Washington Sea Grant
University of Washington

Spring 2011

# Sea Star

## Of PBDEs and Omega-3s

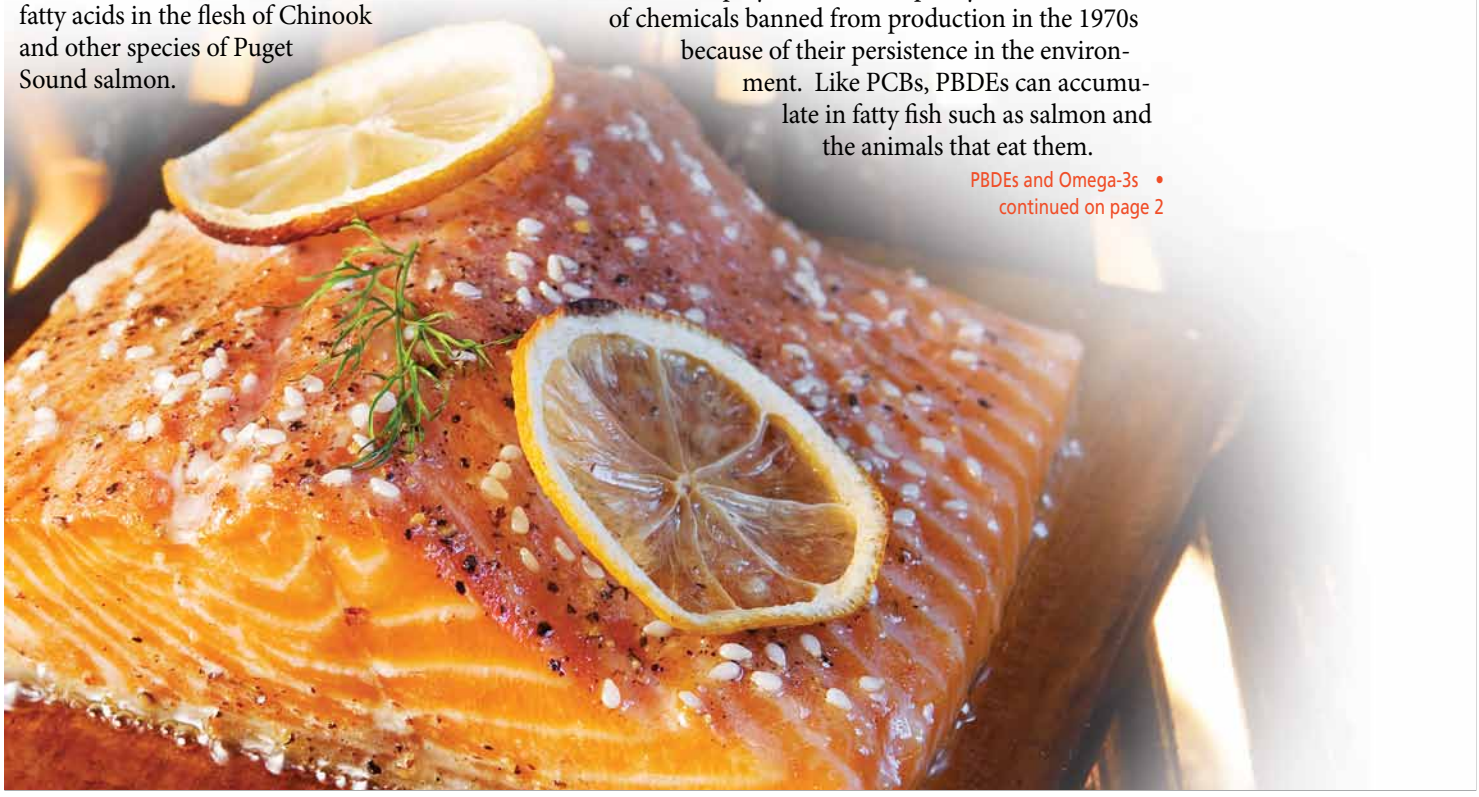
### WSG-funded scientist examines the role of Omega-3 fatty acids in protecting our cells against potentially damaging chemicals

*by Ruth Hall Sedlak, Winter 2011 WSG Science Writing Fellow*

The chair you're sitting on or the fleece you're wearing could be releasing potentially harmful chemicals called polybrominated diphenyl ethers (PBDEs). Used as flame-retardants for the past 50 years in everything from mattresses to outerwear, these chemicals are a growing health concern. With research funding from Washington Sea Grant, University of Washington scientist Evan Gallagher is studying the effects of PBDEs on human cells. In the process, he's examining what could very well be an important ally in PBDE defense: the Omega-3 fatty acids in the flesh of Chinook and other species of Puget Sound salmon.

"PBDEs are not often chemically bonded to the materials they coat," says Gallagher, a professor in the UW's Department of Environmental and Occupational Health Sciences. These human-produced compounds can enter the environment from furniture, electronics, clothing and other manufactured materials and can leech out in landfills. They are designed to withstand heat, so, for the most part, they don't break down in the environment. In this way, they have some similar characteristics as polychlorinated biphenyls (PCBs), a class of chemicals banned from production in the 1970s because of their persistence in the environment. Like PCBs, PBDEs can accumulate in fatty fish such as salmon and the animals that eat them.

PBDEs and Omega-3s • continued on page 2



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PBDEs and Omega-3s • continued from page 1

"Although people are concerned with eating salmon that may contain even trace amounts of these chemicals, there have been virtually no lab studies that investigate interactions among the beneficial nutrients in salmon with PBDEs or other persistent organic chemicals," says Gallagher. "I'm trying to clarify the risk of seafood consumption on a more mechanistic basis," he says. "Does the risk associated with PBDE exposure outweigh the considerable benefits of the omega-3 fatty acids found in seafood?"

Gallagher's research focuses particularly on PBDE accumulation in resident Puget Sound Chinook salmon. Five species of salmon — pink, coho, chum, Chinook and sockeye — co-exist in Puget Sound. NOAA research has revealed that all five have detectable levels of PBDEs, but Chinook have much higher levels than do the other salmon species.

In his UW lab, Evan Gallagher shows research assistant Andrew Yeh the various strains of zebrafish used for his PBDE/Omega-3 studies. The cells of four-day-old zebrafish (next page, bottom) are treated with a fluorescent stain. These cells are sensitive markers for metal toxicity and are easy to visualize with fluorescent microscopy.

"In general, the main driver for contaminant accumulation is exposure in their marine environment. Pink, chum and sockeye have more offshore distributions, and coho and Chinook are more coastal," says Sandra O'Neill, research fish biologist at NOAA's Northwest Fisheries Science Center in Seattle. "Therefore," she says, "there's more chance for contamination. Puget Sound resident Chinook tend to stay around the Sound, so they are exposed to more land-based contaminants."

Relatively little is known about the human health effects of PBDE exposure, whether from seafood consumption or environmental exposure. However, according to O'Neill, NOAA classifies PBDEs as a group of emerging contaminants of concern, based on their chemical similarities to PCBs, which are known to be harmful.

"What really raised the human health concerns of PBDEs were several studies in the early 2000s that examined pregnant women from different parts of the world and found PBDEs in their breast milk and fat stores," says Gallagher. "Studies of pregnant rats exposed to high levels of certain types of PBDEs found neurological defects in the offspring, raising a lot of public health concerns about these persistent organic chemicals. However, we are only beginning to understand if some of the effects seen in rats are translatable to humans."

PBDEs could be harmful to humans in multiple ways. They could act as hormone mimics, disrupting normal development, much like PCBs. They could also be attacking human cells directly. Gallagher's experiments with human cell suggest PBDEs cause harm through oxidative stress — a cellular phenomenon that leads to the production of free radicals such as peroxides that physically damage cells. This is a common mechanism of action for a number of environmental chemicals and side effects of certain drugs, but it is also a process that accelerates during aging.

Gallagher hypothesizes that omega-3 fatty acids can protect cells from any oxidative damage done by PBDEs. These two chemicals potentially interact because, when a person consumes contaminated salmon, he or she is not only getting some exposure to unhealthy PBDEs but also a healthy dose of omega-3 fatty acids.

Omega-3 fatty acids, particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), have been widely touted as beneficial for their anti-inflammatory and anti-oxidant properties. As such, many consumers have started taking fish oil pills along with their multivitamins for a daily dose of omega-3s.

Omega-3s are naturally contained in oily fish such as salmon, lake trout, tuna and herring. Although the U.S. Food and Drug Administration has no formal dietary recommendation for daily consumption of omega-3s, it does support the finding that they may be beneficial in reducing coronary heart disease. Additionally, doctors routinely recommend that pregnant women specifically take DHA supplements to support brain health in developing fetuses.

Gallagher intends to test the hypothesis that the omega-3s in fish counteract the oxidative damage induced by PBDEs in human cells. His approaches involve measuring cell death and damage to cellular mitochondria — the cell's "power plants." He is also surveying anti-oxidant levels and tracking the expression level of the genes responsible for these anti-oxidants. Gallagher explains that by analyzing the antioxidant genes, we can understand if exposure to the omega-3s causes a jumpstart in the machinery that starts a process that ultimately leads to an increased cellular defense system that can protect those power plants within the cells.

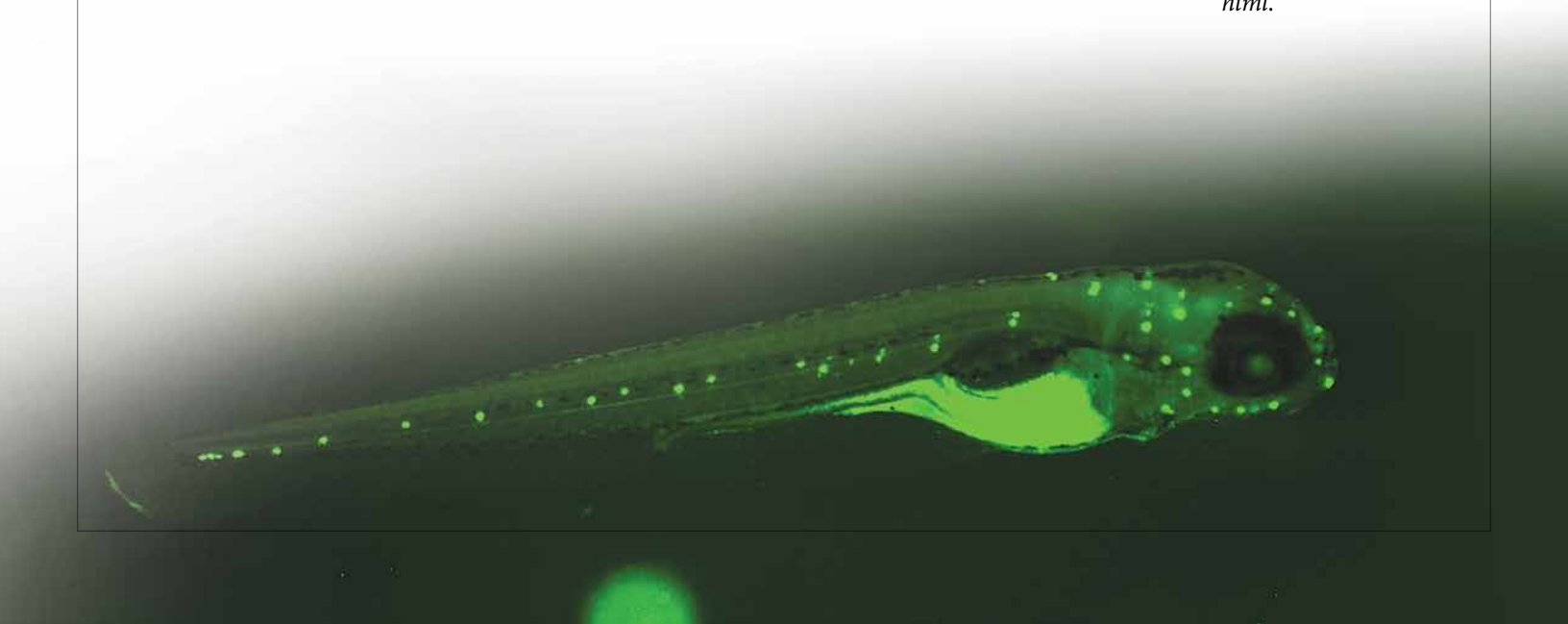
With his two UW graduate students, Andrew Yeh and Chase Williams, Gallagher exposes lab-cultured human cells to BDE-47, the predominant type of PBDE in fish, wildlife and humans. After analyzing any stress to the cells, he tests whether adding omega-3 fatty acids protects the cells against PBDE damage.

The second phase of his WSG-funded experiments involves zebrafish — small black-and-white-striped tropical fish that are often reared for laboratory research. Gallagher hypothesizes that over-expressing key anti-oxidant genes that are turned on by omega-3 exposure in human cells will protect the zebrafish from PBDE damage. "We're going to look at the functional outcome on a whole organism level," says Gallagher.

In the Gallagher lab's tissue culture room, Andrew Yeh feeds batches of cells for future experiments.

The next step for Gallagher and his laboratory will entail taking biochemical approaches with an epidemiological study to fill a key gap in assessing the risk in fish consumption. With salmon, the bottom line is that the concentration of the beneficial omega-3s appears to greatly exceed that of PBDEs. Gallagher's continued research will help people make more informed decisions about the seafood they buy and further inform regulators, who must decide what kinds of chemicals can be used by manufacturers throughout the world.

For additional information, contact Evan Gallagher (206.616.4739 and *evang3@uw.edu*) or for research updates, visit the project page on the WSG Web site at *www.wsg.washington.edu/research/ecohealth/salmon_omega3_toxicity.html*.



# Field Notes

WSG is sponsoring **Suzanna Stoike** as a two-year West Coast Sea Grant Fellow in the Washington State Department of Ecology. Stoike is one of four Fellows placed in state and federal offices in Washington, Oregon and California as part of a NOAA grant to collaboratively support common elements of the West Coast Governors' Agreement on Ocean Health (WCGA) and the Sea Grant West Coast Regional Research and Information Needs Report. Fellows work with regional WCGA Action Coordination Teams on high-priority research areas such as habitat and ecosystem health, climate change adaptation, water quality, sustainable coastal communities and fisheries.

WSG Director **Penny Dalton** has been appointed to the board of the Sea Grant Association, a non-profit organization dedicated to furthering the Sea Grant program concept. SGA's regular members are the academic institutions that participate in the National Sea Grant College Program. SGA provides the mechanism for these institutions to coordinate their activities, set program priorities at both the regional and national level and provide a unified voice for these institutions on issues of importance to the oceans and coasts.

WSG's Science Writing Fellowship program, which ordinarily recruits a single fellow each academic quarter, accepted two aspiring science writers for the past academic quarter. **Lauren Kuehne** is in the master's program at the UW School of Aquatic and Fishery Sciences. **Ruth Hall Sedlak** is a Ph.D. candidate in the UW Department of Microbiology and previously served as a WSG Communications Intern, writing articles for an aquaculture magazine. A third fellow, **Megan McPhaden**, has recently been selected for the spring quarter. McPhaden is a graduate student studying fresh water science through the UW College of Forest Resources. Information about WSG's Science Writing Fellowship and Communications Internship programs can be found online at *wsg.washington.edu/education/index.html*.

In July, WSG Coastal Resource Specialist **Katrina Hoffman** will serve as coordinator,

# Accomplishment and Opportunity: sharing the wor

*By Lauren Kuehne, Winter 2011 WSG Science Writing Fellow*

2010 Fellow Joe Zelasney

February saw the annual transition of Dean John A. Knauss Marine Policy Fellows. This yearlong fellowship program pairs exceptional graduate students with host agencies in Washington, D.C. In 2011, four Knauss Fellows nominated by Washington Sea Grant are completing their tenure while three new Knauss Fellows begin theirs.

Because the Knauss Fellowship offers a policy experience, it is sometimes confused as being available only to students pursuing careers in public policy. The actual program goals are much broader, however; the fellowship is available to any graduate students enrolled in marine or aquatic-related fields. The commitment is to advance marine-related educational and career goals of participating students while fostering partnerships between universities and government. Since its inception in 1979, the Knauss Fellowship program has provided more than 800 people with high-level experiences in national policy and management of public resources. Washington Sea Grant has sponsored more of those fellows than any other Sea Grant program in the nation.

The Knauss Fellowship process begins with applications overseen by Washington Sea Grant and other programs in the national Sea Grant network. A small number of applicants are selected by each office to proceed to the national level, and Fellows are chosen from this pool by a review panel. Fellows attend a placement week in Washington, D.C., during November, interviewing with 10 to 20 legislative or executive branch agencies over a single four-day period. Fellows and agencies rank each other, and final selections are made by pairing rankings.

"Placement week is an interesting and exciting time — it's like being a kid in a candy store," says 2010 Knauss Fellow Joe Zelasney. For Joe, the "candy" was a position with the federal Committee on the Marine Transportation System, which coordinates policies and use of waterways and ports. "I was always fascinated with seaports and transportation. While living in China, I became especially aware how mega-ships facilitate billions of dollars in trade, yet have enormous environmental impacts. Marine transportation is one of those areas where human needs strongly intersect with the environment, and I wanted to understand the issues in the broadest way possible."

2010 Fellow Ian Smith

For Ian Smith, his year as a 2010 Knauss Fellow was rich with travel and first-hand experiences, including a visit to the European Seafood Exposition in Brussels. "That alone would have made my year but, because of the unique timing of the Deepwater Horizon oil spill, I was able to spend much of my summer aiding in the Gulf region trying to help re-open closed fisheries," he notes. Ian is now employed as a fisheries biologist for The Federal Energy Regulatory Commission in Washington, DC.

"I was a little nervous about the process and having to choose," says incoming Knauss Fellow Bethany Craig, "but the placement week was a learning experience in itself. I found myself gravitating toward positions offering the broadest perspectives," she explains. Bethany will be assisting the chief science advisor for

moderator and speaker at a special session of Coastal Zone 2011, one of the largest meetings of marine management professionals in the nation. Titled Coasts, Construction and Carbon Sinks: Low-Impact Development, Ecosystem Services, and Community Resilience on Shorelines, the session will showcase work being done by four West Coast Sea Grant staff, including Hoffman's project, Green Shores for Homes. For more information about the conference or Sea Grant's role in coastal issues, contact Hoffman at 206.616.3368 or *kathoff@uw.edu*.

**Pete Granger**, Program Leader for WSG's Marine Advisory Services, is now working with the planning committee for the upcoming (September 19 - 21) Assembly of Sea Grant Program Leaders/Communicators meeting, hosted by Ohio Sea Grant. WSG held the last such meeting, attended by 75 Sea Grant extension agents and communicators, in September 2008.

Want to see how Japan's Hokkaido-Nansei-Oki earthquake and ensuing tsunami affected Washington's Strait of Juan de Fuca? Then visit Coastal Hazards Specialist **Ian Miller's** new blog, *The Coast Nerd Gazette*, online at *coastnerd.blogspot.com/2011/03/time-lapse-of-pa-harbor-during-tsunami.html* for a time-lapse look at Port Angeles Harbor as the tsunami-propagated waves rolled in. Miller isn't the only WSG staffer with a blog: while you're at it, check out Marine Water Quality Specialist **Jeff Adams'** *Sea Life* blog for the *Kitsap Sun* newspaper, at *pugetsoundblogs.com/sea-life*.

Editor, David G. Gordon; Designer, Robyn Ricks; Web Editor, Marcus Duke; Communications Manager, Dan Williams. All photos © Washington Sea Grant, except as noted.


Sea Grant Washington

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2011 Fellow Bethany Craig

# ds of 2010-2011 Knauss Fellows

2011 Fellow Ethan Lucas

NOAA Fisheries, working closely with all of NOAA's six fisheries regions. Besides being incredibly excited about her up close and personal view of fisheries policy, Bethany is impressed with NOAA Fisheries' commitment to her professional development. "They really want this to be an educational year," she says.

Joe Zelasney is equally enthusiastic about the opportunities for personal and professional growth. "Program and agency staff are committed that we see and experience as much as possible, and that those experiences are tailored to our interests," he says.

The diversity of backgrounds and interests among Knauss Fellows suggests that policy experience can forward a wide variety of goals. Incoming Fellow Ethan Lucas is starting a position with NOAA's Coral Reef Watch after finishing his degree at UW's School of Marine and Environmental Affairs (SMEA). Ethan is no stranger to coral reef issues, having completed a three-year Peace Corps tour in the Philippines and a master's degree focusing on local governance of protected areas. Yet even this extensive experience had left Ethan with a knowledge gap he is seeking to fill during his year in D.C. "I wanted to take the knowledge gained through my degree and the Peace Corps and meld it with knowledge of policy-making at the national level," Ethan says, "I'm hoping it will make me better able to translate scientific data into policies which work at the local level."

2011 Fellow Chelsea Combest-Friedman

Chelsea Combest-Friedman is another incoming Fellow with extensive international experience, having worked as a development consultant for the Natural Capital Institute in Panama and U.S. Aid in Madagascar before completing a master's degree project for the UW School of Marine and Environmental Affairs in the Philippines. She sees the opportunity to spend a year in Washington, D.C., as a huge gift. "In addition to getting to see how our nation will address climate change through policy, the knowledge of the constraints and processes related to how national governments develop policy is unique," she says. "And that knowledge is critical because, even when working overseas, one is usually working within a national framework." Chelsea is also looking forward to her year in D.C. as a means to evaluate various international career trajectories with federal agencies, foundations, trusts and environmental groups.

2010 Fellow Delisse Ortiz

2010 Fellow Danielle Rioux

For Delisse Ortiz, who just completed her year with the NOAA Fisheries, being a Knauss Fellow is part of her path to becoming a university-level professor and researcher. Delisse began this path on her beaches of her native Puerto Rico, where witnessing the deterioration of coral reefs and a fascination with science led to a master's degree in species taxonomy and a doctorate in habitat use by reef fishes. Delisse says that, by completely focusing on policy for a year, the

Knauss Fellows • continued on page 6

# Meet and Greet: Three New WSGers

Please join us in greeting three new members of the Washington Sea Grant team.

Administrator Karen Mooseker joined WSG in late 2010 after nearly a decade with the University of Washington, primarily in research administration. Her non-academic background includes managing field and business operations for both private and non-profit organizations. She holds a bachelor's degree in English from the UW. "Research management is a good use of my skills," she says. "Sea Grant ties together all sorts of marine science projects, including cutting edge research and creative outreach, and that fascinates me." Contact Mooseker at 206.543.9966 and *kmoose@uw.edu*.

Also a 2010 addition and UW graduate, Administrative Assistant Eileen Herman has worked both at Harborview Medical Center and on the UW's Seattle campus in different capacities for the past 25 years. For the UW Department of Surgery administration, her duties included managing the Donor Stewardship Program and coordinating production of the newsletter and other outreach efforts. "Washington Sea Grant is a very supportive environment and has provided further opportunities for career growth," she says. Herman can be reached at 206.543.6600 and *emherman@uw.edu*.

New to WSG: Karen Mooseker (top), Eileen Herman (middle) and Ian Miller (bottom)

As of March 2011, Ian Miller is WSG's new Coastal Hazards Specialist, based in Port Angeles. He conducted his undergraduate studies at Western Washington University and doctoral work at the Ocean Sciences Department of University of California Santa Cruz. Before joining Washington Sea Grant's Marine Advisory Services, Miller served as the education director of Olympic Park Institute and as Washington field coordinator for the non-profit Surfrider Foundation. "Initially, I plan to identify shared goals of our constituents on the Olympic Peninsula and create strategies for approaching them," says Miller. "Whether addressing coastal hazards such as sea level rise and tsunamis or assisting cash-strapped local entities to develop long-term environmental plans, it's all part of my new job." Miller is at 360.417.6460 and *immiller@uw.edu*.

Knauss Fellows • continued from page 6

Knauss Fellowship helped to broaden her research background. During her fellowship year, Delisse worked on every aspect of policy formation pertaining to highly migratory species, from fielding constituent questions to assessing the introduction of catch shares for the Atlantic fisheries. "I wanted to look at things in a more holistic way — to know how the science gets morphed and shaped into policy. If I could do this again, I would in a heartbeat. It's like getting to reinvent yourself for a year and immerse yourself in something completely new."

"I went to graduate school in order to apply for the Knauss Fellowship," 2010 Fellow Danielle Rioux half-jokingly maintains. Following her undergraduate degree, Danielle taught marine science for five years onboard a sailing research vessel but eventually ran into a problem common for those in research. "The science is really exciting, but it often doesn't get to the people who need it," she says. "So I chose to do my master's in policy and communication, followed by a year in Washington, D.C. The Knauss Fellowship really puts you at the center, enabling you to see why decisions get made when they do, and how to present science in the way that people making the decisions need to see it."

During her time in D.C., Danielle accompanied Dr. Jane Lubchenco, Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator, to the Gulf of Mexico eight times during the oil spill crisis. Danielle will be remaining with the Office of the Under Secretary following the end of her tenure as a Knauss Fellow. She says that the last year hasn't changed her career goals, but her perspective certainly has been transformed. "It's turned my focus outward," she says. "I've learned that it's not just policy makers who need to understand the science. Because decision-making processes are often constituent-driven, the general public also needs to understand the science that drives the policy."

For more information about the Dean John A. Knauss Marine Policy Fellowship program, contact Nancy Reichley, WSG Education Specialist, at 206.685.8302 and *reichn@uw.edu* or visit the Fellowship Web page, *www.wsg.washington.edu/education/fellowships/Knauss.html*.

# Orca Bowl's Life-Changing Legacy

*by Liz Ewings, WSG Communications Intern*

Each year, students from 300 schools throughout the country compete in regional matches of the National Ocean Sciences Bowl. The passion for science, inspired by the competitions, can channel these students toward careers in marine biology, oceanography and communications.

Washington Sea Grant is a sponsor of the state's regional competition, the Orca Bowl, held in February at University of Washington's Seattle campus. This year, 16 teams battled for top prizes, which, for the winning team, included a research cruise with the UW's Applied Physics Laboratory scientists, an all-expenses-paid trip to Galveston, Texas, site of the NOSB finals, and the opportunity to receive a partial-tuition scholarship from the UW School of Oceanography.

While all eyes are on Orca Bowl 2011's winners, Friday Harbor High School's Team A, it's also a fitting moment to look back at past NOSB team members — and to assess the impacts of their participation in previous years' competitions. For Washingtonians Hannah Snow, Melissa Brodland and Dana Vujkalovich the excitement of competition and the rewards of scientific mentorship and lifetime friendships have been ample payback for their collective years of effort as NOSB challengers.

Before joining the Orca Bowl team at Friday Harbor High School in her sophomore year, Hannah Snow could only dream of being a marine biologist. "I was pretty intimidated by the older students, who seemed to know everything about this field," she recalls. However, while studying for the upcoming competitions, she gained confidence and, by her senior year in 2010, became captain of FHHS's A team. As the first recipient of the scholarship offered as an Orca Bowl prize, Hannah is now studying civil engineering and oceanography at the UW and working as a molecular oceanography research intern at the Morris Lab in the School of Oceanography. She hopes to use her degree to help optimize and nurture the relationship between humankind and the sea.

Melissa Brodland was a self-described "problem child" in middle school. However, during her first semester at Sedro-Wooley High School, one of her friend's took her to an Orca Bowl practice. It was a life-changing event. Within two years, she was an Orca Bowl alternate team captain and, in 2005, had become captain of the all-female team. Her team came in third and went to sea for a three-day trip on the UW's research vessel *Thomas G. Thompson*. She studied oceanography at the UW for three years and continues to volunteer with Orca Bowl as a competition official. The adrenaline-fired atmosphere continues to inspire Melissa's passion for sharing science with newbie Orca Bowlers. Eight years later, she remains best friends with her teammate and former captain, Erik Bruun.


Hannah Snow consults with her teammates in the 2010 Orca Bowl competition.

Dana Vujkalovich discovered her passion for communicating science with the public in 1998, while participating in the Surf Bowl, the equivalent of the Orca Bowl, hosted by Scripps Institution of Oceanography in La Jolla, California. She graduated from the California Institute of Technology with a bachelor's of science degree in geochemistry and completed her master's degree in oceanography at Scripps. Today, Dana works at the Portal to the Public, a science communications fellowship program at the Pacific Science Center in Seattle. "I help the public understand science and the value of the work scientists are doing," she says of this rewarding position.

For information about Orca Bowls past and present, contact Julie Hahn, Regional Coordinator, 206.685.9117 or *orcabowl@uw.edu*.


# Sea Star Survey Results

We asked and you replied. This past winter, nearly 200 readers of *Sea Star* responded to our mail and online survey, which asked for their opinions about WSG's award-winning newsletter. Here's what your answers told us:

**For how many years have you been receiving *Sea Star*?** *63% of respondents answered "over 5 years."*

**How much of an issue do you normally read?** *73% of respondents read "all" or "most" of each issue.*

**With how many people do you share your issue?** In total, respondents share with an additional 810 people.

**Would you miss the print version if we switched to an online version?** *59% said "yes" and 41% said "no."*

**What else?**

- "Good publication to keep all interested parties informed."
- "Great newsletter & I love the calendar."
- "Images and photos are great."

Thanks to everyone who participated in the survey and congratulations to the winners of our drawing for copies of *Heaven on the Half Shell: The Story of the Northwest's Love Affair with the Oyster*. Your constructive feedback will help us make *Sea Star* more responsive to your information needs.

For more information about *Sea Star* and the recent reader survey, contact David G. Gordon, WSG Science Writer, at 206.685.8191 or *davidg@uw.edu*.

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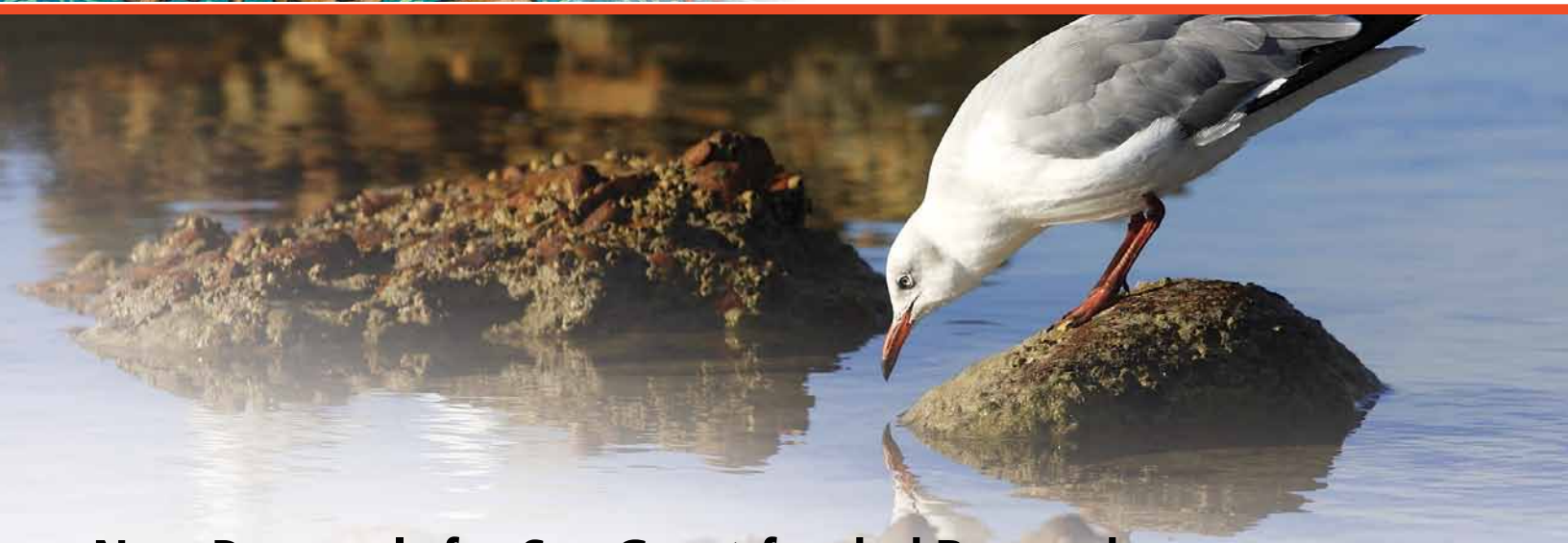

# New Proposals for Sea Grant-funded Research

In February, WSG requested preliminary proposals for research projects for its February 1, 2012, to January 31, 2014, funding cycle. The following month, the program received 66 preliminary proposals from researchers, requesting more than $13 million — well in excess of the $2.4 million dedicated to funding the projects.

Deciding which projects to fund is a group process, conducted by a panel of representatives from academia, federal and state agencies and constituent groups. The panel identifies projects for which full proposals will be requested. These proposals are due on May 23 of this year.

The full proposals will be reviewed by at least three outside experts, a panel of independent scientists and the Washington Sea Grant Advisory Committee before final review and approval from the National Sea Grant Office. Contingent on available funding, the projects selected for funding will be initiated in February 2012. Descriptions of these projects will appear on the WSG Web site, *wsg.washington.edu*, and in future issues of *Sea Star*.

For this funding cycle, WSG looks forward to funding at least six new research projects that focus on the critical program area of changing oceans and coastal communities. Projects may also be selected that address research questions related to the three other WSG critical program areas: living marine ecosystems; ocean and coastal environmental health; and ocean literacy and workforce capacity.

For more information about the proposal selection process, contact WSG Director Penny Dalton at 206.543.6600 or *pdalton@uw.edu*.