



Environmental chemicals and Pacific Northwest salmon

by Joe Dietrich, NOAA NWFSC

The Ecotoxicology Program of NOAA's Northwest Fisheries Science Center (NWFSC) investigates the impacts of flame retardants on salmon health. Using NWFSC's experimental seawater labs on the HMSC campus, researchers expose juvenile Chinook salmon to flame retardants to evaluate potential effects on their immune and endocrine systems.

Why flame retardants? These potent chemicals, called polybrominated diphenyl ethers, or PBDEs, have been added to numerous commercial products including televisions, computers, foam, and mattresses. Designed to minimize flammability, PBDEs can leach out of these products and into the environment, and have been detected in the tissues of numerous species including humans and salmon in the Pacific Northwest. Like legacy pollutants such as DDT and PCBs, early research on PBDEs exposure shows negative health effects. Washington State has banned the manufacture, sale, and distribution of two classes of PBDEs, and banned mattresses containing a third class, while Oregon has recently banned any product containing any of these same three classes of PBDEs.



NOAA Ecotoxicology Program's sampling crew processes salmon tissues for analysis.

In a 2005 study, the Ecotoxicology Program exposed juvenile Chinook salmon to a mixture of the PBDEs most likely to be found in Oregon's environment. Oral doses administered via food mimicked the concentrations found in juvenile salmon sampled from the Willamette River in Portland, as well as a

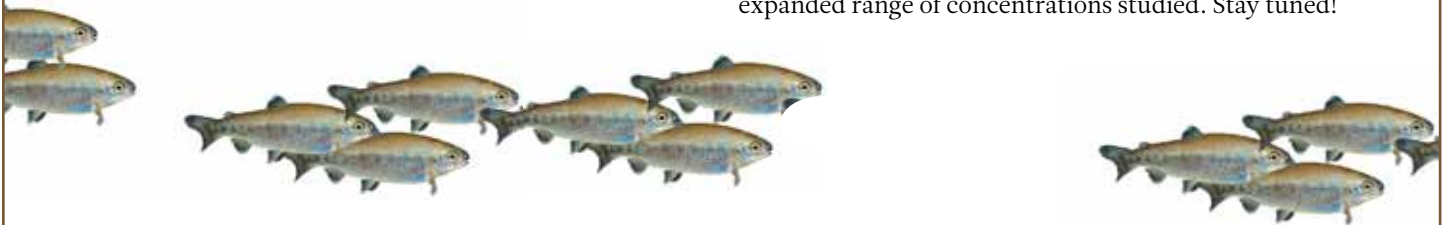


NOAA Team: front from left- Morgan Golding (OCCC Aquarium Science Program Intern), Stacy Strickland, Joe Dietrich; back from left- Mary Arkoosh, Ahna Van Gaest, Greg Hutchinson, Adrian Gonzalez (NSF REU Program, Oregon State University undergrad), Alex Krupkin.

concentration ten times that environmentally relevant dose. After the feeding period, the salmon were challenged with a bacterial pathogen and salmon disease susceptibility was assessed. Published results from the 2005 study revealed that salmon were more susceptible to disease at the low PBDE concentration.

Currently the NOAA team has turned their sights further north to Puget Sound, which may be influenced by urban, industrial, or agriculture surroundings, to study two specific PBDEs found in Puget Sound's Chinook salmon. In a new study, salmon have been exposed to these PBDEs, individually and in combination, over a broad range of concentrations. This study is funded by a competitive EPA Region 10 grant, Puget Sound Science and Technical Studies Assistance Program #EPA-R10-PS-1004.

And what has the NOAA team found? Analyses have been conducted on several fronts and the numbers are currently being crunched, but preliminary results from the current study are intriguing and support the earlier findings. Researchers hope to fill in more of the dots, thanks to the expanded range of concentrations studied. Stay tuned!



Notes from the HMSC Program Manager



Maryann Bozza,
HMSC Program Manager

As fall turns to winter and the calendar year winds down, so too is the OSU Hatfield Marine Science Center facing transition and change.

Dr. George Boehlert, HMSC Director since 2002, recently retired (see page 4), and we look forward to introducing you to our new director in the next issue of *Upwelling*. HMSC will grow and change in the coming years, but we are grateful for the sound

institution, vibrant partnerships and collaborative culture fostered by George and his predecessor, Dr. Lavern Weber.

An exciting development tied to last year's external review is OSU President Ed Ray's support for dramatic growth of academic programs at HMSC over the next decade. Our proximity to the coast, world-class scientists from OSU and six federal and state agencies, and campus-wide access to seawater for experimental marine research makes HMSC a unique and ideal location for experiential learning. Research opportunities for undergraduates, whether in the field or in the lab, are expected to draw increasing numbers of students. Growth in infrastructure and staffing will be a challenge, and support from our HMSC and coastal communities will be vital, but we welcome the opportunity to grow our programs in support of the University, Oregon and the region.

As always, we strive to keep you engaged and informed on our mission-related activities of research, education and outreach through collaborative partnerships. In this issue, we'll introduce you to two very different elements of NOAA: the Ecotoxicology Program of the Northwest Fisheries Science Center (page 1) and the Alaska Fisheries Science Center (page 7). Student activities are highlighted (page 6 & 8), and we are grateful for generous donor support for our academic programs. Finally, on the outreach side, you'll find an update of Sea Grant's activities (page 3) that would not be possible without the unflinching support of our many dedicated volunteers, and a 'Save the Date' for Marine Science Day (page 5).

We wish you and yours a very happy holiday season, and are, especially in this time of transition and opportunity, thankful for the support of our HMSC community.

Australian Fisheries Scientist Visits HMSC

by Noelle Yochum, OSU-HMSC Graduate Student,
Dept. of Fisheries and Wildlife

Dr. Andrew Levings, Australian scientist from Deakin University and 30 year commercial fisherman, came to Newport as a visiting scientist in October 2012. He had advised me over the past year as I set up a mark-recapture study on Dungeness crab (*Cancer magister*), so I was incredibly grateful for the opportunity to work with him directly. As an OSU graduate student in the Fisheries program, my research involves the estimation of mortality rates for crab that are bycaught and discarded and an evaluation of the methods for determining these rates. A key component of my research is collaboration with fishermen, which is also a critical aspect in the work done by Dr. Levings. In addition to incorporating the knowledge and skills of fishermen in his research, Dr. Levings also works as a mediator between the fishing community and competing ocean resource users.

Our goal during Dr. Levings' two week visit was to evaluate the efficacy of using the TBA-LEVO tag (a double "t-bar" anchor tag that Dr. Levings helped to design) on Dungeness crab. This tag is similar to the traditional "t-bar" tag with the addition of a second bar that prevents the tag from entering the crab's body cavity, and with the advantage that the tag will last through a crab molt. We also assessed the holding conditions I am using for my study, and I was able to show my project to

him first hand. During his visit, Dr. Levings toured both HMSC and OSU's Corvallis campus and was introduced to people in Oregon's scientific and fishing communities. He gave a HMSC seminar entitled "Australian fishermen make a major research contribution for a sustainable Giant Crab Fishery", and a lecture in Dr. Scott Heppell's Fishery Biology class. He also assisted me during two sampling days in the field, with



crab dissections to evaluate the positioning of the TBA-LEVO tag in the body cavity, and with an experimental set up to look at crab holding conditions. Dr. Levings also enjoyed the coastal community, participating in the Newport tsunami drill and trying locally caught fish and Dungeness crab. Now back in Australia, Dr. Levings and I continue to work together to broaden the discussion of the use of this tag on crab species.

Thank you for your support. To become a member of the Friends of HMSC, or for more information, please see <http://hmsc.oregonstate.edu/friends/>

Aquarium Science Student gives octopus artist voice

With October designated as Octopus Month in the Visitor Center, it was prime time to unveil a unique form of animal enrichment - allowing the octopus to paint. Visitor Center Aquarist Kristen Simmons, an Aquarium Science student from Oregon Coast Community College, was the brains behind the mechanism. "I did this to combine animal enrichment and public education," she said. "The art gives people a different way to experience this animal behavior." She created a device that allowed the octopus to manipulate a series of paint brushes against a canvas outside of the tank. The public loved it! Kristen also recruited local artists to 'collaborate' with the octopus to create some very unique and engaging pieces. <http://hmsc.oregonstate.edu/visitor/octocam>



New floors pave the way for wave tank exhibit

New anti-slip flooring has been installed in the Visitor Center in preparation for the final installation of the Wave Lab Exhibit. The Visitor Center staff spent all summer with the prototype wave tanks, watching how the public interacted with them and designing activities for deepening STEM (Science, Technology, Engineering and Math) understanding. The long amount of time visitors are spending with these exhibits has been astounding. Now that work on the floor is complete, the final tables and wave makers will be delivered and installed.



R/V *Wecoma* – gone but not forgotten

Some of you may have noticed the grey tower at the *Wecoma/Oceanus* exhibit near the auditorium- this is the binnacle and compass from the R/V *Wecoma*, OSU's recently retired research vessel. A binnacle is a case and stand used to house and protect the ship's compass and mount it in a position that keeps it stable when the ship pitches and rolls at sea. This piece of history is on loan from OSU Ship Ops and serves as a great interpretive tool for learning opportunities as diverse as magnetism, navigation, and the back-up value of using analog tools in a digital world.



Welcome to our new Senior Aquarist!



The Visitor Center welcomes Colleen Newberg as Senior Aquarist. Colleen comes to us from the National Aquarium in Baltimore MD. She will oversee all the animal exhibits, manage the student aquarists, build our animal collection, and bring her new vision and experience to the team.

Colleen began her career at the Florida Aquarium as an intern, where she was pursuing her interest in otters, only to find that her true love was fish! She moved on to the Oregon Coast Aquarium where she helped collect animals for the Passages of the Deep, and worked as an aquarist there for many years. Her recent position at the National Aquarium was spent working with sharks. We are fortunate to have her!





Masterminds Jim Cline of Rogue and Jim Lewis of HMSC present the Castor cephalopod Stout to Dr. George Boehlert on the occasion of his retirement. Rogue generously donated the remaining bottles as a fundraiser for the Hatfield Student Organization (HsO).

Over 200 members of the HMSC Community gathered to honor **Dr. George Boehlert** on his retirement on Saturday, September 29. As HMSC Director since 2002, George brought many positive changes to the Center while preserving the interdisciplinary, interagency collaborative spirit fostered by his predecessor, Dr. Lavern Weber.

Of the many kind, amusing and touching words spoken and gifts given, the most memorable was that delivered by Rogue Ales – 13 cases of specially labeled bottles of stout, sporting George’s own creation, the OctoBeav.

The event ended on a happy note, as well-wishers exclaimed, “See you Monday, George!” He has graciously stayed on as interim Director until December 31, and the search for a new director is ongoing.

George will be missed, but we trust that he’ll stay busy hiking, hunting, backpacking, fishing, gardening, kayaking... We wish him and his wife, Susan, a very happy retirement.

Volunteer Corner



Visitor Center Volunteers **Dick and Judy Brim** have been with us since April 2010. With a background in electricity generation, Dick came here with an interest in wave energy and general marine science. Judy also came



with an interest in marine science and has a background in teaching. Both Dick and Judy excel at engaging visitors and are great interpreters in the VC. Though Dick is working, he still finds time to volunteer regularly and doesn’t mind being contacted at the last minute if we need extra help on weekends. They also pitched in for Marine

Science Day 2012, applying their considerable skill and good humor where they were most needed. We greatly appreciate and enjoy having Dick and Judy Brim as part of our team, thank you both for all you do!

The 2012 HMSC Community Spirit Award was presented to **Betty Kamikawa**, Lincoln County Volunteer Extraordinaire! Betty, a Groundfish Ageing Specialist with the Pacific States Marine Fisheries Commission at HMSC, juggles work and parenting with service to her community toward betterment of the lives of Lincoln County’s children.

Betty is active in the Girl Scouts, as the Toledo Troop leader and Lincoln County Service Unit Manager. She is also Vice President of the Oregon Coast Ballet Company board and has served as President of the Eddyville Charter Booster Club.

As an active member of the Lincoln County Association for Family and Community Education, Betty worked to open the Central Coast Child Development Center and serves as President of their board. She was honored with the 2011 Lynn England Award for Contribution to Improvement of Child Care in Oregon.





The **R/V Oceanus**, acquired by OSU in early 2012 and transferred from her former home at Woods Hole Oceanographic Institution in Massachusetts to her new homeport of Newport, is starting to look more at home in her new berth. The distinctive pale foam green paint has been covered with bright white, complimenting the new OSU orange and black trim and black hull. While her predecessor R/V *Wecoma* will be missed, the R/V *Oceanus* is up to the task, with well over 230 days at sea projected for 2013 and projects as far a field as Guam, Taiwan, and Alaska.



The well-loved **R/V Wecoma** was graced with a double rainbow during her last days as OSU's UNOLS (University-National Oceanographic Laboratory System) vessel in Newport. OSU's Marine Superintendent Demian Bailey took this photo from his office window on October 22.



Save the Date!

Mark your calendar for the second annual **Marine Science Day** on **Saturday, April 13!** This behind-the-scenes event will again celebrate the innovation and synergy in marine science that makes the Hatfield Marine Science Center unique. Your hosts will be scientists and educators from Oregon State University and the six federal and state agencies co-located on the HMSC campus, the Oregon Coast Aquarium and the NOAA Marine Operations Center - Pacific.

Last year, over 3500 visitors enjoyed 30 different exhibits presented by marine scientists and educators, in addition to regular and special Visitor Center activities. Marine Science day 2013 will be even better - don't miss it!

hmsc.oregonstate.edu/marinescienceday

Fall Fisheries & Wildlife Term at HMSC

The Fall term at HMSC features a suite of 400/500-level split-level (undergrad/grad) Fisheries and Wildlife courses with additional laboratory or primary literature discussions for undergraduate and graduate students. Among the courses offered this year were Fishery Biology, Early Life History of Fishes, Dynamics of Marine Biological Resources, Natural History of Whales and Whaling, Aquatic Biological Invasions, and the one-credit HMSC seminar.

Students taking the capstone 5-credit Coastal Ecology and Resource Management (CERM) course (FW426/526) began the term with a week-long intensive field, lab, and lecture series

taught by a team of faculty and agency scientists, followed by weekly seminars, discussions and field trips. Students learned basic biological, chemical, and physical processes of coastal habitats, and some of the issues associated with human use of coastal resources, finishing up with a poster session highlighting research projects they completed during the term.



HMSC Summer Interns talk about their research experiences to new Fisheries & Wildlife students during OSU CONNECT Week 2012.



Rob Suryan leads CERM students out onto Idaho flats estuary near HMSC to observe marine and estuarine birds, including a fresh predatory bird kill, possibly by a Bald Eagle.

Summer Interns share their experience with new OSU Fisheries and Wildlife students at HMSC

Oregon State University's CONNECT Week is an orientation for new undergraduate and graduate students alike, and the OSU Fisheries and Wildlife Department uses CONNECT Week to introduce new students to the many opportunities for research experiences and hands-on learning at HMSC's coastal campus.



HMSC Interns and Students Present at International Research Conferences

In summer 2012, over 40 undergraduate interns participated in research opportunities at the Hatfield Marine Science Center. At the core of this energetic group are the Marine Science REU (Research Experience for Undergraduates) students, six of whom presented at this year's Society for the Advancement of Chicanos and Native Americans in Science Conference (SACNAS) held in Seattle, Washington. In addition, OSU's new SACNAS Chapter also attended which included Danielle Asson, MRM graduate student and 2010 REU Intern, and Jenny De La Hoz, Science Education graduate student; a photo of HMSC's SACNAS attendees is to the left. REU intern Gail Schweiterman (mentored by Cliff Ryer and Louise Copeman) received a 'Best Research Poster in

Marine Sciences' award. Also, five or more 2012 summer REUs will be presenting at the 2013 ASLO (Association for the Sciences of Limnology and Oceanography) meeting in New Orleans in February.



Meet NOAA's Alaska Fisheries Science Center!

The Fisheries Behavioral Ecology Program (FBEP) is part of NOAA's Alaska Fisheries Science Center based at the Hatfield Marine Science Center. The Program provides critical information needed

- to improve survey techniques
- to improve predictions of population abundance, distribution and survival, and
- to conserve populations of economically significant resource species and their habitats.

Traditional fishing methods, scientific surveys, population modeling, and fishery management strategies are all dependent upon a fundamental understanding of fish and crab behavior, physiology and ecology. FBEP conducts research aimed at understanding the relationships between behavior and environmental variables (physical and biological), and how this influences distribution, survival, and recruitment of economically important fish species.



The Program, which employs 12 scientists and staff, relies on HMSC's high quality seawater, a shared resource that can be chilled down to 2° C to mimic Alaskan seawater temperatures. Research emphasis is placed on species that comprise the some of the fisheries in Alaska and the northeast Pacific Ocean: Walleye Pollock, Pacific Halibut, Rock Sole, Pacific cod, as well as red king crab, blue king crab and Tanner crab. Experimental research is conducted with all life history stages from eggs to adults, and brood stock populations of several species, as well as cultures of prey are maintained for larval and juvenile experimentation. The Program has four primary research topics to meet this goal:

Fish, Crabs and Environment - Mortality rates can be high and variable, especially during early life stages, and behavior can play an important role in survival. FBEP's experimental approach assesses fish and crab behavior in response to physical (i.e. light, temperature), biological (i.e. predators,

prey) and physiological (i.e. hunger, stress) variables. The behavioral decisions, or trade-offs, made by fish in an ever-changing oceanic environment are evaluated in conjunction with field studies. By modeling fish responses to environmental change, researchers can improve sampling surveys and aid in predicting both survival and recruitment potential of commercially important populations.



Fish and Crab Habitat - Federal fisheries, especially those of resource species, are managed with consideration of Essential Fish Habitat (EFH) and protected for long-term sustainability of fisheries. A goal of FBEP is to identify principles determining habitat quality and the potential impacts of fishing gear on fish and crab habitat. Identification and protection of critical habitats depends on a fundamental understanding of the habitat requirements and ecological processes that affect distribution, abundance, and production of fishes and crabs in all life history stages. FBEP's efforts focus on experimental analysis of habitat associations, especially for juvenile stages of commercially important Alaskan flatfishes and crabs.

Bycatch Mortality - Undersized and unwanted fish and crabs, known as bycatch in commercial fisheries, are returned to the ocean either through escape from fishing gear or discard after being brought on deck. Accurate assessment of bycatch mortality is critical for stock assessments, and FBEP has developed unique laboratory tools and experimental protocols for studying the effects of fishing-related stressors on fish and crab bycatch mortality. A laboratory approach to identifying fishing stressors that may cause mortality will allow development of more efficient methods for conducting complex and expensive fishing experiments in the field.

Fishing Gear - FBEP conducts behavioral research related to fishing gear, to understand the processes that influence capture of fishes and crabs with trawls, traps, and long-line gear. These processes include vision, olfaction, orientation, locomotory abilities, activity patterns and feeding motivation, as well as the environmental factors that influence them. Specially designed gear used to examine fish passage through net mesh and bycatch reduction devices, as well as infrared lab facilities that allow video observation of fish and crabs in low light, facilitate this experimental laboratory approach.



Hatfield Marine Science Center

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www.hmsc.oregonstate.edu/friends

Save the Date! April 13 is Marine Science Day - See Page 5

Do Salmon Sniff out a Mate?

by Amelia Whitcomb, OSU-HMSC Graduate Student, Dept. of Fisheries and Wildlife

The outdoors and science have always captivated my interests and have guided my education and work experiences. As an undergraduate in Environmental Toxicology at Western Washington University, I not only obtained a great education, but I also took full advantage of the school's close proximity to the North Cascades and San Juan Islands. After college I worked for NOAA in Seattle at the Alaska Fisheries Science Center, where I participated in large groundfish and invertebrate surveys in the Bering Sea in Alaska. This experience helped bolster my field experience and also reaffirmed my interest in fisheries.

As a current master's student, my project uses genetic techniques to study salmon. Specifically, I am trying to identify the mechanism behind observed differences in reproductive success between hatchery-reared and wild salmon when both are spawning in the wild. Reproductive success is defined as the number of offspring from an individual fish that survive to adulthood. One mechanism that may be contributing to these reproductive success differences is mate choice.

Mate choice involves selecting a mate based on desirable qualities. One such quality, size, is not unexpected, but another quality that may be desirable in a potential mate is diversity in genes that encode for key molecules of the

immune system. This is because offspring that have increased diversity at immune genes would be able to fight off a larger array of pathogens and therefore increase their chance of survival. Salmon use their sense of smell to distinguish between a preferred and less desirable mate based on immune gene diversity.

A previous study evaluated the parentage and reproductive success of wild spawning hatchery-reared and wild coho salmon (*Oncorhynchus kisutch*). I am assessing the relationship between the immune gene diversity of those coho mate pairs and their reproductive success to evaluate mate choice. This research provides an opportunity to examine mate choice as a potential driver of the reproductive disparities between hatchery-reared and wild fish when both are spawning in the wild.

