United States Environmental Protection Agency

Fish and Shellfish Program NEWSLETTER

March 2018
EPA 823-N-18-003

In This Issue

https://www.epa.gov/fish-tech

This issue of the Fish and Shellfish Program Newsletter generally focuses on the Pacific Northwest.

Recent Advisory News

Liberty Bay Commercial Shellfish Beds Open for First Time in Decades

On September 14, 2017, improved water quality prompted Washington health officials to open 760 acres of commercial shellfish beds in Liberty Bay near Poulsbo in Kitsap County.

In an effort to address water quality issues that have plagued Liberty Bay for decades, Kitsap County officials teamed up with stakeholders to apply progressive pollution identification and correction strategies. The result is improved marine water quality that meets the strict standards for harvesting shellfish.

Clean Water Kitsap (a partnership of Kitsap County, the Kitsap Public Health District, the Kitsap County Conservation District, and the Washington State University Extension), the Suquamish Tribe, the City of Poulsbo, and hundreds of property owners began working toward the collective goal of improving water quality over a decade ago. Determining the sources of pollution led to individual on-site sewage system repairs, the implementation of manure management practices, and improvements to Poulsbo's wastewater collection system.

While the water quality has improved, federal rules require harvest area closure from May through September each year due to the large number of boats in the bay.

Washington State Department of Health (WDOH) is responsible for the safety of commercial shellfish harvested in Washington. The State's Office of Environmental Health and Safety uses national standards to classify all commercial shellfish harvest areas.

For more information, contact Liz Coleman, WDOH Environmental Public Health Office, at 360-481-2016.

Source:
https://www.doh.wa.gov/Newsroom/2017NewsReleases/17132LibertyBayNewsRelease

Entire Oregon Coast Now Open for Crabbing

On February 1, 2018, the Oregon Department of Agriculture (ODA) and the Oregon Department of Fish and Wildlife (ODFW) announced that recreational crabbing is now open from Cape Blanco, north of Port Orford, to the California border. Crab samples taken from the area indicate that levels of the marine biotoxin domoic acid have dropped below the alert level.

Commercial crabbers in this area could set gear for a three-day presoak beginning Sunday, February 4, and start landing crab on Wednesday, February 7. For more details on the commercial opening schedule, see http://www.dfw.state.or.us/MRP/shellfish/commercial/crab/season_weekly_updates.asp.

ODA and ODFW will continue monitoring marine toxins in crab and shellfish to ensure that the concentrations remain below the alert level.

For more information on toxins, call ODA's shellfish safety information hotline at 800-448-2474 or visit the ODA shellfish closures web page at https://oda.direct/ShellfishClosures.

For additional information, contact Judy Dowell at 503-871-2118 or Alex Manderson at 503-872-2607 from ODA, or Troy Buell from ODFW at 541-867-0300, extension 225.

Source: http://www.dfw.state.or.us/news/2018/02_feb/020118b.asp

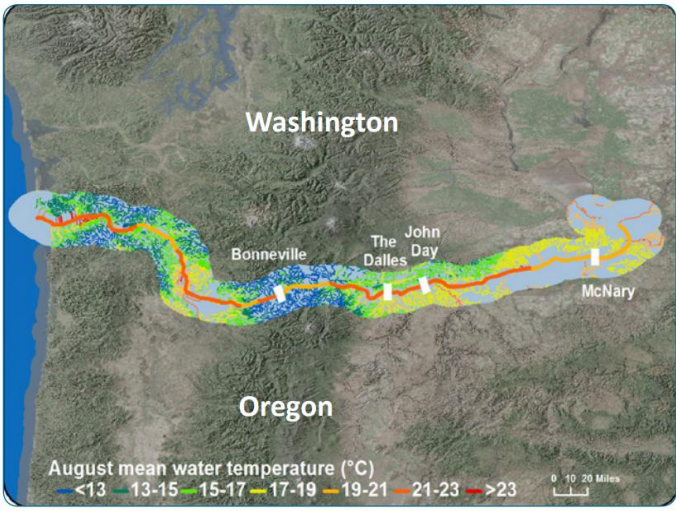
EPA News

Columbia River Cold Water Refuges Project: Supporting Healthy Salmon and Steelhead Migration

What is the Columbia Cold Water Refuges Project?

Cold water refuges are areas that are colder than the main river temperature. Salmon use cold water refuges as they migrate up the Columbia River to their spawning grounds. Protecting and restoring these cold water refuges is important for the survival of migrating salmon and the recovery of future salmon populations. The Columbia Cold Water Refuges Project will:

- Identify the cold water refuges currently available for use by migrating salmon.



Scope of the Columbia River Cold Water Refuges Project *(Data courtesy of NorWeST; Image courtesy of EPA)*

- Assess the sufficiency of the refuges for current and future populations.
- Identify strategies to restore, enhance, and protect high quality refuges for the future.

The project area is from the mouth of the Columbia River to its confluence with the Snake River (the Washington-Oregon border, at River Mile 310).

Project Partners

The U.S. Environmental Protection Agency (EPA) is leading the project, working with the States of Oregon and Washington, National Oceanic and Atmospheric Administration (NOAA) Fisheries, tribes, and others.

Plan to be Completed by November 2018

Working with its partners, EPA will develop and issue a Columbia River Cold Water Refuges Plan by November 2018.

Things to Know about the Columbia Cold Water Refuges Project

- Project work is guided by the most recent science on salmon in the Columbia River.
- The project will implement the State of Oregon's water quality temperature standard. Oregon's standard recognizes that sufficient, well distributed cold water refuges are essential to salmon and steelhead migration.
- The project is connected to climate change. As rivers warm under climate change, cold water refuges will become even more essential to the survival of cold water fisheries, such as salmon and steelhead.

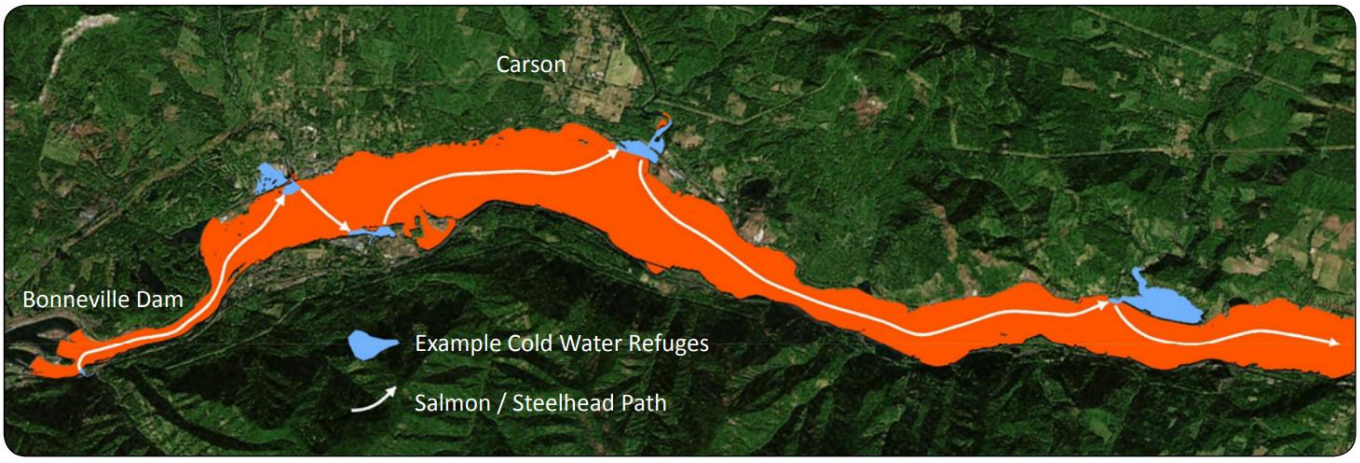


Illustration of potential cold water refuges along the Columbia River Migration Corridor *(Image courtesy of EPA)*

What Might the Project Mean?

The project could have future implications for:

- States' (Oregon and Washington) management of activities that affect stream temperature within the watersheds connected to these cold water refuges.
- Increased funding for restoration projects that increase the amount of water providing cold water refuge.
- Protecting fish within cold water refuges.
- Management of the Columbia River, in terms of the overall mainstream river temperature.

For more information visit https://www.epa.gov/columbiariver/columbia-river-cold-water-refuges.

For more information on regional database and stream features, visit https://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html.

For more information on the Columbia Cold Water Refuges Project, contact:

- Dru Keenan at 800-424-4372 (ext. 1219), 206-553-1219, or at keenan.dru@epa.gov
- John Palmer at 800-424-4372 (ext. 6521), 206-553-6521, or at palmer.john@epa.gov
- Debra Sherbina, Community Involvement Coordinator at 800-424-4372 (ext. 0247), 206-553-0247, or at sherbina.debra@epa.gov

Source: https://www.epa.gov/sites/production/files/2017-07/documents/columbia-river-cold-water-refuges-fact-sheet-july2017.pdf

Other News

Puget Sound Wastewater Carries Emerging Contaminants

A new study of emerging contaminants entering Puget Sound in wastewater plant effluent found some of the nation's highest concentrations of these chemical compounds, and detected many in fish at concentrations that may affect their growth or behavior.

The study by scientists from NOAA Fisheries' Northwest Fisheries Science Center (NWFSC) and the University of Washington tested for 150 of the contaminants and detected 81 of the compounds in wastewater flowing into Puget Sound estuaries. They include pharmaceuticals such as the antidepressant Prozac and the diabetes medication metformin; personal care products such as antibacterial compounds from soap; and industrial chemicals.

The study also examined juvenile Chinook salmon and Pacific staghorn sculpin, both fish native to Puget Sound, and found 42 of the emerging compounds in their tissue. Some of the compounds such as fluoxetine (also known as Prozac), the diabetes drug metformin, and the antibacterial compound triclosan were present in fish tissues at levels that may be high enough to adversely affect their growth, reproduction, or behavior.

"There's also the problem of not knowing how these chemicals act in fish when they are found together as a mixture," said James Meador, a NOAA Fisheries research scientist and lead author of the research published this week in the journal *Environmental Pollution*. "Mixtures such as these may result in responses that occur at lower concentrations than single compounds alone."

The research did not examine the potential effects on human health of consuming fish from Puget Sound, and it is unknown if these levels of emerging contaminants detected in fish could affect people.

The study, funded in large part by the Washington Department of Ecology, examined wastewater plant effluent, estuary water, and fish found in the Puyallup River estuary in Tacoma's Commencement Bay, Sinclair Inlet in Bremerton, and the Nisqually River estuary near Tacoma. The Nisqually estuary was included as a reference site, because it does not have a major wastewater treatment plant and has been used historically as a reference site for other toxicity studies. Unexpectedly, it was found that fish and water in the Nisqually estuary also contained high concentrations of some emerging compounds.

Meador said that the study also noted that the relatively high pH of seawater often makes the contaminants more bioavailable, and therefore, more likely to be absorbed by marine fish compared to fish in freshwater.

The researchers noted in their study that since the two major wastewater treatment plants they examined in the Puyallup and Sinclair Inlet discharged a total of 71 million liters per day, "it is possible that a substantial load of potentially harmful chemicals are introduced into streams and nearshore marine waters daily." If the two wastewater plants sampled in the study are representative of others around Puget Sound, the researchers calculated that nearly 300 pounds of the emerging contaminants likely enter Puget Sound daily.

"When you add it all up, you get millions of gallons of effluent discharging into these estuaries," Meador said. "This is right in the area where juvenile salmon and other fish are feeding and growing."

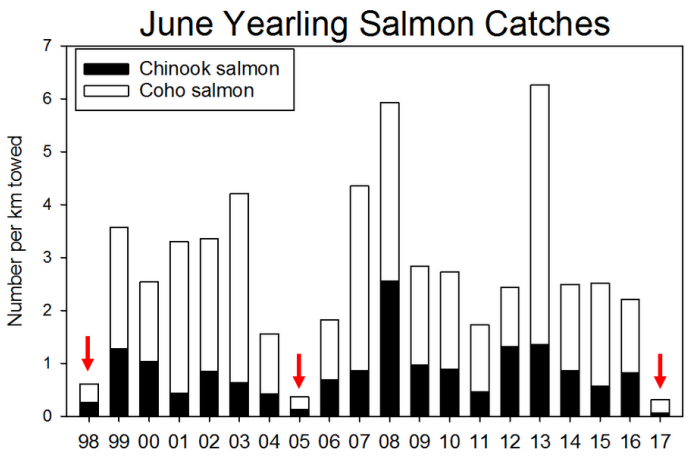
Obtain the study here: https://www.sciencedirect.com/science/article/pii/S0269749116300884.

Source: https://www.nwfsc.noaa.gov/news/features/wastewater_carries_contaminants/index.cfm

Ocean Surveys Show Poor Outlook for Columbia Salmon

NOAA Fisheries reported in September 2017 that ocean conditions for salmon headed to sea that year were very poor, according to recent NOAA Fisheries research surveys, and had a high likelihood of depressing salmon returns to the Columbia River in the next few years.

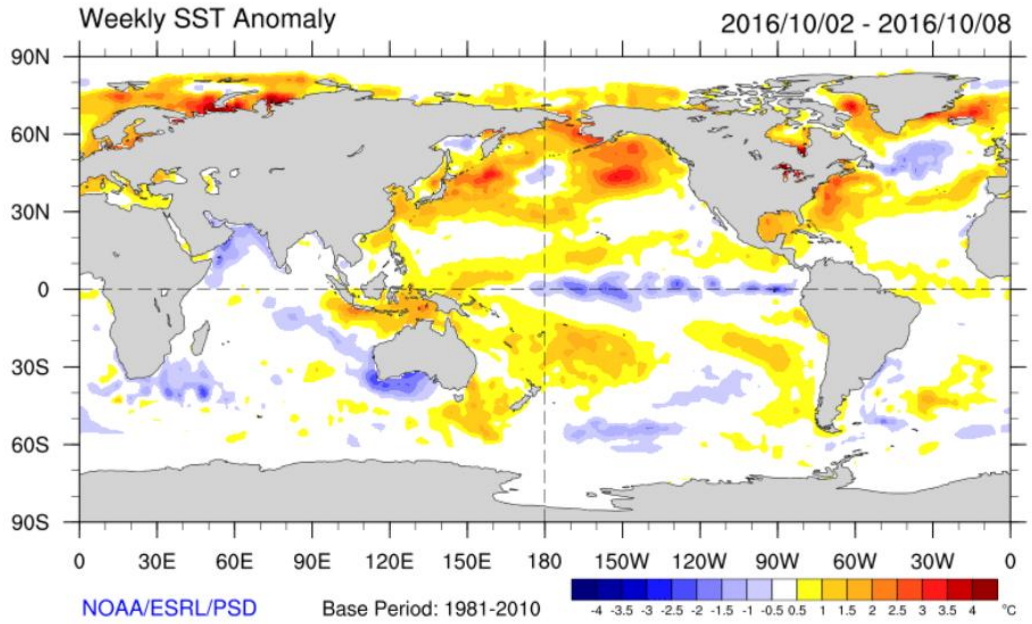
The outlook is described in a recent research memorandum from NOAA Fisheries' NWFSC, which has been studying the ecology of young salmon entering the ocean for more than 20 years. The research has helped reveal how conditions in the ocean affect salmon survival and, ultimately, how many salmon complete their life cycle to return to their home streams and spawn a new generation of fish.



NOAA Fisheries research surveys off the Pacific Northwest this year turned up among the fewest juvenile salmon of any of the last 20 years, an indication that many of the young fish that migrated to the ocean did not survive. Graphic: Northwest Fisheries Science Center *(Image courtesy of NOAA)*

NOAA Fisheries researchers regularly survey ocean conditions off the Pacific Northwest Coast, focusing especially on factors known as "ocean indicators" that can serve as barometers of salmon survival. They also assess the number and condition of juvenile salmon along the Oregon and Washington coastlines, since the survival of the fish during their first months at sea helps predict how many are likely to survive over the longer term.

NOAA Fisheries' many years of ocean research have helped scientists develop online charts of ocean indicators that display the forecast for salmon returns in coming years. In the last few years the indicators have turned largely negative for Columbia River salmon, in large part because of unusually warm ocean temperatures, including the "warm blob," a large swath of warm water that encompassed much of the West Coast beginning in 2013.



A 2016 map illustrates sea surface temperatures, with darker red representing temperatures farther above average. Unusually warm waters have encompassed much of the West Coast in recent years, affecting the marine ecosystem. Graphic: NOAA/ESRL/PSD *(Image courtesy of NOAA)*

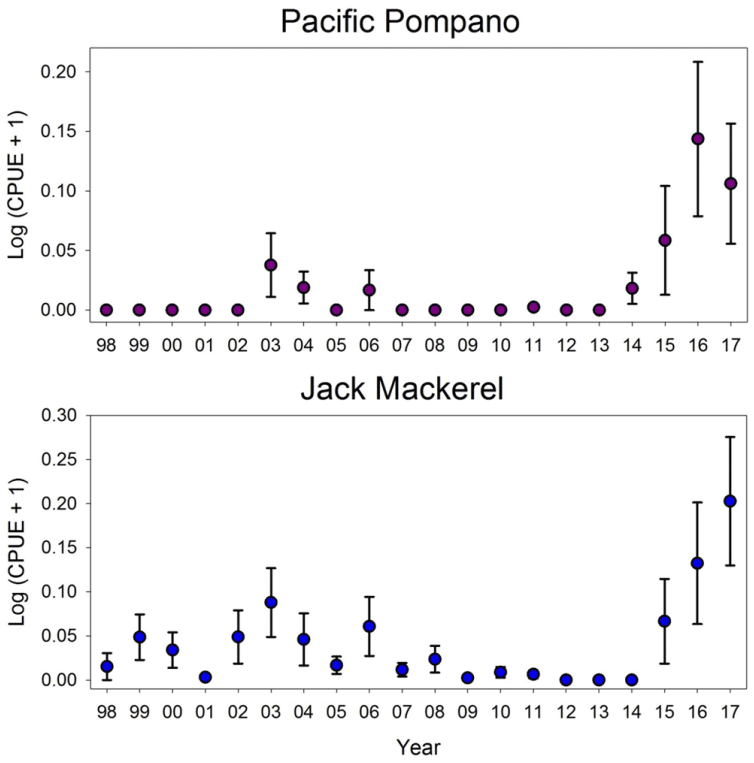
"This is not just about salmon, however, it's about an ocean ecosystem that is changing in ways that affect salmon and everything else out there," said David Huff, manager of the NWFSC's Estuarine and Ocean Ecology Program. "Remote methods of detecting changes to the ecosystem did not highlight the poor ocean conditions this year. For example, the warm blob has dissipated, so satellite imagery shows near-normal sea surface temperatures. It was only by getting out on the water and sampling directly that we were able to identify and describe local biological indicators."

Researchers' catch of juvenile salmon in 2017 was among the lowest in the last 20 years, suggesting that the early survival of young fish was unusually low. Catches of other species such as smelt, herring, and anchovy were also low, a sign that predators such as seabirds near the mouth of the Columbia may have had to rely more heavily on young salmon just entering the ocean.

Surveys in recent years have also turned up record numbers of warmer-water species such as Pacific pompano and jack mackerel that previously had been scarce off the Pacific Northwest coast. Increased abundance of these warm-water species can have direct and indirect ecological impacts on salmon.

Moreover, warm ocean waters typically carry plankton with less of the fatty nutrients that young salmon need to thrive when they first go to sea, starving the food web from the bottom up. In 2017, researchers noted that chlorophyll, which is a barometer of the plankton that helps sustain higher trophic levels, was at its lowest levels in 20 years.

At the same time, tiny marine crustaceans called copepods that signal favorable conditions for salmon have remained at low levels since 2014 according to researchers.



In contrast to salmon, the warm-water species Pacific pompano and jack mackerel have appeared in research nets in record numbers in the past few years. Jack mackerel often prey on juvenile salmon. Graphic: Northwest Fisheries Science Center *(Image courtesy of NOAA)*

The results indicate that salmon fisheries may face some lean times in the next few years. It was expected that biologists would report on 2017 salmon returns later in 2017, and issue forecasts for 2018 in early March. Those forecasts help shape expectations for 2018 fishing seasons.

"While the news is not good, this new information helps us anticipate what's coming," said NWFSC Director Kevin Werner. "We cannot change what the ocean is doing in the short term but this scientific information can help us make good decisions about how best to manage and protect salmon in light of these adverse conditions."

The findings underscore the vast influence the ocean exerts over salmon survival and the importance of providing salmon with healthy freshwater habitat so they can weather poor ocean conditions and take advantage of favorable conditions when they return. That is a central focus of NOAA Fisheries' recovery plans for threatened and endangered salmon and steelhead.

"As difficult as it is for salmon right now, tribes, watershed groups, and others across the region have worked hard to improve freshwater salmon habitat," said Michael Tehan, Assistant Regional Administrator for the Interior Columbia Basin Office of NOAA Fisheries' West Coast Region. "That's essential for sustaining salmon through these tough times so they can rebound when ocean conditions support it."

For more information, see Salmon Returns and Ocean Conditions (NWFSC fact sheet).

Source:
http://www.westcoast.fisheries.noaa.gov/stories/2017/09062017_lean_times_salmon.html?utm_medium=email&utm_source=govdelivery

Increased Mitochondrial DNA Diversity in Ancient Columbia River Basin Chinook Salmon (*Oncorhynchus tshawytscha*)

Research published on January 10, 2018 looked at the reduced genetic diversity and the risk of extinction of native Chinook salmon (*Oncorhynchus tshawytscha*) in the Columbia River basin. The Columbia River and its tributaries provide essential spawning and rearing habitat for many salmonid species, including Chinook salmon. Chinook salmon were historically abundant throughout the basin and Native Americans in the region relied heavily on these fish for thousands of years. Following the arrival of Europeans in the 1800s, salmon in the basin experienced broad declines linked to overfishing, water diversion projects, habitat destruction, connectivity reduction, introgression with hatchery-origin fish, and hydropower development. Despite historical abundance, many native salmonids are now at risk of extinction.

Research and management related to Chinook salmon is usually explored under what are termed "the four H's": habitat, harvest, hatcheries, and hydropower. Here the researchers explored a fifth H: history. Patterns of prehistoric and contemporary mitochondrial DNA variation from Chinook salmon were analyzed to characterize and compare population genetic diversity prior to recent alterations and thus elucidate a deeper history for this species. A total of 346 ancient and 366 contemporary samples were processed during this study. Species was determined for 130 of the ancient samples and control region haplotypes of 84 of these were sequenced. Diversity estimates from these 84 ancient Chinook salmon were compared to 379 contemporary samples.

The researchers' analysis claimed to provide the first direct measure of reduced genetic diversity for Chinook salmon from the ancient to the contemporary period, as measured both in direct loss of mitochondrial haplotypes and reductions in haplotype and nucleotide diversity. However, it was noted that these losses do not appear equal across the basin, with higher losses of diversity in the mid-Columbia than in the Snake subbasin. The results were

unexpected, as the two groups were predicted to share a common history as parts of the larger Columbia River Basin, and instead indicate that Chinook salmon in these subbasins may have divergent demographic histories.

The full study can be read here: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0190059.

A Wealth of Scientific Information, Decades in the Making

On February 26, 2018, NOAA Fisheries released a special issue journal highlighting the status of an Alaska marine ecosystem more than a quarter century after the Exxon Valdez oil spill.

What does the Prince William Sound ecosystem look like more than two decades after the Exxon Valdez oil spill? According to NOAA Fisheries scientists and partners who have been monitoring the ecosystem since the spill occurred in 1989, the answer is complicated. It's a picture that includes loss, recovery, change, and persisting conditions.

A newly published Special Issue of Deep Sea Research II includes 19 research papers on the Sound ecosystem. NOAA Fisheries highlighted a few of the papers authored by its scientists:

Persistent Oil in the Environment

"In the early years after the spill, experts anticipated that the oil would naturally degrade and not persist in the environment. I haven't found this to be the case," says study leader Mandy Lindeberg, a NOAA Fisheries scientist. "For some sites, oil may persist for decades."

According to Lindeberg, during the spill oil made landfall and on some beaches became trapped under an armoring of cobble and boulder. Oil has remained in these pockets and persisted because they lacked the natural processes necessary to break down the oil (e.g., physical action such as waves and weather, and dissolved oxygen to promote microbial degradation).

Humpback whale in Prince William Sound *(Image courtesy of NOAA)*

This has been one of the surprising results from the spill in that these pockets of trapped oil have not weathered significantly since 2001.

Changes in the Ecosystem Structure

With the decline and lack of recovery of the killer whale population after the oil spill, a conspicuous predator, the Dall's porpoise, commonly seen throughout the year in the Sound, seems to be prospering.

During vessel-based surveys from 2007-2015, scientists observed the porpoise using a wide range of habitats, including those not considered typical of the species, such as bays, shallow water, and nearshore waters.

"The ability of the Dall's porpoise to exploit new habitats may be linked to the decline of AT1 killer whales (a group of transients in the Sound), a primary predator of porpoise," said John Moran, fisheries biologist, Alaska Fisheries Science Center. "We don't know a lot about the size of this porpoise population within the Sound, but they seem to be foraging more in bays of the eastern Sound when spawning and overwintering herring are present."

Another marine mammal, the humpback whale, has been keying in on herring in the Sound. Scientists ran models to estimate how much herring humpback whales may be consuming to determine whether whales are preventing recovery of some herring populations. While overall humpback whale predation wasn't viewed as a problem throughout the Gulf of Alaska, in the Sound the models estimate that humpback whales may be consuming as much as 12-34% of the pre-spawning herring biomass.

Complex Factors Affecting Herring Stock Recovery

Alaska Fisheries Science Center scientists Fletcher Sewall and Ron Heintz and their colleagues at the University of Alaska Fairbanks looked at other biological variables that could be affecting herring's ability to survive to adulthood (recruitment). In particular, they found a close, positive relationship between age-1 pollock and age-3 herring in the Prince William Sound ecosystem – when one population went up the other also went up. This isn't surprising because the two species co-occur in the nearshore habitat and their diets overlap and show similar seasonal changes in composition. In addition to humpback whales, adult pink salmon returning to spawn and seabirds have been suggested as important herring predators. Past studies show that common murres can remove as much as 10% of the adult herring biomass and even greater biomass of juveniles.

Knowledge Continues with Long-term Monitoring

Long-term environmental monitoring is important for assessing recovery of injured species, managing those resources and the services they provide, and informing the communities who depend on the resources.

Lindeberg added, "Long-term, consistent, scientific data are invaluable in helping us detect and understand ecosystem changes. The fact that these studies have been able to continue for decades is important to aid in our understanding of ecosystem recovery."

You can read more about these and other studies in NOAA's special issue of Deep Sea Research Part II: Topical Studies in Oceanography.

The work of this collaborative group of NOAA Fisheries scientists and other agencies and organizations is being conducted under the Gulf Watch Alaska and Herring Research and Monitoring programs funded by the Exxon

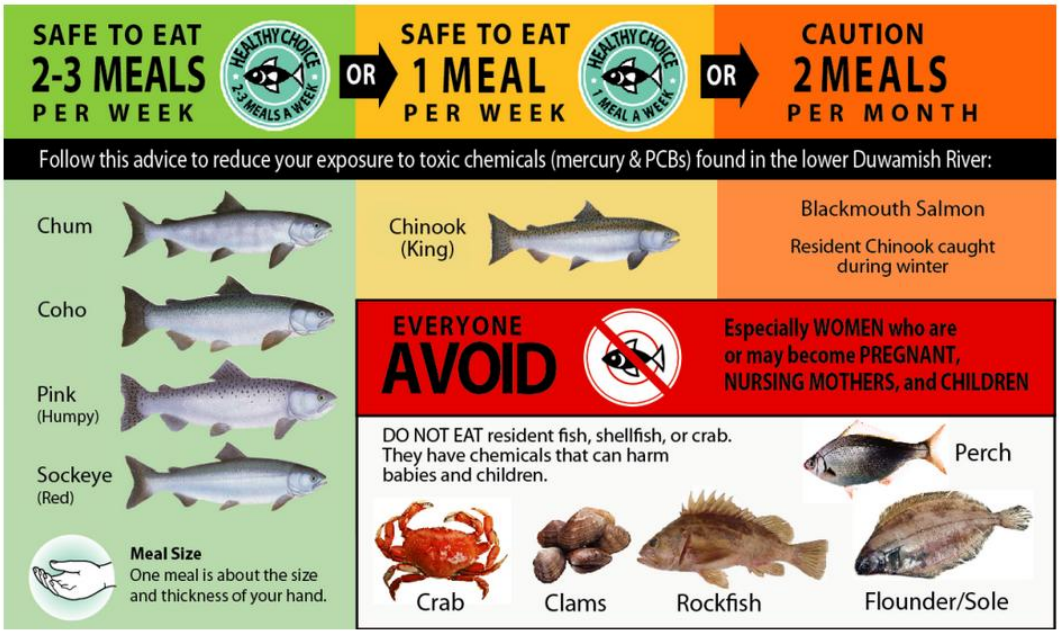
Valdez Oil Spill Trustee Council. Findings from these programs are providing resource managers with important insights for recovery and protection of ecosystems after major oil spills.

Source: https://www.fisheries.noaa.gov/feature-story/wealth-scientific-information-decades-making?utm_medium=email&utm_source=govdelivery

Community Health Advocate Q&A: Families, Fish, and the Duwamish Superfund site

Fish are a healthy component of many diets, but depending on where fish spend their time, they can pick up contaminants like mercury or polychlorinated biphenyls (PCBs) in their bodies. These chemicals are introduced to the environment from industrial and historical uses and enter the food chain, accumulating in seafood, marine mammals, and humans. When people eat seafood from contaminated waters, they are exposed to these chemicals.

More than 20 ethnic groups currently fish in the Duwamish River, which is a highly contaminated Superfund site that runs right through South Seattle, along the South Park and Georgetown neighborhoods. To address the disproportionate burden of health risks associated with consuming PCB-contaminated seafood among low-income and immigrant/refugee fishing communities in the Duwamish River Superfund site, Public Health – Seattle and King County (Public Health) launched a community-based program, the Duwamish Seafood Consumption Program, to confront the long-standing environmental justice issues associated with seafood consumption and fishing in the lower Duwamish Valley. This program, established through a cooperative agreement with EPA, engages affected communities in designing culturally appropriate health promotion tools and building community capacity for sustainable outcomes.



Screen-capture of Fish Consumption Advisory *(Image courtesy of Public Health Insider)*

The Duwamish Seafood Consumption Program talked with Mai Hoang, a Vietnamese-speaking community health advocate who is working with them at Public Health. She shared what drives her work as well as some of the challenges she encounters in sharing this information with her community.

Q: Mai, how did you become a community health advocate? What makes you fit for the job?

I was recruited by a local organization called Just Health Action that worked with Public Health. They were looking for someone in the area who could help share information about the Duwamish Superfund site, and I was excited for the opportunity.

Besides being interested in the work, I'm a woman, a mother, and a food provider for my family. I know what it's like to weigh the pros and cons when making choices about what to feed my family, and I want to help others make informed decisions too. I'm in a unique position because these are my neighbors and friends, and I understand what's important to them.

A group of Duwamish Healthy Seafood Consumption community health advocates with staff from Public Health and Duwamish River Cleanup Coalition *(Image courtesy of Public Health Insider)*

Q: What kinds of things do you do to reach out to your fellow community members?

In many ways, I simply offer more opportunities to connect and learn about issues. I know many parents – like myself – who are busy with work and don't have time to go to Public Health-sponsored events. I try to coordinate times to meet with people that are convenient for them. I like to think of myself as an extension of the larger agencies and non-profits doing this work too. And, of course, when people come to me with questions, I do my best to be a reliable and worthy resource.

Q: Why is your work around Duwamish so important?

Simply put, kids are our future. The issues around fishing in the Duwamish affect adults, but our children are especially vulnerable. If I know all of this information about the destructive effects of the fish and I don't do my best to share it, then I am essentially putting my neighbors – and our future – in harm's way.

Q: What kind of advice do you offer?

I often stress that preventing illness is much easier than treating illness. But, we're talking about real people and real food – so it can be tricky. I try to encourage people to talk about what they're eating. For instance, if a friend gives you a gift of seafood, you can ask in a polite and humble manner, "What kind of fish is this? Where is it from – and how do you prepare it?" This conversation shows you are grateful and curious, and it also helps you understand if you are at risk.

We also talk a lot about the parts of the fish that are the most risky. Some people think the head and fat of the fish are tastiest, but those parts can also be the most contaminated. This can be confusing, so I try to help people understand that taste and health aren't necessarily related.

Q: What are your goals as a community health advocate?

I'd love to expand this program to reach schools. They say "if it rains long enough, then the earth will be wet." If one kid knows about this issue, that's great. But ten? That's even better. I think it's important to start with kids so that this message is shared for future generations.

Mai Hoang with fellow community health advocates, Ivonne Vigo and Luis Amado
(Image courtesy of Public Health Insider)

For more information about fishing and advisories, read a recent blog post by Sinang Lee, MPH, Health Educator at Public Health and check out Public Health's website.

Source: https://publichealthinsider.com/2017/10/27/community-health-advocate-qa-families-fish-and-the-duwamish-superfund-site/

Recently Awarded Research

EPA Announces Funding for Puget Sound Protection, Conservation, and Recovery

On December 13, 2017, EPA Region 10 announced that through its National Estuary Program it is providing $25.2 million in grant funds to state, local, and tribal Puget Sound recovery and conservation efforts.

Among the efforts funded in whole or in part with National Estuary Program funds announced were:

- The restoration of an additional 5,000 acres of key Orca and salmon habitat.
- The re-opening of about 4,000 acres of shellfish beds in Puget Sound.
- Improvement of biological condition from fair to good for at least 30 streams.

EPA distributes its National Estuary Program funds to Washington's Department of Ecology, Department of Health, Department of Fish and Wildlife, Department of Natural Resources, and Department of Commerce, the Northwest Indian Fisheries Commission, Washington State University's Stormwater Center, the Puget Sound Partnership, and the University of Washington's Puget Sound Institute.

These agencies then fund projects that meet the goals of both the National Estuary Program and the Puget Sound Action Agenda which is developed by the Puget Sound Partnership, the state agency charged with leading the state's collective efforts to restore and protect Puget Sound. The Puget Sound Institute conducts and funds scientific research that informs decision-making.

Other success stories over the last decade include:

- A net increase of approximately 5,000 acres of safe, harvestable shellfish beds restored.
- Removal of 1,006 creosote-treated pilings in Northern Hood Canal and Chambers Creek to protect spawning herring populations and reduce embryo mortality. The National Estuary Programs's cumulative investment of approximately $967,000 for all removals (and monitoring) in these two areas inspired the state legislature to appropriate $2.5 million in 2014 for other removals.
- Re-opening 1.5 miles of Coho spawning and rearing habitat in the upper Skagit River by the Upper Skagit Indian Tribe.

The projects helped restore natural watershed processes critical to flood management.

In addition to providing grant funds, through the National Estuary Program and other programs, EPA experts provide their scientific expertise to local, state, tribal, industry, and non-governmental organizations on strategy development, and are typically involved in scientific research and restoration projects throughout the watershed.

Encompassing 8 million acres of rivers, bays, beaches, and shorelines, the Puget Sound watershed serves as an economic and cultural hub for the region's more than 4.7 million people, including 19 federally recognized tribes.

To learn more about EPA's work to protect Puget Sound, visit https://www.epa.gov/puget-sound. Find more information and project photos at https://pugetsoundinnovationstories.blog/. More information about EPA's National Estuary Program can be found at https://www.epa.gov/nep.

For additional information, contact Bill Dunbar at dunbar.bill@epa.gov or 206-553-1019.

Source: https://www.epa.gov/newsreleases/epa-announces-funding-puget-sound-protection-conservation-recovery

EPA Environmental Education Grants Help Students and Teachers Protect Local Watersheds in Idaho, Oregon, and Washington

On November 6, 2017, EPA awarded environmental education grants, which included two Pacific Northwest entities working on fish- and shellfish-related efforts. The grant-funded projects support partnerships among schools and universities, state and federal agencies, watershed councils, private landowners, and public utilities.

EPA environmental education grants were awarded to:

Western Oregon University in Monmouth, Oregon, received $91,000 to expand its salmon life cycle curriculum, 'Fish Eggs to Fry', into a professional workshop for elementary school educators. It explores the connections among the salmon life cycle, healthy fish, and healthy watersheds. In partnership with the Oregon Department of Fish and Wildlife, up to 50 third grade teachers and up to eight partner schools will use this revised curriculum inside and outside the classroom.

Hood Canal Salmon Enhancement Group in Belfair, Washington, received $91,000 to engage low-income and tribal students in watershed restoration through hands-on learning in the classroom. At summer camp and in after-school programs, students will be engaged in programs like Salmon in the Classroom, Enviro Camp, Green STREAM Camp, and Students in the Watershed curriculum and outdoor environmental education. The project will help provide students with the knowledge and skills needed to protect their environment and the Hood Canal watershed.

For more information on EPA's environmental education grants program visit http://www2.epa.gov/education/environmental-education-ee-grants.

For more information about these projects or the grant program, contact Suzanne Skadowski at skadowski.suzanne@epa.gov or 206-553-2160.

Source: https://www.epa.gov/newsreleases/epa-environmental-education-grants-help-students-and-teachers-protect-local-watersheds

Recent Publications

Journal Articles

The list below provides a selection of research articles focusing on the Pacific Northwest.

- Recreational demand for shellfish harvesting under environmental closures
  Anderson, L.E. and M.L. Plummer. 2017. Recreational demand for shellfish harvesting under environmental closures. *Marine Resource Economics* 32(1):43-57.

- Alteration of thyroid hormone concentrations in juvenile Chinook salmon (*Oncorhynchus tshawytscha*) exposed to polybrominated diphenyl ethers, BDE-47 and BDE-99
  Arkoosh, M.R., A.L. Van Gaest, S.A. Strickland, G.P. Hutcinson, A.B. Krupkin, and J.P Dietrich. 2017. Alteration of thyroid hormone concentrations in juvenile Chinook salmon (Oncorhynchus tshawytscha) exposed to polybrominated biphenyl ethers, BDE-47 and BDE-99. *Chemosphere* 171:1-8.

- Selenium: Mercury molar ratios in freshwater fish in the Columbia River Basin: Potential applications for specific fish consumption advisories
  Cusack, L.K., et al. 2016. Selenium: Mercury molar ratios in freshwater fish in the Columbia River Basin: Potential applications for specific fish consumption advisories. *Biological Trace Element Research* 178(1): 136-146.

- Mining-related selenium contamination in Alaska, and the state of current knowledge
  Khamkhash, V. Srivastava, T. Ghosh, G. Akdogan, R. Ganguli, and S. Aggarwal. 2017. Mining-related selenium contamination in Alaska, and the state of current knowledge. *Minerals* 7(3):46.

- High mercury bioaccumulation in Pacific salmons from the Sea of Okhotsk and the Bering Sea
  Khristoforova, N.K., V.Y. Tsygankov, O.N. Lukyanova, and M.D. Boyarova. 2018. High mercury bioaccumulation in Pacific salmons from the Sea of Okhotsk and the Bering Sea. *Environmental Chemistry Letters*:1-5.

- Determining potential adverse effects in marine fish exposed to pharmaceuticals and personal care products with the fish plasma model and whole-body tissue concentrations
  Meador, J.P., A. Yeh, and E.P. Gallagher. 2017. Determining potential adverse effects in marine fish exposed to pharmaceuticals and personal care products with the fish plasma model and whole-body tissue concentrations. *Environmental Pollution* 230:1018-1029.

- Bioenergetics models to estimate numbers of larval lampreys consumed by smallmouth bass in Elk Creek, Oregon
  Shultz, L.D., et al. 2017. Bioenergetics models to estimate numbers of larval lampreys consumed by smallmouth bass in Elk Creek, Oregon. *North American Journal of Fisheries Management* 37(4):714-723.

- Exploring the use of environmental DNA to determine the species of salmon redds
  Strobel, B., et al. 2017. Exploring the use of environmental DNA to determine the species of salmon redds. *North American Journal of Fisheries Management* 37(5):943-950.

- Variability in metagenomic samples from the Puget Sound: Relationship to temporal and anthropogenic impacts
  Wallace, J., J.E. Youngblood, J.A. Port, A.C. Cullen, M.N. Smith, T. Workman, and E.M. Faustman. 2018. Variability in metagenomic samples from the Puget Sound: Relationship to temporal and anthropogenic impacts. *PloS One* 13(2):e0192412.

- Evaluating signals of oil spill impacts, climate, and species interactions in Pacific herring and Pacific salmon populations in Prince William Sound and Copper River, Alaska
  Ward, E.J., M. Adkison, J. Couture, S.C. Dressel, M.A. Litzow, S. Moffitt, T.H. Neher, J. Trochta, and R. Brenner. 2017. Evaluating signals of oil spill impacts, climate, and species interaction in Pacific herring and Pacific salmon populations in Prince William Sound and Copper River, Alaska. *PLoS One* 12(3):e0172898.

- Time trends of persistent organic pollutants in benthic and pelagic indicator fishes from Puget Sound, Washington, USA
  West, J.E., S.M. O'Neill, and G.M. Ylitalo. 2017. Time trends of persistent organic pollutants in benthic and pelagic indicator fishes from Puget Sound, Washington, USA. *Archives of Environmental Contamination and Toxicology* 73(2):201-229.

Upcoming Meetings and Conferences

International Association for Great Lakes Research 2018 Conference
June 18-22, 2018
Toronto, Ontario

72nd Annual PCSGA Shellfish Conference and Tradeshow
October 14-18, 2018
Blaine, WA

Fish Passage 2018 – International Conference on River Connectivity
December 10-14, 2018
Albury, New South Wales, Australia

148th Annual Meeting of the American Fisheries Society - Communicating the Science of Fisheries to Diverse Audiences
August 19-23, 2018
Atlantic City, New Jersey

Organization of Fish and Wildlife Information Managers Annual Conference and Business Meeting
November 4-8, 2018
Hood River, Oregon

Additional Information

This monthly newsletter highlights current information about fish and shellfish.

For more information about specific advisories within the state, territory, or tribe, contact the appropriate state agency listed on EPA's National Listing of Fish Advisories website at https://fishadvisoryonline.epa.gov/Contacts.aspx.

For more information about this newsletter, contact Sharon Frey (Frey.Sharon@epa.gov, 202-566-1480).

Additional information about advisories and fish and shellfish consumption can be found at https://www.epa.gov/fish-tech.