grant*

Since 1987, the State of the Oyster Study (SOS) has engaged citizens in the monitoring of edible shellfish. Waterfront property owners in Puget Sound and Hood Canal collect oyster and clam samples from their beaches at specific times during summer months. WSG arranges for laboratory testing of the samples, which are analyzed for the presence of harmful bacteria or for bacterial indicators of fecal contamination. WSG then helps participants interpret their test results and, if needed, works closely with them to identify and remedy the sources of observed contamination. Through the years, the SOS project has helped waterfront residents on more than 300 Washington beaches learn what makes for safer oysters and clams and how to minimize fecal contamination in their waters.



## Ocean and Coastal Environmental Health

*Assessing and addressing the effects of human activities, including contamination, habitat loss and aquatic invasive species, to protect and maintain ecosystem health.*

### CVA Boater Pumpout Project

*Dan Williams and Eric H. Olsson,  
Washington Sea Grant*

Working with the Washington State Parks and Recreation Commission, WSG is conducting a two-phase education and awareness program to increase recognition of the federal Clean Vessel Act pumpout symbol and promote the use of boat pumpout facilities throughout Washington. Initially, the project is identifying target audiences, designing and producing information materials and promotional items, establishing a Web site and conducting surveys to be used to refine and evaluate the campaign. The campaign will be extended into eastern Washington waters, ultimately reaching operators of 25,000 boats and 50 percent of the state's marinas.

### Ecology and Management of Marine Riparian Areas in Puget Sound

*Jim Brennan, Washington Sea Grant*

Working with the state's Aquatic Habitat Group, WSG staff has drafted a marine riparian guidance document for use by local jurisdictions as they update their Shoreline Master Programs and other planning elements for shorelines. When approved, the guidance document will provide recommendations for improved protection and management standards, particularly with respect to riparian buffers, for marine shorelines in Puget Sound. The project will aid in establishing a standard of practice that improves shoreline land-use practices, reduces degradation and loss of riparian and marine nearshore habitats and species and creates greater consistency among local shoreline management programs.

### Effects of Ocean Acidification on Declining Puget Sound Shellfish

*Carolyn Friedman, Steven Roberts and Brent Vadopalas, School of Aquatic and Fishery Sciences, University of Washington; Simone Alin and Richard Feely, Carbon Group, Pacific Marine Environmental Laboratory, NOAA; Jonathan Davis, Research and Development, Taylor Resources, Inc.; Ralph Elston, AquaTechnics*

R/OCEH-4

The increasing level of carbon dioxide in the atmosphere is absorbed by seawater, causing a chemical change known as ocean acidification. Certain marine shell-builders such as clams, oysters and other mollusks are particularly vulnerable to this change in seawater chemistry. The project will examine the relationship between changing environmental conditions and health of larval mollusks.



## Effect of Salmon Omega-3 Fatty Acids on PBDE Toxicity

*Evan Gallagher, Department of Environmental Health and Occupational Health Sciences, University of Washington*

R/OCEH-5

Levels of polybrominated diphenyl ether (PBDE) flame retardants have increased in fish, wildlife and human tissues during the past decade, and PBDE residues in resident Puget Sound Chinook salmon are high relative to many other species. On the other hand, salmon consumption has demonstrated health benefits from nutrients such as omega-3 polyunsaturated fatty acids. This project will study the biochemical interactions among these compounds at the cellular level and thus facilitate a better understanding of the risks and trade-offs associated with eating salmon that contains both persistent organic chemicals and beneficial omega-3s.

## HAB Formation by a Motile Alga in Dynamic Estuarine Environments

*Daniel Grünbaum, School of Oceanography, University of Washington*

R/B-52

This project is investigating the functional biology and oceanography of harmful algal blooms (HABs) caused by *Heterosigma akashiwo*, an actively swimming alga. Innovative observation techniques are being used to quantify how algal swimming responses vary with genetic strain, physiological state and environmental conditions. Observed cell behaviors will be integrated with oceanographic circulation models to predict their effects on timing, location and severity of toxic blooms. This research will yield new methods for understanding the factors favorable to HAB formation and predicting the effects of future environmental changes.

## How Does Hypoxia Impact Marine Food Webs and Fisheries? Evaluating Distributional Shifts in Hood Canal

*Tim Essington and David Armstrong, School of Aquatic and Fishery Sciences, University of Washington; Phillip Levin, NOAA Fisheries Service; Leif Rasmuson, Department of Natural Resources, Skokomish Tribal Nation*

R/OCEH-3

Hypoxia has emerged as a widespread threat to estuaries, coasts and semi-enclosed seas worldwide. Regionally, hypoxia has been identified as a key threat to the Puget Sound ecosystem. The intensity and extent of hypoxia have been increasing in southern Hood Canal over the past two decades, causing widespread distributional shifts in mobile fish populations. Such shifts may be more ecologically significant than more visible impacts, such as fish kills. This project will determine the nature and extent of species' distributional shifts in response to seasonal hypoxia in Hood Canal so that indirect ecological effects can be discerned.

## Impacts of Armoring on Puget Sound Beaches

*Megan Dethier, Department of Biology, University of Washington and UW Friday Harbor Laboratories*

R/OCEH-2

Surprisingly little is known about the effects of shoreline armoring in Puget Sound, even though about 30 percent of the Sound's shorelines are already armored. Erosion related to sea-level rise will increase the demand for shoreline protection. Extensive armoring could disrupt many natural processes, resulting in cumulative physical and biological impacts. This research will examine changes in some shoreline physical features and ecosystem functions resulting from removal of armoring at Seahurst Park in Burien.

### Integrating Intertidal Habitat into Seattle Waterfront Seawalls (phase 2)

*Jeff R. Cordell, Jason Toft and Charles Simenstad, School of Aquatic and Fishery Sciences, University of Washington*

R/OCEH-1

Seattle's central waterfront seawall on Elliott Bay is a vertical, relatively smooth constructed surface that does not support most of the ecological functions originally provided by natural beaches. Researchers on this project are working with the City of Seattle to design, engineer and evaluate complex habitat panels — a process that will inform the City about how to construct a more ecologically friendly seawall. This project continues monitoring of the panels to provide a more comprehensive evaluation of their effectiveness in restoring nearshore habitat function.

### Optical Detection and Characterization of the Fish-Killing Alga *Heterosigma akashiwo*

*Daniel Grünbaum, School of Oceanography, University of Washington*

R/OCEH-6

*Heterosigma akashiwo* forms massive slicks that can be lethal to fish, particularly penned salmon, and other marine organisms. Models that predict *Heterosigma* blooms can give fish farms time to protect stocks, but current monitoring methods cannot supply needed data in a timely, cost-effective way. Optical instruments are available to quantify *Heterosigma* cell distributions and swimming behaviors from which the timing and locations of toxic slick formations can be predicted. This proposal will integrate these elements into a prototype of a functional, low-cost remote-sensing platform for the detection of *Heterosigma* cells.

### Outreach and Education on Aquatic Invasive Species

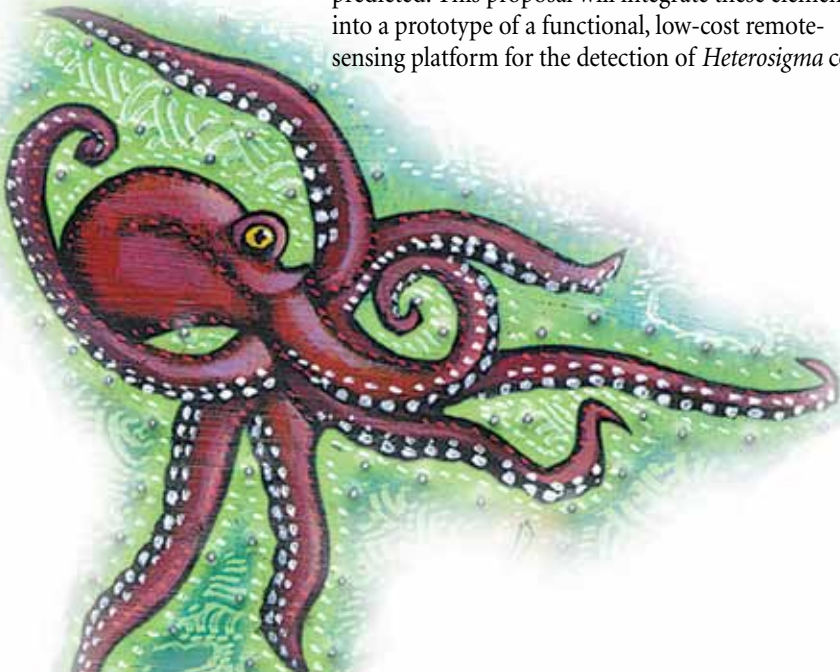
*Jeff Adams, Washington Sea Grant*

Non-native plants and animals are continuously being introduced into aquatic systems. A small number will thrive, threatening personal property, livelihoods, coastal habitats and native aquatic life. Understanding pathways for aquatic invasive species (AIS) allows researchers and marine resource managers to prevent their spread, develop rapid response plans for unwanted arrivals and minimize the impacts of established AIS. Pet stores, seafood suppliers, schools, marine businesses and others play important roles. WSG and UW colleagues promote and support volunteer monitoring of AIS by citizen scientists and work with agencies at the state and regional levels to learn about introduction pathways and develop effective management strategies.

### Puget Sound Water Quality Awareness and Enhancement

*Jeff Adams, Sue Blake and Teri L. King, Washington Sea Grant*

Marine water quality continues to be a serious environmental and public health issue, especially in south Puget Sound and Hood Canal. WSG leads a series of septic socials and community clinics. Micromesh screens are distributed to capture food waste in kitchen sinks, preventing its flow into septic systems and into Hood Canal. WSG staff members conduct dozens of workshops for residents and targeted audiences on a variety of topics, including septic system operation and maintenance, rain gardens and water-friendly gardening, landscaping to reduce stormwater runoff, and clean and simple household practices.



## Scales of Residence-Time Variation in Northwest Estuaries

Jennifer Ruesink, Department of Biology, University of Washington, and Neil Banas and Miles Logsdon, School of Oceanography, University of Washington

R/ES-67

Driven by small-scale tidal currents, patterns of flushing and retention (or residence time) can affect such things as nutrient loading, plankton distribution and oyster growth in coastal estuaries. By understanding these patterns, scientists can more accurately predict how long pollutants may be held in the marine environment and the degree that nutrients and other materials from outside a bay might support the carrying capacity for natural populations and farmed species of fish and invertebrates. For this project, researchers are using high-resolution modeling technologies and data from field studies of oyster growth and environmental and biological conditions in two Washington estuaries. Their findings may have broader applications in estuaries throughout the Northwest.

## Simple Techniques Program for Hood Canal Watershed Residents

Teri L. King, Washington Sea Grant

In the Simple Techniques program, citizen involvement and awareness are key elements for keeping Hood Canal healthy. Through this state-funded program, WSG leads a series of septic socials and community clinics. Micromesh screens are distributed to capture food waste in kitchen sinks, preventing its flow into septic systems and into Hood Canal. About 2,000 property owners around the lower portion of Hood Canal participated in the project, and most have indicated that they would continue to use the screens. Research suggests that micromesh screens potentially reduce the nitrogen load in Hood Canal by 75.2 kg each year. Held in conjunction with other regional events, garbage-grinder round-ups also contribute to nitrogen reductions.

## Slick-Forming Algae: Growth, Genetics and Toxicity

Rose Ann Cattolico, Department of Biology, University of Washington

R/B-48

By predicting the location, timing and severity of highly localized HABs, scientists can help reduce the danger these occurrences pose to fish, invertebrates and humans. This project employs laboratory research and modeling technologies to identify environmental conditions that drive the formation of toxic algal blooms. Molecular “bar-coding” will help identify specific strains of algae that pose the largest economic and ecological risk.

## Small Oil-Spill Prevention Education

Eric H. Olsson, Washington Sea Grant

Small oil spills add up, and their cumulative effects are particularly harmful to the marine environment. Unlike large, catastrophic spills that draw media attention, public concern and rapid response, small oil spills are rarely reported and seldom cleaned up. Often they occur in fertile nearshore marine habitats that are extremely vulnerable to pollution. WSG’s small oil-spill prevention education program emphasizes direct interaction with vessel and marina operators and others to provide safe and practical alternatives to spill-prone practices. The program targets commercial fishing and recreational boats, ferries, ports and marinas to promote innovative waste oil reduction and recycling, as well as sound maintenance and operating practices. WSG plays an active role in the Clean Marina Washington program, encouraging boaters to “leave a light boatprint.”



## Changing Oceans and Coastal Communities

*Providing support to coastal communities for economically sound and environmentally sustainable management and development.*

### Crabber / Towboat Lane Agreement

*Steve Harbell, Washington Sea Grant*

Conflicts between ocean-going tugs and commercial crabbers in Washington, Oregon and California were a major problem in the late 1970s. Crab pots fouled tugs as they moved between coastal ports, and the loss of their gear was a severe economic loss for crab-boat owners. Sea Grant programs on the West Coast helped broker an agreement that provided navigable towboat and barge lanes through the crabbing grounds between Cape Flattery and San Francisco. WSG took a leadership role in the late 1990s that remains pivotal in saving these industries hundreds of thousands of dollars each year.

### Green Shores Project

*Katrina Hoffman, Washington Sea Grant*

Washington has extensive regulations governing the use of shorelines, yet the state's natural shorelines continue to be affected by development and hard armoring. WSG is partnering with the City of Seattle, San Juan County and the Green Shores Technical Team on a Green Shores pilot project. Green Shores uses voluntary incentives to promote sustainable use of coastal ecosystems through planning and design.

Patterned after the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program, Green Shores will incentivize alternatives to traditional shoreline development and help minimize the environmental impacts of development in a cost-effective manner.

### Intensive Technical Assistance Program for Fishermen

*Pete Granger, Steve Harbell and Sarah Fisker, Washington Sea Grant, and John Nelson, Western Center for Risk Management Education, Washington State University Extension*

As a follow-up to the federal Trade Adjustment Assistance program, salmon fishermen who have been adversely affected by foreign competition and have applied for TAA benefits are eligible for an Intensive Technical Assistance (ITA) program delivered by WSG. ITA applicants are given more in-depth training in business management, direct marketing and financial planning as it pertains to their fishing businesses. WSG works with the U.S. Department of Agriculture and Alaska Sea Grant to deliver this program to tribal and non-tribal fishermen.

### Managing Coastal Community Development

*Katrina Hoffman and James Brennan, Washington Sea Grant*

Communities, non-government organizations and coastal businesses in western Washington need sources of information to address long-range coastal futures issues. To meet this need, WSG incorporates training and outreach, network coordination and technical assistance to support shoreline and coastal planning. It continues the long-standing partnership with the Washington Department of Ecology on the Shoreline and Coastal Planners Group and encourages establishment of new partnerships to develop a coordinated network for providing technical assistance. WSG has co-located a coastal resources specialist at the Padilla Bay National Estuarine Research Reserve to facilitate collaboration with the Reserve's Coastal Training Program.



## Projections of Ocean Properties Along the Washington Coast Related to Environmental Health

*Nicholas Bond and Albert Hermann, Atmospheric Sciences, University of Washington, and Joint Institute for the Study of the Atmosphere and Oceans; Enrique Curchitser, Institute of Marine and Coastal Science, Rutgers University*

R/COCC-1

The most significant effects of global climate change on the Pacific Northwest could come in the form of increases in harmful algal blooms, extreme hypoxia and other events that affect environmental health. Many tools now exist for projecting regional oceanographic phenomena crucial to ecosystem structure and function. This project will merge physical, biological and climatic data to help predict the likely evolution of the threats to coastal environmental health associated with different types of climate change events.

## Sound Future Initiative

*Penelope Dalton, Washington Sea Grant; Linda Kirk Fox, Washington State University Extension; Terrence Stevens, Padilla Bay National Estuarine Research Reserve.*

Although the majority of the region's citizens highly value Puget Sound, they do not recognize the danger it faces. Citizen education and outreach are central to protection and restoration of Puget Sound habitats and resources. The Sound Future initiative would leverage university assets to catalyze public involvement in the Puget Sound Partnership's Action Agenda. It would draw on and expand the proven technical expertise of WSG and Washington State University's Extension program, supporting a county-based volunteer network and encouraging development of citizen science programs.

## Tracking Retail Boat Sales

*Michelle Wainstein, Washington Sea Grant*

WSG is partnering with the Washington Department of Licensing and the Northwest Marine Trade Association (NMTA) to provide access to data on boat sales in Washington. Monthly, quarterly and yearly reports help NMTA's boat-dealer members make more informed decisions about business operations, allowing them to redirect sales strategies and boost overall sales. State officials can use boat sales information to more accurately site pumpout stations for boaters' waste, target prevention program strategies for small oil spills and validate demand for new in-water moorage or dry-stack storage throughout Washington.



# Ocean Literacy and Workforce Capacity

*Educating students of all ages and strengthening workforce capacity.*

## Citizen Science

*Kate Little, Washington Sea Grant*

Public involvement in citizen science projects can increase knowledge, awareness and sense of place, inspiring behavioral change. Citizen science can also provide rigorous, cost-effective data collection for research, monitoring and management needs. WSG's citizen science program has gathered information from scientists, natural resource managers, citizen science practitioners and volunteers and convened a Citizen Science Advisory Panel to develop recommendations for advancing citizen science to meet Puget Sound Action Agenda goals. Building from this effort, the program is working to foster connections among scientists, managers, volunteer groups and others, provide consultation services for citizen science and develop resources to facilitate citizen science efforts linked to scientific research, monitoring and management needs.



## Dean John A. Knauss Marine Policy Fellowships

*Nancy Reichley, Washington Sea Grant*

National Sea Grant fellowships provide one-year appointments in Washington, D.C., to graduate students in marine policy and science. The students work with executive agencies and congressional staff dealing with marine issues. These fellowships allow students to broaden their experience and knowledge in national environmental policy and to increase their chances of achieving their long-term educational and career goals. In turn, the students provide the executive and legislative branches with fresh perspectives and knowledge of current science.

## K-12 Watershed and Estuary Education Project

*Terrence Stevens, Padilla Bay National Estuarine Research Reserve*

Through a partnership with WSG and the NOAA B-Wet program, the Padilla Bay National Estuarine Research Reserve is developing onsite, place-based education programs for students throughout northwest Washington. The project will offer teacher workshops on developing experiential, inquiry-based education programs and develop classroom materials.

## Marc Hershman Marine Policy Fellowships

*Nancy Reichley, Washington Sea Grant*

This nine-month fellowship places eligible graduate students or recent graduates with member agencies of the Washington State Ocean Caucus in Olympia, working on ocean and coastal science and management issues. The fellowship offers a first-hand experience in crafting marine and natural resource policies and enables fellows to share their academic expertise with state decision makers. In addition to WSG, the State Ocean Caucus includes members from the Governor's office, Department of Ecology, Department of Natural Resources, Department of Fish and Wildlife, Department of Health and Department of Commerce, as well as the State Parks and Recreation Commission and Military Department Emergency Management Division.

## Marine Safety and Technology Training

*Sarah Fisker, Steve Harbell and Eric Olsson, Washington Sea Grant*

West Coast and Alaska fisheries are the highest-risk fisheries in the country. Because of short seasons and competition for harvestable resources, fishermen face intense pressure to fish under adverse conditions. The pressure, combined with the severe ocean environment in the North Pacific, increases the threats to crews and their vessels. Port-based training for commercial fishermen improves their emergency preparedness and ability to effectively use new safety equipment. WSG offers classes and workshops that focus on vessel safety, maintenance and operations. The workshops also attract recreational boaters and others with close ties to the marine environment. WSG also hosts workshops and classes on marine refrigeration, corrosion, diesel engine troubleshooting, computers and navigation and other topics of interest to the owners and operators of vessels in Puget Sound and along the Washington coast.

## New Models for Solving Future Policy and Management Challenges in the Nearshore and Estuarine Environments

*Tom Leschine and Terrie L. Klinger, School of Marine Affairs, University of Washington*

E/MS-9

The Pew Ocean Commission and the U.S. Commission on Ocean Policy recommended new approaches to ocean governance that consider climate change and other future uncertainties. This project recruits graduate students within the School of Marine Affairs to develop case-study Master's theses that apply integrative approaches to address important policy and management questions for the region. The project goal is to develop a casebook that encourages a new model of analysis — one that is publishable and broadly applicable to difficult-to-resolve current issues in ocean governance.

## NOAA Science Camp

*Julie Hahn, Washington Sea Grant*

Held at NOAA's Seattle facility at Sand Point, five-day summer camp sessions offer opportunities for seventh and eighth graders to learn about marine sciences in an environment that stimulates interest in personal and professional growth. Participants are introduced to earth and ocean sciences and to science careers through hands-on activities emphasizing solutions to real-world problems. The camp brings NOAA scientists and staff together with educators and students to explore and solve an environmental mystery. Established in 2003, the camp is currently operated through a partnership between WSG and NOAA's Western Regional Center. Because of the continuing popularity of this program, two sessions of camp have been offered since 2007.

## Orca Bowl

*Julie Hahn, Washington Sea Grant*

This academic competition and ocean literacy event is designed to challenge and recognize high-school students' knowledge in science, math and technology in the context of the world's oceans. Students tackle questions in all areas of marine studies, facing rapid-fire short-answer questions and team challenges that test problem-solving skills. All students receive prizes for participation, with top awards that include scholarships and shipboard science experiences. The winning Orca Bowl team competes in the National Ocean Sciences Bowl finals, with support from the Consortium for Ocean Leadership.



### SoundCitizen: Students and Citizens Working Together to Evaluate Sources and Fates of Emerging Pollutants in Puget Sound

*Richard Keil, School of Oceanography, University of Washington, and Anne Steinemann, Civil and Environmental Engineering, University of Washington*

R/OLW-1

Persistent exposure to low levels of mixed pollutants can result in a variety of impacts on human and environmental health. While current research focuses primarily on sources and effects of known pollutants, SoundCitizen will examine emerging pollutants that are common in urban households, have multiple sources and pathways into the aquatic environment and are likely to increase in the future because they are found in “green” products of growing popularity. SoundCitizen uses school groups and volunteers to collect water samples for toxin analyses and educates participants about ecosystem health and sustainability.



### Sustainable Seafood Retail Training

*Pete Granger, Steve Harbell and Sarah Fisksen, Washington Sea Grant*

Sustainable fisheries management and catch methods, seafood handling and safety, and health issues are of great concern to consumers, most of whom get their information from the workers behind seafood counters. Based on a survey of meat cutters and seafood department managers in several local grocery chains, WSG designed a 12-hour retail seafood training program for apprentice meat cutters. The program is offered in conjunction with the Meatcutters Apprenticeship Program of South Seattle Community College and the United Food and Commercial Workers International Union.

### Understanding Lummi Perspectives of Marine Resource Management and Marine Protected Areas

*Patrick Christie, School of Marine Affairs, University of Washington, and Roberto Gonzalez-Plaza, Northwest Indian College*

E/ES-12

This project is collecting data on Lummi Indian perspectives on emerging ocean and coastal management issues. It is fostering collaborative efforts among Lummi leaders and non-tribal marine policy makers to develop mutually acceptable policies for

Puget Sound. The project has jointly hosted UW and Northwest Indian College courses, developing students' social science skills while building institutional bridges between native and non-native partners.

### Whatcom County Water Resources Education

*Sue Blake, Washington Sea Grant*

A unique cost-sharing partnership with WSG, Washington State University Extension and Whatcom County has produced a range of public education and applied research programs focused on local waters and watersheds. Beneficiaries of this partnership include the Whatcom County Marine Resources Committee, local outreach and education specialists, the Northwest Indian College and residents of the Lake Whatcom Watershed.

### WOW: Marine Education Resources Database

*Nancy Reichley, Washington Sea Grant*

Washington on Water (WOW) is a unique Web-based resource center with regional scope and impact that brings together K-12 educators, academia, government, businesses and nonprofit organizations in support of quality marine education. It provides Washington educators with a comprehensive and accessible source of information on regional marine science topics and opportunities for professional development and classroom support. WOW encourages a regional network of educators, scientists and field programs. The database includes Pacific Northwest regional education resources with clear connections to a coastal component of watersheds throughout Washington. Secondary emphasis is placed on access to national marine education that has relevance for the Pacific Northwest.

### WSG Science Writing Fellowships

*David G. Gordon and Dan Williams, Washington Sea Grant, and Deborah Illman, University of Washington*

WSG Science Writing Fellows assist in the development of a variety of communication products about Sea Grant projects and issues in marine-related research, education and outreach. One Science Writing Fellow is selected for each of three quarters during the academic year. Upper division undergraduate and graduate students are eligible to apply and work closely with the WSG Communications program.

## Contact Information

**Jeff Adams**

Marine Water Quality Specialist  
Washington Sea Grant  
University of Washington  
345 Sixth Street, Suite 550  
Bremerton, WA 98337  
360.337.4619  
[jaws@u.washington.edu](mailto:jaws@u.washington.edu)

**Simone Alin**

NOAA Pacific Marine Environmental  
Laboratory  
7600 Sand Point Way NE  
Seattle, WA 98115  
206.526.6819  
[Simone.R.Alin@noaa.gov](mailto:Simone.R.Alin@noaa.gov)

**David Armstrong**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.4270  
[davearm@u.washington.edu](mailto:davearm@u.washington.edu)

**Neil Banas**

School of Oceanography  
University of Washington  
Box 355351  
Seattle, WA 98195  
206.221.4402  
[neil@ocean.washington.edu](mailto:neil@ocean.washington.edu)

**Sue Blake**

Water Resource Specialist  
Washington Sea Grant  
Whatcom County Extension  
1000 N. Forest Street, Suite 201  
Bellingham, WA 98225-5594  
360.676.6736  
[sgblake@wsu.edu](mailto:sgblake@wsu.edu)

**Nicholas Bond**

Atmospheric Sciences  
University of Washington  
Joint Institute for the Study of the  
Atmosphere and Oceans  
7600 Sand Point Way NE  
Seattle, WA 98115  
206.526.6459  
[nab3met@u.washington.edu](mailto:nab3met@u.washington.edu)

**Jim Brennan**

Marine Habitat Specialist  
Washington Sea Grant  
University of Washington  
345 Sixth Street, Suite 550  
Bremerton, WA 98337  
360.337.5625  
[jbren@u.washington.edu](mailto:jbren@u.washington.edu)

**Mark Camara**

USDA/ARS Shellfish Genetics  
Hatfield Marine Science Center  
Oregon State University  
2030 S.E. Marine Science Drive  
Newport, OR 97365  
541.867.0296  
[Mark.Camara@oregonstate.edu](mailto:Mark.Camara@oregonstate.edu)

**Rose Ann Cattolico**

Department of Biology  
University of Washington  
Box 355325  
Seattle, WA 98195  
206.543.9363  
[racat@u.washington.edu](mailto:racat@u.washington.edu)

**Patrick Christie**

School of Marine Affairs  
University of Washington  
Box 355685  
Seattle, WA 98195  
206.685.6661  
[patrickkc@u.washington.edu](mailto:patrickkc@u.washington.edu)

**Jeff R. Cordell**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.7532  
[jcordell@u.washington.edu](mailto:jcordell@u.washington.edu)

**Jeffrey C. Cornwell**

Horn Point Laboratory  
University of Maryland  
Center for Environmental Science  
P.O. Box 775  
Cambridge, MD 21613  
410.221.8445  
[cornwell@hpl.umces.edu](mailto:cornwell@hpl.umces.edu)

**Enrique Curchitser**

Institute of Marine and Coastal Sciences  
Rutgers University  
71 Dudley Rd  
New Brunswick, NJ 08901  
732.932.7889  
[enrique@marine.rutgers.edu](mailto:enrique@marine.rutgers.edu)

**Penelope D. Dalton**

Director  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.543.6600  
[pdalton@u.washington.edu](mailto:pdalton@u.washington.edu)

**Jonathan Davis**

Taylor Resources, Inc.  
701 Broad Spit Road  
Quilcene, WA 98376  
360.765.3566  
[jdavis@bainbridge.net](mailto:jdavis@bainbridge.net)

**Nancy Davis**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.7280  
[ncdd@u.washington.edu](mailto:ncdd@u.washington.edu)

**Jody Deming**

School of Oceanography  
University of Washington  
Box 357940  
Seattle, WA 98195-7940  
206.543.0845  
[jdeming@u.washington.edu](mailto:jdeming@u.washington.edu)

**Megan Dethier**

Department of Biology  
University of Washington  
620 University Road  
Friday Harbor, WA 98250  
206.543.8096  
[mdethier@u.washington.edu](mailto:mdethier@u.washington.edu)

**Ralph Elston**

AquaTechnics Inc.  
P.O. Box 687  
Carlsborg, WA 98342  
360.681.3122  
[ralph@aquatechnics.com](mailto:ralph@aquatechnics.com)

**Tim Essington**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.616.3698  
*essing@u.washington.edu*

**Richard Feely**

NOAA Pacific Marine Environmental  
Laboratory  
7600 Sand Point Way NE  
Seattle, WA 98115  
206.526.6214  
*richard.a.feely@noaa.gov*

**Sarah Fisker**

Marine Education Coordinator  
Washington Sea Grant  
University of Washington  
West Wall Building, Room 124  
Fishermen's Terminal  
Seattle, WA 98199  
206.543.1225  
*sfisker@u.washington.edu*

**Linda Kirk Fox**

Washington State University Extension  
P.O. Box 646248  
Pullman, WA 99164-6248  
509.335.2933  
*lkfox@wsu.edu*

**Carolyn L. Friedman**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.9519  
*carolynf@u.washington.edu*

**Masa-aki Fukuwaka**

Fisheries Research Agency  
Hokkaido National Fisheries Research  
Institute  
116 Katsurakoi  
Kushiro-shi  
Hokkaido, Japan 085-0802  
+81.154.92.1715

**Evan Gallagher**

Department of Environmental Health and  
Occupational Health Sciences  
University of Washington  
Box 354695  
Seattle, WA 98195  
206.616.4739  
*evang3@u.washington.edu*

**Frederick Goetz**

Great Lakes WATER Institute  
University of Wisconsin-Milwaukee  
600 East Greenfield Avenue  
Milwaukee, WI 53204  
414.382.1742  
*rick@uwm.edu*

**Roberto Gonzalez-Plaza**

Tribal Environmental and Natural Resources  
Management  
Northwest Indian College  
2522 Kwina Road  
Bellingham, WA 98226  
360.392.4307  
*rgonzalez@nwic.edu*

**David G. Gordon**

Science Writer  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.685.8191  
*davidg@u.washington.edu*

**Pete Granger**

Program Leader, Marine Advisory Services  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.543.6600  
*pgranger@u.washington.edu*

**Daniel Grünbaum**

School of Oceanography  
University of Washington  
Box 354350  
Seattle, WA 98195  
206-221-6594  
*grunbaum@ocean.washington.edu*

**Troy Guy**

Marine Fisheries Research Associate  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.616.1250  
*troyguy@u.washington.edu*

**Julie Hahn**

Education Coordinator  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.685.9117  
*jkhahn@u.washington.edu*

**Steve C. Harbell**

Marine Field Agent  
Washington Sea Grant  
University of Washington  
P.O. Box 88  
South Bend, WA 98586  
360.875.9331  
*sharbell@u.washington.edu*

**Lorenz Hauser**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.685.3270  
*lhauser@u.washington.edu*

**Albert Hermann**

JISAO  
University of Washington  
Box 354925  
Seattle, WA 98195  
206.526.6495  
*hermann@u.washington.edu*

**Ray Hilborn**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.3587  
*rayh@u.washington.edu*

**Kevin Hill**

Southwest Fisheries Science Center  
NOAA Fisheries Service  
8604 La Jolla Shores Drive  
La Jolla, CA 92037  
858.546.7003  
*Kevin.Hill@noaa.gov*

**Katrina Hoffman**

Coastal Resources Specialist  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
360.416.7048 (Padilla Bay)  
206.616.3368 (Seattle)  
*kathoff@u.washington.edu*

**Deborah Illman**

Department of Communication  
University of Washington  
Box 357940  
98195-7940  
206.616.4826  
*illman@u.washington.edu*

**H. Paul Johnson**

School of Oceanography  
University of Washington  
Box 357940  
Seattle, WA 98195

**Richard Keil**

School of Oceanography  
University of Washington  
Box 355351  
Seattle, WA 98195  
206.616.1947  
*rickkeil@u.washington.edu* 206.543.8474  
*johnson@ocean.washington.edu*

**Teri L. King**

Marine Water Quality Specialist  
Washington Sea Grant  
University of Washington  
P.O. Box 488  
Shelton, WA 98584  
360.432.3045  
*guatemal@u.washington.edu*

**Terrie L. Klinger**

School of Marine Affairs  
University of Washington  
Box 355685  
Seattle WA 98195  
206.685.2499  
*tklinger@u.washington.edu*

**Tom Leschine**

School of Marine Affairs  
University of Washington  
Box 355685  
Seattle, WA 98195  
206.543.0117  
*tml@u.washington.edu*

**Phillip Levin**

Northwest Fisheries Science Center  
NOAA Fisheries Service  
2725 Montlake Blvd. E  
Seattle, Washington 98112  
206.860.3473  
*Phil.Levin@noaa.gov*

**Kate Litle**

Citizen Science Specialist  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.616.0151  
*kalitle@u.washington.edu*

**Miles Logsdon**

School of Oceanography  
University of Washington  
Box 355351  
Seattle, WA 98195  
206.543.5334  
*mlog@u.washington.edu*

**J. Adam Luckenbach**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.860.3463  
*jalucken@u.washington.edu*

**Nathan Mantua**

School of Marine Affairs Climate Impacts  
Group  
University of Washington  
Box 355672  
Seattle, WA 98195  
206.616.5347  
*nmantua@u.washington.edu*

**Edward F. Melvin**

Washington Sea Grant  
University of Washington  
Box 355060  
Seattle WA 98195  
206.543.9968  
*emelvin@u.washington.edu*

**Richard Methot**

Northwest Fisheries Science Center  
NOAA Fisheries Service  
2725 Montlake Blvd. E  
Seattle, WA 98112  
206.860.3365  
*Richard.Methot@noaa.gov*

**Katherine Myers**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.1101  
*kwmyers@u.washington.edu*

**Kerry Naish**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.221.6375  
*knaish@u.washington.edu*

**John Nelson**

Western Center for Risk Management  
Education  
Washington State University Cooperative  
Extension  
222 N. Havana  
Spokane, WA 99202  
509.477.2176  
*jgnelson@wsu.edu*

**Roger Newell**

Horn Point Laboratory  
University of Maryland  
Center for Environmental Science  
P.O. Box 775  
Cambridge, MD 21613  
410.221.8410  
*rnewell@hpl.umces.edu*

**Eric Olsson**

Oil Spill Prevention Education Specialist  
Washington Sea Grant  
University of Washington  
P.O. Box 1632  
Langley, WA 98260  
360.221.4636  
*olsson@u.washington.edu*

**Andre Punt**

School of Aquatic and Fishery Sciences  
University of Washington  
School of Aquatic and Fishery Sciences  
Box 355020  
Seattle, WA 98195  
206.221.6319  
*aepunt@u.washington.edu*

**Thomas P. Quinn**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206-543-9042  
*tquinn@u.washington.edu*

**Leif Rasmuson**

Skokomish Department of Natural Resources  
North 541 Tribal Center Road  
Skokomish Nation, WA 98584  
360.877.5213  
*lrasmuson@skokomish.org*

**Nancy Reichley**

Education Specialist  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.685.8302  
*reichn@u.washington.edu*

**Steven Roberts**

School of Aquatic and Fishery Sciences  
University of Washington  
1122 NE Boat Street  
Seattle, Washington 98105  
206.600.4495  
*sr320@u.washington.edu*

**Jennifer Ruesink**

Department of Biology  
University of Washington  
Box 351800  
Seattle, WA 98195  
206.543.7095  
*ruesink@u.washington.edu*

**Jim Seeb**

School of Aquatic and Fishery Sciences  
University of Washington  
1122 NE Boat  
Seattle, WA 98195  
206.685.2097  
*jseeb@u.washington.edu*

**Charles Simenstad**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.7185  
*simenstad@u.washington.edu*

**Anne Steinemann**

Civil and Environmental Engineering  
University of Washington  
Box 352700  
Seattle, WA 98195  
202.616.2661  
*acstein@u.washington.edu*

**Terrence Stevens**

Director  
Padilla Bay National Estuarine Research  
Reserve  
10441 Bayview-Edison Road  
Mount Vernon, WA 98273-9668  
360.428.1558  
*tstevens@padillabay.gov*

**Penny Swanson**

Northwest Fisheries Science Center  
NOAA-NMFS  
2725 Montlake Boulevard E.  
Seattle, WA 98112  
206.860.3282  
*penny.swanson@noaa.gov*

**Jason Toft**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.221.5460  
*tofty@u.washington.edu*

**Alan Trimble**

Department of Biology  
University of Washington  
Box 351800  
Seattle, WA 98195-1800  
206.734.6717  
*trimblea@u.washington.edu*

**Brent Vadopalas**

School of Aquatic and Fisheries Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.616.6341  
*brentv@u.washington.edu*

**Glenn VanBlaricom**

Washington Cooperative Fish & Wildlife  
Research Unit  
School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.6475  
*glennvb@u.washington.edu*

**Michelle Wainstein**

Senior Program Coordinator  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.616.9568  
*mwain@u.washington.edu*

**Samuel Wasser**

Center for Conservation Biology  
University of Washington  
Box 351800  
Seattle, WA 98195  
206.543.1669  
*wassers@u.washington.edu*

**Raechel Waters**

Associate Director  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.685.8209  
*rlw@u.washington.edu*

**Dan Williams**

Communications Manager  
Washington Sea Grant  
University of Washington  
Box 355060  
Seattle, WA 98195  
206.616.6353  
*dw7@u.washington.edu*

**Graham Young**

School of Aquatic and Fishery Sciences  
University of Washington  
Box 355020  
Seattle, WA 98195  
206.543.4291  
*grahamy@u.washington.edu*



**Washington Sea Grant**  
University of Washington  
3716 Brooklyn Avenue N.E.  
Seattle, WA 98105-6716

206.543.6600  
*seagrant@u.washington.edu*  
*www.wsg.washington.edu*

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