



# Sea Star

## The Persistent Professor:

### With Help from Washington Sea Grant Program, UW Oceanographer and Astrobiologist Jody Deming Carves a Crucial Niche in Cold Seas

Like the microorganisms she studies, Professor Jody Deming is persistent. For more than 25 years, the WSGP-funded scientist has focused her attention on cold-adapted bacteria from the sea.

The marine environment contains some of the coldest habitats on earth. Worldwide, the mean water temperature of the sea floor is about three degrees Centigrade (37 degrees Fahrenheit), barely above the freezing point of sea water. These cold, deep waters exist under very high pressures, reflecting the weight of the ocean above. At the surface of the oceans, in polar regions where sea ice forms, the liquid brine pockets within the ice can reach a mind-numbing -35 degrees C (-31 degrees F) during winter months and still remain liquid due to their extreme saltiness.

Yet despite the inhospitable natures of such environs, certain strains of bacteria can — and routinely do — survive and grow. As Deming discovered during her years as a doctoral candidate at the University of

Cold Seas • continued on page 2





Jody Deming collects a core sample of bacteria-laden Arctic sea ice.

Maryland, bacteria that are both cold-adapted (or psychrophilic) and pressure-adapted (barophilic) are the dominant forms of active life on the ocean floor.

## Pioneering Research

“When I started, as a grad student at the University of Maryland in the 1970s, there were no forms of truly barophilic bacteria from the cold, deep sea being cultured successfully in laboratories,” Deming recalls. “In fact, there was some doubt as to whether these organisms even existed,” she says.

The tools and techniques for studying deep sea bacteria were still evolving at that time. A true pioneer, Deming worked with novel methods for collecting psychrophilic barophiles and keeping them alive in the lab.

Samples were brought up from depths in stainless steel chambers, designed to keep the temperature and pressure of the sea water constant throughout the operation. As Deming soon discovered, however, guarding her samples from the effects of decompression was less important than keeping the bacteria cold.

“The original sampling method was intended for collecting sea water and any microscopic forms of life suspended in it,” she says. “I went after bacteria-laden sediment and animals — mainly sea cucumbers, types of starfish and amphipods — that had particles of such sediment in their guts.”

With the discovery of hydrothermal vents (commonly known as undersea “volcanoes”) in the late 1970s, the scientific community’s attention turned to thermophilic, or heat-adapted, bacteria that also must live under high pressure. Still, Deming never lost sight of her interests in cold-adapted bacteria. She always kept a hand in that research. She took up the challenge of the bioremediation of cold marine sediments and began to pay attention to near-freezing and below-freezing Arctic environments. “Those environments are now confronted with the possibility of extinction during this century, due to global climate change,” she says.

Beginning in 1992, WSGP stepped in to help support Deming’s work with funds for the many phases of her projects. “Today, we no longer regard cold-, heat- or pressure-adapted bacteria as oddities,” says Deming. “Rather, we consider them masters of survival, from which we strive to learn their secrets for success.”

## Secrets of Psychrophiles

What allows psychrophiles to function under conditions of cold and high pressure in the deep sea or the extreme cold and saltiness of sea-ice pockets? The answer, says Deming, lies in some of the unique enzymes that these microorganisms produce.

Typically, enzymes from microbes, animals and plants perform best over a range of temperatures, from about room temperature to well above human body temperatures. Surprisingly, most of the well-studied enzymes from cold-adapted microbes also perform optimally within the same range. However, in her University of Washington laboratory, Deming and her students have isolated several enzymes that can function efficiently down to  $-1$  degree C (30 degrees F). After several years of study, the search has shifted to bacterial enzymes that can work at temperatures far below the freezing point.

Deming is particularly interested in the bacterial production of exopolymers — complex organic compounds made primarily of various sugar molecules. These compounds serve as a means to stabilize enzymes so they can continue to be active, even as water molecules freeze around them.

“The exopolymers act as antifreeze compounds, much like those we add to automobile fluids in wintertime,” offers Deming. “Enzymes that are critical to bacterial survival in Arctic winter sea ice can continue to do their work if they are embedded in a cell coating of exopolymers that protect both the enzymes and the cells from freeze-damage,” she explains.

From a practical, industrial perspective, cold-adapted enzymes have incredible potential. They could be especially useful as the active ingredients in coldwater laundry detergents, gobbling up fats and oils at much lower temperatures than existing detergents, conferring energy cost savings to their users. They might also be effective at breaking down contaminants in bottom sediments or the gunky residue of oil spills at sea. Want to remove the lactose in milk without stimulating the growth of warmth-adapted bacteria? Enzymes from psychrophiles could probably do that, too.

Low-temperature enzymes have already shown their worth in the biotechnician’s laboratory. They are helpful to the Ligase Chain Reaction, used routinely as part of the medical molecular biologist’s tool kit for connecting pieces of DNA.

## Delving Even Deeper

“We’re presently collaborating with Profishent, a Seattle-based firm that is looking at ways to freeze fish eggs without harming them,” says Deming. New exopolymers that originate from cultures in her laboratory and are then optimized in Profishent’s could enable the biotech firm to safely ship frozen but viable eggs to hatcheries and other facilities around the world. Preserving fish eggs in this way could not only optimize the operations of fish hatcheries but could help to preserve genetic lines from threatened and endangered fish populations.

Similar technologies might have medical applications. In the not-too-distant future, compounds extracted from psychrophilic bacteria could be instrumental for storing human organ cells or tissue.

Perhaps as important, an understanding of psychrophiles could offer valuable insights into the origins and persistence of life on Earth and the possible habitability of other celestial bodies.

“Among the best candidates for finding microbial life elsewhere in our solar system are the planet Mars and Europa, one of Jupiter’s moons. The surface of Mars is frozen,” notes Deming. “So is Europa’s surface,” she adds, “where conditions dip as low as  $-160$  degrees C ( $-256$  degrees F).

“Few people realize that 20 percent of our own planet is frozen. However frigid, the environments of Earth’s polar regions, Mars and Europa could support as-yet-undiscovered forms of psychrophilic life.”

With all this in mind, Deming has recently expanded her academic focus. In addition to her work with the UW School of Oceanography, she is also a professor in the university’s newly created Astrobiology Program. Each year, she spends time aboard research vessels and ice stations in the Arctic, studying polar ecosystems in the cold, dark winter, when the physical limits on life are most severe. This past winter, from January to April, she served as Chief Scientist for an international project on a Canadian icebreaker, frozen into Franklin Bay, at the entrance to the Northwest Passage. There, she and her students examined the natural behavior of cold-adapted bacteria, their enzymes, exopolymers, and even viruses in deeply frozen sea ice. Stay tuned for those results.



Top: sampling at the sea’s edge. Below: Deming poses with members of her Arctic research team.

In recognition of her body of work, Deming was recently elected to membership in the National Academy of Sciences, the nation’s most prestigious organization of scientists. Clearly persistence has paid off — for psychrophiles and the professor who, with help from WSGP, has made their study her life’s work.

# Earthquake/Tsunami Preparedness Project Moves Forward

In February 2001, a magnitude 6.8 earthquake rocked the Puget Sound region, injuring 400 people and causing property damage in excess of \$1 billion. The quake was minor, compared to the one that occurred about 900 years ago on the Seattle Fault. This ancient event lifted parts of Puget Sound 20 feet and produced a tsunami that inundated low-lying coastal areas, including Sinclair Inlet and the present-day sites of Port Orchard and Bremerton.

Could either scenario happen again, and if they did, how could members of the Sinclair Inlet Port and Harbor Community prepare to reduce exposure to risk and mitigate their impacts? For nearly three years, Robert Goodwin, WSGP's Coastal Resources Specialist, has worked with community members and a team of UW faculty, federal and state agency scientists and technical staff to address these important questions.

Last autumn, Goodwin and project intern Andrew Bohlander of the UW School of Marine Affairs produced a planning document, assessing the port and harbor community's vulnerability to earthquake and tsunami hazards and identifying mitigation options. Community members provided input during all stages of the document's creation.

"Ports and waterways will be immensely important following a tsunami-producing earthquake," says Goodwin. "Sinclair inlet communities depend on the ferry system and the waterways it uses. Restoring that system after a tsunami — clearing debris, charting obstructions and seafloor changes — will require a concerted community effort involving the Navy, Coast Guard, the Port of Bremerton and local marine businesses."

Among the top-ranked vulnerability issues the plan identified:

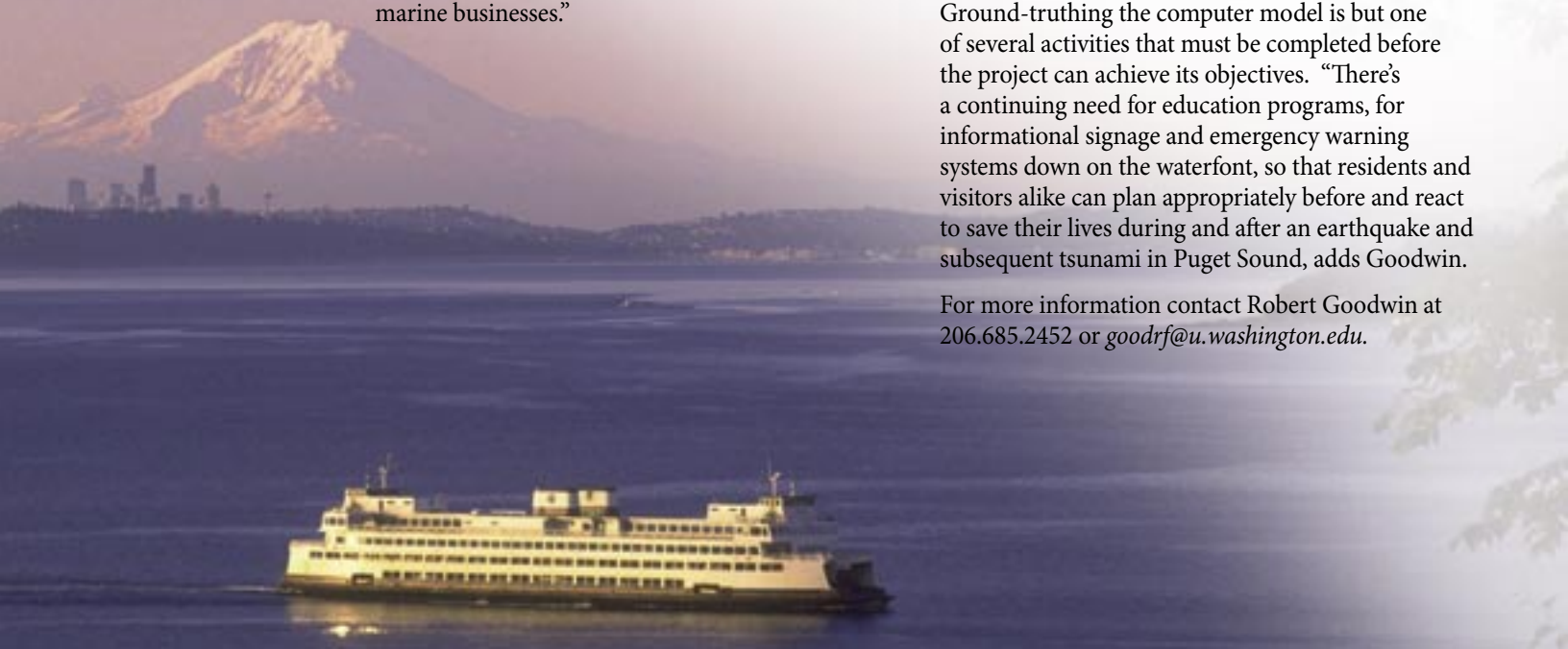
- ◆ loss of human life;
- ◆ reduced military readiness;
- ◆ waterways and highways blocked with debris from tsunami action;
- ◆ damage to shellfish beds, salmon habitat, tidal wetlands and other natural resources;
- ◆ damage to utilities and to ferry docks, bridges, highway overpasses and other components of the transportation infrastructure; and
- ◆ danger to homes and businesses in vulnerable shorelines or at the foot of steep bluffs.

One of the first steps in identifying these issues was to develop a Geographic Information Systems "atlas" illustrating specific geological hazards and vulnerable sites and facilities. A visiting Japanese scientist created a computer model to simulate the effects of a tsunami similar to the 930 AD event. While Dr. Koshimura's model was only a preliminary simulation, it was important for educating the community about the danger posed by a tsunami, which could come with virtually no warning.

"Without a detailed inundation map — one with more accurate bathymetry and shoreline topography — the amount of information that can be shared with the community is limited," Goodwin says. "Further refinement will be necessary before a mapped line can be drawn, showing areas subject to tsunami flooding and currents."

Ground-truthing the computer model is but one of several activities that must be completed before the project can achieve its objectives. "There's a continuing need for education programs, for informational signage and emergency warning systems down on the waterfront, so that residents and visitors alike can plan appropriately before and react to save their lives during and after an earthquake and subsequent tsunami in Puget Sound, adds Goodwin.

For more information contact Robert Goodwin at 206.685.2452 or [goodrf@u.washington.edu](mailto:goodrf@u.washington.edu).



# What Makes Hood Canal Hypoxic? WSGP-Funded Project Probes the Depths, Searching for Clues.

In recent months, much attention has been focused on the extremely low dissolved oxygen levels in the waters of Hood Canal. Scientists, resource managers and the general public have all expressed concern over this condition, known as hypoxia that has led to large-scale fish and shellfish die-offs in many parts of the canal. While theories abound, no one has been able to pinpoint the exact cause or causes of hypoxia in Hood Canal.

“Several possibilities could be responsible,” says University of Washington oceanographer Michael Gregg. “But until the flow and mixing dynamics of Hood Canal are known, we will be unable to evaluate these possibilities or to estimate future conditions by realistic computer modeling.”

Hood Canal waters are more likely to have low oxygen levels than other parts of Puget Sound. That’s because the waters at the surface and bottom tend to mix less, especially in summer months, when the weather is warm and the breezes are mild. The Skokomish, Hamma Hamma, Duckabush and other rivers and streams feeding into Hood Canal contribute lighter weight fresh water, which sits on top of the canal’s denser and heavier salt water — a condition called stratification. Without wind and wave action, this oxygen-rich water does not get mixed into the lower depths.

As part of a multi-year study funded by WSGP, Gregg has been gathering data on water flow and mixing in Hood Canal.

Two physical features of Hood Canal are of special interest to Gregg and his fellow researchers, Jack Miller of the UW’s Applied Physics Laboratory (APL) and Jan Newton of the Washington Department of Ecology. One of these is the South Point Sill — a submerged promontory of rock and sediment, rising up nearly 500 feet from the bottom of Hood Canal.

To reach the main portion of Hood Canal, dense, oxygenated ocean water entering from Admiralty Inlet must cross the South Point Sill. Major intrusions of this water seems to occur only in early autumn, when coastal upwelling off the Washington coast produces the most dense water entering Admiralty Inlet, says Gregg. Between renewals, oxygen in the deep water south of the sill slowly decreases as it is consumed.

Owing either to year-to-year variability in the density of these intrusions or to the variability of mixing within the canal, several years may elapse before the intruding ocean water can slip beneath the existing bottom water. When this happens, oxygen in the bottom water becomes dangerously low.

The Hood Canal Bridge may be another strong influence on dissolved oxygen levels. This two-lane structure extends across the mouth of the canal, possibly further restricting the mixing of oxygen-rich surface water with deeper water

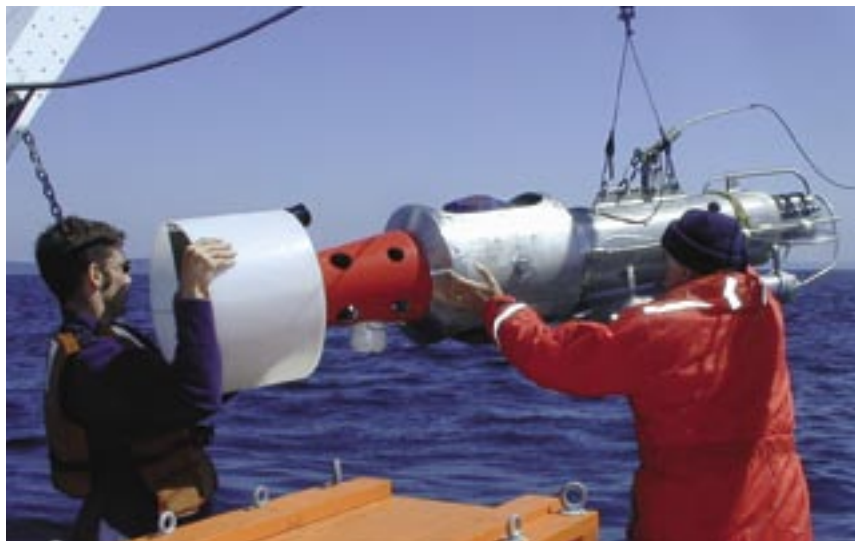
Gregg has been studying oceanographic data, using the RV *Miller*, a 50-foot utility boat operated by APL. During its data-gathering forays, the *Miller* has been towing a torpedo-shaped device called SWIMS — short for Shallow Water Integrated Mapping System.

Developed in the early ‘90s with funding from WSGP, SWIMS carries a dissolved oxygen sensor and a small acoustic altimeter for measuring its height above the bottom. Other oceanographic information has come from a pair of Microstructure Profilers, instruments lowered from the boat on a cable and outfitted with sensors for monitoring water temperature, depth and current speeds.

Results of Gregg’s study were presented at the 2004 Ocean Sciences meeting in Portland, Oregon. They will soon be incorporated in a high-resolution model of Hood Canal, developed by Amanda Babson, a UW graduate student working with oceanographer Mitsuhiro Kawase, also with the UW.

*Editor’s note: User-friendly information about Hood Canal’s hypoxic condition and an assortment of ways you can protect this waterbody’s health are contained in a free one-pager, Low Dissolved Oxygen Levels in Hood Canal by WSGP’s Marine Water Quality Specialist Teri King. Information is also available as a large-format poster titled Ten Things You Can Do to Help Hood Canal. Contact WSGP Publications for one or more copies of these helpful print resources.*

*Gathering clues: Gregg and an assistant get the SWIMS ready for another mission beneath the surface of Hood Canal.*



## Industry Fellowship— Laura Beer



Laura Beer has been involved in Sea Grant research since her undergraduate days at East Carolina University in North Carolina. Now a PhD student in pharmacology and toxicology at the University of Arizona, Beer will begin a two-year Sea Grant Industry Fellowship in June. She has partnered with Nereus Pharmaceuticals in La Jolla, California, to explore marine sources important to drug development. Beer studies the biosynthesis of salinosporamide A, a chemical that arises naturally from marine bacteria. It is potentially toxic to cancer cells.

The National Sea Grant College Program set up the Industry Fellows Program in 1995, to foster industry-academia alliances in which students, advisors, Sea Grant and industry partners work together on a project of mutual interest. Beer's project attracted the support of Nereus, whose "mission is to isolate and develop anti-cancer and anti-infective clinical candidates from marine microbial sources," Beer says. Both of Beer's advisors — Brad Moore at Arizona and Ray Lam at Nereus — weigh in on her project. Nereus is "a few hundred miles away from Tucson, so visiting often isn't possible," says Beer. "However, they are extremely supportive of the project." Moore, who was at the University of Washington before joining the faculty at Arizona, retained funding from Washington Sea Grant Program to continue projects he started at the UW. Beer was nominated for her fellowship through WSGP, since Arizona does not have a Sea Grant program.

"The fellowship offers a unique way to find scientists devoted to issues important to both industry and Sea Grant," Beer says. In addition to funding for research and a stipend, the fellowship provides funding for travel to professional conferences, where Beer will present her research and meet scientists with similar interests. "There are some remarkable individuals in this field and I'm looking forward to meeting them and hearing about their research," she says.

Beer plans to continue exploring drug applications of marine biology after she finishes her degree. "I'm leaning toward biotech, with an emphasis on natural products and drug discovery and development," she says. "I would really love to see a project through from start to finish. I hope that my project leads to something of that caliber."

## Opportunities for the Region's Fishers

Northwest fishers who want to get more cash for their catches will continue to get help from Washington Sea Grant Program. In separate but related efforts, WSGP and its partners — the Northwest Indian Fisheries Commission, Alaska and Oregon Sea Grant programs and the Women's Coalition for Pacific Fisheries, to name a few — have designed a suite of programs to meet the marketing needs of the fishers:

- ◆ Collaborative efforts have yielded direct marketing and other workshops addressing issues of interest to the salmon industry, such as seafood quality, market restructuring and economic vitality. The next opportunity will be offered in association with the Wild Seafood Exchange conference (*wildseafoodexchange.com*) in Seattle on November 10<sup>th</sup>. WSGP is a major sponsor of this event, which will encourage commerce by bringing fishers together with retail and restaurant buyers.
- ◆ This past summer's pilot program, in which fishers could sell their catches directly to buyers at the Port of Bellingham's Squalicum Harbor, was a big success. It's likely that sales will continue through Fall and into Winter. WSGP, the Port and industry are now exploring the option of a permanent facility for fresh seafood sales in coming years.
- ◆ WSGP will continue to offer technical training workshops as part of the Trade Adjustment Assistance program, coordinated by the U.S. Department of Agriculture. The workshops are designed to help the fishers remain competitive in the increasingly globalized marketplace. Under the TAA program, relief funds of up to \$10,000 are available to salmon fishers who have suffered economically from foreign imports of salmon. Approval for the petition for the 2003 season is expected soon.

For more information on upcoming workshops for fishers, contact Pete Granger (206.685.9261 or [pgranger@u.washington.edu](mailto:pgranger@u.washington.edu)) or visit [wsg.washington.edu/research/coastaldev/fishing.html](http://wsg.washington.edu/research/coastaldev/fishing.html).

## October

### 22ND LOWELL WAKEFIELD FISHERIES SYMPOSIUM

September 30-October 3, 2004

Anchorage, AK.

FFI: Sherri Pristash, [fyconf@uaf.edu](mailto:fyconf@uaf.edu), [uaf.edu/seagrant/Conferences/sealions/](http://uaf.edu/seagrant/Conferences/sealions/)

### OYSTERFEST

October 2, 2004

Mason County Fairgrounds, Shelton.

FFI: Teri King, WSGP, 360.432.3054, [guatemala@u.washington.edu](mailto:guatemala@u.washington.edu), [oysterfest.org](http://oysterfest.org)

### COAST DAY - DELAWARE SEA GRANT COLLEGE PROGRAM

October 3, 2004

11 a.m. to 5 p.m., Hugh R. Sharp Campus, 700 Pilottown Road, Lewes, DE. FFI: University of Delaware Marine Public Education Office, 302.831.8083, [MarineCom@udel.edu](mailto:MarineCom@udel.edu), [ocean.udel.edu/coastday/](http://ocean.udel.edu/coastday/)

### COAST DAY - NEW JERSEY

October 9-10, 2004

October 9 at Viking Village, Long Beach Island, and October 10 at Cape May, Lobster House Restaurant, Utsch's Marina and NJ Audubon Nature Center. FFI: New Jersey Marine Sciences Consortium and New Jersey Sea Grant, 732.872.1300 x22, [cvalkos@njmsc.org](mailto:cvalkos@njmsc.org), [njmsc.org](http://njmsc.org)

### DOCKS AND MARINAS 2004

October 11-13, 2004

University of Wisconsin, Madison. FFI: C. Allen Wortley, Program Director, University of Wisconsin-Madison, 432 N Lake Street, Madison, WI 53706, 800.462.0876, [wortley@epd.engr.wisc.edu](mailto:wortley@epd.engr.wisc.edu), [epdweb.engr.wisc.edu/webF904](http://epdweb.engr.wisc.edu/webF904)

### WORLD WATER MONITORING DAY

October 18, 2004

Volunteer groups in Kitsap County will monitor local waters, including estuaries, for a month and report the results on an international Web site, [worldwatermonitoringday.org](http://worldwatermonitoringday.org) FFI: Anne Nelson, WSGP, 360.337.7170, [annen2@u.washington.edu](mailto:annen2@u.washington.edu) or Pat Kirschbaum, Kitsap Surface and Stormwater Management Program, 360.337.5777, [pkirschbaum@co.kitsap.wa.us](mailto:pkirschbaum@co.kitsap.wa.us)

## SEPTIC TRAINING

October 30, 2004

9 a.m. to 1 p.m., Thunderbird Room, Fairgrounds Complex, 1200 NW Fairgrounds Rd, Bremerton. "Septic Systems and Landscaping," will be discussed by Teri King, Water Quality Specialist, WSGP, and Mindy Fohn, Kitsap County Health District. FFI: Peg Tillary, 360.337.7224

## PACIFIC FISHERY MANAGEMENT COUNCIL

October 31-November 5, 2004

Embassy Suites Airport Hotel, Portland, OR.

FFI: Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, OR 97220-1384, 503.820.2280, 866.806.7204 (toll-free), [pcouncil.org/](http://pcouncil.org/)

## November

### PACIFIC MARINE EXPO

November 11-13, 2004

Washington State Convention and Trade Center, Seattle. FFI: Diversified Business Communications, PO Box 7437 Portland, ME 04112-7437, 207.842.5500, [pacificmarineexpo.com](http://pacificmarineexpo.com)

### WATERSHED RESTORATION VIDEO AND WEBCAST

November 16, 2004

9:00 to 11:30 a.m., Streaming Web video of restoration projects in the Pacific Northwest at [wawater.wsu.edu](http://wawater.wsu.edu). Satellite broadcast at WSGP's Port Orchard office and other host sites in the state. FFI: Anne Nelson, WSGP, 360.337.7170, [annen2@u.washington.edu](mailto:annen2@u.washington.edu) or Jan Seago, WSU Water Resource Education Program Coordinator, WSU Extension @ Heritage College, [seagoj@wsu.edu](mailto:seagoj@wsu.edu)

### INTERNATIONAL CONFERENCE ON SHELLFISH RESTORATION

November 17-20, 2004

DoubleTree Guest Suites, Charleston, SC. FFI: Elaine Knight, 843.727.6406, [Elaine.Knight@scseagrant.org](mailto:Elaine.Knight@scseagrant.org), [scseagrant.org/icsr.htm](http://scseagrant.org/icsr.htm)

## PEOPLE FOR PUGET SOUND SPEAKER SERIES

November 18, 2004

7 to 9 p.m., Seattle REI, 222 Yale Ave N. Dr. Usha Varanasi, Director, Northwest Fisheries Science Center, will speak about some of the successes and challenges in maintaining the health of Puget Sound. FFI: Cliff Sanderlin, Development Director, People for Puget Sound, 206.382.7007, [anance@pugetsound.org](mailto:anance@pugetsound.org)

## SALMON TOURS

November 20, 2004

South Kitsap County. Travel by bus to three or four different salmon-viewing sites around the county, assisted by trained biologists. FFI: Anne Nelson, WSGP, 360.337.7170, [annen2@u.washington.edu](mailto:annen2@u.washington.edu)

## EXTREME 2004: EXPEDITION TO THE DEEP FRONTIER

November 30-December 20, 2004

Underwater research, conducted by University of Delaware marine scientists, will explore the effects of extreme temperatures and toxic chemistry on sea vent life. In a live conference call, 50 selected classrooms across the country will participate in expeditions aboard the submersible *Alvin* and the research vessel *Atlantis*. FFI: Tracey Bryant, Graduate College of Marine Studies and the Sea Grant College Program, Newark, DE 19716-3530, 302.831.8185, [tbryant@udel.edu](mailto:tbryant@udel.edu), [ocean.udel.edu/expeditions/](http://ocean.udel.edu/expeditions/)

## December

### 6TH INTERNATIONAL AQUARIUM CONGRESS

December 5-10, 2004

Monterey Bay Aquarium, Monterey, CA. FFI: Ginger Hopkins, Conference Organizer, Monterey Bay Aquarium, 886 Cannery Row, Monterey, CA 93940, 831.648.4925, [GingerHopkins@IAC2004.org](mailto:GingerHopkins@IAC2004.org), [iac2004.org/default.htm](http://iac2004.org/default.htm)

### NORTHWEST FISH CULTURE CONFERENCE 2004

December 7-9, 2004

Victoria, British Columbia, Canada. FFI: [nwfcc@gofishbc.com](mailto:nwfcc@gofishbc.com), [nwfcc.confmanager.com](http://nwfcc.confmanager.com)

## On the Horizon

### PACIFIC SEABIRD GROUP

32ND ANNUAL MEETING

January 19-23, 2005  
Portland, OR.

### PACIFIC FISHERY MANAGEMENT COUNCIL

March 6-11, 2005  
Sacramento, CA.

### KITSAP WATER FESTIVAL

March 23, 2005  
Bremerton.

### SEA GRANT PUBLICATIONS

Many marine-related publications are available from Washington Sea Grant Program.

To order publications or to request a current catalog, please contact: Washington Sea Grant Program Publications, University of Washington, 3716 Brooklyn Ave. N.E., Seattle, WA 98105. Phone 206.543.0555. Fax 206.685.0380. [sgpubs@u.washington.edu](mailto:sgpubs@u.washington.edu) [wsg.washington.edu](http://wsg.washington.edu)

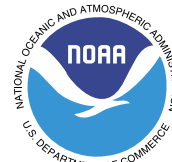
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**JANUARY/FEBRUARY/MARCH 2005 SEA STAR SUBMISSION DEADLINE**  
NOVEMBER 12, 2004.

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**Sea Grant**  
Washington



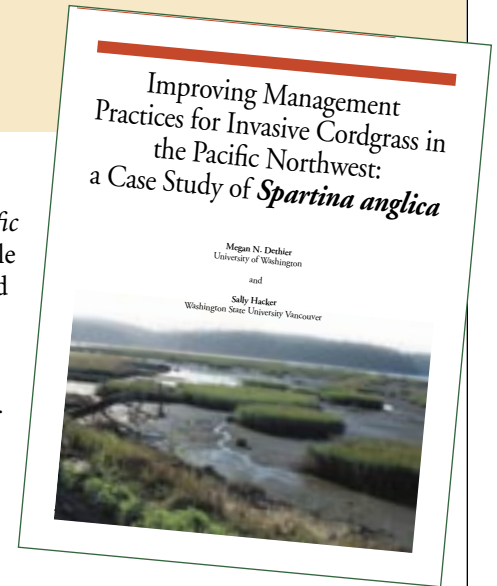


## Web Site Make-Over

Are you one of the thousands of people who visit our Web site each day? If so, then you've probably noticed our new look, which features the award-winning artwork of Joel Nakamura and a streamlined, easy-to-navigate design. The site was recently revamped by WSGP Communications with help from UW Health Sciences Academic Services & Facilities. If you haven't been there yet, please set your browser to [wsg.washington.edu](http://wsg.washington.edu). Then contact us at [seagrant@u.washington.edu](mailto:seagrant@u.washington.edu) and tell us what you think of the redesign.

## New Publications from WSGP

*Improving Management Practices for Invasive Cordgrass in the Pacific Northwest: a Case Study of *Spartina anglica**. This is an indispensable guide for developing strategies to control the spread of Puget Sound's most aggressive aquatic invasive plant species. Comprehensive with numerous maps, tables and charts, this 24-page report is the product of WSGP-funded scholars Megan Dethier of the University of Washington and Sally Hacker of Washington State University, Vancouver. Call WSGP Publications for price.



*Fellowships for the Future: Washington Sea Grant Program Fellowships and Internships* presents a photo-illustrated overview of opportunities for graduate students and doctoral and post-doctoral candidates to gain direct experience in marine policy-making, industrial innovation, coastal planning, marine population dynamics and resource management and communications. Washington Sea Grant Program leads all other Sea Grant programs in successfully placing fellows in these disciplines. No charge.



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