

# confluence

*Promoting discovery, understanding, and resilience for Oregon coastal communities and ecosystems*

Oregon Sea Grant | Spring/Summer 2016

## Sea Grant helps Oregon Coast adapt to a changing climate

For the past 45 years, Oregon Sea Grant (OSG) has been helping the state's coastal communities prepare for and adapt to change. Perhaps one of the biggest changes coastal residents are now facing is the changing global climate, driven by increased concentrations of carbon dioxide, methane, and nitrous oxide. Our changing climate is raising sea levels, warming oceans, changing precipitation patterns, and increasing extreme weather. Increases in atmospheric carbon dioxide are also acidifying our waters, compounding the acidic conditions from Oregon's natural coastal upwelling.

In this issue of *Confluence*, we address how OSG is supporting research and outreach related to climate change and ocean acidification. Here are some of the pressing questions we explore:

- How can coastal communities tap into existing laws to manage their resources on an ecosystem level? With funding by OSG, a University of Oregon law professor and several students asked that question with the aim of improving governance and sustainability on the Oregon Coast.
- What are some water conservation and restoration strategies that can mitigate the effects of drought on farmers, riparian areas, and ski resorts? With 2015 being the warmest year in Oregon's recorded history, OSG traveled parts of the state, posed the question to individuals, and documented their answers in a series of four videos.
- How much do members of the west coast shellfish industry know about ocean acidification? Have they been adversely affected by it? Do they feel able to adapt to it? These are some of the questions OSG asked in a survey of the industry to gauge their perception of a problem that makes it hard for oyster larvae to form shells.



*Sea-level rise and increased frequency and severity of coastal storms are among the effects of climate change (Pat Kight photo).*

- What role can stakeholders play in research projects? OSG Scholar Laura Ferguson addressed this question after interviewing participants as part of a modeling project that evaluated how climate change and economic and population growth will affect the availability of water in the Willamette River Basin.
- How will rising sea levels affect estuaries in Tillamook and Coos Bays? OSG Scholar Kai Parker is helping to develop computer forecasting models that aim to answer that question.

From the legal aspect to the hydrological angle to the social science side, OSG is convening conversations and giving coastal communities the resources and knowledge they need to stay informed and adapt to a changing climate.

A handwritten signature in black ink, appearing to read 'Shelby Walker'.

Shelby Walker, Director



## OSG research examines legal aspects of ecosystem based management

A University of Oregon (UO) law professor and three law students have built a “road map” of legal analyses showing how global-scale environmental issues can be addressed through an ecosystem based management (EBM) approach that includes local laws.

To protect ecosystems, EBM employs an array of laws—from international law of the sea to the U.S. Clean Air and Clean Water Acts to state land-use laws. Oregon Sea Grant’s strategic plan supports EBM as a means of overcoming political and jurisdictional challenges that can get in the way of keeping entire coastal ecosystems healthy.

With funding from OSG, UO law professor Richard Hildreth and his students chose as their test case the growing problem of ocean acidification. This shift in ocean chemistry—caused by increases in atmospheric carbon dioxide and other greenhouse gases—is produced mainly by human activity, including industrialization and the burning of fossil fuels. As more carbon dioxide is absorbed into the oceans, it reduces the water’s pH, making many ocean ecosystems inhospitable to coral reefs, commercially important shellfish, and other marine life.

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From a legal standpoint, Hildreth said, acidification is challenging because laws are written jurisdiction by jurisdiction but the causes and effects of acidification are global. Fossil-fuel emissions from one country, for instance, can affect seawater chemistry and ecosystem health in another far away.

“Ocean acidification is a byproduct of the larger climate change issue. But it’s one we can use as a legal starting point for looking at the bigger picture,” said Hildreth, the director of the UO School of Law’s ocean and coastal program.

As case studies, Hildreth’s law students examined two proposals in Oregon to transport fossil fuels:

- The Jordan Cove liquefied natural gas export terminal proposed for Coos Bay. In March 2016, the Federal Energy Regulatory Commission denied permits for the Jordan Cove facility and a connecting pipeline.
- The Coyote Island coal export facility proposed in Boardman along the Columbia River, some 250 miles east of where the river empties into the Pacific Ocean.

Ally Hoffman, a Sea Grant Fellow and third-year UO law student, presented her research on the proposed Boardman terminal at an environmental sustainability conference in Portland earlier this year. A paper she wrote about the project has been accepted for publication in the *International Journal of Environmental Sustainability*.

Hoffman’s draft manuscript points out that the National Environmental Policy Act allows decision makers to integrate EBM into their rulings. In Oregon, she wrote, the existing state laws covering a variety of existing and potential ocean resource management issues “effectively apply EBM to very large areas of the state.”

She analyzed how multiple federal and state laws, from the Endangered Species Act to Oregon’s land-use planning system, can be used together as EBM tools—if obstacles

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*Richard Hildreth (left) debriefs with Sea Grant Fellow and third-year UO law student Ally Hoffman following her presentation, “Ecosystem Based Management: A Solution to the Permitting Problems of the Coyote Island Coal Terminal,” at the 5th Annual UO Climate Change Research Symposium (Vanessa Ciccone photo).*

involving regulatory power, interagency coordination, and adequate funding can be overcome.

Brent Suttan and Libby Pettit, both second-year law students, studied the proposed Jordan Cove terminal to determine whether existing permit processes provide sufficient legal framework to address environmental and economic issues connected with ocean acidification.

Suttan examined U.S. federal and state laws and case law, and Pettit tracked international law, including the United Nations Framework Convention on Climate

Change. In February, all three students presented their own legal analyses at the annual UO Climate Change Research Symposium.

“We’re watching the courts, the legislatures, and the treaty negotiators for responses to ocean acidification,” Hildreth said, “and there’s chatter, but nothing we can point to as a major response.”

Meanwhile, he said, “we’re trying to raise consciousness [within the legal profession] about ocean acidification. The excellent work these students have done demonstrates that EBM is a good tool for approaching ocean acidification.”

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## Sea Grant videos feature case studies on mitigating drought in Oregon

**F**our new videos produced by Oregon Sea Grant (OSG) show how certain business practices, farming techniques, and riparian management strategies are better poised to tolerate droughts in Oregon.

The short videos form a series called *Documenting the Drought: Mitigating the Effects in Oregon*. OSG created them in response to the state’s 2015 drought, said John Stevenson, a climate specialist with OSG Extension at Oregon State University (OSU).

“We found that the people and places that did better during the drought were the ones where investments had been made in water conservation and restoration efforts over the past decade,” he said.

In one video, OSU’s Kathie Dello, the deputy director of the Oregon Climate Service, explains the conditions that led up to the 2015 drought: “If we go back to 2013,” she said, “we had a winter with very low snowpack. Snowpack is important because it provides a lot of our surface-water supply and our soil water moisture in our drier summer months. As we moved into 2014, we had a really hot summer. As we moved into the winter of 2014, we saw a similar situation to 2013 in that we weren’t building snowpack, but it wasn’t because of a lack of precipitation; it was our really warm winter. So storms would move in, they’d fall as rain, and they just weren’t staying up in the



*A series of four new videos from Oregon Sea Grant shows how certain practices, techniques, and strategies are helping mitigate the effects of drought.*

mountains.”

One video features Frank Burris, the county leader of the OSU Extension Service in Curry County and OSG’s watershed health specialist for the southern Oregon coast. He describes riparian restoration projects that were prompted by concern over the effects of rising stream temperatures and reduced stream flow on salmon, a mainstay of the region’s recreational fishing economy. Among the streams Burris worked on were Pea and Gallagher Creeks.

He helped the South Coast Watershed Council monitoring coordinator, Cindy Ricks Myers, place water-temperature data

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*Preserving riparian zones along creeks can help lower stream temperature, reduce evaporation, and improve water quality and quantity.*

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*“Through buried pipelines and gravity systems, we’ve been able to conserve water. We probably get two to three weeks longer irrigation season because of those efficiencies.”*

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recorders, do statistical analyses of multiple-year water temperature data, and plant wetland specific plants in Pea Creek. In 1995, before they initiated these efforts, water temperatures on the lower part of the creek were much higher than on the upper. “By 2000,” Burris said, “we had dropped the temperature six to seven degrees between the upper and the lower parts. By 2004, we had matched the temperatures almost perfectly.”

For the Gallagher Creek project, Burris wrote the grant proposal, directed the work, installed data monitors, and analyzed the results. A crew dug a new channel through what had been a grassy pasture and planted trees to shade the creek. As a result, Burris said, water now flows for three to four additional weeks.

In a video filmed in Treasure Valley, Bill Buhrig, a crops specialist with the OSU Extension Service in Malheur County, talks about planting varieties of crops, such as corn, that mature faster. “It really is a huge factor in having success in a year where we

don’t have a full season of water,” he said.

Buhrig also describes efforts by the Owyhee and Vale irrigation districts to conserve and extend the summer water supply by automating headgates and replacing open-ditch canal systems with gravity-fed, pressurized water via buried pipes.

“Through buried pipelines and gravity systems, we’ve been able to conserve water,” said Jay Chamberlin, the manager for the Owyhee Irrigation District. “We probably get two to three weeks longer irrigation season because of those efficiencies.”

In that same video, Dana Tuckness, owner of Tuckness Farm, a wheat and row-

crop farm near Ontario, describes how he changed his farming practices because of the 2015 drought. “The way I’ve adapted to the short water this year is to not plant some crops,” he said. “I left some ground idle. About half my sugar beet crop and probably about two-thirds of my bean crop I did not plant because of lack of water, and that way I’d have enough water to finish the crops that I did plant.”

In a fourth video, Hiram Towle, the general manager of the Mt. Ashland Ski Area, talks about how his business adapted to sparse winter snowfall by relocating snow and was thus open for 38 days in 2014–15 versus none in the prior ski season. The business, he said, aims to offer summer recreation activities such as ziplining, a bungee trampoline, disc golf, and concerts to supplement ski-season income.

The videos, produced by OSG videographer Vanessa Ciccone in collaboration with Stevenson, are online at <http://bit.ly/DroughtVideos>

# Survey: Shellfish industry recognizes impacts of ocean acidification

By Mark Floyd, OSU News and Research Communications

A survey funded by Oregon Sea Grant (OSG) has found that more than 80 percent of respondents from the west coast shellfish industry are convinced that ocean acidification is having consequences—a figure more than four times higher than the general public’s perception, researchers say.

Results of the online survey, conducted by researchers at Oregon State University (OSU), appear in a 24-page report published by OSG called *The U.S. West Coast Shellfish Industry’s Perception of and Response to Ocean Acidification*.

“The shellfish industry recognizes the consequences of ocean acidification for people today—and for future generations—to a far greater extent than the U.S. public,” said Rebecca Mabardy, a former OSU graduate student and lead author of the report. “The good news is that more than half of the respondents expressed optimism—at least, guarded optimism—for the industry’s ability to adapt to acidification.”

Ocean acidification makes it harder for coral, phytoplankton, shellfish, and other marine organisms to build their shells and skeletal structures. Shellfish larvae are especially sensitive to acidified waters during critical, early life-stage development.

“Many have seen the negative effects of acidified water on the survival of their juvenile oysters—and those who have experienced a direct impact obviously have a higher degree of concern about the issue,” said OSU marine ecologist George Waldbusser, lead investigator on the study. “Others are anticipating the effects of acidification and want to know just what will happen, and how long the impacts may last.”

“Because of some of the success we’ve had in helping some hatcheries adapt to changing conditions, there is a degree of optimism that the industry can adapt,” added Waldbusser, who was Mabardy’s mentor in the College of Earth, Ocean, and Atmospheric Sciences (CEOAS) at OSU.

In the 44-question survey, shellfish industry leaders were asked who should take the lead in responding to the challenges of acidification. Their strong preference was the shellfish industry itself, followed by academic researchers. A majority said that any governmental regulations should be led by federal agencies, followed by the state and then local government.

“As a whole, the industry felt that they should be working closely with the academic community on acidification issues,” Waldbusser said. “In the spirit of full disclosure, there were some people who reported a distrust of academics—though without any specifics—so we clearly have some work to do to establish credibility with that subset of the industry.”

Among the other findings from the 86 participants in Oregon, Washington, and California who answered the questionnaires:

- About half reported having already experienced some impact from acidification.
- Of those who said they have been affected by ocean acidification, 97 percent reported financial damage, while 68 percent cited emotional stress.
- The level of concern reported by industry was: 36 percent, extremely concerned;

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*“The shellfish industry recognizes the consequences of ocean acidification for people today—and for future generations—to a far greater extent than the U.S. public.”*

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*Oyster bags await high tide in an eelgrass bed (Becky Mabardy photo).*

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39 percent, very concerned; 20 percent, somewhat concerned; 4 percent, not too concerned; and 1 percent, not at all concerned.

- Most respondents felt that ocean acidification was happening globally (85 percent), along the U.S. west coast (86 percent), and in their local estuary (84 percent).

“One thing that came out of this survey is that we learned that not only is the shellfish industry experiencing and acknowledging ocean acidification,” Mabardy said, “they are committed to learning about the issue and its implications for their business. They want to share their insights as they are forced into action.”

“The next step is to continue shifting conversations about ocean acidification from

acknowledgment of the problem toward solution-oriented strategies,” she added.

OSG has supported the work of Waldbusser and others studying ocean acidification, investing nearly \$1.4 million in NOAA research dollars in seven projects since 2010.

Since graduating from OSU, Mabardy has been working as the outreach and project coordinator for the Pacific Coast Shellfish Growers Association, based in Olympia, Washington. Her report can be found online in the OSG publications and videos catalog: <http://bit.ly/shellfishsurvey>

Co-authors of *The U.S. West Coast Shellfish Industry's Perception of and Response to Ocean Acidification* were Flaxen D. L. Conway, Oregon Sea Grant Extension; Christine S. Olsen, CEOAS; and George G. Waldbusser, CEOAS.

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## OSG scholar recommends expanding NSF's broader impacts criteria

**A**n Oregon Sea Grant (OSG) scholar has recommended that the National Science Foundation (NSF) add a sixth element to its broader impacts criteria that would encourage scientists to make stakeholders part of the research team.

Laura Ferguson, who is now doing a year-long, Sea Grant-funded John D. Knauss Marine Policy Fellowship in Washington, D.C., made the recommendation after spending 18 months studying the roles and expectations of stakeholders involved in the NSF-funded Willamette Water 2100 project (WW2100).

Ferguson, who received her master's in marine resource management from Oregon State University (OSU) in 2015, proposed the idea during a meeting of NSF program managers and NSF-funded researchers in the nation's capital in March.

If it comes to fruition, her recommendation could impact the NSF's funding decisions. In addition to intellectual merit, when evaluating grants the NSF looks at how a proposed project would benefit others, also known as having broader impacts. It takes into consideration factors such as whether the proposed project advances discovery while promoting teaching and training, broadens participation of under-represented groups, or enhances infrastructure



*Making stakeholders such as fishermen a part of research teams might improve the relevance of the research (Pat Kight photo).*

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for research and education. Ferguson's proposed criterion would say, "develop the research community."

Launched in 2010, Willamette Water 2100 was a five-year, \$4.3 million project that examined how climate change, population growth, development patterns, and other factors might influence water scarcity in the Willamette River Basin during the 21<sup>st</sup> century. Led by OSU, in partnership with researchers from the University of Oregon, Portland State University, and University of California at Santa Barbara, the project involved dozens of scientists from 18 disciplines, and representatives of 101 stakeholder groups. WW2100 made stakeholders part of the research teams from the start.

Ferguson was brought into the project by OSG's watershed and invasive species specialist, Sam Chan, who served on the project's executive committee and led its broader impacts team.

"The applications and process for achieving broader impacts are evolving, and I felt we needed to study the benefits of researcher-stakeholder engagement and the process," said Chan, who was Ferguson's adviser in graduate school. "It was important for us to know why people even wanted to come together, what kept them there, and what products they hoped would come out of it."

Ferguson participated in WW2100 meetings, observed how scientists and stakeholders interacted, then surveyed and interviewed them about what they expected and hoped would come out of the project. She learned that stakeholders valued the opportunity to connect with scientists and other stakeholders throughout the Willamette Valley, share in discussions, and better understand the natural and socioeconomic processes that influence water quality and availability. She concluded that scientists



*Ferguson concluded that scientists should not only ask stakeholders for feedback but also involve them in the research from the beginning (Lynn Ketchum photo).*

should not only ask stakeholders for feedback but also involve them in the research from the beginning. The relationships that develop in the process, she said, could result in better science and a better-informed public.

Based on her work with WW2100, Ferguson has written a manuscript, which she hopes to publish. In it, she wrote, "Future projects can look to WW2100 as an example of what their stakeholders and research team members may expect, and use these results to better define and improve their own engagement processes."

While conducting her research, Ferguson reviewed 134 journal articles about natural resource research, management, policy, and modeling. She summarized the key points in a 20-page report published by OSG called *Collaborative Science-Stakeholder Engagement*. The document can be found online in the OSG catalog: <http://bit.ly/CSSengagement>

"Laura's work demonstrates that we need to connect the researchers to stakeholders at the start of the process," said Chan. "They need to understand how their work connects to stakeholder needs and motivations. Stakeholders can not only provide feedback and reality checks, they can also help define the research goals and improve the relevance of the research."

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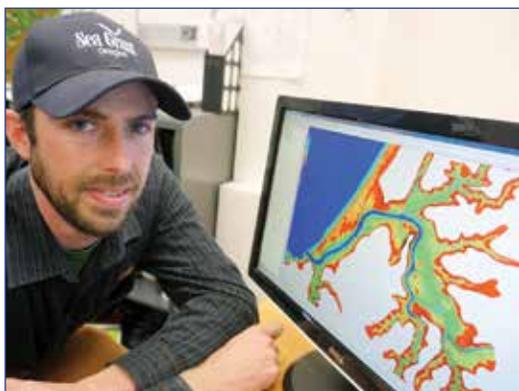
*"It was important for us to know why people even wanted to come together, what kept them there, and what products they hoped would come out of it."*

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## How will climate change impact estuaries?

By Kai Parker

Small estuaries, like those prevalent in the Pacific Northwest, are strongly coupled to their watersheds, and thus signs of climate change will show up visibly in these ecosystems. What this change will look like, and how it will affect our coastal communities and ecosystems, is the foundation of my research.



*Kai Parker models how climate change affects flooding in estuaries in Tillamook and Coos Bays. The image on his computer screen is of the Coos Estuary, with the colors showing height. (Tiffany Woods photo.)*

The first question that should be asked in a research project, especially one viewed through the lens of Oregon Sea Grant's mission of connecting research and stakeholders, is simply, "Why does this matter?" For me, the answer is that our coasts will change in response to climate change,

and if we can find ways to more accurately predict what those changes might be, we'll have a better chance of being prepared. Experience has shown me that it's difficult to gain traction with stakeholders over the problem of climate change because of its nebulous nature. My research attempts to

replace this "looming shadow" of a threat with something actionable that can be integrated directly into community planning. In this way, I believe my research and Oregon Sea Grant's base ethic of public service are aligned, as my work is specifically designed to create usable products for Pacific Northwest communities.

My research uses numerical modeling to examine estuaries in Tillamook and Coos Bays as they change through time, driven by the predicted future climate. The current state of the practice for this type of study is the "bathtub model," in which one simply raises the water level by the predicted amount of sea-level rise. However, this model ignores other effects of climate change such as precipitation, wind, and wave action, resulting in oversimplified data. My procedure greatly expands this paradigm through something called a continual hydrodynamic model run, which captures all the ways in which climate change might affect an estuary.

My advisor, professor David Hill in Oregon State University's College of Engineering, and I have attended several stakeholder meetings regarding coastal hazards and local community planning, to present our research and to get feedback as to what products might be most useful. We intend to continue to be a presence at such meetings and to provide a scientific resource to communities interested in learning how climate change might affect them. While we have not "solved" the question of climate change's effect on small estuaries, we are trying to answer the question, and I hope my research will eventually provide a universally usable tool to help coastal communities and ecosystems build resilience to climate change.

*Kai Parker is a doctoral candidate in coastal and ocean engineering in OSU's College of Engineering. He is a 2015–16 Robert E. Malouf Fellow funded by Oregon Sea Grant.*

*confluence* is published by Oregon Sea Grant, Oregon State University, 1600 SW Western Blvd., Suite 350, Corvallis, OR 97333. Phone: 541-737-2714. Web: <http://seagrant.oregonstate.edu/>

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This report was prepared by Oregon Sea Grant under award number NA140AR4170064 (project number M/A-21) from the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce, and by appropriations made by the Oregon State Legislature. The statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflect the views of these funders.

