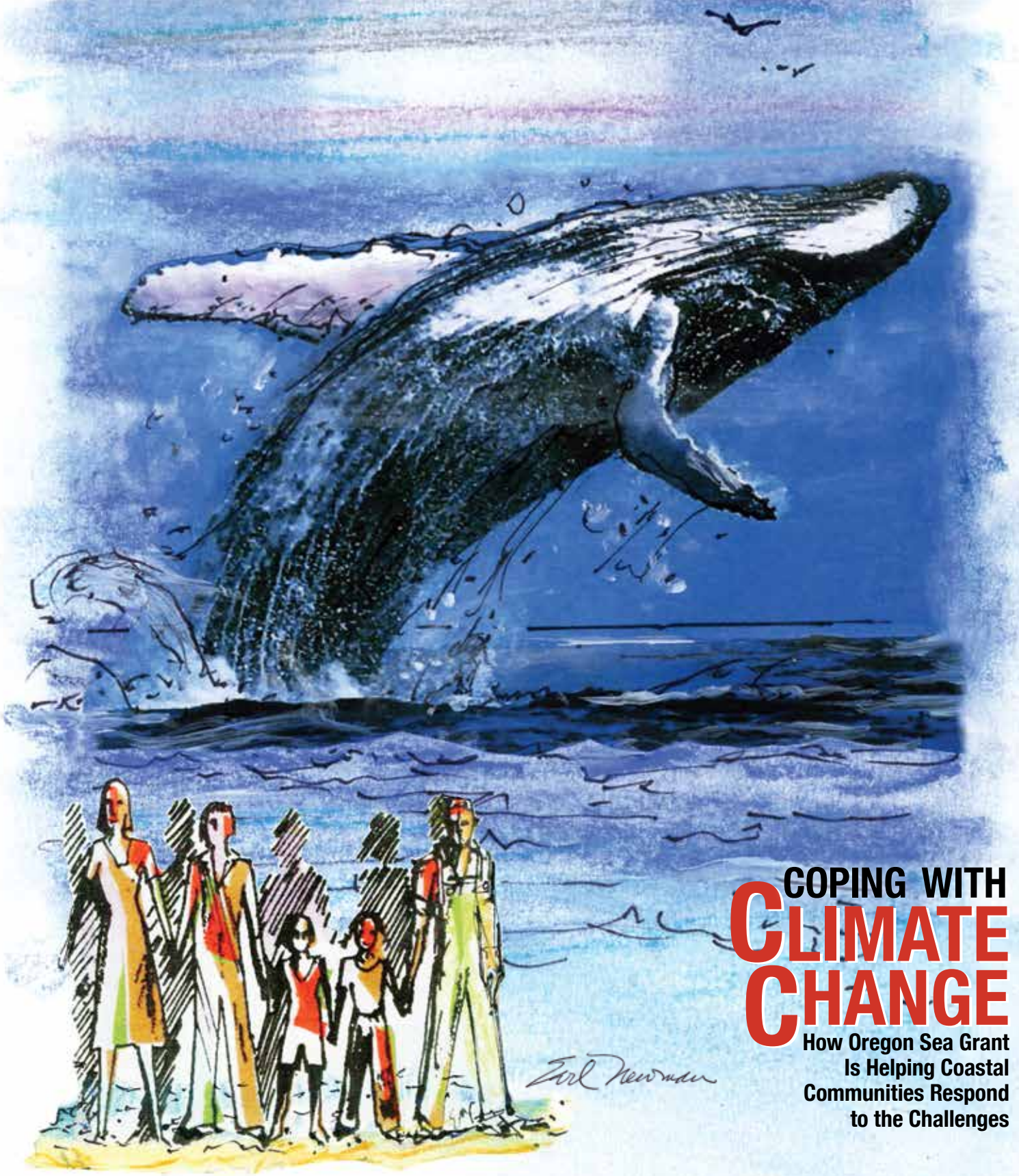
CONFLUENCE

OREGON SEA GRANT | SUMMER 2014 | VOLUME 3 NO. 1



COPING WITH CLIMATE CHANGE

How Oregon Sea Grant Is Helping Coastal Communities Respond to the Challenges

FROM THE EDITOR

Everybody complains about the weather, but nobody does anything about it.

Charles Dudley Warner made that tongue-in-cheek observation more than 100 years ago, but if you replace the word "weather" with "climate" it could've been said yesterday.

I say "yesterday" because today people *are* doing something about the climate. In fact, Oregon Sea Grant researchers have been studying climate change and its effects on the marine environment and coastal communities for about 10 years now. Much of that research has focused on climate change *resilience*, or the ability of an organism or system to survive current and anticipated effects of climate change. And some of the research has centered around the sensitive issue of how, exactly, to *talk* about climate change with those whom it may affect most directly, and most adversely: coastal residents.

Rick Cooper, editor

In this issue of *Confluence*, science writer Nate Gilles takes us on a tour of Neskowin, Oregon, where Oregon Sea Grant researchers are working with residents and community leaders to mitigate beach erosion, caused in part by increasing wave heights and greater storm intensities. Is there a way to slow down or stop the erosion and save people's homes and business?

In "Communicating about Climate Change: Reflections," Oregon Sea Grant Communications Leader Joe Cone takes a look at the science—or is it art?—of engaging with coastal residents on the topic. There are, as you will see, right ways to do it.

Finally, in this issue's Confluence Connections section you'll learn about some of the interesting work being done by Oregon Sea Grant scholars and fellows, a new app that helps you identify beached marine critters, and a new exhibit at the Hatfield Marine Science Visitor Center that illustrates the life stages of Oregon's world-famous Dungeness crab.

And, as always, you can learn more about these topics and others from our online edition of *Confluence*: **seagrant.oregonstate.edu/confluence**

Cover artist Earl Newman, taking a break from selling silkscreened posters in his booth at the Oregon Country Fair. Newman is perhaps best known for his Monterey Jazz Festival posters (the full 50-year collection of which is in the Smithsonian's Division of Musical History) and his Oregon Coast Aquarium and Oregon Shakespeare Festival posters.

IN THIS ISSUE:

On the cover and inside: Original pastels by Earl Newman, 84, of Summit, Oregon.

CONFLUENCE: *The junction of two or more rivers; an act or process of merging; from the Latin word "confluere," meaning "flow together."* We chose the name *Confluence* to reflect the merging, or flowing together, of Oregon Sea Grant's three "rivers": research, education, and engagement. Integrating the three supports our mission of helping people understand, rationally use, and conserve marine and coastal resources.

CONFLUENCE
VOLUME 3, NUMBER 1 SUMMER 2014

Director of Oregon Sea Grant: Shelby Walker

Assistant Director and Communications Leader: Joe Cone

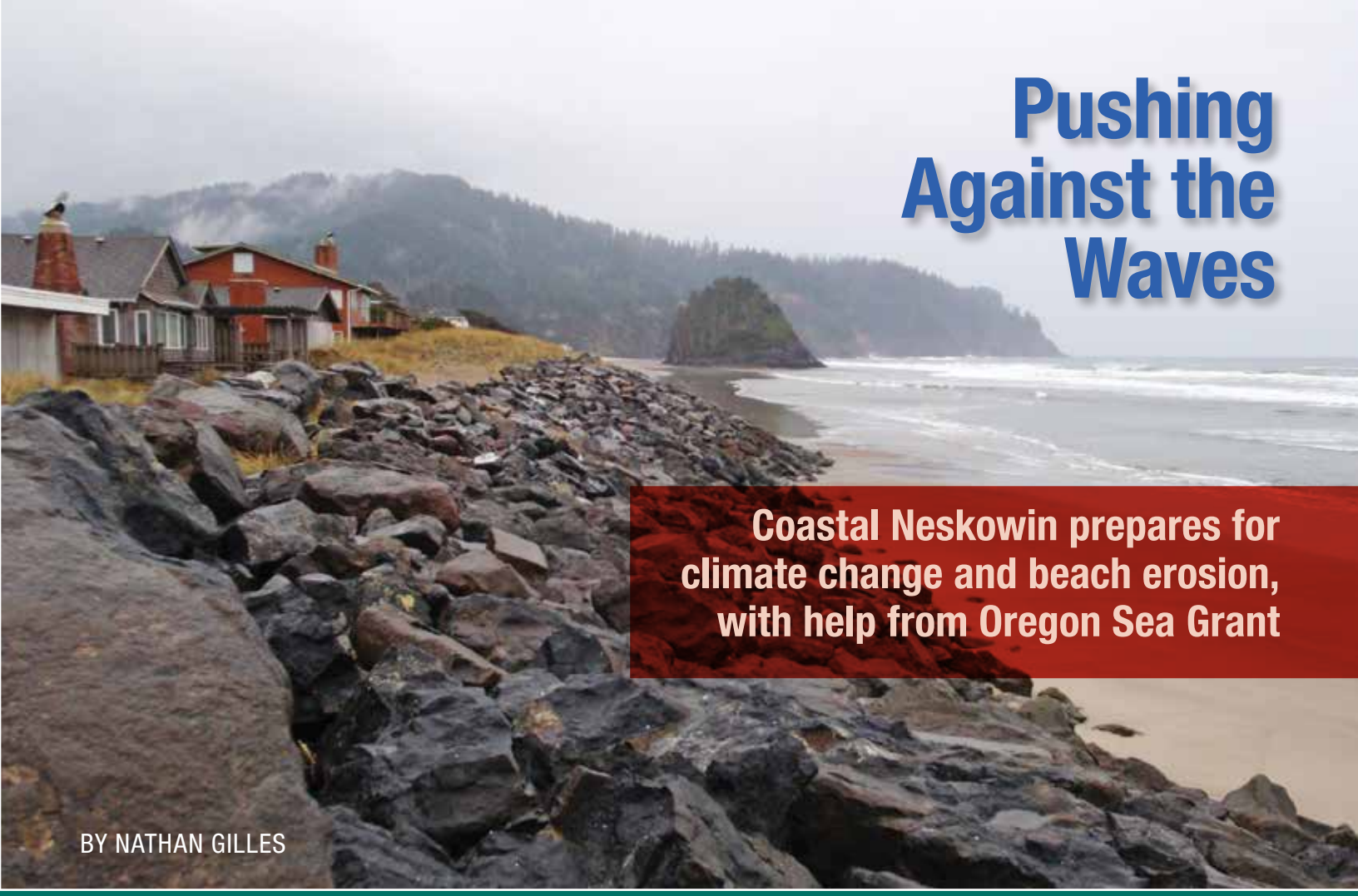
Editor: Rick Cooper

Designers: Jared Corcoran, Rick Cooper

Webmaster/Photographer: Pat Kight

E-mail sea.grant.communications@oregonstate.edu to request a no-cost subscription to *Confluence,* or to be removed from the mailing list.

Sea Grant is a unique partnership with public and private sectors, combining research, education, and technology transfer for public service. This national network of universities meets the changing environmental and economic needs of people in our coastal, ocean, and Great Lakes regions.



Pushing Against the Waves

Coastal Neskowin prepares for climate change and beach erosion, with help from Oregon Sea Grant

BY NATHAN GILLES

Riprap—piles of large rocks placed between the surf and houses—provides some measure of protection for beachfront property owners.

Bill Busch drives his car through the small Oregon coast town of Neskowin. He stops in the driveway of a shingle-sided house with large picture windows, some 30 feet from the beach. There's a portable basketball pole that's toppled over at the driveway's far end. We soon find out why. Busch, fellow Neskowin residents Alex Sifford and Guy Sievert, and I pile out of the car into a very wet, very windy, winter afternoon.

Following a small path along the house, we pass knee-high, American beachgrass peeking out of the foredunes all around us. Then we arrive at Neskowin's beach. Not far off, the Pacific Ocean's rough winter waves are pummeling the narrow shoreline. To my left is a heap of stones. To my right is open seashore.

"Is this where it ends?" I ask, pointing toward the rocks.

"Yeah," shouts Sifford above the wind.

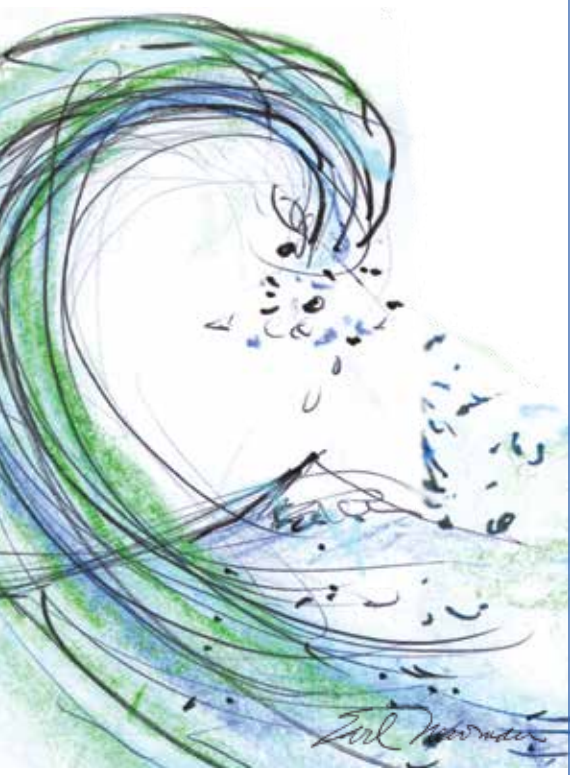
I'm looking at an intentionally stacked assemblage of large, dark-brown rocks that form a seven-foot barrier in front of the house. Called riprap, the rocks are part of an engineering effort known as "armoring" or "hardening," intended to protect Neskowin's shoreside homes from the ravages of the Pacific Ocean.

Here in mostly low-lying Neskowin—just barely above sea level—riprap of various heights stretch the length of the town from where we're standing to the bluffs overlooking Proposal Rock, a "haystack" formation that juts out of the beach some two miles to the south. This armoring—installed at homeowners' expense—is the first line of defense Neskowin has against some very real threats from the sea.

Over a mere three decades, Neskowin has lost roughly 2 meters of its beach per year to the Pacific. Over the recorded period from 1965 to 2000, this resulted in some 70 meters of erosion. Much of this loss has been due to a series of observed trends that includes growing wave heights, powerful El Niños, and surprisingly massive winter storms. It's not yet known whether these trends will persist into the future. Still, researchers conclude Oregon's coast can expect more erosion, collapsing hillsides, and increased flooding, with places like Neskowin acting as "hotspots" for these changes. Nonetheless, Neskowin's

residents—Busch, Sifford, and Sievert among them—aren't standing idly by.

In 2009, Neskowin residents hoping to make their town more resilient in the face of these changes formed the Neskowin Coastal Hazards Committee, or NCHC. Through the NCHC and its numerous community meetings, Neskowin homeowners have been leading an effort to transform how their town responds to the Pacific Ocean's hazards.



Partnering with local elected leaders and local and state agency staff, Oregon State University scientists, and Oregon Sea Grant, NCHC members drafted an ambitious 300-page document called the Neskowin Adaptation Plan that details the science of these changes. But this one-of-a-kind plan goes a step further. It suggests a series of far-reaching regulations that could determine how and where people can build in town.

Neskowin, like many small communities in Tillamook County, is unincorporated. This places lawmaking authority in the county's hands. As of this writing, the Neskowin Adaptation Plan was being reviewed by Tillamook County and state land-use planners. A commission vote is expected later this year.

For now, NCHC's adaptation strategies are limited to Neskowin only. However, the Neskowin Adaptation Plan could become the testing ground for a larger Tillamook County-wide plan, which will be voted on only after the Neskowin sub plan is first approved. And this reversal of order isn't the only way the Neskowin plan has been creating change from the bottom up. State land-use planners are also expected to use many of the sub plan's suggestions as a template for their own recommendations for the coast.

What follows is the story of how motivated citizens—with a little help from the right people, including Oregon Sea Grant—are leading Oregon's effort to stay resilient and save lives and property in the face of a changing and dangerous coastal environment.

The Pace of Change

Neskowin is tiny. Really, it's not much more than a strip of roughly 400 homes—most not occupied all year—tucked between Highway 101 and the Pacific Ocean. There's a restaurant. There's a sort of general store, called the Neskowin Trading Company. There's a golf course, which when I visited was so waterlogged it could've doubled as a wetland. And there's not much else.

My tour in Busch's car takes me down narrow, sleepy roads; past seemingly deserted homes, past a mixture of high-end getaways and older cottages and bungalows. Here and there are colorfully painted signs with acrylic flowers and words scrawled in children's handwriting asking drivers to "Please, slow down!" That's Neskowin's pace: slow. But that's not, says coastal researcher Peter Ruggiero, the pace of change on the town's beach.

"What I'm trying to do is quantify coastal hazards," says Ruggiero. "Before I learned about the Neskowin project, I wasn't always sure how to make my work usable. I thought about it a lot, but there wasn't usually a really good connection."

He says the NCHC changed that.

Ruggiero is one of a handful of scientists who has worked with NCHC members to inform them about the latest research on the coastal hazards they face. For the past decade, Ruggiero, an associate professor at the College of Earth, Ocean, and Atmospheric Sciences at Oregon State University, has been investigating how Oregon's beaches are changing. Much of his research runs headlong against a common misconception the general public has about climate variability and change and their impacts: that they're overwhelmingly gradual processes.

Probably the biggest of these gradual processes that comes to our minds—especially when we think about anthropogenic climate change—is rising sea level. In the Pacific Northwest, our local sea levels are rising about one to two millimeters per year. That's lower than the world average of about three millimeters a year. The difference between our regional rates and the world's is largely due to the North American Plate's gradual rising, or uplifting. In some places this uplifting is faster than sea-level rise.

Depending on the climate modeling used, estimates of sea-level rise for the Pacific Northwest range from less than half a meter to as much as two meters by the year 2100. This, says Ruggiero, could lead to the ocean inundating our coastal land and communities by up to 50 meters or more. But Ruggiero says sea-level rise isn't the whole picture. He and his fellow researchers have noted several interesting—and, for coastal residents, alarming—trends that are happening right now.

Working with Jonathan Allan from the Oregon Department of Geology and Mineral Industries, or DOGAMI, and fellow OSU researcher Paul Komar, Ruggiero reviewed data collected from 1975 to 2005 by buoys along the Oregon and Washington coasts. They discovered our local waves are growing.

The researchers looked at what are called "mean wave heights"—think of these as your run-of-the-mill waves, not

Over the recorded period from 1965 to 2000, Neskowin lost roughly 2 meters of its beach per year to the Pacific, resulting in some 70 meters of erosion.

too big and not too small. After reviewing the three decades of data, Allan, Komar, and Ruggiero concluded these mean wave heights have increased at a rate of approximately 1.5 centimeters per year. The trend was even more pronounced in the winter months. Winter wave heights, they found, had gone up by about 2 centimeters a year. If that doesn't sound like much, add it up: it's about one-half meter of growth over three decades. And that's just the "normal" waves.

Ruggiero, Allan, and Komar found that over the same period the biggest of the big waves also grew, and at a rate that's outpaced the mean waves. The height of these maximum winter waves has been increasing at about 10 centimeters a year. Do the math here and the biggest of the big waves have ballooned by about three meters over three decades.

If all that still seems a little abstract, Ruggiero says think of these increasing wave heights as they relate to storms. Big storms make big waves. So it's not too surprising then that the number and intensity of winter storms have also increased.

Whether this change results from anthropogenic climate change or is an as-yet-unobserved, decades-long pattern isn't known for sure. But Ruggiero says one thing is clear: bigger storms means more flooding and erosion for coastal communities like Neskowin.

El Niño, a Little Boy Behaving Badly

Back on the north end of Neskowin, Bill Busch, Guy Sievert, Alex Sifford, and I are squinting through the winter haze at the Pacific Ocean's aggressive waters.

"There's a lot of sand here, right now," says Busch.

"I know. It's wonderful," responds Sifford.

The tide is just about half in, which gives us about 14 meters of beach before the waves start. My three tour guides tell me I'm getting a rare glimpse at a beach that lately has been disappearing.

Earlier at the Neskowin Trading Company, Sievert told me he first bought property in town in 1997. It turned out to be a fateful year. That year saw the largest, most powerful El Niño of the 20th century.

El Niño—which means "boy" or the "Christ Child" in Spanish, due to the weather pattern's tendency to show up around Christmas—is a periodic, above-average warming of the waters of the eastern tropical Pacific. These warm waters, which form along the coast of South America, eventually find their way to the Pacific Northwest. Because warm water is less dense than cold water, sea levels during El Niños can be tens of centimeters higher than during non-El Niño winters. For coastal towns like Neskowin, that means trouble.

Neskowin flooded extensively during the winter of 1997–98. Intense flooding also continued the following winter. (The 1998–99 winter flooding was pinned to high tides and heavy rains.) Locals

remember ocean water rushing down Hawk Creek, which empties into the Pacific. The water came in a torrent over the Salem Avenue Bridge, which crosses the stream, carries utility lines into town, and, most importantly, is the only public vehicle access to Highway 101 and safety.

In 1997, Sievert's place was a vacation home not far from the beach. He now lives in Neskowin full time, in a house on a bluff overlooking his low-lying neighbors, including Sifford, who lives just one house back from the beach.

Sievert says moving to the hilltop—and out of harm's way—was a very conscious choice, and one his wife insisted on, following the 1997–98 El Niño and the heavy storms that came the following winter. It was probably a smart move.

From 1977 to the late 1990s, El Niños, and the large storms and the flooding they bring, became more prevalent. Some recent marine-science journal articles have suggested the frequency of major El Niños might increase with climate change. But the jury is out on whether these changes will continue. Unfortunately, for places like Neskowin, much of the damage has already been inflicted. Far worse than the flooding of the late 1990s was the erosion, which, unlike more gradual processes such as sea-level rise, can happen virtually overnight.

"We had to ask, 'What happened to the beach?' Those two winters were amazing," says Sievert. "It's pretty dynamic. We can lose 10 feet in a weekend."

Ruggiero, Allan, and Komar have been studying this erosion. Looking at a historical record running from 1967 to 2002, the researchers found Neskowin lost roughly 70 meters of its beach to the Pacific. But by far the largest percentage of this loss happened in the late 1990s. Those years saw not only an El Niño but also four 100-year storms (so named because, based on past records, they have just a one-percent chance of occurring in any given year). The beach has never fully recovered.

"Those storms caused very extensive erosion in a number of communities. And Neskowin and Rockaway beaches were two areas in particular that were especially hardest hit," says Jonathan Allan.

Allan, who introduced Ruggiero to the NCHC, has probably been the most influential scientist working with the group. Starting in 2004, Allan began documenting coastal change at multiple locations along the coast, including several on Neskowin's beach. His research confirmed what many locals already suspected: their beaches were disappearing. NCHC members who spoke with Oregon Sea Grant for this story say Allan's research has greatly influenced their group's approach to coastal hazards. But his work has had an even more direct effect.

Allan's day job with DOGAMI involves creating Oregon's official hazard maps. Coastal hazards Allan has mapped include everything from flood and tsunami inundation zones to landslide threats. Allan's maps documenting flooding and erosion zones became the basis for the NCHC's new building rules. Enter the land planners.

How Science Becomes Policy

Laren Woolley is the coastal shores specialist for the Oregon Department of Land Conservation and Development, or DLCD. Woolley's agency oversees how and where structures can be built in Oregon. He began working with the NCHC shortly after it formed.

"This was kind of an amazing process," says Woolley about the group. "You had all the right things coming together. And a motivated group of citizens who had an issue and a county that was willing to step up to the plate and listen to them."

Woolley's job—with citizen input and the help of a number of other planners—was to help take Allan's hazard's maps and turn them into new building codes for Neskowin.

What the NCHC and Woolley created was what's called a hazards overlay zone. It works like this: the overlay zone follows Allan's hazards maps. Legally, it exists on top of—or overlaying—the area's existing building zones and requirements. This means if building owners were to build or remodel in Neskowin's hazards overlay zone, they would be required to follow the specific zoning rules that apply there, as well as the statewide and county- or city-specific rules set by DLCD. Woolley says the idea behind the new rules is to keep people safe, not to penalize homeowners.

"It was very important to us and the

Neskowin residents, Tillamook County Commissioner Mark Labhart (second from far left), agency staff, and OSU students at an early meeting of the Neskowin Coastal Hazards Committee.

community that we didn't try to regulate people out of their property," says Woolley. "So the zone doesn't address if you can build a house, but how you can develop."

The NCHC's overlay zone recommendations range from raising the elevation of buildings—meaning new buildings will have to rest on stilts to avoid first-floor flooding—to limiting dense construction and requiring that structures are built on a property's safest spots.

Like other building requirements, the process would work through a series of "triggers," where existing homes and other buildings would be grandfathered in. But if somebody wanted to do a renovation or build on an empty lot he or she owns, that would trigger the new rules. What's unique here is that homeowners themselves are asking for these potentially costly new rules.

"I think we want our community to survive," Sievert says. "We live right next door to one of the greatest hazards, and we want Neskowin to survive. So we're going to do these building codes so if the water levels follow Peter's [Ruggiero's] probabilities, those homes will still be standing and we can keep going."

What Makes Neskowin Different

Taking my tour and talking with Busch, Sifford, and Sievert, I get the impression Neskowin is different. As we drive around town following the riprap and climbing the hill to the bluff near Busch's house, we not only see the spectacular erosion that almost sent some of his neighbors' homes into the sea, but we also pass million-dollar and multimillion-dollar houses. These belong to some of Oregon's most influential residents.

There's Dan Wieden's house, of the Portland-based adverting giant Wieden+Kennedy. Governor John Kitzhaber used to have a home here. The owners of the McMenamin pubs and breweries have homes here, too, as

(Continued on page 8)

Anticipated Impacts of Climate Change on Oregon's Coast

Adapted from an article by Oregon Sea Grant climate researcher Hannah Gosnell

Climate change will likely have significant effects on Oregon's coast and estuarine shorelines. The most pressing concern is sea-level rise, with a projected three- to six-foot increase in sea levels over the next century. Impacts associated with sea-level rise in Oregon include inundation of low-lying areas and loss of coastal infrastructure, as well as diminished fish habitat in rivers, bays, and wetlands along the coast. Water supply, wastewater systems, and stormwater systems will also be impacted by inundation.

Other concerns include more-powerful storm events and higher storm surges, resulting in increased beach erosion. In fact, extreme waves associated with storms have already lowered beach elevations in places, especially along the stretch of coastline between Florence and Astoria. Rising water temperatures and ocean acidification will result in another set of concerns, including negative impacts on fisheries and local fishing economies.

Ways We're Already Prepared—and Continuing to Prepare

Climate-change adaptation in Oregon is set against a backdrop of previous policy decisions, some several decades old, that precluded widespread coastal development. Unlike Washington and California, Oregon has made a series of decisions about not developing the coastline, beginning with Governor West securing legislation in 1913 that declared the beach a state highway, since it was the primary means of transportation before Highway 101 was built. This action prevented people from building along the beach. In 1967 the Oregon Beach Bill was passed, also restricting landowners' ability to build on the beach. And in 1973, Senate Bill 100 established a statewide land-use planning system that led to land-use goals regarding the protection of coastal resources. Because of these strong restrictions on coastal development, the risks to infrastructure and human life along the coast in Oregon are arguably lower than in neighboring states.

The first systematic consideration of adaptation planning and policy in Oregon was completed by the Governor's Climate Change Integration Group (GCCIG) and presented in a 2008 report that called for immediate adaptation programming, research, and funding. The GCCIG report spurred legislation that created the Oregon Climate Change Research Institute (OCCRI), now housed at Oregon State University. This state investment has since grown to include federal funding from the NOAA RISA Program and the Department of Interior's Regional Climate Centers. Under state law, OCCRI publishes the Oregon Climate Assessment Report (http://occri.net/ocar) periodically as a way of alerting Oregon's policymakers to climate impacts within the state.

For More Information

Governor's Climate Change Integration Group. 2008. "Final Report to the Governor: A Framework for Addressing Rapid Climate Change in Oregon." Available at: http://www.oregon.gov/ENERGY/GBLWRM/CCIG.shtml

Ruggiero, P., C. A. Brown, P. D. Komar, J. C. Allan, D. A. Reusser, and H. Lee III. 2010. Impacts of climate change on Oregon's coasts and estuaries. pp. 209–267 in Dello, K. D., and P. W. Mote (editors), Oregon Climate Assessment Report. *Oregon State University, Corvallis, Oregon (http://occri.net/ocar)*

Oregon Climate Change Adaptation Framework. *Available from: http://www.oregon.gov/LCD/CLIMATECHANGE/pages/index.aspx.*

do the Widmer brothers of the brewing company with the same name. Neskowin also contains an inordinate number of Ph.Ds. Busch is one of them. He taught oceanography at the University of New Orleans before he left after Hurricane Katrina. In short, Neskowin is educated, largely affluent, and very motivated.

"It's an intelligent community. So when they said, 'We're having a problem here and we're wondering if the commissioners could come down and listen to our problems,' well, we did," says Tillamook County Commissioner Mark Labhart, who gave the NCHC the county's blessing and later become its chair.

He, like others who spoke with *Confluence* for this story, described the Neskowin project as "bottom up," "grassroots," and "unique." Oregon Sea Grant Extension Specialist Pat Corcoran agrees.

"I've worked on projects where we've identified a community as being vulnerable and offered to help them become more resilient," says Corcoran. "But, often—despite some pretty innovative approaches and methods—the local circumstances weren't ripe for a sustained effort."

Corcoran says Neskowin was different.

"Right away," he says, "folks in Neskowin were very interested. And they had already done their homework on the problem and they were focused on doing something about it. They sought us out!"

Corcoran's job with Oregon Sea Grant is essentially to give Oregon's coastal communities the bad news about the coastal hazards they face. Often this involves facilitating meetings and other exchanges between community stakeholders and ocean scientists. But Corcoran says as important as this education is, he's always looking for a policy hook, a way to make the science extend to and work for the stakeholders he works with. He says the folks in Neskowin made his job a lot easier. They not only wanted him there, but they also drove the process.

Oregon Sea Grant Extension Specialist Pat Corcoran talks to coastal managers about the effects of climate change on Neskowin's shoreline.

"It ended up being a classic Sea Grant model between the locals, scientists, and managers thinking their way through these problems," says Corcoran. "My role was to facilitate local involvement with OSU researchers and students, serve the NCHC with things such as meeting facilitation and data management. And since then, we've been sharing what we learned from the folks in Neskowin with other communities."

Looking to the Future

Along with recommending building reforms, the NCHC, with funding from the state, hired a coastal engineering firm to perform an analysis of the sorts of engineering methods that might be used to soften the Pacific's blows on Neskowin's beach. The firm's recommendations ranged from "beach nourishment," or adding more sand, to building structures such as sea walls and breakwaters. But after reviewing their options, Neskowin's residents got sticker shock.

"The bottom line," says Labhart, "is even though we've got some great ideas about putting in sea walls and breakwaters and sand nourishment, all those types of things are clearly going to be too expensive."

What's more, ESA PWA, the firm that performed the study, found that even before Neskowin can start these big projects, the town must consider its existing riprap. The firm's report concluded the town's two miles of rock protection just isn't tall enough—it's about eight feet too short—to fight the incoming waves.

Only it's not quite that simple.

The problem is this: the cost of putting in riprap—a whopping $500 a linear foot—is placed entirely on the homeowner (although some towns and developments pool the burden). Riprap is also, at its heart, just a big pile of rocks. That means it can't be built straight up forever; if you tried, it might come crashing down. Consequently, for every foot up you build, you have to build about twice as far out. You get the idea: the cost of maintaining Neskowin's existing riprap could be a potential drain on future engineering efforts.

And there's another concern.

Extending the town's riprap would encroach on Neskowin's beach, which is publicly owned. And armored beaches aren't popular with the public. So for now, Neskowin's bigger engineering plans will remain just plans.

But where engineering faltered, the Neskowin Adaptation Plan is expected to succeed.

As of this writing, the plan is now with the Tillamook County Planning Commission. The commission will review the document—which has already been looked over by a second county-blessed citizen committee—before sending it on to Labhart and Tillamook County's other two commissioners for a vote.

Busch, Sifford, and Sievert say they're hopeful their representatives will okay their efforts.

Adapting to Climate Change: Some Continuing Challenges

BY JOE CONE, ASSISTANT DIRECTOR AND COMMUNICATIONS LEADER, OREGON SEA GRANT

While this issue of *Confluence* is largely about the practice of adapting to climate change and, particularly, about assisting coastal communities in that effort, it's good to know that a small number of scholars are also conducting research on climate adaptation success, with the ultimate goal of helping practitioners and communities do better, as there's much still to learn.

Among those researchers is a group that received funding from the Sea Grant programs in Washington, Oregon, and California, as part of a regional solicitation of social science projects in 2011. The investigators' project, "Successful adaptation to climate change," convened workshops of climate-change practitioners and researchers as part of an effort to understand both the special challenges and strategies of successfully adapting to this change.

For a portion of their work, the researchers drew on relevant literature for insights, including *The Practice of Adaptive Leadership: Tools and Tactics for Changing Your Organization and the World*.[1] Item 1 at right, Distinguishing Technical Problems from Adaptive Challenges, is an extract from this book. Item 2, Four Common Adaptive Challenges, is adapted from a handout[2] used in one of the five project workshops.

1. Distinguishing Technical Problems from Adaptive Challenges

The most common cause of failure in leadership is treating adaptive challenges as if they were technical problems. What's the difference? While technical problems may be very complex and critically important (like replacing a faulty heart valve during cardiac surgery), they have known solutions that can be implemented through current know-how. They can be resolved through the application of authoritative expertise and through the organization's current structure, procedures, and ways of doing things. Adaptive challenges can be addressed only through changes in people's priorities, beliefs, habits, and loyalties. Making progress requires going beyond any authoritative expertise to mobilize discovery, shedding certain entrenched ways, tolerating losses, and generating the capacity to thrive anew. The figure below lays out some distinctions between technical problems and adaptive challenges.

KIND OF CHALLENGE	PROBLEM DEFINITION	SOLUTION	LOCUS OF WORK
TECHNICAL	Clear	Clear	Authority
TECHNICAL AND ADAPTIVE	Clear	Requires learning	Authority and stakeholders
ADAPTIVE	Requires learning	Requires learning	Stakeholders

2. Four Common Adaptive Challenges

CHALLENGE	CHARACTERIZED BY...	ONE REASON FOR...
VALUES-BEHAVIOR GAP	People espouse different values and goals than they actually enact or implement	Socially or politically expedient to espouse the ideal (combined with lack of accountability)
COMPETING COMMITMENTS	Plans are not implemented, decisions not taken because of perceived conflicts or tradeoffs	Choice between commitments is painful
AVOIDING THE UNSPEAKABLE	People avoid raising the most difficult issues	Speaking the unspeakable creates tension, discomfort, or conflict
WORK OR CHANGE AVOIDANCE	People do everything to avoid change	Distractions and diverting attention (e.g., focus on easy parts, denial, proxy fight, take options off table)

1 Heifetz, R. A., A. Grashow, and M. Linsky. 2009. *The Practice of Adaptive Leadership: Tools and Tactics for Changing Your Organization and the World*. Boston, MA: Harvard Business Review Press.

2 Used by permission, with thanks to Susanne Moser, Ph.D.: Susanne Moser Research & Consulting and Stanford University. The original handout cites the 2009 book by Heifetz et al. (above) as a source.

Communicating about Climate Change: REFLECTIONS

BY JOE CONE, ASSISTANT DIRECTOR AND COMMUNICATIONS LEADER, OREGON SEA GRANT

Portions of this article first appeared in Terra, *OSU's research magazine*

The small meeting room is crowded with a dozen men and women from Port Orford. The mayor in his ballcap. The commercial fisherman in his big suspenders. The city administrator in *his* big suspenders. The environmental leader in her T-shirt. Neighbors. Willing to take on a big topic.

"Not to worry," Shawn Rowe had said, 10 minutes before. "There are a lot of experts on global climate. But the problem is that there are not a lot of experts on how it affects small, rural communities, because that's not on the global climate experts' radar." He had looked around the table and pointed to the planning commission chairman: "But you have a piece of the expertise"; to the former mayor: "you have a piece of expertise"; to the high school science teacher: "you have a piece…and all of you together, you probably have a lot of expertise, and this exercise is to get that out." Smiles and nods all around: Let's get to it.

Rowe, an Oregon Sea Grant (OSG) faculty member and learning specialist, then had described the process of developing concept maps, so that everyone's ideas could be shared on a big collective sheet, and then he had passed out sticky notes for jotting down those ideas. Ten minutes later it was time to take stock of the effects of climate change these community activists were concerned about.

Now everyone joins in putting the sticky notes onto a bigger sheet and then sorting them into groups. OSG Extension Coastal Hazards Specialist Pat Corcoran helps Rowe call out the concepts and put the stickies into groups the community endorses: ocean chemistry, ocean life, ecosystem change, economy, extreme weather, and infrastructure destruction emerge as major effects.

"Where do you see 'collapse of the fishing industry going here'? Rowe asks. "Under economy, or…?"

Through discussion, we rearrange the stickies into clusters until everyone is satisfied with the way his or her concerns are sorted.

"Everyone's ideas are up there"…"no one's excluded"…"we're beginning to see an overall picture," say members of the group. Bingo. I'm feeling the workshop

will be productive.

With contentious issues such as climate change, a good place to begin is to have each voice be heard within the group. This isn't the end-point, of course, but it does highlight what's often missing from national discussions of climate change, and what can happen in a small-group context in a workshop: actual two-way communication; listening respectfully, contributing respectfully.

The workshop itself represented the culmination of months of preparation and planning. Still, our OSG team arrived in Port Orford not knowing how the diverse community group would respond to the issue of a changing local climate when we were all face to face. We started listening long before the face-to-face meeting. Like other professional communicators and similar climate programs on campus, my extension, education, and research colleagues and I use methods such as surveys, focus groups, and interviews with target populations before we start engaging them on the substantive issues—in this case, actions a particular community may want to take around climate change.

From our 2008 surveys of coastal decision makers in Oregon and coastal property owners in Maine, for example, we learned about not only what information related to climate effects they thought they needed, but also what personal attitudes and other behavioral factors they held that were influencing their actions and intentions to act on information. Without understanding those attitudes and beliefs, we wouldn't really know what information might be directly useful or how best to present it. Beyond workshops in both states, one communication tool we used was short videos that specifically addressed concerns the intended viewers expressed. (Follow-up surveys confirmed their value and have been the subject of articles in professional journals.)

Focusing on the decisions individuals and communities feel they need to make to address a recognized problem yields a much more constructive conversation than does focusing on global warming itself, we find. No surprise there, really: if coastal residents are concerned about flooding, that's tangible and relevant to them. Whether humans caused it by increasing use of fossil fuels that led to global warming is, for most, an abstraction—and an invitation to argument.

Participants in the Port Orford workshop discuss climate concerns.

Americans certainly have different views on the subject, which puzzles some people. How do we explain that despite about two decades of scientific pronouncements about global warming and the environmental, economic, and social hazards it presents, just 63 percent of Americans believe global warming is happening? And fewer believe it's mostly caused by human activities, even while global greenhouse gas emissions have increased, according to ongoing survey research by Yale and George Mason Universities.

Clearly, if "getting the word out" about the science was the only determinant of whether Americans believe the science about humanity's contribution to global warming, we'd have higher percentages of believers. But, of course, the calculation each of us makes with the myriad topics presented to us daily is far more complex than if we were blank sheets walking around waiting to be filled by indisputable facts.

We're all drowning in information and in competing claims on our time, making attention the scarce resource, as

Winter storms, such as this one near Lincoln City, often pack big waves that can make a dent on shorelines.

psychologist Herbert Simon observed way back in 1971. Before we turn up the volume on this or that "communication" about science, then, a good first question would be, have we dialed into the right frequency that the other party is tuned to? Guessing isn't good enough. As a 2008 federal government report about climate communication pointed out, "There's no such thing as an expert in communication, in the sense of someone who can tell you ahead of time (i.e., without empirical study) how a message should be framed, or what it should say."

Hence the research we do on the populations we hope to work with. Beyond the empirical research we do, and the specific communication strategies we employ in result, our team uses tools from behavioral and decision research to guide our efforts. Still, gaining others' attention by focusing on their concerns and providing information that helps them make decisions may seem worthwhile but somehow incomplete. What is to be done—if anything—about the approximately 25 percent of Americans in the Yale/George Mason research who are "dismissive" or "doubtful" about global warming—and who may be actively hostile, even in the face of an overwhelming consensus of climate scientists?

Probably the first thing to recognize is that for all of us—except maybe the climate scientists themselves—every new science "fact" is not a fact of our direct experience but rather one received from someone else, and thus we either must collect evidence about it or accept the words of others. "So, just like any other kind of fact," as researcher Dan Kahan of Yale mentioned during an interview (part of our "Communicating Climate Change" Podcast series), "your beliefs are going to be influenced by your values in exactly the same way as any other kind of belief that you might form."

Those who do believe claims made by scientists tend to have one set of "cultural" values, according to research by Kahan and his colleagues in the Cultural Cognition Network, while those who don't typically have another set. So, for example, if today's fact appears to undercut other deep-seated value beliefs that are far more important to us than the fact du jour, what do we do? We tend to discount the "fact." So don't expect all Americans to suddenly believe… any particular thing.

A few of Oregon Sea Grant's climate-change-related publications and videos. For more, visit http://seagrant.oregonstate.edu/sgpubs/collection/climate-change

What one does with this insight to improve science communication is a topic of intense interest and discussion among science communication researchers and practitioners. (Indeed, the National Academy of Sciences held major conferences in 2012 and 2013 to discuss the "Science of Science Communication".) Many science communication practitioners advocate using an understanding of the audience's values to frame scientific information in a way that's congenial to them. If the understanding and framing are used to promote respectful dialogue, this seems like good manners. On the other hand, if they're used only to construct persuasive "messages," this seems like more of the same one-way monologue.

I've led projects in eight other Sea Grant states to help our colleagues there make use of some of the same social science methods used in Port Orford. These included "mental models interviewing," to help us understand how individuals think about risks associated with climate change; focus or discussion groups; and survey research. At OSG we've published on interviewing and surveying, to capture some of this value. And we've published extensively on the major climate-related projects.

Bottom line: effective communication is critical. Being sensitive to others, curious about them, attempting to understand them and their thinking, and responding to them thoughtfully as they engage in the conversation—we know this works in our personal lives. It's not the end, but it may be a way forward. Even with communicating about climate change.

Climate Change in the Northwest

Ed. note: This is an excerpt from the Northwest section of the recently released National Climate Assessment. *The full text of the Northwest section was edited by Meghan Dalton and Philip Mote, of the Oregon Climate Change Research Institute (based at Oregon State University), and Amy Snover, of the Climate Impacts Group at the University of Washington. Read the full text of* Climate Change in the Northwest: Implications for our Landscapes, Waters, and Communities *here: http://occri.net/reports*

Ongoing research on the regional implications of global climate change largely confirms observations, projections, and analyses made over the past decade while providing more information about how climate impacts are likely to vary from place to place within the region.

Climate

Projected warming by 2070 is 2.0°F to 8.5°F, with the lower end possible only if greenhouse gas emissions are significantly reduced. The average annual precipitation by 2070 is projected to change by –5 percent to +14 percent. For every season, some models project decreases and some project increases; most models project lower summer rainfall by as much as 34 percent.

Water

Changes in precipitation and air temperature have already affected hydrology and water resources in the Northwest. In most watersheds (except those with little snow), as snow accumulation diminishes, spring peak flows shift earlier, winter flow increases, and late-summer flow decreases. Dry years are becoming drier everywhere.

Irrigated agriculture is the largest consumptive water user in the Columbia River Basin and poses the greatest extractive demands on reservoir systems. Warmer, drier summers and longer growing seasons may increase those demands.

Hydropower production, which provides two-thirds of the region's electricity, will also be affected by snowmelt-driven shifts in streamflow. By the 2040s, summer production is projected to decrease by about 15 percent and winter production to increase by about 4 percent, compared with the period 1917–2006.

Changes in flood risk depend on the type of basin, with mixed rain-snow basins in Washington and Oregon already seeing increases in flood risk. Floodplain development has increased vulnerability in many areas.

Continued warming of rivers, lakes, and wetlands will affect the health of aquatic species and the extent of suitable habitat for many species, especially salmonids and other species already near their upper thermal tolerance.

Forests and Other Vegetation

About half the land area in the Northwest is forested. Climate directly affects tree growth in forests through temperature and moisture controls, and indirectly through its influence on disturbances—wildfires, insects, and diseases.

Federal and state policies governing management and harvest may impact the economy as much as any effect attributable to climate change. Increased productivity in a milder climate with higher CO_2 may be offset by insect and disease outbreaks and wildfires.

Agriculture

The Northwest's diverse crops depend on adequate water supplies and specific temperature ranges, which are projected to change during the 21st century. Warmer winters and longer growing seasons could increase growth for some crops while adversely affecting other crops dependent on chilling periods. Warmer, drier summers could result in yield reductions due to heat and drought stress. More rainfall in the winter could mean wetter soils in the spring, which could benefit some crops while hampering planting of others. These climate changes could also result in changes in pressures from pests, weeds, diseases, and invasive species.

Human Health

Effects of climate change on human health will depend on specific attributes of climate change and on exposure to climate-related risks. While vulnerability remains relatively low in the Northwest, adverse impacts of climate change outweigh any positive ones. Concerns include increased morbidity and mortality from heat-related illness, air pollution and allergenic disease, and emergence of infectious diseases. A changing climate is also expected to impact mental health.

Heat-related deaths in the U.S. have increased over the past few decades. In Oregon, analysis of hospitalization and climate data showed that each 10°F increase in daily maximum temperature was associated with a nearly threefold increase in the incidence of heat-related illness. Wildfires, especially east of the Cascades, lead to days or weeks of poor air quality and respiratory disease. In Puget Sound, rising water temperatures promote longer harmful algal blooms, which can cause paralytic shellfish and domoic acid poisoning in humans who consume infected shellfish.

Tribal Communities

Tribes have always been intimately connected to the land and natural resources. In ceding their lands and resources to the U.S., tribes were guaranteed the rights to continue to hunt, fish, and gather in all their usual and accustomed places both on and off reservation lands. By altering the distribution and timing of traditional resources, climate change could affect these treaty-protected rights. Treaty-protected fish and shellfish populations may become less accessible to tribes. Changes in salmon abundance and tree species distribution, and risks to infrastructure, can affect the cultural, medicinal, economic, and community health of tribes.

Oregon Sea Grant Scholars and Fellows: Shared Experiences

Every year, Oregon Sea Grant provides funding for students to pursue their various passions in the realms of research, policy, education, and communication. Undergraduate and graduate students are supported through fellowships, scholarships, and internships. Whether studying modeling estuaries in Yaquina Bay or serving as a congressional aide in Washington, D.C., the opportunities these students have often lead directly to their careers.

"The overall intent of the program," says Sarah Kolesar, Oregon Sea Grant's research and scholars program leader, "is future workforce development, to develop people with a range of skills who understand the Sea Grant mission. It's rewarding to see the work the students have done connect back to a career with Sea Grant or in their field." Some projects last one summer, others multiple years, and they take place all across the country. The stories of some of the scholars and fellows are highlighted below.

Sarah Heidmann

When Sarah Heidmann entered her first college-level lab, star-struck by the intellectual prowess contained in one room, she assumed she would be relegated to a corner bench where her inexperienced voice would go unheard. Ten weeks later, she realized she couldn't have been more wrong.

"The biggest surprise was that it wasn't like that. Even though I was an amateur, everyone really valued my input. There were graduate students, Ph.Ds., and people who had been working in the government for years, but we were all on equal footing," says Heidmann.

During the summer of 2013, Heidmann was one of seven Oregon Sea Grant Summer Scholars. From Newport, she worked for the USDA to investigate the response of juvenile Dungeness crab to different habitats.

"It was the first real lab and research experience I'd had. It jump-started me toward my desire to be in research. It gave me connections, and helped when I needed letters of recommendation," says Heidmann.

Andy Lanier

One year after graduating from his master's degree program at OSU, Andy Lanier was accepted as a NOAA Coastal Management Fellow in partnership with Oregon Sea Grant. During this two-year fellowship, Lanier assembled geographic information and data focused on Oregon's ocean environment. He helped get this information out to the public to assist in the Ocean Policy Advisory Council policy process, ultimately resulting in the creation of marine reserves in Oregon's Territorial Sea.

His technical background and fellowship experience led directly into a career with the Oregon Department of Land Conservation and Development. Five years later, he is still doing work similar to what he did during his fellowship, and loving his job.

Andy Lanier

"The fellowship allowed me to get my feet wet. It's why I have the job I have today," says Lanier. "I get to help the people of Oregon make decisions about how resources are managed that have lasting impacts, and potentially have an effect on the decisions made. For me, that is very fulfilling."

Jennifer Dresler

Eighteen months ago, Jennifer Dresler was a National Sea Grant College Program Dean John A. Knauss Marine Policy Fellow in Washington, D.C., working with Senator Roger Wicker (R-Mississippi). After completing the one-year fellowship, she went straight into her current job as a policy analyst for the Oregon Legislature. Though she has "14 bosses now instead of one," Dresler loves her work. She interacts with the constituents of the 14 Senate Republican caucus members, relays that information to the legislature, writes speeches, drafts amendments, and juggles a host of other tasks.

"Oregon Sea Grant was instrumental in helping me identify the direction of my career," says Dresler, "I wouldn't be here if I hadn't participated in the fellowship or worked with Oregon Sea Grant."

Hilary Polis

Skyping from her apartment in South Africa, Hilary Polis speaks about her "perfect summer job" as a Sea Grant Summer Scholar and how it led to where she is today.

Before the summer after her junior year at OSU, Polis hadn't been immersed in a marine science community. She found that community during her summer scholar internship with ODFW in Newport. She had studied abroad in Australia the previous summer and had been fascinated by the use of marine reserves. Upon her return, Polis knew she wanted to do something with marine reserves and economics, and Oregon Sea Grant provided the perfect opportunity: a way for her to study the socioeconomic factors behind marine reserves in Oregon.

"It was exactly what I was looking for," says Polis. "I didn't think I'd find the perfect internship but I got really lucky and I did. The internship and that job helped me realize that's exactly what I want to do."

This is an excerpt of an article by Kim Kenny; read the full text at seagrant.oregonstate.edu/confluence

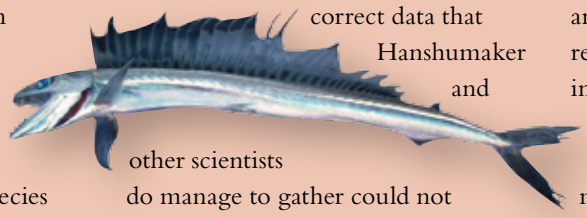
New App Helps Beachcombers Identify Beached Marine Critters

A mangled carcass lay, fanged mouth gaping, on a beach in Neskowin, Oregon. As John Forsythe approached the silvery creature, he noticed a large bite had been taken out of the tail and a piece of flesh dangled near the head, revealing bright red gills. Its large, sail-like dorsal fin was in tatters.

The six-foot-long fish, which is often mistaken for a barracuda, turned out to be a longnose lancetfish *(Alepisaurus ferox)*, one of the myriad species that wash up on Oregon's coast.

As many people have done in such situations, Forsythe contacted a local authority, in this case Oregon Coast Beach Connection. Word of the finding eventually made its way to Bill Hanshumaker.

As Oregon Sea Grant's chief scientist and public marine education specialist at OSU's Hatfield Marine Science Center, Hanshumaker has been receiving these kinds of calls for the past two decades. Unfortunately, callers often misidentify species or misreport their locations. The correct data that Hanshumaker and other scientists do manage to gather could not previously be deposited into one location to which citizens can directly contribute.



A new smartphone app called "Beached Marine Critters" helps solve this problem. With this app, beachcombers can now snap a photo of any beached creature their paths may cross, identify it using the app's key characteristics and comparison photos, and upload it to an online database. The app records the user's GPS location. This data can then be used to better understand how the creatures got here and where they might wash up next.

The app, developed by Danielle Asson, an Oregon State University student who recently finished her graduate degree in marine resource management under the guidance of Hanshumaker, is free and currently available on iTunes. For more information, visit the Beached Marine Critters website: http://beachedmarinecritters.org/

This is an excerpt of an article by Kim Kenny; read the full text at seagrant.oregonstate.edu/confluence

Photo of longnose lancetfish by Allan Shimada, NOAA NMFS.

Kim Kenny

Model of Dungeness crab larva featured in new exhibit at the Hatfield Marine Science Center in Newport.

The Dungeness Crab, from Larva to Dinner Plate

Before you bite into that delicious Dungeness crab gracing the dinner plate at your favorite seafood restaurant, you might pause to consider the journey it took to get from larva to adult.

Understanding the travels and travails of the Dungeness crab is critical to managing the Oregon crab fishery. One method of management is the placement of marine reserves.

"Marine reserves are a place to conserve marine diversity and potentially enhance productivity, which can translate to commercial harvest," says Harold Batchelder, the lead researcher on an ongoing Oregon Sea Grant-funded project investigating larval connectivity of Dungeness crab and other invertebrates.

"The key question in assessing whether any particular marine reserve is successful," Batchelder says, "is whether it is doing those two things [conserving marine diversity and enhancing productivity]. If you know something about the timing, duration, and behavior of these larvae, and of course the physics of the ocean, you can help answer that question."

Learning more about these factors is what Batchelder's team has set out to do. By collecting net samples about five miles off the central Oregon coast and inputting this data into sophisticated models, they can map the probable paths larvae take on their way to adulthood. If the paths of larvae lead from, say, a marine reserve to a fished area, the larvae can repopulate that area, protect the local stock, and allow fishermen to continue their harvest.

To help make larval connectivity more understandable to the public, a new exhibit has been constructed at the Hatfield Marine Science Center (HMSC) Visitor Center in Newport, Oregon. The exhibit features sketches showing the larval forms of some of these organisms, with brief descriptions of their life stages. The exhibit also includes a simulation showing the probable movements of larvae along the Oregon coast.

To help achieve this, three-foot-long models dangle from the ceiling like strange alien mobiles guarding the exhibit in anatomically correct authority. The translucent figures represent the larval stage of the crab that is spent in the open ocean.

As investigations on larval connectivity continue, we can learn more from the newly finished exhibit, now on display at the HMSC Visitor Center.

This is an excerpt of an article by Kim Kenny; read the full text at seagrant.oregonstate.edu/confluence

CONFLUENCE
Oregon Sea Grant
Oregon State University
1600 SW Western Blvd.
Corvallis, OR 97333

LEARN MORE AT CONFLUENCE ONLINE

You can learn a lot more about the topics covered in this issue of *Confluence* by visiting seagrant.oregonstate.edu/confluence

Coastal climate change…

- Read all about Oregon Sea Grant's research and work on community resilience to coastal climate change, erosion, and hazards

Climate change around Oregon and the Northwest…

- Read more about the Oregon Climate Change Research Institute, the Climate Impacts Research Consortium, the Northwest Climate Science Center, and the Oregon Climate Service
- Find out how to register for the 5th Annual Pacific Northwest Climate Science Conference (Sept. 9–10, 2014 in Seattle)
- Read the entire Oregon Climate Assessment Report and the Northwest Climate Assessment Report

The National Climate Assessment…

- Read all or parts of the *National Climate Assessment*, including "Our Changing Climate" (an overview of the causes and effects of climate change), "Sectors" (climate change's impacts on health, water, agriculture, etc.), "Regions" (how climate change is affecting and may potentially affect each region of the U.S.), "Response Strategies" (actions we can take both to mitigate the effects of and learn to adapt to climate change)

The complete text of stories in this issue…

- Read the full versions of the Confluence Connections stories on pages 14 and 15 of this issue: "Oregon Sea Grant Scholars and Fellows: Shared Experiences," "New App Helps Beachcombers Identify Beached Marine Critters," and "The Dungeness Crab, from Larva to Dinner Plate"

Former Oregon Sea Grant summer scholar Hilary Polis tends the rockhopper penguin exhibit at Two Oceans Aquarium in Cape Town, South Africa.

Confluence (ISSN: 2165-0748) 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/

ORESU-O-14-001

This report was prepared by Oregon Sea Grant under award number NA10OAR4170059 (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.