WASHINGTON SEA GRANT

SEA STAR

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How to save the pinto abalone

New research informs future restoration efforts for endangered pinto abalone populations in the Pacific Northwest.

By Emma Duckworth, WSG Science Communications Fellow

The pinto abalone is a crucial organism in Puget Sound. "They are the Roomba of the rocky intertidal," says doctoral student Eileen Bates.

Abalone nursery tanks. Photo: Josh Bouma

Abalone are key grazers that feed on the rocks of the intertidal, which allows for the natural succession of other species in the habitat and keeps the entire ecosystem in good health. Pinto abalone is culturally important to Tribes in the Pacific Northwest with spiritual and artistic uses, and historically as a food source.

However, widespread commercial harvesting of pinto abalone has led to heavy declines in their populations, landing them on the endangered species list in Washington in 2019. Since their overexploitation, numerous efforts have been implemented to try to restore populations in the area through abalone hatcheries and the outplanting of juveniles. With funding from Washington Sea Grant, Bates has been working on a project led by Jacqueline Padilla-Gamiño, a professor at the University of Washington School of Aquatic and Fishery Sciences, that aims to increase the success of these restoration efforts.

Since 2003, the Puget Sound Restoration Fund has led multiple collaborative efforts with the Washington Department of Fish and Wildlife to help recover pinto abalone populations by rearing juveniles in hatcheries and outplanting them in the wild. There are many unknowns about rearing these animals, and survival rates once they are released in the wild are highly variable — scientists don't know which factors give the abalone the best chance of thriving in their natural environment. Through partnering with the Puget Sound Restoration Fund, Padilla-Gamiño aims to gain insight into growing and releasing abalone, with the hopes of identifying the best conditions for future restoration efforts.

Beyond understanding how to rear pinto abalone in the hatchery or where they best thrive, restoration practitioners today need to understand how ongoing ocean change could impact their efforts. "It doesn't matter if we can produce more, if the waters are not clean or are too acidic, the abalone just won't survive," Padilla-Gamiño says.

One of the main focus areas of Padilla-Gamiño's study was investigating how variables like temperature and pH affect larval and juvenile abalone survival. Preliminary results suggest that abalone is more sensitive to pH than to temperature, which was something the research team had not previously hypothesized.

Another factor that can determine the success of pinto abalone restoration is the type of substrate used to grow the young organisms in the hatchery. Pinto abalone are broadcast spawners, which means they release sperm and eggs into the water column. Eggs are then fertilized and develop into larvae. After a short period, the larvae settle down into the rocky bottom of the water column and eventually grow into adults. In their natural habitat, pinto abalone settle on coralline algae — however, most hatcheries use a synthetic substrate called GABA for rearing juveniles. The research team utilized both coralline algae and synthetic GABA substrate in the experimental tanks to test the relative success of each strategy.

They found that hatchery tanks with the coralline substrate yielded better survival rates compared to synthetic GABA substrate, indicating that hatcheries should use coralline algae over GABA for the best results. In hatcheries today, GABA is more commonly used, as it is much easier to work with than trying to culture coralline algae. According to Bates, trying to grow coralline algae for the

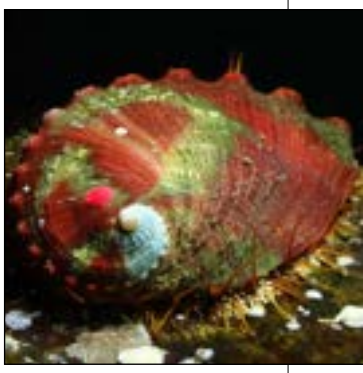
substrate was one of the biggest challenges of this experiment — however, perfecting this process to enable the widespread use of coralline algae as a substrate may be a key ingredient in increasing survival rates of outplanted juvenile algae.

This project is also investigating how using probiotics in abalone hatcheries affects growth and survival rates for juveniles. The use of probiotics is popular in commercial settings like oyster hatcheries to promote the growth of beneficial bacteria and discourage the survival of bad bacteria. However, probiotics haven't been studied as much in abalone hatcheries. Bates explains that the motivation behind this focus of the project was to "harness the research going into probiotics for commercial aquaculture and apply it to conservation aquaculture."

Once the abalone have grown to the juvenile stage, restoration practitioners outplant the animals in the wild. But the abalone don't always survive. As part of this project, the team is analyzing the factors that may contribute to the animals' survival, looking at environmental conditions such as pH, dissolved oxygen and salinity in the natural environment. The researchers have studied 16 sites over three years with varying abalone survival rates. As Padilla-Gamiño explains, information from this research will give insights into where the best outplanting areas for juvenile abalone will be, now and in the future as climate change continues. "While it's important to know where abalone survive, it's just as important to know where abalone cannot survive," she says. By understanding the environmental conditions that give outplanted juveniles the best chance at survival, organizations like the Puget Sound Restoration Fund can focus efforts in the right areas and more efficiently work towards restoring populations.

As for what's next for abalone restoration research, Bates shares that she is eager to investigate the use of probiotics in abalone hatcheries and that this pilot study is just the first of many. This work is just scratching the surface: Padilla-Gamiño explains that there is much more research to be done on pinto abalone in general. Because they aren't commercially harvested, very little is known about their relationship with other organisms and their environment compared to shellfish species like oysters. "We still need to work a lot in the field to really understand how abalone are connected to other organisms... we need to understand the basic natural history of abalone in Washington," she says. "We need to truly understand their ecology and their physiology."

Partnerships between research and restoration organizations are vital to preserving endangered species like the pinto abalone. Especially in the face of a rapidly changing environment, research projects like this are key to figuring out how we can adapt and maximize restoration efforts for these organisms. Future research projects and partnerships like this one will continue to teach us more about the pinto abalone and, hopefully, one day restore wild populations.



Above: An outplanted juvenile pinto abalone. Photo: Taylor Frierson; Below: Doctoral student Eileen Bates installing a sensor. Photo: Katie Sowul

"While it's important to know where abalone survive, it's just as important to know where abalone cannot survive."

The Washington Sea Grant Hershman Fellowship has a proven track record of launching recent graduates into marine policy careers

Many Hershman alums find themselves coming back full circle as they mentor the next generation of fellows

By Samantha Larson, WSG Science Writer

Since 2008, Washington Sea Grant (WSG) has placed recent graduate students in offices across the state to spend a year working on ocean and coastal science and policy issues. Over that time, the WSG Hershman Fellowship has grown into a highly respected, sought-after opportunity for students and host offices alike.

The 2023–2024 iteration of the WSG Hershman Fellowship has established yet another bar of the program's success: six of the seven host mentors are themselves fellowship alums. "I think this speaks to the value that those former fellows found through the program, it speaks in how many of those former fellows have now ended up in leadership roles, and it speaks in those former fellows being able to build the argument to invest more of their organization's resources in hosting a current fellow," says Deborah Purce, WSG fellowship and research specialist.

Above: Fellows kayak at their orientation with fellowship and research specialist Deborah Purce (far right).

The WSG Hershman Fellowship was the brainchild of former WSG director Penny Dalton. As an alum of the Knauss Fellowship — a Sea Grant program that places recent graduate students in host offices in Washington, D.C. — she deeply understood the value of these types of early career opportunities and the potential of a marine policy program in Washington state. "Because the state of Washington has always been a national leader in ocean and coastal policies, it seemed like a logical place to have a state policy fellowship program," Dalton says. "Soon after I came to Washington Sea Grant I started working with Marc Hershman — former director of the University of Washington School of Marine and Environmental Affairs — to develop the program. It quickly became our most competitive fellowship because we have many students who are really interested in policy, but want to stay in the state of Washington." When Hershman passed away in early 2008, Dalton decided to name the fellowship program in his honor.

Over the past 15 years, WSG Hershman alums have grown careers that have demonstrated the power of the fellowship program in building pathways into high-impact marine fields. Part of this is thanks to the high-level work fellows are thrown into. "The fellowship is a unique opportunity for a recent master's or doctoral student in marine science and policy to have the chance to jump into an agency in a way that otherwise wouldn't be open to them through a typical entry-level position," says Purce. "Fellows often reflect on what a big deal that is — the people and rooms they have access to, and the partners they engage with. The fellowship gives them this unparalleled networking opportunity."

The trend of former WSG Hershman fellows becoming host mentors began years ago. Nathalie Hamel, one of the two fellows in the very first year of the program, was placed at the Washington Department of Ecology in 2008. She now works at the Puget Sound Partnership as the vital signs reporting lead and has mentored many fellows in the time since.

When Henry Bell was a Hershman fellow placed at Ecology in 2020, he was mentored by Bobbak Talebi. "From day one, the mentorship and friendship that I got from Bobbak was really amazing," Bell says. "He respected and sought out my opinion and recommendations on some pretty big publications and other work he was doing." Down the road, Bell tried to mirror this approach in his mentorship of 2022–2023 fellow Olivia Zimmerman — which he found to benefit his own work as well. "I've grown a lot and learned more about my work and position from mentoring her. When you teach a subject, you learn it much better," he says.

Bell's mentorship propelled Zimmerman's career forward. "The fellowship created an opportunity to work on projects entailing a lot of nuance and complexity that I wouldn't otherwise have been comfortable leading," Zimmerman says. "It's so valuable to have that mentor and space for learning and being able to ask a ton of questions." When her fellowship ended, Zimmerman was able to successfully apply for a permanent position at Ecology as a coastal resilience project coordinator.

WSG Hershman fellows also get networking and community-building opportunities through being part of a remarkable group of alums. "Something I've really enjoyed as a Hershman alum is that almost anywhere I go in the marine world of Washington I run into other Hershman fellows," says Molly Bogeberg, who was placed at The Nature Conservancy as a fellow in 2014 . "It's always a nice connection point, having that shared experience of being a fellow. It's been a really neat thing to take with me through my career."

The development of relationships also extends to the environment that fellows work in. "There's a feeling of genuine connection through the fellowship," says 2022–2023 fellow Monea Kerr, who was mentored by Bogeberg at The Nature Conservancy. "It gave me the opportunity to get to know Washington in a different way. Being from the Jamestown S'Klallam Tribe, my ancestors are traditionally from here; I love Washington and have lived here my entire life. But there are plenty of places I hadn't been to or knew much about. Learning through the fellowship deepened my sense of place and belonging here in Washington." When their fellowship came to a close, Kerr accepted a communications position at the organization.

"Professional development is baked into the spirit and philosophy of the fellowship," says Purce of WSG. Hershman mentors ensure that fellows can participate in engaging, impactful work while also having the freedom to learn more about the things that capture their interest. This includes fellows making use of the program's generous professional development funds — whether that be to travel to the other side of the world for a conference or to earn a new certificate.

"Mentors come in with the approach of 'you're going to do great work for us while you're here — and in exchange, we're going to prepare and launch you into your next great thing,'" says Purce. If history continues to repeat itself, the chances are good that the next great thing just might bring the fellows back full circle.

Who was Marc Hershman?

In addition to his academic and policy achievements, Hershman is remembered for being an exceptional mentor

Marc J. Hershman has been credited with turning coastal management into an academic field of study. He taught coastal and ocean law, seaport management and coastal management at the University of Washington (UW) for over 30 years. From 1993–2003, he served as director of the UW School of Marine Affairs (now known as the School of Marine and Environmental Affairs). He founded the *Coastal Management Journal* in 1972 and served as editor-in-chief through 2007.

Hershman also devoted countless hours to advising students and mentoring colleagues. "He was very patient," Tom Leschine, former UW School of Marine Affairs director, told *The Seattle Times* when Hershman passed away in 2008. "He was the best person with students, because he understood how they struggled to learn. He had a knack for working with them that much harder when they needed it." Hershman's commitment to fostering the next generation of marine and coastal scientists and policymakers is what makes having the Washington Sea Grant (WSG) Hershman Fellowship named after him so fitting.

"He had a special ability to connect with students at a human level," remembers coastal scientist Simon Geerlofs. "I always felt Marc was happy to see me when I knocked on his office door and excited to think things through together — whether it was a review of a challenging article for the *Coastal Management Journal*, or planning a regional ocean governance workshop. He valued his students and gave us opportunities to contribute; he was excited about our ideas and happy to see us succeed."

Hershman's prominence in the coastal management field led him to a Presidential appointment to the US Commission on Ocean Policy in 2001, through which he provided insight on enhancing national ocean policy. He was also an active member of the Ocean Governance Study Group, an alliance of marine policy leaders at academic institutions across the country. From 2005–2007, he was involved in the Washington State Governor's Project on Ocean Governance.

At the same time, Heshman's impact went well beyond his academic and policy achievements. "He was a great mentor," Geerlofs says. "The WSG Hershman Fellowship is the perfect way to celebrate that legacy."

Campers watch a remotely operated vehicle maneuver underwater.

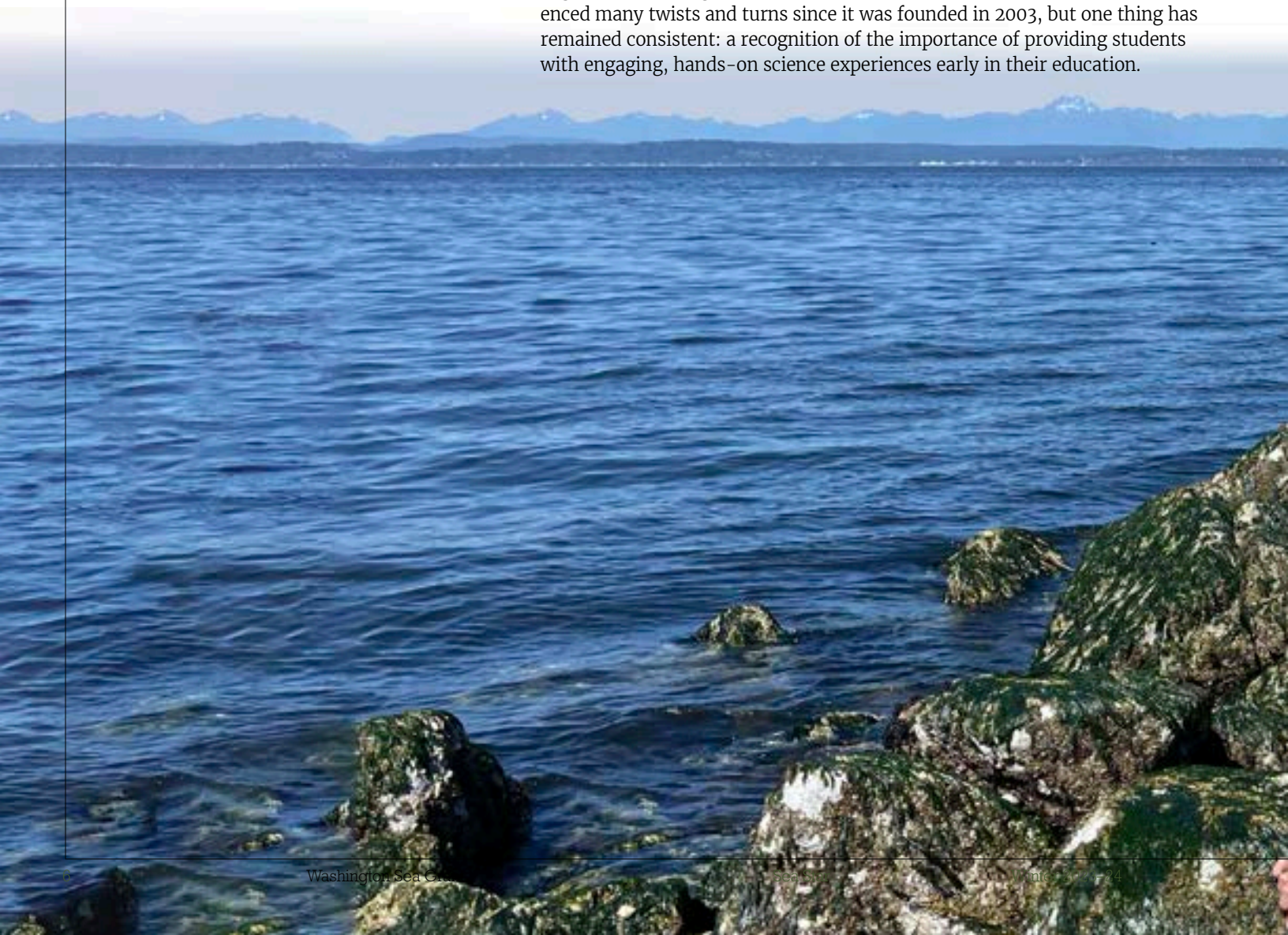
Twenty years of

NOAA Science Camp has brought a breadth of marine programming to middle and high school students since 2003

By Samantha Larson, WSG Science Writer

Minutes away from Seattle's Space Needle and skyscrapers, a pocket beach along the waterfront hosts an abundance of marine life. On a warm day in July this past summer, about two dozen middle schoolers poked through these tidepools, uncovering animals many of the students had never even heard of before — spiny pink scallops, lampshells, creeping pedal sea cucumbers, and hairy shore crabs among them. "It's amazing, we're right on the edge of downtown, and here are all these amazing creatures we share our beaches with," said Jen Strongin, a naturalist with the Seattle Aquarium who served as a marine tour guide for the kids that day.

For the past 20 years, NOAA Science Camp has captured the imaginations of middle and high school students every summer and introduced them to cutting-edge science through activities led by real-life experts. The camp has experienced many twists and turns since it was founded in 2003, but one thing has remained consistent: a recognition of the importance of providing students with engaging, hands-on science experiences early in their education.



NOAA Science Camp

The idea for the camp came from Lieutenant Commander (LCDR) Tom Callahan, a NOAA Corps Officer working at the NOAA National Ocean Service's Office of Response and Restoration in the early 2000s. The NOAA Western Regional Center, located on Lake Washington in Seattle, is home to the largest NOAA staff outside the headquarters near Washington, D.C., with NOAA programs from all of NOAA's main line offices (NOAA Fisheries; National Weather Service; National Ocean Service; Office of Oceanic and Atmospheric Research; Office of Marine and Aviation Operations; and National Environmental, Satellite, Data and Information Service). These offices each do distinct work, from fisheries and marine mammal research to oil spill response to weather forecasting. With such a breadth of knowledge and experience available, LCDR Callahan envisioned a NOAA "show and tell" program tailored for a middle school audience, as there were few summer programs aimed at that group. This first iteration of NOAA Science Camp was held in 2003.

The initial camp was such a success that several NOAA scientists worked together to expand and hold it again the next year. At the same time, the NOAA staff began to come to terms with the enormous workload involved in holding such an event. If they wanted to continue, "We realized that we would need to partner with an organization to do the logistical side," says Lisa Hiruki-Raring, education and outreach coordinator at the NOAA Alaska Fisheries Science Center. "We thought Washington Sea Grant would be the perfect partner."

Washington Sea Grant (WSG) came onboard in 2005, and Maile Sullivan, WSG education specialist, joined the team in 2006. Together, the Science Camp team worked to develop a more robust, weeklong summer program. "We honed

NOAA Science Camp • continued on page 8

Campers' notebooks wait for them on a beached log. Below: WSG education specialist Maile Sullivan points out the features of a tidepool.

NOAA Science Camp • continued from page 7

Above: Fish bones can be one clue helping campers solve an "environmental mystery." Below: High school students conduct research in the Junior Leadership Program (on hold for Summer 2024).

in on middle school as the target audience, since research suggests that's the point at which youth interest in science, technology, engineering and math starts to plummet," Sullivan says.

They developed a program curriculum that integrates a broad range of NOAA science, presenting complex concepts in innovative and interesting ways. Solving an "environmental mystery" became a core thread throughout the week: at the beginning of the week, camp staff would present a mysterious event — say, a big fish die-off — and then the students would spend the next few days visiting various NOAA offices in which they learned about marine topics while piecing together the clues to solve the puzzle. For example, in the fisheries lab students would learn to identify fish species while checking for signs of wounds, trauma or disease; at the oceanography station students would practice measuring the chemical properties of ocean water; and in the marine mammal lab, students would analyze seal scat, looking for remnants that could help identify what the animal had for dinner.

A few years down the road, staff began getting feedback from students and parents that they wanted opportunities to continue in camp beyond middle school. In 2011, the Junior Leadership Program (JLP) was launched for high school students interested in diving deeper into NOAA research. Over two weeks, the junior leaders participate in field trips in which they gain scientific research experience by building and implementing data-collecting buoys, testing water quality, conducting boat and beach surveys on Puget Sound, and communicating the results of their research. They also get professional development opportunities such as a two-hour networking session in which they can learn about the careers of various NOAA scientists and gain job interview skills.

Science Camp staff continued to look for ways to expand their offerings — such as holding mini-sessions focused on robotics and engineering in 2016 and 2017, during which middle schoolers learned about and constructed their own underwater remotely operated vehicles. Before long, Science Camp staff also started seeing the path they helped chart for former campers: there was a growing trend of middle school campers becoming junior leaders, who then became camp staff assistants, who then became college students pursuing ocean-related majors.

In other words, Science Camp turned into a fairly "well-oiled machine," says Sullivan, hosting about 100 middle school and 20 high school students every summer. That is until the pandemic hit. During the summers of 2020 through 2023, what had become the typical NOAA Science Camp wasn't possible due to health and safety precautions as well as closures at the NOAA Western Regional Center.

But far from stopping altogether, NOAA Science Camp pivoted to a new direction. In the summers of 2020, 2021 and 2022, Science Camp offered virtual programming including a webinar series, guides for at-home Science Camp activities, and an online networking event for junior leaders. In the summer of 2023, the Science Camp team dipped back into in-person programming by hosting one week of camp specifically for students from two middle schools in underserved communities.

"The pandemic allowed us to press pause and look at what was still working for us, and what could be changed to adapt to different priorities," says Sullivan. Practicing inclusivity and creating opportunities for underserved and under-resourced students had long been a focus for Science Camp: over the years, camp staff worked with community partners to provide scholarships to students who might not otherwise be able to access summer camp, including sponsoring several Alaska Native students to travel and attend camp, as well as providing accommodations and programming for students with disabilities. The 2023 Science Camp, tailored for underserved students in the Seattle area, provided a chance for staff to brainstorm on how they might expand program offerings to broader communities beyond a week at camp, even as they plan to return to more typical programming in the summer of 2024.

"I think the next 20 years of Science Camp will look quite different," says Sullivan. "It's not lost on me that there will still be the kids who were born wanting to be marine scientists — and we want to keep those kids engaged. But we also want to really prioritize opening doors for kids who have never been told that these types of opportunities exist for them."

The pulse of the ocean

UW and Smithsonian researchers develop DNA identification methods for monitoring Salish Sea planktonic communities

By Katalin Plummer, WSG Science Communications Fellow

Sometimes it's the smallest living things that can tell us the most about the state of the ocean. For decades, scientists have tracked the diversity and abundance of plankton — microscopic organisms that include larval fish (ichthyoplankton), other small animals (zooplankton), and photosynthesizing bacteria and protists (phytoplankton) — on the surface of the ocean. Traditionally, this type of survey work is completed by towing a fine mesh net behind a boat, analyzing the samples under a microscope and identifying and counting individuals by hand. Such methods are both time-consuming and prone to inaccuracies, as many species are difficult to distinguish.

Thanks to recent technological advances, scientists can now address these shortcomings with the incredible capacity of DNA. Through the use of DNA extraction, amplification and high-throughput sequencing techniques — known as "metabarcoding" — scientists can take those same towed samples and identify numerous species more quickly and with greater accuracy. Think of it like trying to recognize each person at a crowded party: the microscope method would be like going to each partygoer one by one and asking their name, while the metabarcoding approach would be like simply looking at the attendee list.

But metabarcoding techniques are still under development as scientists fine-tune the appropriate protocols for their areas of interest. That's why oceanographer Julie Keister and molecular ecologist Carol Stepien led a Washington Sea Grant-funded study to couple the two techniques for their community assessment of the Salish Sea.

"Microscopy identification is considered the gold standard for identifying organisms — that's how we've done it for centuries," says Keister, who is a professor at the University of Washington. By using this "gold standard" alongside the newer methods, the researchers were able to validate their metabarcoding results. "One of our main goals with this study was to resolve the identities of members of complex communities more efficiently and accurately," says Stepien, who is a research associate at the Smithsonian Institution's National Museum of Natural History. Species can be difficult to identify accurately based solely on their physical characteristics, so the metabarcoding method allows scientists to distinguish among species that may look incredibly similar.

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Above: Carol Stepien returning from a sampling trip. Below: Fine mesh nets used to trap plankton. Photos: Carol Stepien

After nearly 40 years of sharing life-saving skills, Sarah Fisken retires

As a WSG marine operations specialist, Fisken grew the organization's marine workshop program and forged trust and community in the process

By Samantha Larson, WSG Science Writer

The first time Sarah Fisken put on a survival suit, she was immediately thrown overboard. She was on a boat anchored in Southeast Alaska, spending the summer commercial fishing for salmon. There was another boat anchored nearby that she and the rest of the crew wanted to get to, but they didn't have a skiff. So, they all put on their survival suits — emergency gear intended to protect oceangoers from hypothermia. Then the boat's skipper picked Fisken up and threw her into the water. "He thought it was funny," Fisken says. "We swam over to the other boat, had a party, and swam back. The suit kept me warm and dry!"

Little did she know then, Fisken would go on to have a long career teaching hundreds of people skills essential to a water-based lifestyle. A Washington Sea Grant (WSG) marine operations specialist for nearly 40 years, she retired this past summer. Over that time, Fisken's name became synonymous with marine education across Washington, as she offered about a dozen workshops every year to commercial fishermen and recreational boaters. Many people have credited Fisken with giving them life-saving skills that they used in emergencies. Perhaps most of all, however, she's known for the great lengths she'll swim to foster community.

In 1984, Fisken became the first female marine advisory agent at WSG. Having worked as a commercial fisherman, however, she had an easy rapport with her male-dominated constituency. She started out helping with fishing net mending courses from her office at Fishermen's Terminal in Seattle. As she chatted with skippers and fishermen, they told her about their other educational needs, such as first aid at sea and how to maintain a diesel engine. At the same time, she met more people who could serve as instructors. "I would say, okay, well, let's try it," Fisken says.

Fisken increasingly brought the workshops to communities outside of Seattle, particularly tribal communities. Her connection with the Makah Tribe goes back to 1972 when she worked on the Ozette Village Archeological Site in Neah Bay as a fresh high school graduate. For 30 years, Fisken drew upon those connections to offer First Aid at Sea workshops to the tribal community. "Participation is a big deal," says Cheryl Sones, Makah Fisheries management coordinator. "Every topic covered in the workshops is something that could happen out there, anytime — but they know what to do in case an accident happens."

At least 15 people credit Fisken's workshops with saving their lives. For example, fisher Libby Cain knew exactly what to do when her boat caught on fire while at sea, having recently taken WSG's Drill Instructor workshop. When another course participant's boat sank in Southeast Alaska, the crew was able to stay calm. "He told me that no one panicked, because they had been through the class," Fisken says.

Throughout her career at WSG, Fisken made an impact in other areas as well. She helped fishermen directly market their fish to consumers, including helping to develop outreach events like the Wild Seafood Exchange. She was constantly in the community, watching for the next need. During the pandemic, she connected a food bank in Jefferson County tasked with feeding Native families to a fish processor with fish he couldn't sell due to losing his overseas market, creating a win-win for all.

Fisken's fondest memories of working at WSG are her time spent in a close-knit team. For years, she worked with former WSG staff Steve Harbell and Eric Olsson to bring workshops to the coast. "We would go to La Push and share a condo and make meals together — and we had just over-the-top fun," Fisken says. "It was a perfect dynamic."

Working with Fisken meant a lot to these colleagues as well. "As a work colleague, I found her to be a dedicated, steadfast and committed professional — a true catalyst for getting things done. As a friend, I continue to find comfort in her unwavering loyalty," says Olsson. "Sarah never sought the limelight but found success in her ability to engage in a trusting and honest manner — to grasp obscure maritime traditions and to understand and embrace cultural sensitivities."

Fisken's next adventures will include continuing to work on Jefferson County's Marine Resources Committee as well as lots of time on her sailboat. She'll be sure to have her survival suit at the ready for whatever may come her way!

FIELD NOTES

Ashleigh Epps

Nicole Naar

A WSG project was selected for funding through the NOAA Sea Grant Aquaculture Workforce Development Support Projects competition. Led by aquaculture specialist Ashleigh Epps and social science and education specialist Nicole Naar, the project seeks to revive a previously successful crew training program by updating it to reflect current industry needs and adding a manager training component to equip employers with the necessary tools for recruiting and retaining a next-generation workforce. The project will provide the skills needed to be a successful farmhand through a crew training program; provide enhanced skills and resources for successfully recruiting and retaining a next-generation workforce through a manager training program; and evaluate the effectiveness of both programs in terms of employee recruitment and retention programs in terms of employee recruitment and retention

Congratulations to the 2023–2024 class of WSG fellows! UW graduate students Zoe Rand and Anna Simeon were selected for the National Marine Fisheries Service–Sea Grant Joint Fellowship in population and ecosystem dynamics, a program that supports students pursuing doctoral degrees in related fields. Catalina Burch, Hannah King, Noah Linck, Katie Love, Ellie Mason, Andrea Richter-Sanchez and Hannah Tennent were awarded the WSG Hershman Fellowship, which places recent science and policy master's and doctoral students in marine and coastal host offices throughout Washington. Jackelyn Garcia is this year's WSG Keystone Fellow, a program that seeks to build pathways into marine science, policy and related industry careers for individuals who are historically underrepresented in those fields. Jillian Everly, Devon Lombard-Henley and Leslie (To-Nhu) Nguyen were selected for this year's Dean John A. Knauss Marine Policy Fellowship Program, through which fellows spend a year working within federal government offices in Washington, D.C.

WSG has appointed Melissa Poe as assistant director for outreach. Poe has been at WSG for 10 years, leading the social science program. She was promoted internally after having served as a Team Lead on the Integrated Knowledge and Education team for the past year and a half, and supervising staff since 2017. In her new role, Poe will lead the outreach and engagement strategy across Washington covering marine research, education and outreach, and supervise four team leads and an overall program of 22 staff. "I am very inspired by the creative, smart and dedicated team of people that I get to work with, rooted in our shared love of this place and commitment to coastal communities," Poe says. "It's incredibly satisfying to work in partnership to solve urgent challenges and to bring a sense of care, bravery and fun to this collective purpose."

Melissa Poe

Sanpisa Sritrairat

Hannah Shelly

Alison Lorenz

We are thrilled to welcome community engagement specialist Sanpisa Sritrairat, and communications specialist Hannah Shelly and science writer Alison Lorenz as new staff on the WSG team. Sritrairat has dedicated her career to protecting coastal ecosystems and the communities that depend upon them. Trained as a multidisciplinary ecologist, hydrogeologist, climate scientist and environmental educator, she has led numerous research and educational outreach efforts to address coastal environmental issues. As a member of the WSG communications team, Shelly plays an integral role in coordinating projects, supporting ongoing outreach efforts, social media and website management, as well as assisting with both internal and external communications. They seek to use their skills for bringing awareness to important social issues and uplift the voices of marginalized communities. Also joining the communications team, Lorenz creates and proofs flyers, blog posts, news releases, reports, and more to keep the public connected to WSG's work across its program areas. She also supports WSG's media relations and outreach efforts.

After working at WSG for more than 30 years, Teri King, aquaculture and marine water quality specialist, has moved on to her next chapter. King's contributions to WSG, the University of Washington, and broader aquaculture communities during her tenure here are exceptional. Among her accomplishments, she developed the "Septic Sense" program to help homeowners reduce pollution into Puget Sound; managed SoundToxins, a diverse partnership of aquaculture businesses, environmental learning centers, tribes and volunteers working together to minimize the impacts of harmful algal blooms; provided technical assistance to hundreds of aquaculture farms and businesses; created the State of the Oyster Study to train waterfront property owners to test the safety of their shellfish; developed training programs for proper seafood handling; organized the annual Conference for Shellfish Growers; conducted groundbreaking research; and much more. King is now working as the Washington and Oregon Regional Aquaculture Coordinator for NOAA's West Coast Regional Office. "My new position will allow me to continue working with WSG, the aquaculture community, and grow professionally," King says.

WSG is grateful for the legacy that Teri built in serving Washington's coastal communities. WSG will be working over the coming months to fill the vacancy left by her retirement and looks forward to continuing many of the programs she started. The SoundToxins program is now under the leadership of WSG marine water quality specialist Michelle Lepori-Bui. The 2024 Conference for Shellfish Growers will be held March 11-12; more information and registration are available on the *WSG website*.

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The researchers had to choose their DNA markers wisely. DNA markers are snippets of gene sequences that act as DNA bookmarks; different markers will highlight different plant and animal species. Keister and Stepien's team used multiple markers to maximize the number of species they could identify as well as confirm that different markers yielded the same identification for one individual. "We went into this study knowing that it was unlikely that any one marker would identify all of the organisms [in a sample] because there is such a breadth of diversity [in the Salish Sea]," Keister says. They decided on markers that were known to work well for a variety of taxa, particularly those that are economically important, ecologically critical, sensitive to ecosystem variability, or a combination of the above, such as crustaceans.

The team reports that the metabarcoding method identified a multitude of organisms to the species level and found several species that had been missed in microscopy identification. The researchers think the new metabarcoding methodology could be key for detecting and monitoring rare species, including threatened organisms like chum salmon or invasive organisms like the European green crab or zebra mussel.

The results also show the potential of using metabarcoding to study climate change in the Salish Sea. Ocean conditions have been changing rapidly in recent years, primarily due to human activities. The organisms prioritized in Keister and Stepien's study — small crustaceans, mollusks and fish — are particularly sensitive to the ocean becoming more acidic and to decreases in oxygen levels. These small animals are key food sources for larger organisms and therefore form an important part of an ecosystem that provides humans with cultural, economic and ecological value. "As we develop these methods that can identify different types of taxa with higher resolution than we could ever do with a microscope, we may find more sensitive indicators of climate variability," Keister says.

"The plankton really are the pulse of the ocean," says Stepien. They serve as the base of the food chain, meaning that plankton biodiversity is critical to maintaining the tremendous diversity of bigger animals like fish and whales. "Metabarcoding and other exciting new tools can help determine who is where in the ocean at any given time."

This study contributes invaluable protocols that could allow the scientific community at large to study the ever-fluctuating Salish Sea reliably. "We're asking what are the things that scientists want to know now," says Keister. "And we're working to focus on those methods."