Sea Grant Oregon
confluence
Promoting discovery, understanding, and resilience for Oregon coastal communities and ecosystems
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Guidelines help boaters enjoy watching whales without disturbing them

By Tiffany Woods

Oregon Sea Grant (OSG) has helped whale-watching charter boat companies, fishermen and conservationists agree on best practices for enjoying—but not disturbing—the 20,000 gray whales that migrate past the Oregon coast each year.

Leigh Torres, a marine mammal specialist with OSG and a professor in Oregon State University's Department of Fisheries and Wildlife, began meeting with these groups in 2014 to get their buy-in on the voluntary guidelines, which are modeled after those of the National Oceanic and Atmospheric Administration (NOAA).

"We weren't trying to come up with new rules," said Torres, adding that most regular boaters are already following most of the practices.

The recommendations will appear on the website WatchOutForWhales.org, which is under development, and in a brochure that Torres aims to distribute along the coast at tourist spots, state parks and marinas. She hopes the guidelines will also be posted aboard charter vessels and at the charter companies' offices. The idea is not only to educate boaters but also to help participants on chartered trips better understand why vessels shouldn't get too close to whales, said Torres. "Otherwise they push the operators to get closer," she said.

The guidelines recommend, among other things, that boaters don't approach quickly, don't bang on the sides of their boats, don't spend more than 30 minutes with a whale, stay at least 150 yards away if a calf is present and don't surround a whale.

A gray whale breaches near Port Orford, Oregon. (Photo by Leigh Torres, OSG)

The latter two recommendations take into account whales' behavior once they reach Oregon, where they tend to feed close to the shore and are thus more susceptible to being hemmed in, Torres said. Also, on their northward migration, they have calves in tow and so the mothers might be stressed and need more space than the recommended 100 yards, said Torres.

NOAA's six regional offices have developed voluntary viewing guidelines tailored to species in their areas. Additionally, federal law makes it illegal to attempt to feed any marine mammal and limits people's proximity to certain whales.

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A report by the International Fund for Animal Welfare estimated that nearly 377,000 tourists watched whales along the Oregon coast by land, sea or air in 2008 and spent $30 million on tickets, lodging, food, transportation and related costs. About 64,000 of those tourists watched whales from boats. In 2008, there were 11 operators running boat-based tours along the Oregon coast in more than 35 vessels, the report said.

For the past two summers, from lookouts at Port Orford and Depoe Bay, Torres and her team have been monitoring the feeding behavior of gray whales and their interactions with all types of vessels, to determine whether and to what degree such interactions have an effect on the whales' behavior.

Every fall, about 20,000 gray whales migrate south to calve along the Baja California Peninsula. In the spring they head north to the bountiful feeding grounds in the Bering Sea. About 200 of those whales cut their northern migration short and instead summer between northern California and southeast Alaska. As a result, gray whales can be seen along the Oregon coast from May to October, creating a popular tourist attraction.

Additional reporting by Mark Floyd.

University of Oregon study reveals why hypoxia hasn't affected Coos Bay

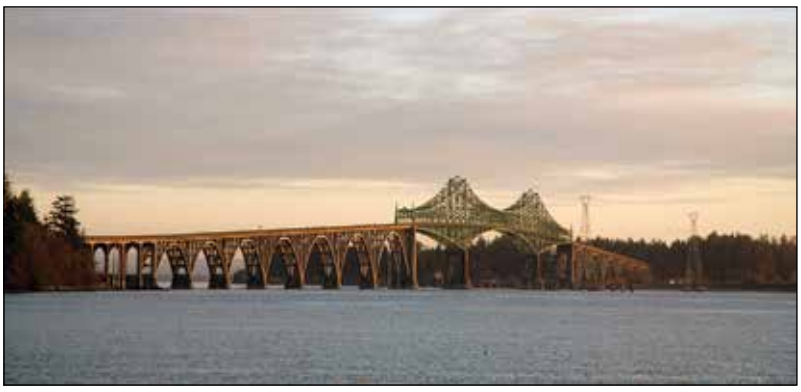
By Jim Barlow

A study of the 15-mile length of Coos Bay, from the ocean to the city of the same name, has found that the main channel of the bay is free of toxic levels of reduced oxygen that often affect other Oregon locations.

The research is good news for the region's fishing industry.

The bay's narrow offshore continental shelf and its deep-dredged ship channel combine to help maintain safe oxygen levels, even during times of reduced rainfall and freshwater discharge from the Coos River, said Dave Sutherland, a professor in the Department of Geological Sciences at the University of Oregon (UO).

The research, funded by Oregon Sea Grant, is good news for the region's fishing industry, said Sutherland, the study's lead author. More importantly, he added, the study provides a foundation for monitoring and projecting how changing climate conditions may raise the chances of oxygen depletion, or hypoxia, in the future.



A narrow offshore shelf, a dredged ship channel, and fresh river water combine to keep the bay flushed, but that could change as the climate warms. (Photo by Lynn Ketchum, OSU)

"This region of the coast is understudied," said Sutherland, who leads the UO's coastal oceanography research group. "This research was really about getting a wealth of baseline information so that we can figure out what is happening now and use it to help us prepare for what may happen in the future. The system is working now but could change based on weather conditions."

The study—published in the journal *Estuarine, Coastal and Shelf Science*—was based on almost two years of monthly water samples gathered in the estuary and reviews of 50 years of similar records (1957-2007) kept by the Oregon Department of Environmental Quality. Data gathered included acidity, salinity, temperature and levels of dissolved oxygen.

The UO study also incorporated measurements taken since 2002 by the South Slough National Estuarine Research Reserve and since 2011 by the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians.

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Lowest readings of dissolved oxygen were found in late summers, as is the case in other estuaries along the Oregon coast, when incoming salty seawater settles longer in the estuary and warmer, drier conditions reduce the amount of fresh water from the Coos River.

With the stagnant seawater in late summer, biological processes become important as microscopic organisms known as phytoplankton die off, Sutherland said. Phytoplankton are an important part of the equation because they consume carbon dioxide and release oxygen.

"As phytoplankton die, they sink to the bottom where all the oxygen gets depleted and you get low-bottom hypoxia," he said. That leads to stress on such fish as salmon, which seek out deeper, cooler waters. Bottom dwellers—crabs, oysters, worms, clams, sponges and rockfish—face potentially lethal effects.

Early in the summer, upwelling occurs: Prevailing winds blow the ocean's surface water away from shore and cold, nutrient-rich but low-oxygen deep water rises, making for the chilly summertime temperatures experienced on the coast.

In Oregon coastal estuaries to the north of Coos Bay, the offshore shelf is much wider than that of Coos Bay. Combined with the wind, seawater remains longer in the shallower estuaries as the summers get dry, making for stagnant conditions, less flushing and more lethal hypoxic conditions.

"Despite recent alarm about inner-shelf hypoxia on the Oregon coast, there appears to be no hypoxia currently in the main channel of Coos Bay, and there is little evidence of past hypoxia in the estuary," Sutherland and co-author Molly A. O'Neill wrote in their conclusion.

That could change, however, if climate change makes the region hotter and drier and chokes off the flushing action of fresh water from the river, Sutherland said.

The study began as a graduate thesis for O'Neill, who earned her master's degree in 2014. Together, she and Sutherland collected their monthly samples from Coos Bay from a small research vessel made available for the UO's Oregon Institute of Marine Biology, located in Charleston just inside the ocean end of the bay.

Sutherland expanded that effort and continues to study the region. The research, which will be featured in a five-panel display dedicated to UO research in the new Charleston Marine Life Center, provides basic data that could help feed mitigation efforts to battle hypoxia in the region and elsewhere.

In addition to Oregon Sea Grant's support, the research was also funded by the Oregon Legislature and the National Science Foundation.

Dave Sutherland (photo by Jonathan Nash, OSU)

"Despite recent alarm about inner-shelf hypoxia on the Oregon coast, there appears to be no hypoxia currently in the main channel of Coos Bay."

Simulator helps coastal residents prepare tsunami evacuation strategy

By Gregg Kleiner and Kirk Richardson

When the Cascadia subduction zone earthquake strikes 50 miles off North America's west coast, people from northern California to Canada will have only 15 to 30 minutes to move to higher ground before the ensuing tsunami inundates coastal areas.

"When it comes to tsunamis, minutes matter," said Dan Cox, a professor of civil engineering. Cox is part of an Oregon State University cross-disciplinary research team that is developing a computer tool to model various evacuation scenarios. His collaborators on the project are Haizhong Wang, an assistant professor in civil engineering, and Lori Cramer, an associate professor in sociology. Their research is funded by Oregon Sea Grant.

Tsunami evacuation scenarios can be challenging to analyze, because they involve human behavior, split-second decision-mak-

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"When it comes to tsunamis, minutes matter."

Signs along the coast let people know when they're in a location that might be struck by a tsunami. Oregon Sea Grant helped create the signs. (Photo by Pat Kight, OSG)

Tsunami evacuation scenarios can be challenging to analyze, because they involve human behavior, split-second decision-making, multiple modes of transportation, and the fluid mechanics behind a massive wall of water.

ing, multiple modes of transportation and the fluid mechanics behind a massive wall of water. The researchers hope that the tool will help beach visitors, city officials, State Park staffers and other coastal residents plan for the tsunami scientists say the Really Big One will unleash.

When Cox launches the tsunami simulation tool on his computer, colored dots—representing people on the beach—start moving on the screen in real time. These virtual people follow several evacuation routes that lead away from the beach toward safe zones on higher ground. Soon, a blue wave appears onscreen, washes onto land and inundates beaches and other low-lying areas.

When the animation ends, Cox points to some of the dots that are now covered in blue.

"Some of the people here, who chose to go along the jetty route, didn't make it," he said. "And in this area, people who walked along this route would have made it to safety. Those who went back to their cars didn't escape because of the bottleneck."

Cox was initially quite surprised at this result.

"We can vary the walking speeds, driving conditions and all of those kinds of inputs, but it still plays out that there are huge differences in survivability based on people's choices," he said. "And that's the value of these models."

The team is trying to illustrate that making what might appear to be minor changes to an evacuation plan can make major differences in terms of survivability. Sometimes the shortest route is not necessarily the safest. And although many people fleeing a tsunami will turn to vehicles for evacuation, Wang said that using a car or truck is not a fail-safe solution, because damage to roads and bridges caused by the earthquake that precedes a tsunami can cause traffic problems and create chaos. "While you might be able to get to your vehicle and start driving, you don't know what you'll encounter in road infrastructure and traffic conditions ahead of you," he said. "For example, if a bridge is destroyed, people have to find other ways to cross a river or inlet, and vehicles abandoned in traffic jams or at accident scenes can cause dangerous bottlenecks."

Wang, an expert in post-disaster transportation network resiliency, has done research to try to understand how evacuee decision-making behavior impacts traffic flow. He takes various transportation modes, such as automobiles, pedestrians and bicycles, into account.

"A tsunami evacuation is likely to be multi-modal," said Wang. "This tool lets us view different kinds of scenarios. For instance, we can evaluate different pedestrian and vehicle speeds to see how cars and pedestrians interact in an emergency scenario, and how that impacts the mortality rate."

Cramer brings her expertise in social behavior to the project. She is contributing valuable information on individual and group behavior and decision-making during emergencies.

"We're trying to understand the parameters that go into the models," she said. "What are the decisions that people make before they decide to leave?"

For example, the amount of time people spend between first feeling the earthquake and taking action is called *milling time*. The researchers can adjust milling time in their model to show people that taking quick, decisive action can increase the odds of survival. The next step of the research project will be talking with people living in or near tsunami inundation zones to better understand how they might think and react in the wake of a tsunami alert.

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"We can't predict what every person is going to do, but we can help inform and educate so they can be better prepared for the event before, during and after, in order to maximize lives saved," said Cramer.

To further inform the research, it is important to understand the unique challenges of various populations who work and live in tsunami inundation zones.

"This tool is a great start, but until we're able to have others tell us how we can best use it, we're not there yet," she said. "We have to recognize that there is a lot of diversity within a community in terms of social vulnerability and that these scenario models can inform some of that planning. We need to make sure that we communicate with community members, bring those voices into this process and not assume that a one-size-fits-all model is going to work."

Researching a complex topic like tsunami evacuation methods from multiple angles and disciplines might not lead to a comprehensive solution, but it has the potential to make a significant contribution to education and planning in coastal communities. Ultimately, it will save lives.

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Students get their feet wet in watershed science with StreamWebs

By Pat Kight and Tiffany Woods

A dozen fourth- and fifth-grade Girl Scouts splash in the shade-dappled shallows of Rock Creek, southwest of Corvallis, trying to scoop up tiny aquatic insects with small dip nets and deposit them into plastic dish tubs.

They're learning about their watershed—and getting a taste of what it's like to be a scientist—thanks to Oregon Sea Grant's StreamWebs program (www.streamwebs.org). The statewide program provides educators with field equipment, data sheets, lesson plans and training so they can teach students how to collect data about the health of waterways. It also provides an online database where students can enter and analyze the information they gathered.

"What's special about StreamWebs is it's a way for teachers to extend students' field experience into the classroom," said the program's coordinator, Renee O'Neill.

Between August 2014 and July 2015, more than 350 students participated in the program and more than 70 educators were trained on how to use the resources that StreamWebs provides, O'Neill said. During that same period, StreamWebs loaned scientific testing equipment 650 times to educators, she said.

The equipment, contained in plastic totes, can be checked out online and picked up from the Oregon Sea Grant (OSG) office in Corvallis or the Hatfield Marine Science Center in Newport. Each

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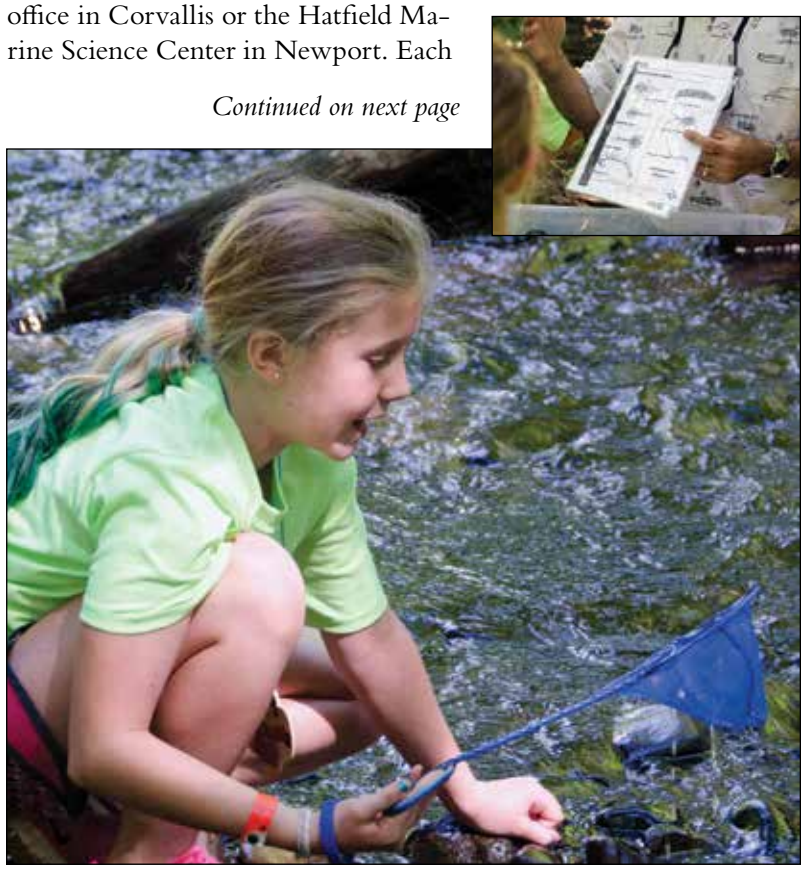

StreamWebs students collect aquatic macroinvertebrates such as caddisflies, mayflies, crayfish, snails, and water striders and use an identification sheet (inset photo) to name their finds. (Photos by Pat Kight, OSG)

tote—called a kit—addresses specific learning objectives. There's a kit with equipment to measure the temperature, pH, turbidity and dissolved oxygen of water. There's another with measuring tapes, ropes and soil augers so kids can document the vegetation in a designated space and characterize the soil along riparian areas. Tubs of rubber boots and clipboards can even be checked out. Lesson plans and handouts for recording data are available on the StreamWebs website, as are two new videos produced by OSG that show how to use the kits for studying water quality and macroinvertebrates.

On the StreamWebs website, an interactive map of the state pinpoints where data have been collected. For example, clicking on the pinpoint for D River shows that students at Taft High School in Lincoln City recorded an average pH of 5.9 on Nov. 18, 2014, and 6.76 on May 23, 2016. Site names are also listed alphabetically from Agate Beach to the Zigzag River.

Since the program's inception, 850 people have created accounts on the website, O'Neill said. Between August 2015 and July 2016, about 120 people contributed data, 503 data sheets were uploaded, and 41 new locations were entered, she said.

The kit the girls at Rock Creek are using is the one for collecting macroinvertebrates, such as caddisflies, mayflies, crayfish, snails and water striders. The girls are being instructed by Guillermo Giannico, a fish ecology and watershed specialist with OSG Extension and a researcher with Oregon State University's Department of Fisheries and Wildlife. They bring their catch to a card table Giannico has propped among the streambank rocks, and use hand lenses and an identification sheet to name what they've caught. "I got a stonefly nymph," one girl exclaims, pointing at the tiny animal's distinctive tail appendages—and then: "I got another stonefly! I am the queen of stoneflies!"

Once back at a computer, students can upload their findings onto the StreamWebs website so that they and others—including the public—can analyze the health of various watersheds over time.

"The site makes it more like doing real-life science," said Emmet Whittaker, a science teacher at Lebanon High School who uses StreamWebs in his classroom. "[Students] see how the data can be used over time [and] how they can be shared with other scientists."

Oregon Sea Grant helps prepare coastal kids for high-tech jobs

By Rick Cooper

Veterinarian. Forester. Architect. Physician assistant. Video game designer. Firefighter.

A student builds a solar car during a science and engineering camp held at Siuslaw Middle School in Florence. (Photo by Stacia Fletcher, Oregon Coast STEM Hub)

What do all these seemingly disparate jobs and careers have in common?

Each requires some degree of proficiency in science, technology, engineering or math—collectively known as STEM. As a partner of the Oregon Coast STEM Hub, Oregon Sea Grant (OSG) is helping students prepare for jobs that require such skills.

The goal of the Oregon Coast STEM Hub, one of 11 STEM hubs across the state, is to ensure that coastal schools and educators have the support necessary to prepare students from preschool through college for 21st century STEM careers. The coastal hub is unique in that many of the subjects it focuses on are tied to marine resources, such as fisheries, wave energy and ecosystem health.

The coastal hub boasts 59 partners, including about 20 school districts and three community colleges. Housed at Oregon State University's Hatfield Marine Science Center (HMSC), it is funded by the Oregon Department of Education.

OSG's Cait Goodwin serves as the hub's

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communications coordinator. She writes and emails a monthly newsletter about hub happenings to more than 700 subscribers. She also manages the hub's website (oregoncoaststem.oregonstate.edu), which informs students about STEM-related camps, scholarships and internships. For example, in the past they've been able to find information on how to submit an application for a three-day stint aboard a research ship (see photo at right) and how to apply for paid summer internships assisting with field work for public agencies in Oregon.

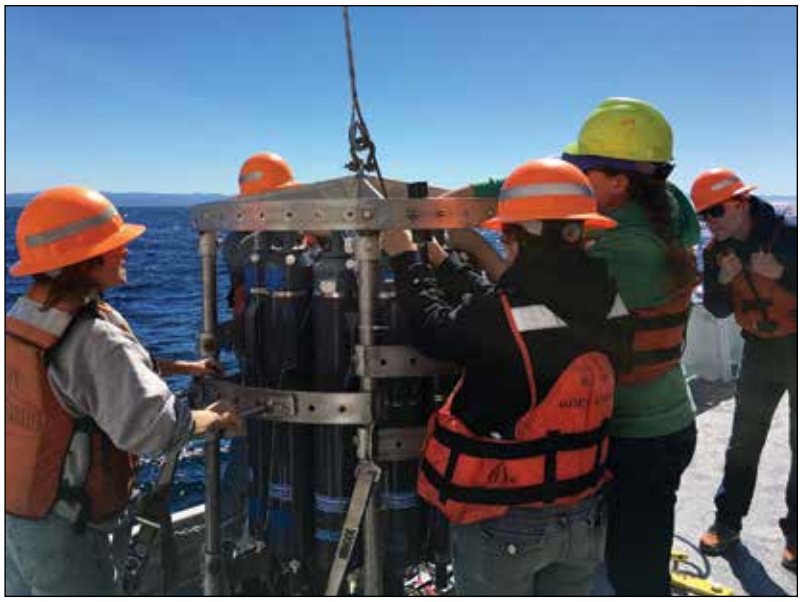
For educators, the website provides links to grants, field trip ideas—such as visits to fish hatcheries—and opportunities for professional development. Since 2014, the hub has funded and helped coordinate over two dozen professional-development activities reaching more than 500 coastal educators, said Tracy Crews, OSG's marine education program manager and programming lead for the hub.

On the website, teachers can also find information about educational field kits that can be checked out, including ones involving lessons on LEGO robotics, maritime history and watersheds. They can also borrow rain boots, microscopes, scales and other field equipment from three trailers in Coos Bay, Newport and Warrenton that were purchased by the hub.

Since 2014, the hub has supported more than 130 different STEM activities for students, said Crews. One of those activities is an annual competition in which students build devices powered by waves, wind and light and then compete to see which designs produce the most energy. In 2016, nearly 200 students entered 59 devices into the competition.

The hub also sponsors an annual contest in which students build remote-controlled robots. In 2016, more than 200 students on 41 teams built devices to collect hypothetical "oil samples" and "coral specimens" in a swimming pool and also navigate under lunar "ice sheets."

The hub also sponsored a "STEMposium" in which fifth- and sixth-graders shared their ecosystem research posters with researchers at HMSC—and then heard from those same scientists about their own work. Waldport elementary teacher Faith Forshee commented about the event, "It was a great opportunity for my kids to feel like a college student, a researcher, and a member of something bigger in our community."



Coastal students and teachers aboard the R/V Oceanus learn to deploy a device that records the conductivity, temperature and depth of water. Information about and applications for the three-day cruise were available on the website of the Oregon Coast STEM Hub, which helped coordinate the trip. (Photo by Tracy Crews, OSG)

Support for STEM on the coast picked up momentum in 2006 when OSG and education leaders from HMSC, the Oregon Coast Aquarium and the Lincoln County School District started discussing the topic, with the goal of helping local students become the most ocean-literate in the nation. In those 10 years, STEM-related jobs in Oregon have grown three times faster than non-STEM jobs, said Oregon Coast STEM Hub director Stacia Fletcher, adding that this pace is expected to continue.

"Many marine-related industries and resource management agencies, such as NOAA [the National Oceanic and Atmospheric Administration], have reported difficulties finding qualified hires for STEM-related positions," Fletcher said. "Students who can take what they've learned and apply it to new situations will be in the highest demand in the workforces of the future."

"It was a great opportunity for my kids to feel like a college student, a researcher, and a member of something bigger in our community."

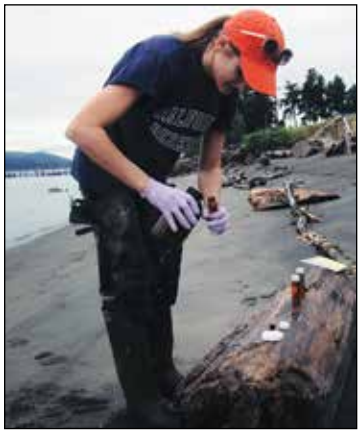
SCHOLARS CORNER

When human health affects environmental health

By Brittany Cummings

I am an Oregon Sea Grant-funded scholar who has been given the wonderful opportunity to attend the Institute of Environmental Health at the Oregon Health and Science University (OHSU) in Portland.

Marine science at a school of medicine? That's right! My research is based on the idea that our environment becomes unhealthy when its inhabitants are unhealthy. Under this guiding principle, my colleagues and I are trying to determine the concentration of the antidiabetic drug metformin and its main breakdown product, guanylurea, in the surface water and sewage effluent of the lower Columbia River basin. Since spring 2016, we have been collecting water samples at various points along the lower Columbia. We have also enlisted the help of volunteers from Columbia Riverkeeper to collect additional samples.



Oregon Sea Grant scholar Brittany Cummings samples Columbia River water to determine metformin levels. (Photo by Claudia Tausz, OHSU)

Metformin, also known as Glucophage, is a commonly prescribed drug for Type 2 diabetes. Taken orally, it lowers glucose levels in the blood without being metabolized. In other words, it simply does its job then passes through the body. Considered a "contaminant of emerging concern" (CEC), metformin has been shown to disrupt the endocrine systems of fathead minnows. The drug is prevalent in the Puget Sound, according to a 2016 study. Researchers detected 81 CECs in effluent from two sewage treatment plants there and found that metformin topped the list in terms of concentration and amount discharged per day.

My colleagues and I aim to find out if a similar situation is true in the Columbia River. Our research follows on the heels of a previous Oregon Sea Grant-funded exploratory study, conducted by Tawnya Peterson and Joseph Needoba at OHSU, which detected metformin in the lower Columbia River. But now we hope to expand on that. In addition to determining the concentration of metformin and guanylurea, we plan to explore how light and microbes might break down these two compounds. We will also study the potential toxicity of these chemicals by looking at how they might affect phytoplankton, the foundation of the aquatic food web. We hope our findings will ultimately be used to develop strategies for reducing metformin in the river and to help the public and policymakers understand the drug's potential risk to wildlife, including salmon.

For the outreach component of the project, I have been explaining my research at "Meet a Scientist" events at the Oregon Museum of Science and Industry, where I explore concepts of aquatic toxicology sampling through a hands-on demonstration with youth and adults. In addition, I'm looking forward to talking about my work while teaching a class about healthy rivers through Saturday Academy, which offers classes and camps for students in the Portland area.

I find this project particularly compelling due to the potential for positive change in humans and our environment—two passions that I find impossible to separate. By making simple changes in our lifestyles, like exercising and eating healthier, we can reduce the incidence of Type 2 diabetes and decrease metformin's possible threat to the Columbia River watershed.

Brittany Cummings is a 2016–17 Robert E. Malouf Fellow funded by Oregon Sea Grant. She is working on a master's in environmental science and engineering at OHSU under the guidance of Tawnya Peterson and Joseph Needoba.

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