

WASHINGTON SEA GRANT College of the Environment University of Washington Autumn 2017 Black Cod Aquaculture Can this "it" fish be farmed? Page 2 Maritime Discovery Schools Place-based education for the next generation. Page 4 Night Owls for Albatrosses Fishing at night can save seabirds. Page 6 WSC Field Notes Updates on Crab Team, SeaFeast and more. Page 7

# **OCEAN ACIDIFICATION**

## Are Pacific salmon heading for a nosedive?

f you're not one for the smell of fish, be thankful that you're not a Pacific salmon. Salmon have a sense of smell that's said to be thousands of times stronger than a dog's, and that sensitivity is essential. Salmon smell their way to food, to their mates, to safety and even to their way back home. Salmon famously return from the open sea back to their freshwater birthplaces when they are ready to spawn, and scent is the guide that they use to get there. However, ocean acidification could be putting this strong sense — and the fish themselves — under threat.

Ocean Acidification • continued on page 3

## **SABLEFISH: THE NEW "IT" FISH**

Whether you call it sablefish, black cod or butterfish, this species is making a name for itself as a desirable menu item.



Graham Young

Ative to the West Coast, sablefish is highly valued in the U.S. for its buttery flavor, and has potential for new markets abroad in Korea, United Arab Emirates and Singapore. Wild sablefish currently support a lucrative fishery but their stocks are not likely to increase, meaning that harvests from wild populations are unlikely to keep up with growing market demand. A possible solution? Aquaculture.

Sablefish aquaculture could benefit Washington's fishing industry and local tribe economies. However, because the sablefish lives at great depths in the ocean, it is particularly difficult to rear: hurdles such as lengthy, expensive production processes, disease, and poor-quality eggs and larvae have presented serious challenges to developing a sablefish aquaculture industry. With the help of Washington Sea Grant-funded research, however, this is starting to change.

A WSG-supported research team is partnering with the Jamestown S'Klallam Tribe and others to find cost-effective ways to successfully raise this finfish for commercial-scale production. The team includes Graham Young, professor at the UW School of Aquatic and Fishery Sciences and director of the Western Regional Aquaculture Center, along with Rick Goetz, director of the marine finfish and shellfish biology program at NOAA's Northwest Fisheries Science Center (NWFSC). After working closely with partners for the past decade on these challenges, the team is now making great strides. "Research on the rearing of sablefish conducted over the past 10 years by NOAA, in partnership with UW, Troutlodge Marine and the Jamestown S'Klallam Tribe, has given us the ability to produce sablefish fingerlings in a more economical and efficient way," Young explains. "This provides a path for the commercial grow out of this species by Pacific Northwest tribes to produce a healthy and native seafood product for our local communities."

Working from the NWFSC research station in Manchester, Washington, the investigators are now producing sablefish larvae at commercial scales by fine-tuning several strategies. First, they reduced feeding costs substantially by increasing rearing temperatures and shortening the length of the larval rearing phase. After the first week of larval rearing, they introduced more-affordable clay as a substitute for expensive green algae. The clay medium helps the fish larvae feed by creating a background against which they can better spot their prey. The researchers adopted a strategy of only producing female sablefish because females grow faster. To improve egg quality and fertilization rates, the



Above: Dr. Rick Goetz, Director of the Marine Finfish and Shellfish Biology Program at NOAA's Northwest Fisheries Science Center, is observing tiny zooplankton (rotifers), which serve as food for sablefish larvae grown at the Manchester Research Station (Port Orchard, WA). Photo by Tiffany Royal, Northwest Indian Fisheries Commission, 2016.

Washington Sea Grant

scientists tested the storage of eggs in different solutions prior to fertilization ultimately, they tested a solution containing sablefish serum that enhanced fertility by 20 percent. Finally, the researchers successfully tested a vaccine to protect against common diseases.

The combined result of all these innovations has made it possible to produce more than 60,000 female fingerlings at a time. Last year, the team reached a milestone when they shipped 50,000 female fingerlings to Golden Eagle Sablefish to be reared in their facilities in Canada.

In 2016, the researchers shipped another small batch of fingerlings to Perciformes Group, a Texas-based company, and the small fish were grown out and ultimately marketed to top Washington, D.C., restaurants. Encouraged by the positive restaurant response, the Perciformes Group hosted a tasting event for Michelin star chefs — featuring the sablefish cooked by the Manchester researchers.

Growers can now access an impressive number of scientific publications to learn more about these innovations. "This body of work represents a lot of people putting in a lot of hours over a decade of research," Goetz says. "We have it to a point now where it is reasonably easy to produce sablefish, so a commercial producer could do much more."

By improving productivity, these researchers may help to introduce a new, healthy native product for local tribes and industry to develop — and provide the public with a tasty alternative to the standard seafood fare on the menu.



### Ocean Acidification • continued from page 1

Salmons' discerning noses could soon be losing their power. As carbon emissions are absorbed into the ocean, they are changing the water's chemistry through a process known as ocean acidification. According to Washington Sea Grant-funded research from toxicologist Evan Gallagher's lab, this chemical change to our seas could be impacting salmons' perception of how the world around them smells — and this could threaten their very survival.

Gallagher and his UW lab have spent years researching the impacts of various pollutants on fish. "The main focus in the lab has been how pollutants disrupt fish behavior," Gallagher says. In the past, this has included the impacts of pollutants from sources such as industrial, agricultural and wastewater runoff. Now, as the marine waters of the Pacific Northwest continue to acidify, carbon dioxide (CO<sub>2</sub>) has been added to the list.



Gallagher and team conducted an experiment using a series of tanks with three different CO<sub>2</sub> treatments. The first treatment tested Puget Sound's current average pH of 7.8; the second tested a pH of 7.5, which is the projected average 50 years from now; the third used a pH of 7.2, which is the projected average 100 years from now. To assess the effects of the different CO<sub>2</sub> exposures, coho salmon were placed in a simple maze that presented the fish with two distinct incoming streams of water. In one, the salmon got normal water. In the other, the incoming water included salmon skin extract — which has a smell that salmon typically avoid.

Evan Gallagher

"When salmon skin is lacerated — like when a fish is attacked by a seal or an orca — it releases a chemical compound," postdoctoral researcher Chase Williams explains. When other salmon smell the

compound, as they should from the salmon skin extract the researchers put in the tank, it is their cue to swim away from the danger. "Using behavioral tracking software, we could follow the fish in real time and measure the amount of time the fish spent in one stream versus the other," Williams says. The research team predicted that salmon would stay in the arm of the tank that didn't have the skin extract in it.

What the results showed was far more complicated. In the control tank (with the pH of 7.8), the salmon only spent 20 percent of their time in the arm with the salmon skin extract, meaning they displayed the expected behavior of generally avoiding the stench associated with predators. As the pH dropped, however, it appeared the salmon responded less and less to the smell. In the tank with a pH of 7.5, the salmon spent 30 percent of the time in the "predator arm." In the tank with a pH of 7.2, they spent 50 percent of their time in the same fetid branch of the maze — indicating that by this point, they were unable to respond to the signal of danger.

While ocean acidification will likely make a pH of 7.2 more common in the years to come, such a number is currently possible. "You can already pick that up in some areas of Puget Sound," Williams says. Which means some salmon could be starting to feel the impacts now.

The good news is that ocean acidification does not appear to similarly damage the sniffers of all fish species. The researchers also conducted a simultaneous experiment on sablefish and found that the acidified water did not impact their smell-bound behavior.

After the behavioral studies, the scientists began to investigate where, exactly, the change in behavior was coming from. Did the acidified water cause problems with their noses? Or did the low pH cause neurological change that reshaped how the salmon perceived the smell? While the former would mean no longer being able to pick up smells — say, if you were stuffed up from a cold — in human terms the latter would be more along the lines of becoming indifferent to the odor of sewage. This second case is what the team found held true for the salmon.

There are still a lot of unknowns in terms of the implications, including whether the impaired sense is permanent. Regardless, "this kind of outcome can be deleterious to the life of the fish," Williams says. For a salmon, being able to react to smell could mean the difference between enjoying its own dinner — or becoming someone else's.

Washington Sea Grant

# HOISTING

Maritime Discovery Schools Initiative Helps Teachers Foster the Next Generation of Maritime Workers

> n a drizzly day early this fall, more than 130 first and second graders from Grant Street Elementary crawled in their stocking feet from the dock onto the deck of the schooner *Martha*. After setting off for a cruise around Port Townsend Bay, Captain Robert d'Arcy let the students unfurl a sail and taught them names of boat parts. Similarly, last spring another group of Grant Street Elementary students climbed the steep, well-worn stairway leading to Hasse & Company/Port Townsend Sails, where they watched as canvas was sewn into sails.

Place-based education that moves kids out of the classroom and onto a schooner or up to a sail loft is an increasingly accepted form of learning and a specialty of the Maritime Discovery Schools Initiative (MDS) located in Port Townsend, Washington. An innovation of the local school district and many collaborators including the Northwest Maritime Center, the primary goal of MDS is to give students early exposure to Port Townsend's rich maritime heritage and industry by getting them out on the water and into marine-related businesses. With support from Washington Sea Grant and numerous donors, MDS has partnered with local maritime businesses and nonprofit organizations to expose all K-12 students to the maritime experience over a five-year period.

The need to introduce our youth to ocean-related skills is becoming urgent. Washington's maritime sector makes an important annual contribution of \$38 billion to the state's overall economy. But the associated workforce is aging, with only 35 percent of the workforce now between the ages of 16 and 39. The job pipeline isn't attracting enough new workers to replace older workers as they retire, and many youth are not staying in the area to work once they graduate from high school. The median age in Jefferson County, where Port Townsend is located, is 57.5 — the oldest in the state.

Recognizing the urgency, the Port Townsend maritime business and education communities joined forces to rebuild the maritime workforce

# SAILS

while improving upon their children's education in a remarkable example of innovative cooperation. Local business owner Carol Hasse, of Hasse & Company/Port Townsend Sails, believes that giving students maritime experience early on could awaken something within them. "Moving with the wind is not only a joy, but a skill that we need," she says. "For thousands of years all commerce was conducted by sail. It is in our DNA; it is our history."

Ms. Hasse's enthusiasm is shared by many other local business owners and entrepreneurs in the community. "It is phenomenal to see the high level of involvement in the initiative, with over 70 partners engaged from every sector of the community," Sarah Rubenstein, director of MDS adds. "Sea Grant funds have furthered the project by supporting the teachers and their training so they could make it a reality. The teachers have planned curriculum, trained in maritime skills and interacted with each other in close collaboration with the Northwest Maritime Center."

In 2016, with the Sea Grant funding support, Port Townsend educators worked with eight industry partners to hold a series of three-day, place-based workshops. MDS also held curriculum development sessions during the school year, where 90 teachers learned about the breadth of maritime jobs and how to prepare their students for the industry.

Forty-nine teachers participated in immersive summer workshops, visiting maritime employees in their work environments. Experiences included a tour of an operating ferry, a day onsite with a shellfish survey team and a tour of a shipyard in Port Townsend at the Shipwrights Co-op, where historic ships are being restored. The tour even included a visit to the *Western Flyer*, the historic vessel that John Steinbeck sailed on when he wrote the Sea of Cortez.

Although MDS's place-based curriculum integrating maritime skills may seem like a radical educational approach, it has many predecessors. These include the New York Harbor School in Brooklyn, the Raisbeck Aviation High School in Tukwila and San Diego's High Tech High.

"Lots of kids have never dreamt you could sail on the water, let alone live and work on the water," Hasse says. "Hands-on connections are missing in public education generally and that is what we are providing [through MDS]. The maritime program actually goes beyond career training and provides students with an opportunity for self-expression and shows them how they can learn and teach themselves."

While the MDS program isn't a cure-all for the industry's workforce woes, it is building skills and connections to the maritime sector for hundreds of Port Townsend students. With dedicated community partners collaborating with educators, it looks like the future of the Port Townsend maritime industry will have smooth sailing ahead.



Previous page: Trimming the sails on the *Adventuress*, owned by Sound Experience, is part of the Maritime Discovery School program for Port Townsend high school students. Photo by Kelley Watson.

A group of students from Grant Street School watch as a sail is being cut and prepared for sewing during a tour led by Carol Hasse of Hasse & Company/Port Townsend Sails. Photo by Chris Tucker, *Port Townsend Leader*, 2016.

## Lots of kids

have never dreamt you could sail on the water, let alone live and work on the water," Hasse says. "Hands-on connections are missing in public education generally and that is what we are providing." CAROL HASSE, HASSE & COMPANY/ PORT TOWNSEND SAILS

## How Fishing at Night Can Help Save West Coast Albatross



Bird-saving streamer lines at work behind a vessel in Alaska.

ongline fishing, in which long lines with baited hooks are attached at intervals behind a boat, is a common technique used to catch many highvalue species including halibut, tuna and sablefish. However, those fish are sometimes caught along with unintended targets — known as

bycatch — including about 160,000 seabirds a year globally. Along the West Coast some of the accidentally-caught birds are endangered species, such as the short-tailed albatross.

Continuing research that earned a 2015 Presidential Migratory Bird Federal Stewardship Award, Washington Sea Grant scientist Ed Melvin and partners at Oregon Sea Grant, Oregon State University and NOAA Fisheries published a new paper in the December 2017 issue of the journal, *Fisheries Research*. The paper builds upon past work and suggests a new option for consideration by fishery managers to reduce short-tailed albatross bycatch: encouraging fishermen to set their lines at night.

Melvin's work to reduce seabird bycatch from longlines began in 1999 in Alaska, which is home

to the country's biggest fisheries. He worked with fishermen to test and fine-tune streamer lines, a type of seabird avoidance technology that is towed above the water behind the fishing vessel, creating a visual barrier that keeps seabirds away from the baited hooks below. In Alaska, this technique has resulted in reducing seabird bycatch by 90 percent. Melvin and his colleagues embarked on the recently published study with the intention of finding out whether the same held true for longline fisheries down the rest of the West Coast.

It did and it didn't. For West Coast vessels that use fishing gear similar to that used in Alaska, streamer lines were effective. But the researchers discovered that some boats in the West Coast sablefish fleet use floats to keep their bait off the seafloor — a technique that renders streamer lines less effective because the bait sinks slower and further away from the vessel. "Encountering this unique gear led us in an unplanned direction," Melvin says.

Through workshops held in ports throughout the region, the researchers learned that some fishermen set their lines at night, when birds are generally less active, as a way to avoid seabird bycatch. "The fishermen invited us onto their boats and provided us with a lot of insights," says Amanda Gladics, a coastal fisheries specialist with Oregon State Sea Grant who co-authored the *Fisheries Research* paper.

The researchers quantified the fishermen's anecdotal findings by sifting through 12 years of data collected



# FIELD NOTES



eri King, WSG's marine water quality specialist, organized and led the 25th Kids' Day at Oysterfest on October 6. About 500 fourth graders from Mason and Thurston counties participated, cycling through ten different stations in which they learned about everything from how oysters filter water, to putting on a life jacket and other boater safety tips, to the importance of cleaning up pet waste. "It's always been fun and fast and furious," King says. Approximately 12,500 students have participated in the program since King founded it in 1992.



ood news: through the GWashington Department of Fish and Wildlife. the Puget Sound Marine and Nearshore Grant Program is funding WSG's Crab Team for another year. The funding will maintain volunteer monitoring in 2018 for invasive European green crab at approximately 50 sites in Puget Sound. This news comes just in time, as more crab are being discovered in the Salish Sea. To date, more than 100 invasive crabs have been found and the monitoring program has been carefully designed to help detect them. Funds will also support transboundary management discussions and a graduate student project to model the movement of European green crab larvae from different locations outside and within the Salish Sea.



After five years working for the City of Seattle and nine years working with the UW, **Katy Curtis** became WSG's new administrator in September. She will pair her administrative skills with her love of the marine environment in handling WSG's human resources, managing budgets, finances and grants, and overseeing the administrative team. Katy has a B.A. in business administration from Seattle University and an M.A. in public administration from the UW. he colorful spectacle of sleek, wooden sloops, tall ships, yachts and schooners, with full sails and flags flapping in the wind, regaled this year's visitors

wind, regaled this year's visitors from around the region on September 8–10 at Port Townsend's popular Wooden Boat Festival. The festival included two Washington Sea Grant booths: one partnered with Jefferson County WSU Extension staff to share water quality games, while a second handed out hundreds of small oil spill prevention kits and pumpout tools to eager boaters.



Photography Magic, SeaFeast 2017.

Undoubtedly, the highlight of SeaFeast 2017 was the dramatic entrance of a United States Coast Guard helicopter sweeping down over Bellingham Bay, above the 8,000 attendees who thronged the maritime festival on Saturday, September 23. The "Washington Sea Grant–USCG Rescue at Sea" demonstration near Zuanich Point Park involved the rescue of

a dummy by a real Coast Guard crew over the water while WSG's MaryAnn Wagner emceed the event from shore. Over 65 booths and dozens of music and seafood events entertained and educated Bellingham residents throughout the day, including a popular Sea Grant booth promoting small oil spill prevention and green crab monitoring updates.



SG water resource educator Sue Blake moderated the Baker to Bay Symposium, a September event that brought together policymakers, business leaders, scientists and community members to learn and share information about ecosystem recovery in Whatcom County. The first day focused on community perspectives, challenges and solutions, and featured speakers such as commercial fisherman Pete Granger and Lummi Nation member Steve Solomon. The theme for the second day was the "state of the science," with presentations from Western Washington researcher Robert Mitchell, Washington State University scientist Jessica Shaw and more. The event highlighted diverse environmental challenges - from stormwater pollution to urban growth — giving the audience direction in how to act on them. As Erika Douglas of

Whatcom County Public Works observed, "There are solutions that work."

WSG is one of 33 Sea Grant College programs, and while program leaders often consult one another, face-toface meeting opportunities are rare. Oregon Sea Grant recently hosted a joint conference in Astoria for communication and extension leaders, and WSG's

#### MaryAnn Wagner and Paul Dye

participated. Given that the Sea Grant network just celebrated its 50th year, the meeting's capstone session focused on how to envision and prepare for the next 50 years. Other session topics ranged from preparing for future crises and disasters to producing short videos for social media platforms. Astoria is a picturesque, historic seaport and a thriving hub of the West Coast fisheries and aquaculture industries, which allowed attendees to spend networking and social time together in a rich maritime setting. Paul Dye, WSG's extension leader, observed that, "Still being 'new' (1.5 years) in my position, I benefitted tremendously from conversations with more experienced leaders, but I also felt welcome offering a fresh perspective on the common challenges we face."





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### WSG IS PROUD TO INTRODUCE ITS 2017–2018 FELLOWS



Fellows, from left to right: Natalie Lowell, James Kralj, Grace Ferrara, Adam Hayes, Sara Brostrom, Jackson Blalock, Haley Kennard.

Sarah Idczak from the UW's Evans School of Public Policy and Governance was awarded a Coastal Management Fellowship to work with the Oregon Coastal Management Program. This year's Marc Hershman Marine Policy Fellows are UW School of Marine and Environmental Affairs (SMEA) graduates Haley Kennard, Marisa Nixon and Sara Brostrom, and UW Program in Landscape Architecture graduate Jackson Blalock. Their respective host offices for the next year are the Makah Office of Tribal Affairs, Washington Departments of Health and Ecology and The Nature Conservancy. SMEA graduates James Kralj, Grace Ferrara and Carrie Schumaus, and UW's School of Aquatic and Fishery Sciences graduate Laura Koehn have been selected as Knauss Marine Policy Fellowship finalists and, beginning in February 2018, will each be placed in a legislative or executive office in Washington, D.C. UW graduate students Elizabeth Ng, Caitlin Allen-Akselrud, Natalie Lowell and Adam Hayes have been awarded Sea Grant/NOAA Fisheries Graduate Fellowships for their research. Finally, Max Showalter, a UW graduate student in oceanography and astrobiology, will join the WSG communications team for two quarters as the Science Communications Fellow.

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#### Albatross • continued from page 6

by the NOAA Fisheries West Coast Groundfish Observer Program. "Not only did we find that night fishing reduced seabird bycatch — it did so dramatically," Melvin says. Night fishing reduced albatross bycatch by 30 times compared with setting lines during the day. What's more, it increased the target catch by 50 percent, meaning that fishermen would have to spend less time with their hooks in the water to take home the same amount of catch.

This isn't to say that night fishing is a great fit for every fishery. "Alaska's high latitude fisheries for sablefish and halibut peak in the late spring to early fall, so there's not a lot of night to work with," Melvin says. Plus, he and his colleagues found that night fishing in Alaska increases the bycatch rate of northern fulmars, which are less common farther south. "A single 'one size fits all' solution won't work for all fishermen and all boats, so developing multiple seabird avoidance options that are specific to the region is crucial," Gladics says.

Seabird bycatch has obvious environmental implications. Gladics points out that it has economic ones, too. "Losing bait to birds can be costly, and serious economic harm can occur if excessive seabird bycatch triggers a fishery closure," she says.

The researchers' work could frame future policy development. For example, the U.S. Fish and Wildlife Service incorporated these finding into a Biological Opinion that will soon trigger new federal regulations to protect the endangered short-tailed albatross in West Coast longline fisheries

"We're delivering the science to the loading dock of policymakers, and they decide how to use it," Melvin says.