

RESEARCH, OUTREACH AND PARTNERSHIPS

2004-2007

*Washington Sea Grant Program
College of Ocean and Fishery Sciences
University of Washington*



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VISION

Knowledge for Use in the Marine Environment

MISSION

Washington Sea Grant Program serves communities, industries and the people of Washington state, the Pacific Northwest and the nation through research, education and outreach by:

- identifying and addressing important marine issues;
- providing better tools for management of the marine environment and use of its resources; and
- initiating and supporting strategic partnerships within the marine community.

ABOUT THIS DIRECTORY

This directory contains brief descriptions of current and continuing research and outreach projects for the 2004-2007 funding period. Primary areas of interest for research and outreach include Living Marine Resources, Ecosystem Health, New Technologies, Economic and Community Development, and Education, Training and Public Information. These Critical Program Areas (defined by Washington Sea Grant Program's Strategic Plan) make up the headings under which projects can be found. Additional information is available through the Washington Sea Grant Program office, or directly from the project investigators. Contact information is listed in the back pages of this directory or on the program Web site: www.wsg.washington.edu.

INTRODUCING WASHINGTON SEA GRANT PROGRAM

Established in 1968, Washington Sea Grant Program (WSGP) began as a federal experiment in local investment. The program grew as part of the University of Washington's major interest in marine science, engineering and policy. In 1971, the program became one of the first four programs designated nationally as a Sea Grant College. Today WSGP is part of a national network of 30 Sea Grant colleges and programs administered by the National Oceanic and Atmospheric Administration (NOAA) in the U.S. Department of Commerce.

WSGP uses a partnership approach in all its activities, often including cost sharing, advice and counsel, and hands-on involvement in projects. Frequent partners include UW units, other universities and educational institutions; tribal and local, state and federal agencies; business and industry; marine-oriented interest groups; and citizens of the state of Washington.

By bringing together individuals and organizations within the university, the state, the region and the nation, Washington Sea Grant Program serves as a catalyst for and facilitator of marine research. The program's ongoing relationship with its researchers reflects both stability and commitment.

Research and outreach projects funded through WSGP must meet the defined criteria for a specific funding cycle or initiative, and must compete against other proposals in a process that includes rigorous peer review. Additional information on WSGP's proposal process can be obtained from the program office and from the Web page: www.wsg.washington.edu (click on "Funding Opportunities").

Outreach efforts are a central component of Sea Grant. Specialists in Marine Advisory Services and Communications, as well as WSGP-funded researchers, work individually and in teams, reaching out to the marine community with program-generated information.

Marine Advisory Services links university resources and expertise with local communities and user groups. MAS specialists and field agents work in a broad range of topic areas including aquaculture, fisheries, coastal economic development, coastal tourism, ports and marine transportation, water quality, small oil spill prevention, public safety and safety at sea, marine and aquatic education, global environmental change, and marine technology training.

Through publications, electronic communication, media relations, community interaction and cooperative efforts with researchers and outreach specialists, Communications keeps the public informed about current research and technology in marine science and promotes the understanding of marine issues among industry, educators and marine resource users. The office maintains a publications database, sells and distributes informational products and responds to public inquiries about Sea Grant activities and research.

FUNDING POLICIES

RESEARCH PROJECT SELECTION CRITERIA

The best Sea Grant research proposals combine scientific excellence and a focus on problems or opportunities of broad societal concern, such as resource management, public interest or industrial use. Projects are selected based on the following criteria:

- Scientific quality;
- Significance of expected scientific contribution;
- Importance of the marine resource/marine environmental need or opportunity that the project addresses;
- Appropriateness as a university-sponsored activity;
- Potential for societal impact;
- Interaction with other projects and activities and potential for leverage of funds;
- National competitiveness; and
- Capabilities of project team.

EDUCATION PROJECT CRITERIA

The best Sea Grant education proposals focus education efforts on problems or opportunities of broad societal concern, such as resource management, public interest or industrial use. Innovative education projects are selected based on the following criteria:

- Potential for making a significant contribution to resource conservation;
- Importance of the marine resource/marine environmental need or opportunity addressed by the project;
- Linkage of the information or programming to a strong science base;
- Potential as a model or reproducible project, or for long-term use;
- Objective and impartial nature of the proposed project;
- Importance of the target audience and readiness of that audience to receive the information or programming;

- Appropriateness as a university-sponsored activity, carried out by an educational institution;
- Interaction with other projects and activities and potential for leverage of funds; and
- Capabilities of project team.

PROGRAM DEVELOPMENT

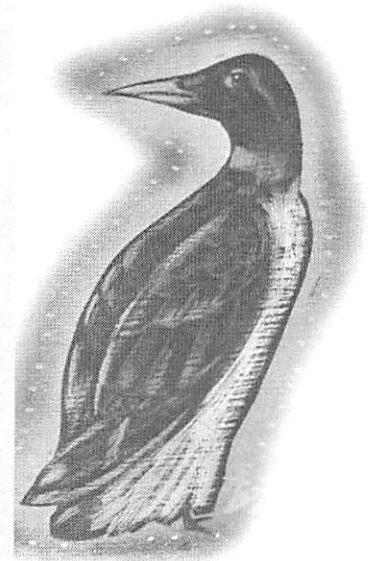
Important issues and unique opportunities cannot always be anticipated. So that WSGP can be effective in its mission, the program maintains a development fund that allows timely response to special needs or opportunities as they arise. The activities could not have occurred without program development funds.

Interested investigators should write or e-mail the WSGP director or associate director and provide a brief description of the need and projected activity, plus a modest budget figure. If it appears that the proposed activity may be of sufficient priority and that adequate funds are available, the director will request additional information and a formal budget request.

Requests for these funds are subject to normal project selection criteria. These short-term projects may fall into several categories including (but not limited to) complementary activity to existing high-priority projects, new and promising research, student support and partnership-building.

STRATEGIC PARTNERSHIPS

The capabilities of Washington Sea Grant Program researchers and outreach specialists are enhanced through strategic partnerships with public agencies and organizations. WSGP often can match agency needs with university resources through cooperation with federal and state agencies. If proposals meet Sea Grant standards of appropriateness, quality and relevance, other agencies can either provide funding directly or they can transfer funds to WSGP's federal grant partner, NOAA, which then passes the funds to WSGP. *It is essential that interested agencies and investigators work with the Sea Grant director or designee during concept and proposal stages.* Proposals must be approved for further consideration by the WSGP director before submission.



CRITICAL PROGRAM AREAS

LIVING MARINE RESOURCES

Conserving marine resources while providing for their beneficial use and exploitation, thus ensuring sustainable harvests and healthy populations in the future.

REDUCING SEABIRD BYCATCH IN THE PACIFIC COD FREEZER LONGLINE FISHERY

Edward F. Melvin, Washington Sea Grant Program, University of Washington

A/FP-7

Seabirds are long-lived species with limited reproductive capability and, as such, are vulnerable to population declines, even at low rates of annual mortality. The persistent declines of several South Pacific albatross populations linked to incidental mortality in longline fisheries have sparked international debate over whether and how offending fisheries should be regulated. Longline fisheries in the North Pacific — where three species of albatross have been taken — have come under fire in scientific publications. This project seeks to reduce seabird bycatch in North Pacific longline fisheries and eliminate the threat of fishery closures stemming from the incidental catch of endangered seabirds or all seabirds protected under the Migratory Bird Treaty Act. Investigators will work cooperatively with the fishing industry to test seabird deterrent devices, develop recommendations for seabird avoidance regulations, and recommend future research and protocols. This project is also sponsored by the U.S. Fish and Wildlife Service and NOAA's National Marine Fisheries Service.

FAST-SINKING LINES FOR LONGLINE FISHERIES

Graham Robertson, Australian Antarctic Division; Edward F. Melvin, Washington Sea Grant Program, University of Washington

Worldwide, tens of thousands of birds are killed annually in longline fisheries, causing many seabird populations to decrease. With support from the Pew Fellowship program, WSGP and the Australian Antarctic Division this project will explore mitigation measures for the Spanish and autoline systems — the two most common methods for deploying longlines in deepwater fisheries. Field trials in Chile will determine the effectiveness of these measures. Test results and mitigation recommendations will be submitted to the Convention on the Conservation of Antarctic Marine Living Resources for adoption by longline fisheries in South Africa, Australia, Antarctica and several other nations.

TOWARDS SUSTAINABLE FISHERIES IN THE CALIFORNIA CURRENT ECOSYSTEM

Robert C. Francis, School of Aquatic and Fishery Sciences, University of Washington

R/F-145

Many West Coast fisheries, their resources and the port communities they support have collapsed in recent decades. To gain insight into sources and remedies for current problems, this project will develop and link two models: a biophysical model of the coastal marine food web and a socioeconomic model of port communities. The primary method of linkage is through bioeconomic valuation — a methodology for expressing relationships between direct (commodity) values and indirect values of ecosystem services. With these valuation techniques and a broader view of West Coast fisheries, the project can assist the Pacific Fishery Management Council and others examine a broad range of topics, including techniques for rebuilding overfished stocks, and alternative ways to manage regional fisheries. Project partners include researchers from California State University, Monterey Bay, and the nonprofit organization Ecotrust.

SPATIAL DYNAMICS, RECRUITMENT TRENDS AND SUSTAINABILITY OF PUGET SOUND GEODUCKS

Ray Hilborn, David Armstrong and Jose Orensanz, School of Aquatic and Fishery Sciences, University of Washington; Ana Parma, Consejo Nacional de Investigaciones Cientificas y Tecnicas, Argentina; Bob Sizemore, Washington Department of Fish and Wildlife

R/F-146

In Washington and British Columbia, geoduck clam harvests average several million pounds per year, making this the most valuable fisheries on the West Coast. Recent concerns about the sustainability of the geoduck fishery have prompted state and tribal scientists and managers to explore alternative management options. However, decision-making has been hampered by lack of information on geoduck population dynamics. For this project, scientists will analyze the physical and biotic processes affecting the dynamics of geoduck populations and evaluate alternative management approaches that take into account the spatial heterogeneity in the dynamics of the population and the fishery.

GENETIC STOCK STRUCTURE IN PACIFIC COD

Lorenz Hauser, School of Aquatic and Fishery Sciences, University of Washington; Michael Canino, NOAA Alaska Fisheries Science Center, Seattle, WA; Gregory Bargmann, Washington Department of Fish and Wildlife

R/F-147

Current management plans for both federal and state Pacific cod (*Gadus macrocephalus*) fisheries are based on the assumption of random mating among subpopulations throughout the Pacific Ocean. However, there are few data to show that these fish are, in fact, genetically equivalent. Researchers on this project will conduct genetic analyses of Pacific cod in the Gulf of Alaska and eastern Bering Sea, to assess the similarities and differences of the two populations and ascertain the degree of genetic connectivity among them. These results will provide a firm platform for informed, sustainable management of this important foodfish resource.

EVALUATION OF THE IMPACT OF MARINE PROTECTED AREAS ON STOCK ASSESSMENT-BASED FISHERIES MANAGEMENT

Andre Punt and Ray Hilborn, School of Aquatic and Fishery Sciences, University of Washington; Richard Methot, NOAA Northwest Fisheries Science Center

R/ES-51

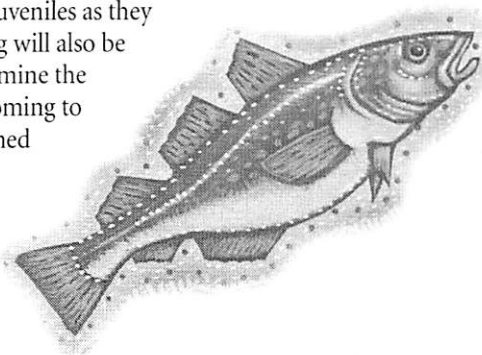
How can the impacts of marine protected areas (MPAs) be included in traditional methods for assessing fisheries stocks? The results of this study will provide guidelines for modifying stock assessment methods in the presence of MPAs — a boon to resource managers nationally and internationally. Researchers will evaluate how well standard methods for assessing stocks perform when the stocks are found within and outside large MPAs. They will also explore how existing MPAs might be combined with catch regulations to achieve management objectives by evaluating alternative decision rules. The decision rules will be based on conventional and modified stock assessment methods.

RECOLONIZATION OF THE UPPER CEDAR RIVER BY ANADROMOUS SALMONIDS

Thomas Quinn, School of Aquatic and Fishery Sciences, University of Washington; Peter Kiffney, NOAA Northwest Fisheries Science Center

R/F-148

For more than 100 years, a diversion dam in the upper Cedar River system blocked access by salmon and steelhead to 36 kilometers of stream habitat. In the fall of 2003, these fish were allowed back into these mainstream and tributary habitats. This project will establish a scientific basis for evaluating the success of the re-colonization effort, using the Cedar River as a case study. Researchers will follow the movements of the fish, identify local spawning areas, and measure growth and productivity among juveniles as they migrate downriver. Genetic testing will also be performed at a later date, to determine the extent that adult salmonids are homing to their natal sites. Information gleaned from this project will assist future salmonid reintroduction programs, following the removal or circumvention of other dams.



DENDROECOLOGICAL RECONSTRUCTION OF SALMON ABUNDANCE IN PACIFIC NORTHWEST RIVERS

*Robert J. Naiman, School of Aquatic and Fishery
Sciences, University of Washington*

R/F-152

Studies of growth rings in trees may shed light on the complex interactions among salmon abundance, salmon-borne nutrients, riparian forest dynamics and ocean climate patterns over time. This study will use labeled isotopes of nitrogen to measure the uptake and redistribution of salmon-related nutrients in tree roots, stems and leaves over two years. The experiment will be conducted in a salmon-influenced riparian forest and will provide a foundation for the future development of a mechanistic model of salmon/nutrient fertilization in Northwest forests. By providing long-term estimates of natural patterns and changes in salmon abundance, it will also aid in future river-specific reconstructions of salmon returns — especially important information for assessing the recent, drastic decline of salmon throughout much of the Northwest.

ASSESSING CHANGES IN INSHORE NORTHWESTERN WASHINGTON MARINE BIRD POPULATIONS FROM 1979 TO 2005

*John Bower, Fairhaven College,
Western Washington University*

R/ES-50

Many marine bird populations in northwest Washington appear to have experienced significant changes over the past few decades. However, there has been no comprehensive study of these populations since the Marine Ecosystems Analysis (MESA) Puget Sound Project of the late 1970s. For this project, the researcher will collect data on marine bird populations in northwestern Washington's inshore waters and document any changes to these populations over the past 25 years. The causes of such changes will be studied and the data incorporated in a long-term population study of inshore marine birds. Use by marine birds of the San Juan Island marine protected areas will be compared with that of ecologically similar unprotected sites. While assisting with this project, more than a dozen graduate and undergraduate students will receive training in population ecology theory and methods. Outreach efforts will foster public appreciation of marine birds and the environmental issues affecting them.

DEVELOPMENT OF A SPATIALLY- EXPLICIT, BIOPHYSICAL MODEL OF PUGET SOUND NEARSHORE PROCESSES

*Charles A. Simenstad, School of Aquatic and
Fishery Sciences, University of Washington; Allan
Devol and Miles Logsdon, School of Oceanography,
University of Washington*

R/ES-43

In recent years, resource managers have recognized that estuarine and nearshore marine environments have ecological, chemical and physical processes completely distinct from those in the open waters of Puget Sound. The Sound is also rapidly being altered by manmade structures and chemical and biological introductions. Because a large number of fish and wildlife species depend on the Sound's nearshore areas for food, shelter and reproduction, managers need tools that will help them assess and predict responses to habitat changes that may result from these kinds of alterations. By building a conceptual model of nearshore processes, this project will allow simulation of nearshore processes to promote scientifically sound shoreline management. It will also be used to educate students and agency personnel about estuarine and marine shoreline management.

LONG-TERM CHANGES IN GENETIC DIVERSITY AND POPULATION STRUCTURE OF PACIFIC HERRING IN PUGET SOUND

*Lorenz Hauser, School of Aquatic and Fishery
Sciences, University of Washington*

R/F-149

Recent declines in Puget Sound stocks of pacific herring (*Clupea pallasii*) have alarmed many scientists and fisheries management officials. Of special concern are the fluctuations in abundance in spawning aggregates, which may reflect local extinctions or merely range shifts. An analysis of DNA from herring scales may reveal temporal changes in genetic diversity and population structure over the past 30 years. The results will provide valuable data on the conservation status of individual spawning aggregates, which can be used by state, tribal and federal resource management agencies.

GENOME MAPPING OF GROWTH AND GROWTH-RELATED TRAITS IN COHO SALMON

Kerry Naish, School of Aquatic and Fishery Sciences, University of Washington; Ruth Phillips, Biological Sciences, Washington State University –Vancouver; Mitchell Sewell, Oak Ridge National Lab, Oak Ridge, TN

R/B-41

This project will broaden our understanding of the complex interactions among genes and the environment. The research team will examine the genetic basis of growth traits and the correlations between the genes underlying growth traits and those contributing to maturation, fecundity and other life history traits affecting the fitness of individual coho salmon. They will study the inheritance of both neutral genetic markers and the genes coding for fitness traits in crosses between wild and farm-raised fish. Neutral markers linked to fitness traits can be used to estimate the genetic diversity relevant to the long-term survival of salmon species. As such, the project will set the stage for more complex studies into the long-term monitoring of conservation-based mitigation programs in the Pacific Northwest.

UNDERSTANDING DISPERSAL AND RECRUITMENT DYNAMICS OF A KEY MARINE INVERTEBRATE SPECIES USING MOLECULAR TECHNIQUES FOR LARVAL IDENTIFICATION

Carolyn S. Friedman and Brent Vadopalas, School of Aquatic and Fishery Sciences, and Terrie Klinger, School of Marine Affairs, University of Washington; Jonathan P. Davis, Taylor Shellfish Company, Inc.; Don Rothaus, Washington Department of Fish and Wildlife

R/F-150

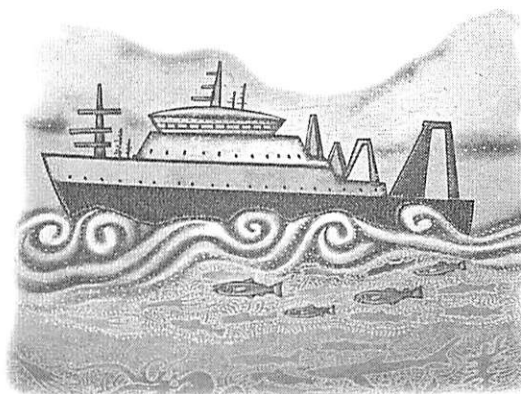
This project will develop molecular markers for tagging larval pinto abalone (*Haliotis kamschatkana*), characterize larval dispersal patterns and calculate abundances of juvenile abalone at index sites. Information from the project will be useful for managing what is likely to become the next threatened or endangered marine invertebrate species in the Northwest. Investigations of larval dispersal will provide direct empirical data on larval behavior in the field and will aid in testing the effectiveness of restoration efforts.

JUVENILE SALMON RESPONSE TO INTERTIDAL EELGRASS LANDSCAPE STRUCTURE

Charles Simenstad and Jeffery Cordell, School of Aquatic and Fishery Sciences, University of Washington; Julia K. Parrish, School of Aquatic and Fishery Sciences and Department of Biology, University of Washington; Susan Bell, University of South Florida; Christopher Weller, Point No Point Treaty Council

R/ES-52

Intertidal and shallow subtidal eelgrass beds are considered to be important habitats for juvenile salmon migrating through estuaries and coastal areas to the open ocean. As such, eelgrass is specifically managed as a critical shoreline habitat in Washington and other Pacific states. However, the actual behavioral response of fishes such as salmon to varying levels of eelgrass habitat fragmentation, both natural and human-induced, is poorly understood. Field observations, sampling, laboratory experiments and data from high-resolution remote sensing will provide insights that may be helpful in managing salmon stocks for optimum survivability in the future.



ECOSYSTEM HEALTH

Understanding the marine environment and protecting it from the deleterious effects of human activities, including contamination from terrestrial and ship-borne sources, degradation of nearshore, upland and open-water habitats, overharvesting of fish, shellfish, algae and invertebrates, and introductions of non-native plant and animal species.

CONTROLLING INTRODUCTIONS OF BALLAST WATER ORGANISMS

Russell P. Herwig, School of Aquatic and Fishery Sciences, University of Washington

Millions of gallons of sea water are often carried as ballast aboard oil tankers and other commercial vessels. Minute jellyfish, larval mussels and barnacles, marine worms, copepods and juvenile fish may inhabit this water, along with an assortment of single-celled plants and even smaller bacteria and viruses. When a ship docks in Washington and empties its ballast tanks, the plants, animals and microbes are unintentionally released into the local environment. WSGP's Marine Ballast Water Specialist Russ Herwig is currently exploring technologies to curb such introductions of unwanted organisms. Among the most promising of these are ozone, ultra-violet disinfection and biocidal disinfection of ballast water.

REDESIGN AND TESTING OF WATER INTAKE SYSTEMS FOR THE CONTROL OF AQUATIC NUISANCE SPECIES

Russell P. Herwig and Jeffery Cordell, School of Aquatic and Fishery Sciences, University of Washington; William T. Cooper, University of North Carolina at Wilmington

R/ES-55

For this project, laboratory and shipboard experiments will compare the efficacy of in-line introductions of ozone using an injector, or venturi, contact system versus the diffuser contact system presently installed on the oil tanker *S/T Tonsina*. A small-scale venturi system will be examined at the USGS Marine Field Station at Marrowstone Island, Washington. In addition, the formation and fate of chemical by-products from the ozonation of seawater will be examined. A venturi system could prove simpler, cheaper and safer to use, compared to an ozone diffuser system. Test results will be shared with maritime user groups and academic and technical audiences.

ANALYSIS OF A TOXIC ALGA IN STASIS

Rose Anne Cattolico, Department of Biology, University of Washington

R/B-42

The ability of many toxic algae to enter stasis is essentially unstudied at the molecular and biochemical levels. These metabolically quiescent cells can form "seed beds" in coastal sediments, as well as move to new geographic locations via natural currents or ships' ballast water. Thus, their occurrence presents a significant challenge in coastal ecosystem management. The long-term goals of this project are to generate life-history specific DNA probes for the toxic dinoflagellate *Heterosigma*, to correlate genetic identity and physiological responses with toxicity and to apply the data from *Heterosigma* to other toxic members of the taxon Raphidophyceae.

LINKING VARIABILITY IN CELL MOTILITY TO HAB FORMATION BY *HETEROSIGMA AKASHIWO*

Daniel Grünbaum and Rachel Bearon, School of Oceanography, University of Washington

R/B-43

The harmful biological and societal effects of the toxic alga *Heterosigma akashiwo* are based on overall population levels and how these populations are distributed. This project will explore *H. akashiwo*'s swimming behaviors in a variety of environmental conditions. Researchers will also study those facets of the alga's environment that are most likely to encourage active swimming versus passive transport through flowing water. This information will be incorporated into models for predicting how *H. akashiwo* congregates and what environmental repercussions such congregations may have.

EXPOSURE OF SALMONIDS TO CARBARYL FOLLOWING APPLICATION TO CONTROL BURROWING SHRIMP

Christian Grue, School of Aquatic & Fishery Sciences, University of Washington, and Brett Dumbauld, Washington Department of Fish and Wildlife

R/F-144

For four decades, commercial oyster growers have used the pesticide carbaryl to control infestations of burrowing shrimp. However, in recent years, concerns have been raised over the possibly harmful effects of carbaryl to juvenile salmon. To date, all data on the carbaryl/salmon controversy have been obtained from laboratory studies, not from fieldwork. By sampling fish (primarily juvenile Chinook salmon) from the waters above carbaryl-treated oyster beds, this project will provide the data necessary to interpret the results of laboratory studies. In this way, it will facilitate more environmentally friendly use of the pesticide in any future efforts.

LINKING NEARSHORE PROCESSES WITH INTERTIDAL DIVERSITY IN PUGET SOUND

Megan Dethier, Department of Biology and Friday Harbor Labs, University of Washington; Helen Berry, Washington Department of Natural Resources; Jennifer Ruesink, Department of Biology, University of Washington

R/ES-57

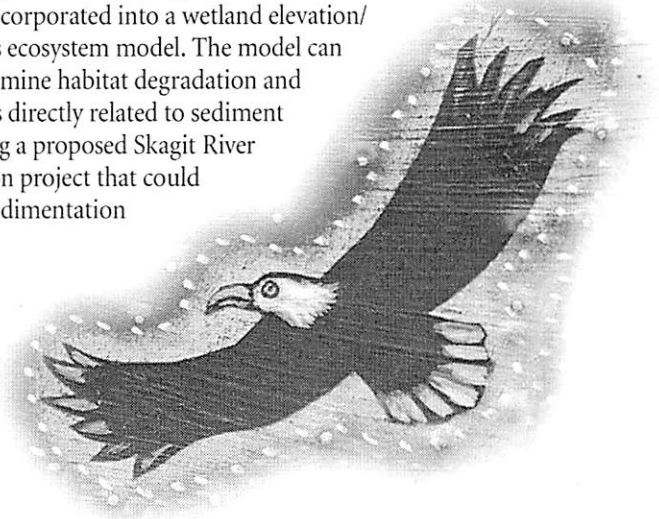
How will intertidal communities respond to changes in key physical and ecological processes? Answering this question is central to maintaining a healthy Puget Sound. For this project, researchers will investigate the ecological processes that generate conspicuous patterns of diversity and species composition along the estuarine gradient in south and central Puget Sound. To accomplish this, the project team will draw on an extensive, multi-year database of biotic and physical characteristics of 64 sites in the Sound, augmenting this information with newly gathered data on growth and recruitment rates of transplanted algae, juvenile bivalves and other organisms.

SEDIMENT DYNAMICS AND SUSTAINABLE ESTUARIES: A FIELD AND MODELING APPROACH

John Rybczyk, Huxley College, Western Washington University

R/ES-58

The overarching objective of this project is to use an integrated field and modeling approach to gain a better understanding of sediment dynamics in Padilla Bay. Data on rates of sedimentation, shallow subsidence, and elevation change in the bay's seagrass beds and mud flats will be incorporated into a wetland elevation/sediment dynamics ecosystem model. The model can then be used to examine habitat degradation and management issues directly related to sediment dynamics, including a proposed Skagit River floodwater diversion project that could potentially affect sedimentation rates in the bay.



RECRUITMENT PATHWAYS AND INTERSPERSION OF CRITICAL HABITATS

Donald R. Gunderson, School of Aquatic & Fishery Sciences, University of Washington; H. Gary Greene, Moss Landing Marine Laboratories (CA); Wayne Palsson, Washington Department of Fish and Wildlife

R/ES-59

Several critical questions must be answered before state and county agencies can design and monitor effective, sustainable networks of Marine Protected Areas. Products from this project include statistically based survey protocols that can be used to delineate essential habitats for rockfish and lingcod and assess the fish densities within them. The research team will also identify critical distances and spatial relationships between habitats for adult, larval and juvenile rockfish and lingcod — factors that must be considered when enhancing the productivity of an area.

EDUCATION INTERFACES RESEARCH: FORAGE FISH AND NEARSHORE HABITATS

Anne Murphy and Libby Palmer, Port Townsend Marine Science Center

E/ES-3

The Port Townsend Marine Science Center will host a series of one-day training workshops on forage fish biology and life cycles, shoreline processes, forage fish food webs, human impacts on the shoreline and collaborative planning of presentations. A one-day teacher's workshop on nearshore marine resource issues will also be offered. Along with 12 guided research investigations of the beach at Fort Worden State Park, these activities will improve public awareness of the biological and ecological complexity of nearshore environments, nurture public understanding of the role of research in shoreline management, and contribute to marine resource conservation practices. Additional funding is provided by the Russell Family Foundation.

CARPENTER CREEK INTEGRATED WATERSHED CURRICULUM AND ESTUARY PROJECT

Joleen Palmer, Stillwaters Environmental Education Center; Sheila Fagan-Trunkey, Kingston Junior High School

E/ES-4

Important marine habitat for Puget Sound Chinook salmon is at risk in Kitsap County's Carpenter Creek watershed. This project will introduce students and local residents to the Carpenter Creek salt marsh and estuary, fostering an educated citizenry that will work to protect these habitats. Project-based learning units will be created, along with field activity kits for on-site studies in the salt marsh and estuary. Interpretive displays will also be designed and constructed, for use at a variety of public education venues.

FIDALGO LEARNING ABOUT THE INTERTIDAL PROJECT (FLIP)

Gisele Muller-Parker and Denise Crowe, Shannon Point Marine Center, Western Washington University; Brian Bingham, Department of Environmental Science, Huxley College, Western Washington University; Kate McEowen, Anacortes School District

E/ES-5

FLIP brings together scientists, educators, middle and high school students and community volunteers to conduct a study of the intertidal zone of a section of Fidalgo Island. Key findings will be shared with the local community through public displays to be showcased in the Anacortes High School, Anacortes Public Library, Washington State Ferry Terminal, Padilla Bay National Estuarine Research Reserve and other locations in Skagit County. A final report will be posted online and presented to the Anacortes School District, the City of Anacortes, the Anacortes Parks Foundation and other public agencies.

SPARTINA ERADICATION AND EDUCATION SERVICE-LEARNING PROJECT

Susie Richards and Chris Burt, Langley Middle School/South Whidbey School District; Sally Hacker, Department of Botany and Program in Environmental Science, Washington State University

E/ES-6

Attempts to control the invasive saltmarsh plant *Spartina* are severely impaired by the lack of community education and public awareness efforts. With guidance from the Island County Noxious Weed Control Board, the Washington Department of Agriculture and others, middle school students will develop a brochure, design an interpretive display board and assist in the production of a public service announcement on *Spartina* issues. Students will also assist in local efforts to destroy existing *Spartina* patches in nearby bays. This project will provide meaningful environmental studies to local students and serve as a model for other schools and communities dealing with similar non-native plants.

SPARTINA CONTROL HANDBOOK

Megan Dethier, Department of Biology and Friday Harbor Labs, University of Washington, and Sally Hacker, Department of Botany and Program in Environmental Science, Washington State University

R/ES-60

The non-native cordgrass *Spartina anglica* was first introduced into Puget Sound in 1961. Since then, this highly productive and dominant plant has altered the landscape of coastal marine habitats, converting existing mudflats into saltmarshes. Eradication efforts have been underway for several years, with limited success. Building on previous WSGP research projects, the *Spartina Control Handbook* will assist resource managers and decisionmakers in formulating and implementing effective *Spartina* eradication efforts.

BEACH WATCH INTERTIDAL EDUCATION PROGRAM

Crina Hoyer, RE Sources for Sustainable Communities

E/ES-2

A team of volunteers will be trained and deployed as informal naturalists on heavily used beaches of Whatcom and Skagit counties. These volunteers will share their knowledge of intertidal ecology and the

effects of human activity on beach and nearshore ecosystems. Working in partnership with the City of Bellingham, project leaders will teach Bellingham's third grade students about shoreline ecology and impacts to the coastal environment. Through such informal, citizen-to-citizen contact, beach users will be empowered to enjoy their beaches without destroying plants and animals or their habitats.

IMPACTS AND DYNAMICS OF TWO INTRODUCED DRILLS CONSUMING CULTURED AND THREATENED OYSTERS

Jennifer Ruesink, Department of Biology, University of Washington; Brett Dumbauld, Washington Department of Fish and Wildlife

R/ES-45

Two species of oyster-eating mollusks became established in Washington's waters nearly a century ago. The eastern oyster drill *Urosalpinx cinerea* was accidentally introduced with shellfish from the Atlantic Ocean coast and the Japanese oyster drill *Cerastostoma inornatum* with Pacific oysters from Asia. Today, both oyster drills cause substantial economic damage to shellfish-growing operations and could interfere with efforts to replenish native Olympia oyster stocks. This project will combine field surveys and experiments with two ecological modeling techniques to compare traits, predict impacts and assess control strategies for these two invading organisms.

BIOLOGICAL INVASION OF MARINE RESERVES BY AQUATIC NUISANCE SPECIES

Terrie Klinger, School of Marine Affairs, University of Washington, and Dianna K. Padilla, Department of Ecology and Evolution, State University of New York, Stony Brook

R/ES-54

The spread of the non-native oyster *Crassostrea gigas* to marine reserves in the San Juan Islands may be undermining the utility of these sites as conservation tools. To better understand the long-term impacts of such invasions, researchers will conduct a series of field experiments and observations to determine which factors — environmental change, genetic drift, natural selection or hybridization — are most likely to facilitate this spread and whether increased populations of *C. gigas* can alter the ecosystem functions in areas they invade.



NEW TECHNOLOGIES TO ENHANCE OCEAN PRODUCTIVITY

Creating and applying technologies that show promise for expanding the horizons of ocean exploration, leading to deeper understanding of marine coastal processes, greater resilience among ocean resources, and the development of new products from the sea.

SPONGE SYMBIONT NATURAL PRODUCTS

Bradley Moore, College of Pharmacy, University of Arizona

R/B-39

Marine invertebrates are a proven source of diverse natural products having potential applications for pharmaceuticals and other industrial uses. Source organisms for some of these products may be difficult to collect or rare in nature. Working with the South Pacific sponge *Theonella swinhoei*, this study seeks to prove that bacteria associated with marine invertebrates can synthesize bioactive natural products. Researchers will then attempt to replicate the genetic make-up of the bacteria to artificially produce the compounds of interest. This verification and synthesis is critical to the fields of marine natural products and marine biotechnology because it can lead to the creation of sustainable supplies of clinically important natural products.

CRAB SHELL CHITOSAN AS A PESTICIDE STICKER AND IMMUNE RESPONSE ACTIVATOR

Lee A. Hadwiger, Department of Plant Pathology, Washington State University

R/B-44

Chitin is a natural material found in crab and shrimp shells. At one time, crab shells were regarded as waste and, through indiscriminate disposal, a source of pollution. The pollution problem has diminished since the discovery of commercial uses for chitin's main by-product, chitosan. Prior Sea Grant-funded research has demonstrated the ability of chitosan to inhibit the development of blight in potatoes by suppressing the activity of one potato gene. Now, the investigator is working with a manufacturer of chitosan and various pesticide industries currently manufacturing agriculture chemicals to define additional uses of chitosan as a pesticide "sticker."

NOVEL APPLICATIONS FROM NOVEL MICROORGANISMS AT SUBMARINE HYDROTHERMAL VENT ENVIRONMENTS

John Baross, School of Oceanography and the Astrobiology Program, University of Washington

R/B-45

During the past decade, WSGP-funded research at deep sea hydrothermal vent environments has focused on isolating microorganisms at different geographical locations, and particularly from new eruption sites on the Juan de Fuca Ridge off the coast of Washington. It has become increasingly clear that an extraordinary diversity of microorganisms exists at these environments, and this diversity also will be reflected in enzymes and other products that could be used for biotechnology. This work will continue the search for novel microorganisms from hydrothermal and subsea floor environments, and will determine and compare phylogenetic diversity in an existing culture collection of thermophilic and hyperthermophilic bacteria and archaea. Some of the novel organisms already isolated include hyperthermophiles that grow at temperatures greater than 120 degrees Centigrade, have new metabolic pathways for fixing carbon dioxide and use iron in place of oxygen to oxidize organic substrates. Such efforts could provide new microorganisms and compounds for biotechnology, medical and engineering applications.

GENOME-ENHANCED STUDIES OF LOW-TEMPERATURE ENZYMES

Jody Deming, School of Oceanography and the Astrobiology Program, University of Washington

R/B-46

As the next step to a previous WSGP-funded study of cold-active proteolytic enzymes and exopolymers, this project will explore these and other enzyme/exopolymer interactions at sub-freezing temperatures. In the long-term, such studies will shed light on microbial survival strategies in extreme habitats and, ultimately, contribute new compounds and insights for biotechnological, medical and engineering applications.

REMOTELY MONITORING KILLER WHALES BY CHARACTERIZING VOCALIZATIONS FROM INDIVIDUALS

John Horne, School of Aquatic & Fishery Sciences, David Bain, Psychology, and Les Atlas, Electrical Engineering, University of Washington

R/Ac-13

Previous studies of killer whale vocalizations have been limited to group analyses, due in large part to the technical difficulty of tracing specific vocalizations to the individual that produced them. As such, we know much about groups and less about individual killer whales. This project's remote acoustic monitoring system and "intelligent" computer program will enable researchers to gather and classify vocalizations and to correlate this information, enabling researchers to acoustically "track" individual animals. This non-invasive technique to remotely detect and identify individuals could also be applied to the study of humpback whales and other sound-producing aquatic animal species.

MINIATURIZED SONAR SYSTEM FOR SHARK IMAGING

Lee Thompson, Applied Physics Laboratory, University of Washington

R/OT-25

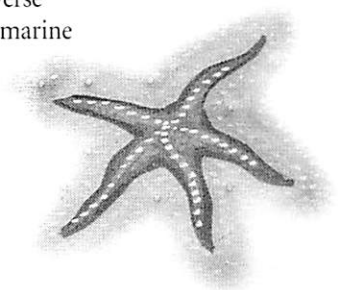
Because of their preference for deepwater habitats, Puget Sound's sixgill sharks (*Hexanchus griseus*) have been difficult to study in the wild. This project will provide shark biologists with a high-resolution imaging sonar prototype for viewing and tracking sixgill sharks at depths of 100 feet or more. This prototype device will be installed at The Seattle Aquarium during shark research events to give the researchers a ten-fold improvement over their existing tracking technology — an underwater camera and lights. This additional range will allow them to more effectively anticipate and plan for filming and tagging any incoming sixgill sharks, provide more insight into the sharks' individual feeding behaviors and help gather additional data on the number and sizes of the sharks in Seattle's Elliott Bay. Lightweight and economical, the sonar technologies developed on this project can be used for many other marine science-oriented applications.

EXPLORATION, INTER-COMPARISON AND ANALYSIS OF OCEAN DATA FROM OBSERVATION SYSTEMS, GRIDDED PROJECTS AND MODEL RESULTS

John Osborne, Ocean Atlas Software

R/OT-24

This project will extend the applications of Java OceanAtlas, a multi-OS software program, allowing scientists to visualize, manipulate and compare a wide variety of *in situ* data from ocean observing systems with model results and other gridded data products. In this way, workers in government agencies and academia will gain access to cost-effective tools for dealing with the ever-increasing volume of data from new and existing ocean observation systems. Access to diverse data sets will also enhance collaboration among marine science communities.



ECONOMIC AND COMMUNITY DEVELOPMENT

Assisting marine and coastal-dependent enterprises, agencies and communities in making sound business, planning and development decisions that provide economic benefits to local communities and to the region, while managing resources for sustainability.

USER-CENTERED BOATER INFORMATION SYSTEM

David Jones and Janet Olsonbaker, Applied Physics Laboratory, University of Washington

R/OT-26

The boating community must routinely rely on numerous sources for vital information on cruise planning, safety, navigation and other pertinent matters. Access to these sources often can be cumbersome and the information is not always understandable or useful. This project will create a Boater Information System, accessible on the World Wide Web, that is based on Cognitive Task Analysis and User-Centered Design principles for ease of use. As part of this project, the UW's Applied Physics Laboratory will foster improved relations with members of the boating community through a users group and advisory board. This project builds heavily on APL's previous work with the U.S. Navy to provide improved weather information for ships and airplanes.

RECREATIONAL BOATING INDUSTRY DATA PROJECT

Robert Goodwin, Washington Sea Grant Program, University of Washington

The recreational boating industry generates hundreds of millions of dollars and thousands of jobs in coastal and non-coastal communities throughout Washington. The Northwest Marine Trade Association (NMTA) is the leading trade representative for the boating industry and, for years, has sought boat sales data that could enhance its members' abilities to remain competitive. WSGP is assisting NMTA to publish monthly and quarterly sales reports on their Web site and in their newsletter, thus providing a significant tool for boat dealers and marina operators.

COASTAL STORMS INITIATIVE

Robert Goodwin, Steve Harbell and Pete Granger, Washington Sea Grant Program, University of Washington

Coastal communities in Washington state are threatened by frequent and severe coastal storms. In a partnership of sister agencies, WSGP and Oregon Sea Grant will join forces with NOAA partners to conduct a multi-year program of research and outreach targeting the lower Columbia River and estuary as well as Tillamook Bay to the south and north as far as Grays Harbor in Washington state. NOAA's goal for this second pilot study of CSI (the first was in Florida's St. Johns River estuary) is to help predict and reduce the impacts of coastal storms to watersheds and communities by developing improved products and services that address the needs of specific state and local decision makers. WSGP will provide outreach to stakeholders in Washington state.

COASTAL COMMUNITY DEVELOPMENT PROGRAM IN WASHINGTON AND THE PACIFIC NORTHWEST

Pete Granger, Robert Goodwin, Andrea Copping, Anne Nelson and Sue Texeira, Washington Sea Grant Program, University of Washington

ET/CC DP-1

Coastal areas are under severe stress, both from natural and human-induced influences. Urban and rural, or less suburbanized, areas face very different concerns. This multi-disciplinary effort will provide science-based outreach and education support to coastal decisionmakers and planners. Key areas of concern include coastal hazards, watershed planning, waterfront revitalization, nearshore habitat protection and GIS-based planning and management.

SHORELINE/COASTAL PLANNERS GROUP EDUCATIONAL EFFORT

Robert Goodwin, Washington Sea Grant Program, University of Washington

There is an ongoing need for planning and policy specialists to learn about current and proposed policies, applicable science and best practices for shoreline management, restoration and planning in Washington's coastal zone. The Shoreline/Coastal Planners Group is an informal gathering that meets quarterly to explore these issues. WSGP Coastal Resources Specialist Robert

Goodwin was the original organizer of this effort and continues to coordinate each session in conjunction with the Shorelands Division of the Washington Department of Ecology and the Padilla Bay National Estuarine Research Reserve.

EDUCATIONAL ACTIVITIES AND TECHNICAL SUPPORT FOR SHELLFISH GROWERS

Teri King and Steve Harbell, Washington Sea Grant Program, University of Washington

Washington State's shellfish industry leads the nation in production of oysters and ranks high in clam, mussel and geoduck landings. It 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. Field agents King and Harbell are strategically placed in the heart of the shellfish industry. Their project activities include hosting an annual conference for West Coast shellfish aquaculturists, sharing information on aquatic nuisance species and coordinating research on a variety of environmental and water quality issues facing the industry.

TECHNICAL TRAINING AND INFORMATION FOR COMMERCIAL FISHERS

Sarah Fisken, Steve Harbell and Eric Olsson, Washington Sea Grant Program, University of Washington

Commercial fishing continues to be a very large, diverse, complex and significant industry in Washington State. Most commercial fisheries are now being harvested at or near their maximum sustainable levels. This means that, to increase or even maintain profits, fishers must move into fully exploited fisheries, increase the value of their catches and reduce their operating costs. This is especially true of Tribal fishers, who represent a significant percentage of those fishing in Washington waters. This project is highlighted by hands-on safety training workshops designed to teach procedures that save lives. Other technical workshops include marine refrigeration, corrosion, diesel engine troubleshooting, computers and navigation and small oil spill prevention.

TRADE ADJUSTMENT ASSISTANCE PROGRAM

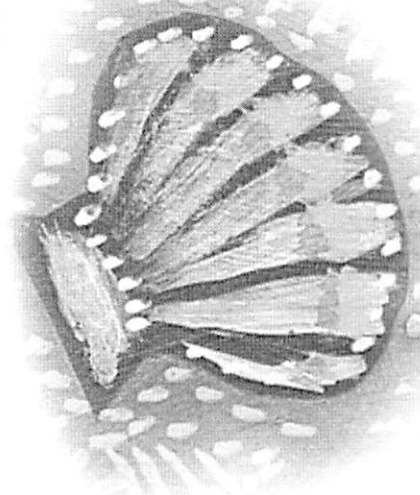
Pete Granger, Steve Harbell and Sarah Fisken, Washington Sea Grant Program, University of Washington, and Dennis Fleiss, Western Center for Risk Management Education, Washington State University

Under the recently expanded Trade Adjustment Assistance for Farmers program, salmon fishermen who have been adversely affected by foreign import competition may be eligible for up to \$10,000 in relief funding from the U.S. Department of Agriculture, plus job retraining through the U.S. Department of Labor. After filing for assistance, fishermen must participate in technical assistance training workshops, conducted by WSGP, in partnership with the Western Center for Risk Management Education. Held throughout the state in 2004, the workshops will present overviews of the global marketplace for salmon and address topics such as improving production efficiency, marketing and adding value to one's catch.

DIRECT MARKETING BY COMMERCIAL FISHERMEN AND SEAFOOD PROCESSORS

Pete Granger and Sarah Fisken, Washington Sea Grant Program, University of Washington

WSGP collaborations with Alaska and Oregon Sea Grant programs, the Women's Coalition for Pacific Fisheries and other agencies and organizations are yielding new programs and products for tribal and non-tribal commercial fishermen and seafood processors. These include a series of direct marketing workshops, emphasizing strategies for marketing one's own fish or shellfish catches, and *Tools for the Salmon Industry*, a series of workshops to examine restructuring, marketing, quality and overall health of the salmon industry in the northeastern Pacific Ocean. With guidance from WSGP, the Port of Bellingham's Squalicum Harbor facility is developing a Fishermen's Wharf facility for direct marketing of spot prawn, salmon and Dungeness crab — a measure to help fishermen bring in top dollars for their catches.



EDUCATION, TRAINING AND PUBLIC INFORMATION

Educating the workforce and informing the public as a means of sustaining the vitality of marine resources and the enviable lifestyle in Washington state and the Pacific Northwest.

REGIONAL WATER QUALITY EDUCATION PROJECT

Teri King and Anne Nelson, Washington Sea Grant Program, University of Washington

Since 1990, Washington Sea Grant Program has received state funds to develop an educational program on Puget Sound water quality issues in cooperation with Washington State University Cooperative Extension, the Puget Sound Water Quality Action Team, and several counties. Currently, two WSGP water quality specialists and three WSU Cooperative Extension agents operate as a team, combining their expertise and resources to provide technical assistance, public information and educational programs to local governments, tribes, industry, schools and water resource users in Jefferson, Kitsap, Mason and Thurston counties.

MARINE OIL SPILL PREVENTION EDUCATION PROJECT

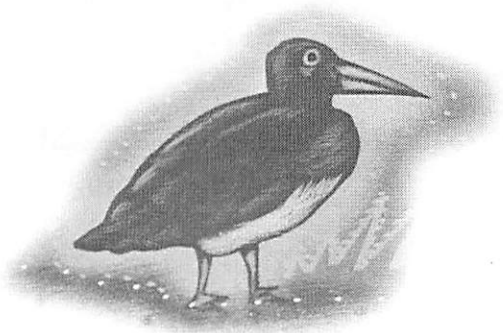
Eric Olsson, Washington Sea Grant Program, University of Washington

Small oil spills in marine waters may seem harmless, but may contain highly toxic refined or contaminated waste oil products. These small spills add up, and their cumulative impact can be particularly harmful to shallow, fertile nearshore environments. These spills are often considered normal, receive little media attention and are rarely reported or cleaned up. Operating under the state Oil Spill Prevention and Response Act of 1991, this WSGP voluntary prevention education program emphasizes direct interaction with vessel and marina operators and other marine users and agencies to provide safe and practical alternatives to spill-prone practices and to exchange ideas and technical information. The program targets commercial fishing and recreational boat operators, ferries, ports and marinas to promote innovative waste oil reduction and recycling, as well as sound maintenance and operating practices.

RECREATIONAL DIVERS MONITORING FOR AQUATIC NUISANCE SPECIES

Andrea Copping, Washington Sea Grant Program, University of Washington

Recreational divers in Washington are learning to become volunteer monitors through workshops on recognizing and reporting aquatic nuisance species (ANS). Free WSGP-sponsored workshops provide training and materials to help identify and prevent the introduction and dispersal of animals and plants that compete with, prey on, or disrupt the lives of Northwest native marine life. Several of these organisms are threatening the critical habitats of Dungeness crab, Pacific salmon and other commercially valuable species. Properly trained scuba divers are among the best lookouts for plant and animal invaders and can offer valuable insights to resource managers and researchers regarding the establishment and spread of aquatic nuisance species in Washington waters.



OUTREACH AND EDUCATION ON AQUATIC NUISANCE SPECIES

Andrea Copping, Washington Sea Grant Program, University of Washington

The introduction of non-native aquatic nuisance species (ANS) into the coastal waters of the Pacific Northwest poses a serious economic and environmental threat of increasing concern to resource managers, the aquaculture industry, non-governmental organizations and the general public. WSGP has taken a proactive approach to information sharing by producing pamphlets, fact sheets and identification cards on ANS. In the past, program staff have collaborated with other agencies and entities to develop an ANS curriculum and Web site. Future projects include a touring exhibit on ANS identification and control.

MPA NEWS

John B. Davis, School of Marine Affairs, University of Washington

Produced at the University of Washington and distributed online and by mail, *MPA News* is the leading forum for sharing information on management strategies and studies concerning marine protected areas. Sea Grant support for this monthly newsletter includes a partial editorial salary, consultation on newsletter content and increased advertising via a WSGP-designed poster and brochure. Principal support for *MPA News* comes from the Packard Foundation and the UW School of Marine Affairs with additional support from NOAA's Marine Protected Areas office.

EDUCATIONAL SUPPORT, SALISH SEA EXPEDITIONS

Ellie Linen Low, Salish Sea Expeditions

The mission of Salish Sea Expeditions is "to inspire a passion for exploring, understanding and respecting the marine environment through hands-on scientific inquiry on Puget Sound." WSGP funding for program evaluation and equipment upgrades will enable the Bainbridge Island-based organization to more effectively meet this educational challenge, nurturing creativity among public school students in 5th to 12th grades.

FELLOWSHIPS

DEAN JOHN A. KNAUSS MARINE POLICY FELLOWSHIPS

These 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. Since the Fellowship's inception in 1979, a total of 49 WSGP nominees have been selected — the most from any program in the nation.

INDUSTRY FELLOWSHIP PROGRAM

In 1995 the National Sea Grant College Program initiated the Industry Fellows program to strengthen ties between academia and industry. In cooperation with specific companies, the program provides support for graduate students pursuing research on topics of interest to a particular industry. The student, faculty advisor, Sea Grant and the industry representative work together on the project. As many as seven fellowships are granted each year, and each fellowship may last up to three years. WSGP-nominated Industry Fellows have made significant contributions to the fields of instrumentation and fisheries technologies in the past.

NMFS/SEA GRANT GRADUATE FELLOWSHIP PROGRAM IN POPULATION DYNAMICS AND MARINE RESOURCE ECONOMICS

Two fellowship programs have been established nationally to support graduate students in the population dynamics of living marine resources and in the economics of conserving and managing living marine resources. These fellowships foster closer relationships between academic scientists and NMFS and can accelerate the students' career development by providing real-world experiences. By contributing four successful candidates for these fellowships, WSGP has assisted a new generation of marine scientists to thrive and grow.

COASTAL MANAGEMENT FELLOWSHIPS

Established to provide on-the-job training opportunities for post-graduate students in coastal resource management and policy and to provide technical assistance for coastal resource management programs, these fellowships match highly qualified professional staff and master's or doctoral degree students with hosts around the nation involved in coastal zone management programs. WSGP has sponsored five Coastal Management Fellows in the past seven years.

SCIENCE WRITING INTERNSHIP PROGRAMS

In collaboration with the Science and Technology News Writing program of the UW's Technical Communication program, WSGP Communications staff provides assistance and opportunities for students to develop their science writing skills within a real-world context. In previous years, such internship experiences have paved the way for students to publish their work in *The Sciences* magazine and on the Web site of ABC News and have resulted in internships with *Discover* and *Science* magazines.

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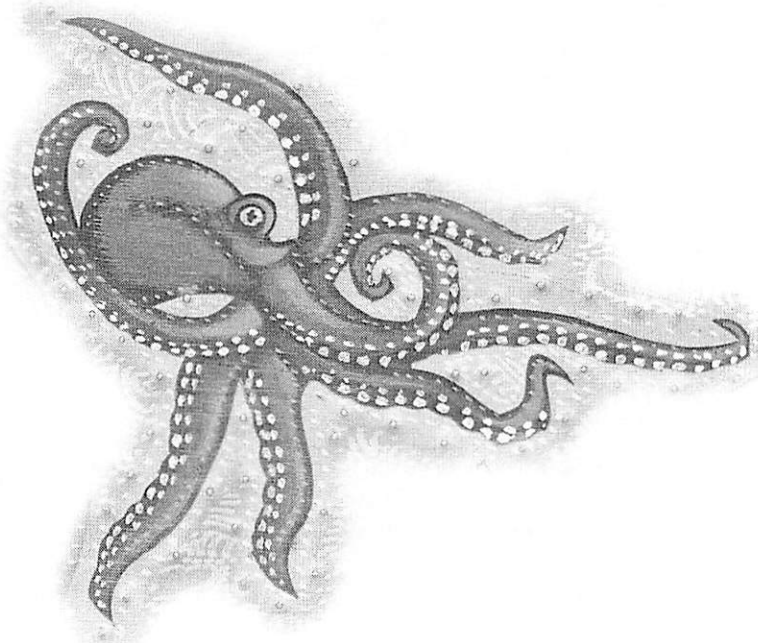
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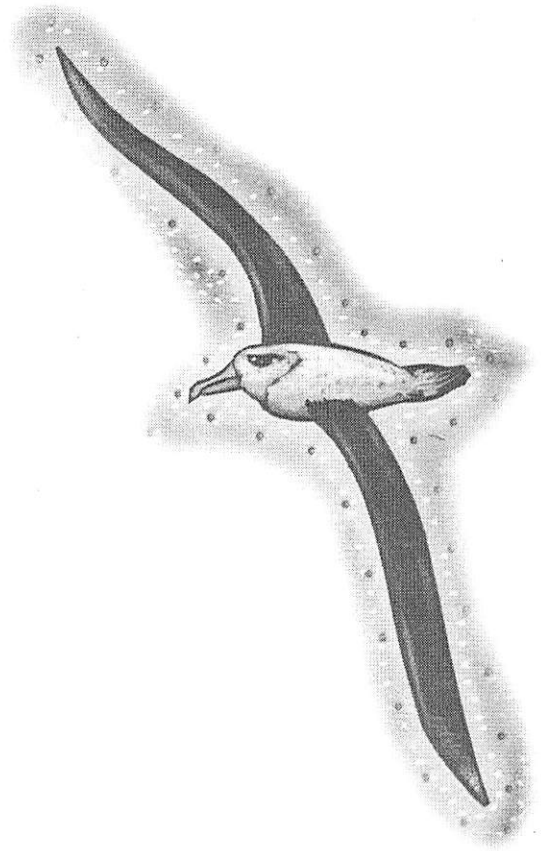
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