

# University of Washington Superfund Research Program

## *Effects-Related Biomarkers of Environmental Neurotoxic Exposures*



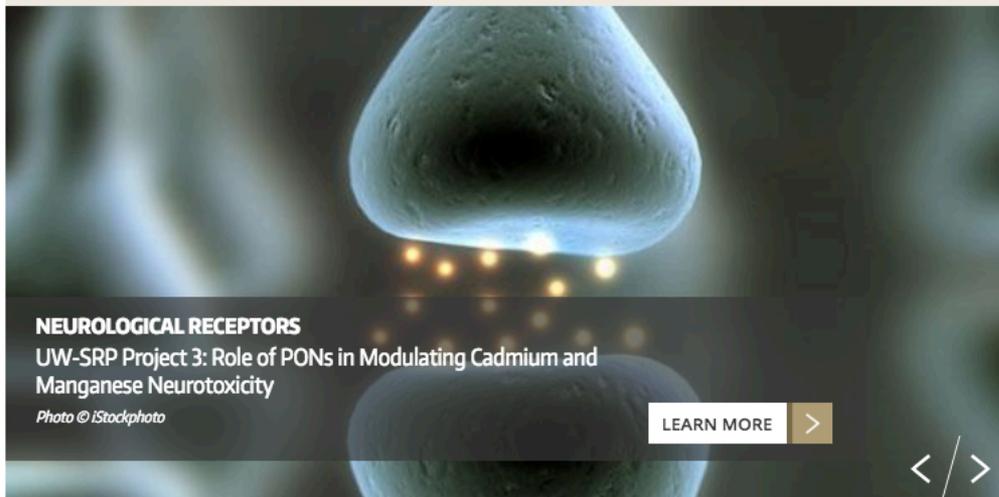
*PI, Evan P. Gallagher*



*Co-PI, Zhengui Xia*

Department of Environmental and Occupational Health Sciences  
School of Public Health

# SUPERFUND RESEARCH PROGRAM



## NEUROLOGICAL RECEPTORS

UW-SRP Project 3: Role of PONs in Modulating Cadmium and Manganese Neurotoxicity

*Photo © iStockphoto*

[LEARN MORE](#) >



Investigating the neurotoxic effects of metals commonly found at Superfund hazardous waste sites on human and ecological health.

## OVERVIEW

The University of Washington Superfund Research Program is an interdisciplinary program that conducts and communicates research on the impacts of metal neurotoxicity on human and ecological health. Our research focuses upon metals that commonly occur at Superfund hazardous waste sites for which there are important data gaps impeding the full understanding of their neurotoxic effects on human and ecological health. The physiological processes we study include adverse effects on cognition, olfaction and neurobehavioral processes, and are associated with the risk of developing Alzheimer's and non-Alzheimer's related dementia, Parkinson's disease, and other neurodevelopmental diseases.

[> READ MORE](#)

## LATEST NEWS

**Gallagher Lab discusses loss of olfaction in fish on King 5 News**  
August 16, 2018

**UW SRP hosts BRANCH and SURE-EH students for campus visit**  
July 20, 2018

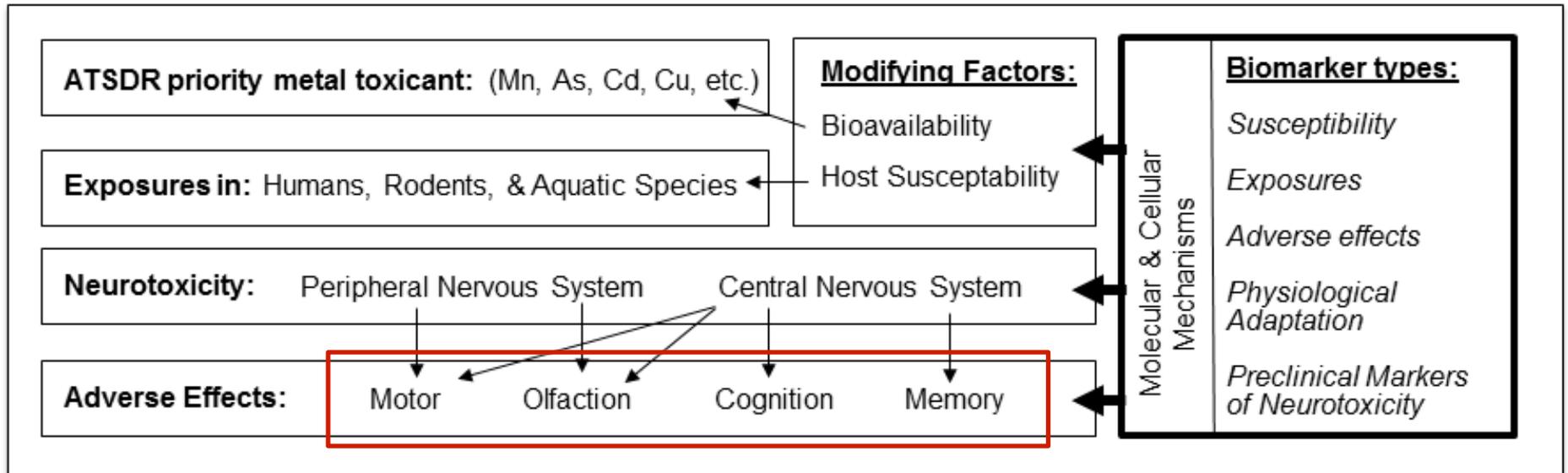
**Dr. Xia presents to leading Alzheimer's researchers on the role of gene-environment interactions on cognitive impairment in mice**  
June 6, 2018

**Cadmium found to impair cognition and olfaction in mice**  
May 23, 2018

**UW SPR hosts the 14th Summit of the Northwest Toxic Communities Coalition**  
May 8, 2018

[> ALL NEWS](#)

# Conceptual model : UW Superfund research program



# Our Research Projects

Mechanisms and Biomarkers of  
Metal Olfactory Injury in Salmon

*PI, Evan Gallagher, PhD. (collaborators, Zia, Storm)*



Cellular and Molecular Mechanisms of  
Cadmium Neurotoxicity

*PI, Zhengui Xia, PhD. (collaborators Gallagher, Storm)*

Role of Paraoxonases in Modulating  
Cadmium and Manganese Neurotoxicity

*PI, Clement Furlong, PhD. Co-PI-Lucio Costa*



Arsenic in Shallow, Un-stratified and Seasonally  
Stratified Urban Lakes: Mobility, Bioaccumulation and  
Ecological Toxicity *PI, Rebecca Neumann, PhD.*

*(collaborators Gawel, Olden, Horner-Devine, Gallagher)*

# UW SRP Support Cores



Functional Genomics  
and Bioinformatics Core

*Director, Theo Bammler, Ph.D.*

Research Translation and  
Community Engagement Cores

*Director, Tom Burbacher*

*(L. Hayward, Ph.D., Communications manager)*



Administrative and Training Cores

*Director, Evan Gallagher, Ph.D.*

*(Euzy, Program Manager)*

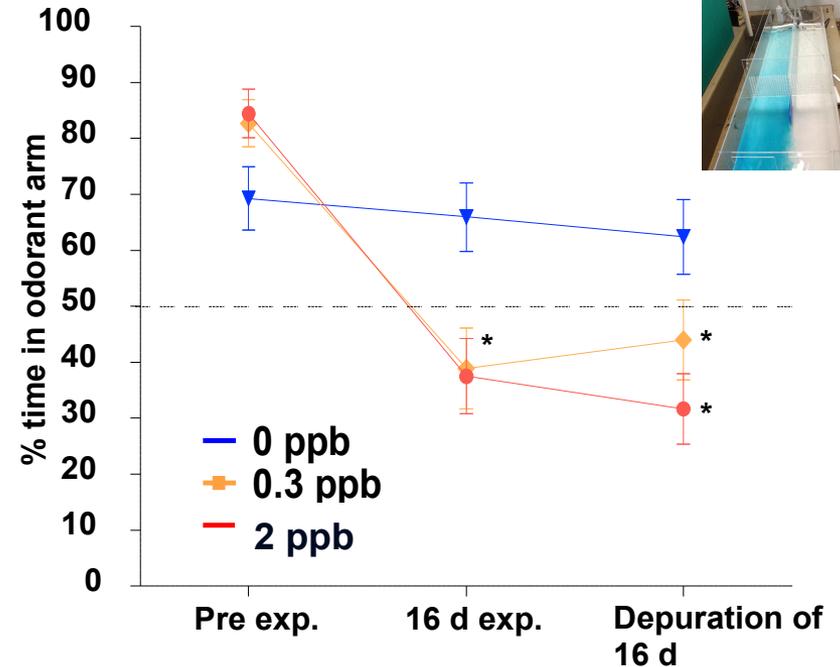
# UW SRP investigators



# Project 1-Mechanisms of olfactory injury: Effect of environmental levels of Cd on salmon neurobehavior



Effect of Cd on time spent in con-specific odorant arm of a Y-maze



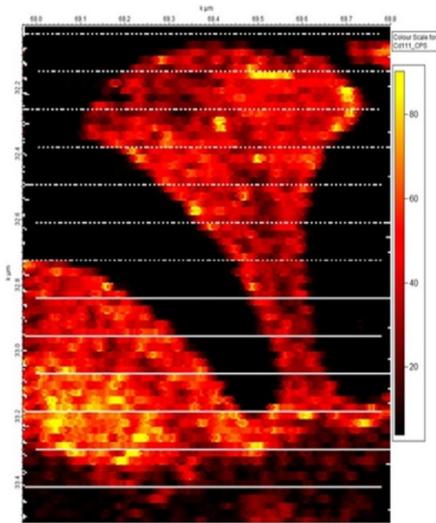
*Toxicological Sciences 2016*

# LA-ICP-MS shows that Cd rapidly accumulates and persists in the salmon olfactory epithelium

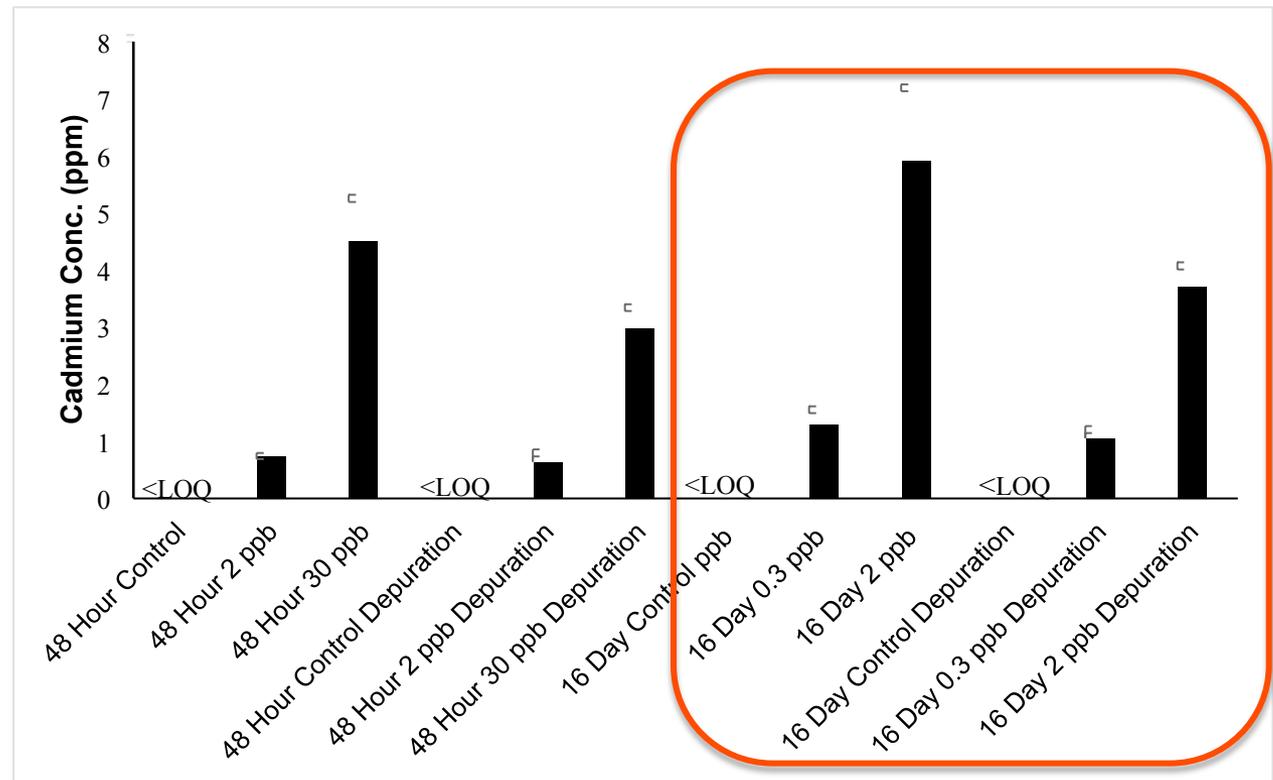
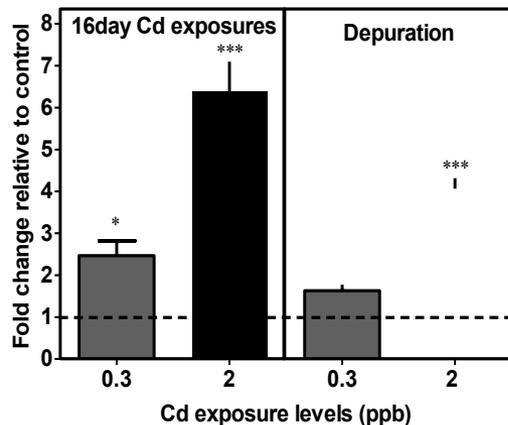
Cadmium Exposure Differentially Alters Odorant-Driven Behaviors and Expression of Olfactory Receptors in Juvenile Coho Salmon (*Oncorhynchus kisutch*)

Chase R. Williams, James W. MacDonald, Theo K. Bammler, Michael H. Paulsen, Christopher D. Simpson, and Evan P. Gallagher<sup>1</sup>

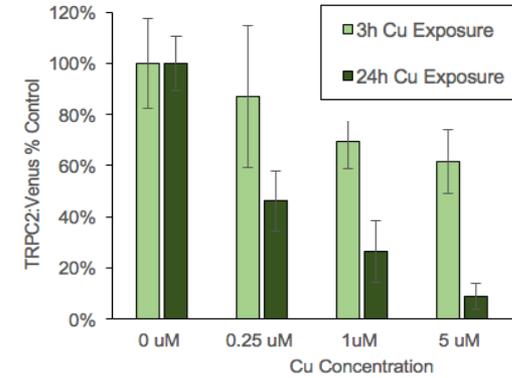
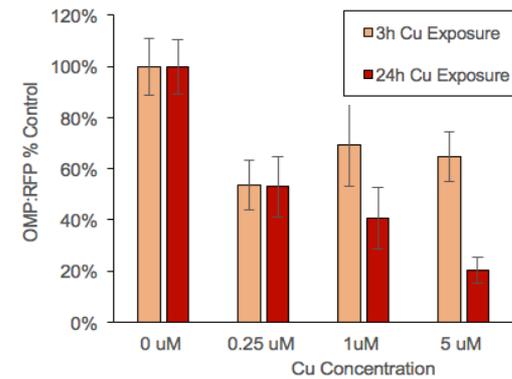
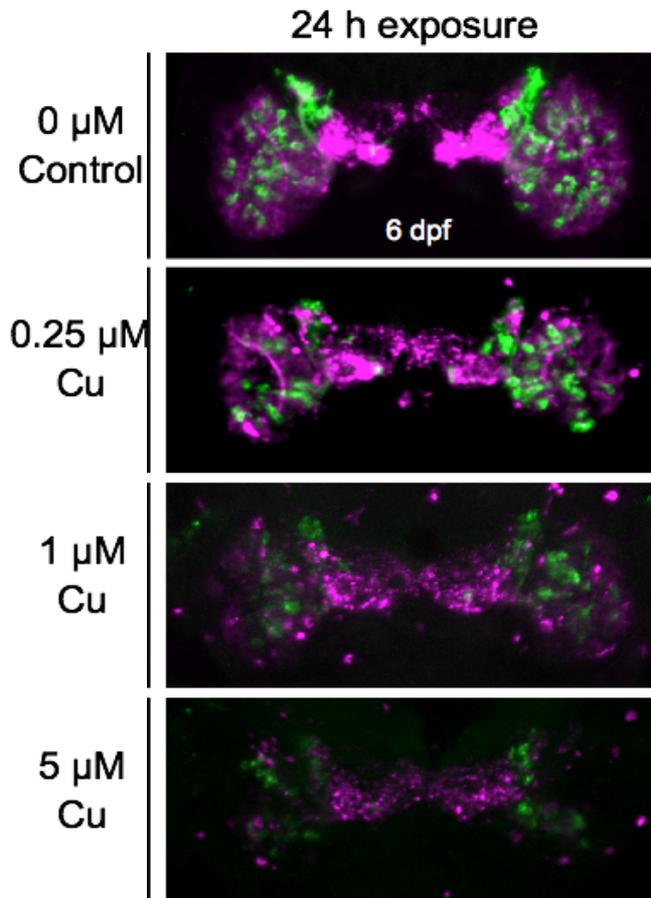
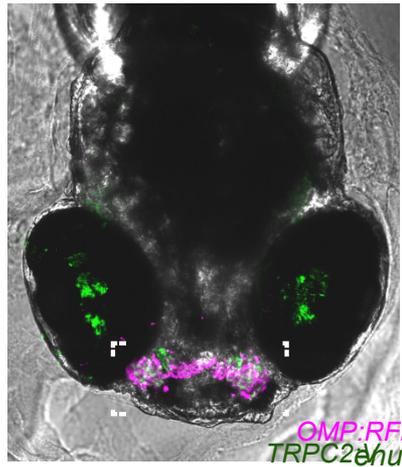
Department of Environmental and Occupational Health Sciences, University of Washington, Seattle, Washington 98105



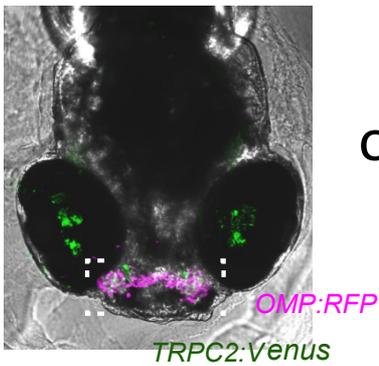
*mt1a*



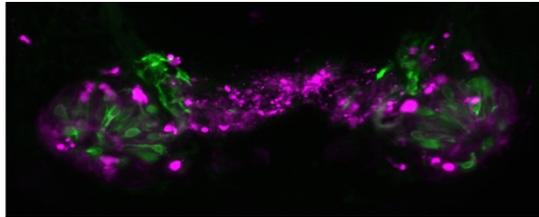
# Project 1. Copper injury to zebrafish OSNs is dose-dependent and targets both ciliated and microvillous OSNs



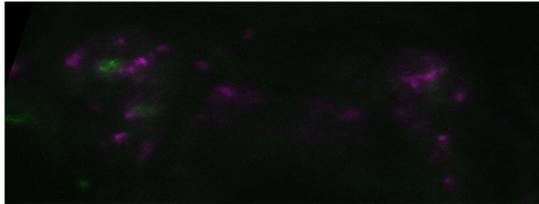
# Project 1. Using zebrafish transgenics we see that olfactory cell proliferation increases after injury from Copper and leads to recovery of olfaction



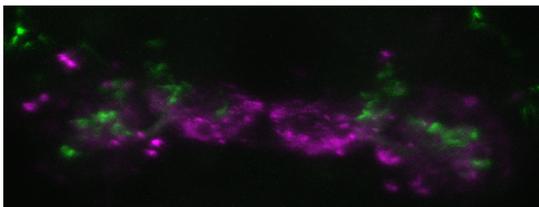
0 uM (6 dpf)



10 uM Cu 24 h (6 dpf)

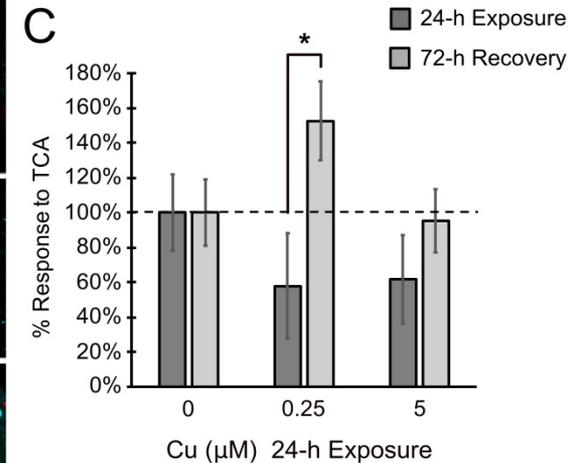
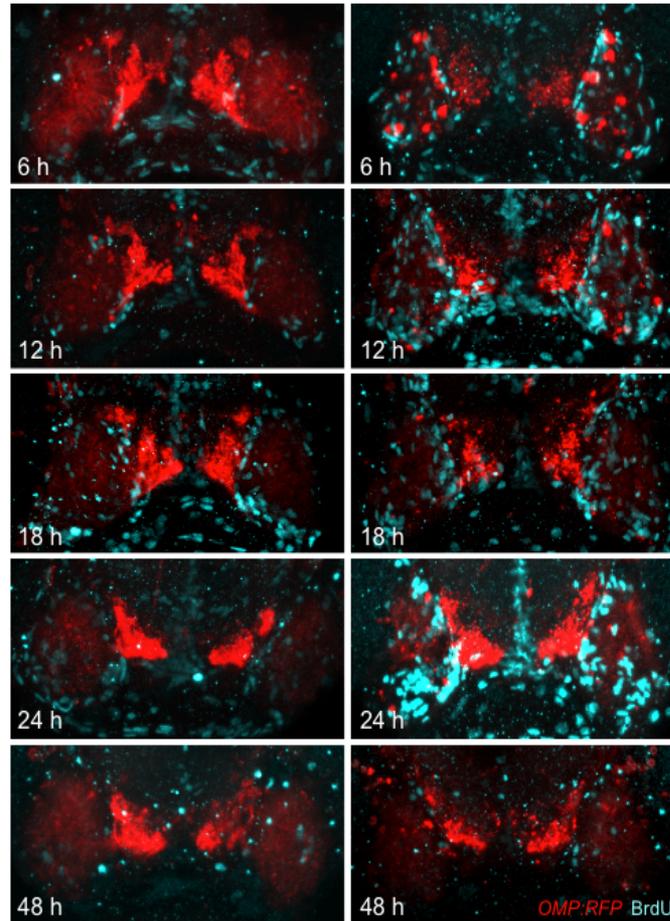


10 uM Cu for 24 h and  
24 hr recovery (7 dpf)



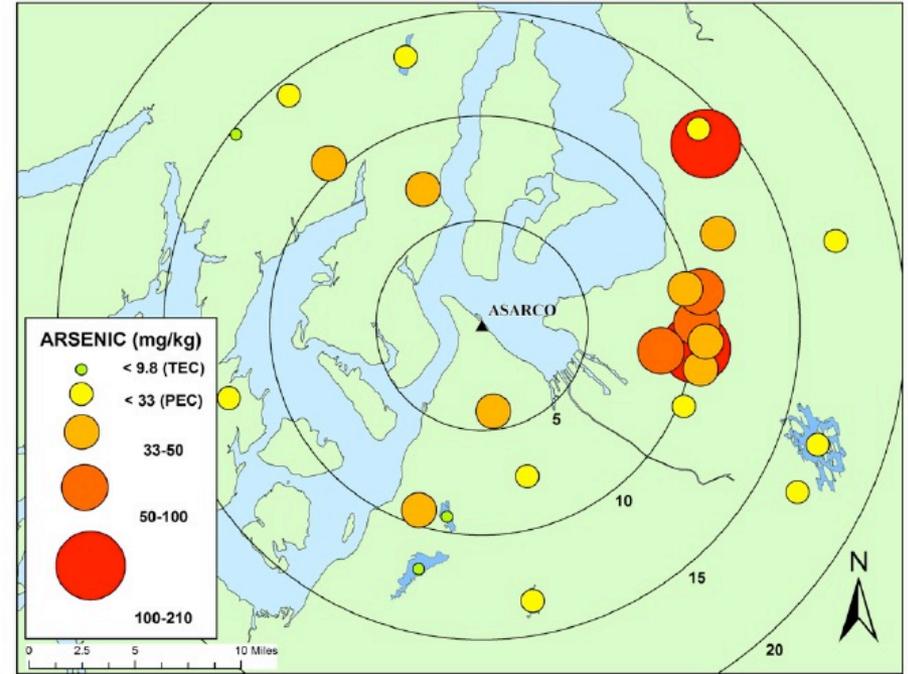
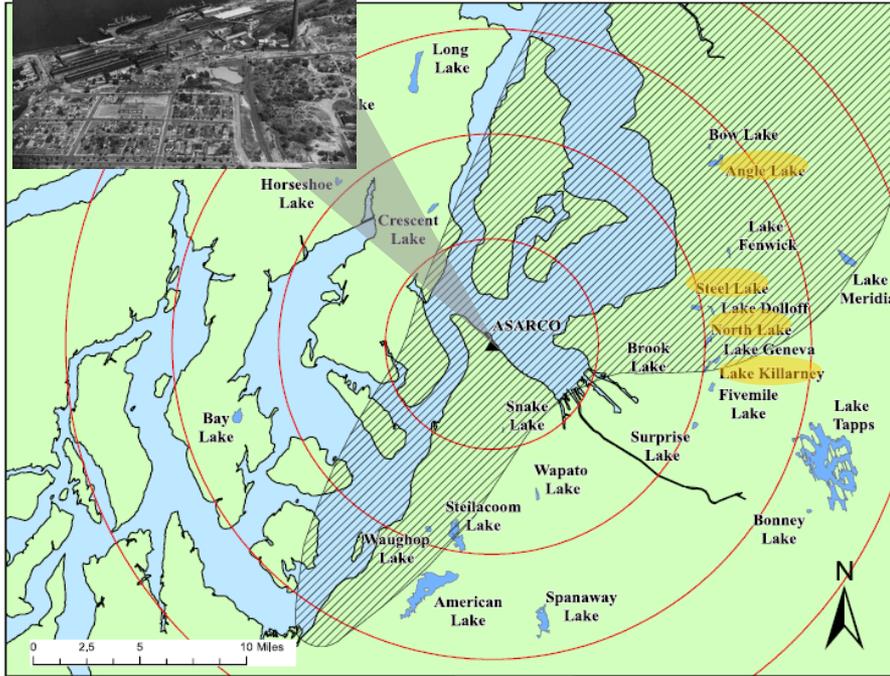
0  $\mu$ M Cu (Control)

5  $\mu$ M Cu (3 h)



BrdU labeling in OMP-RFP transgenics

# ASARCO smelter, Ruston, WA 1890–1986

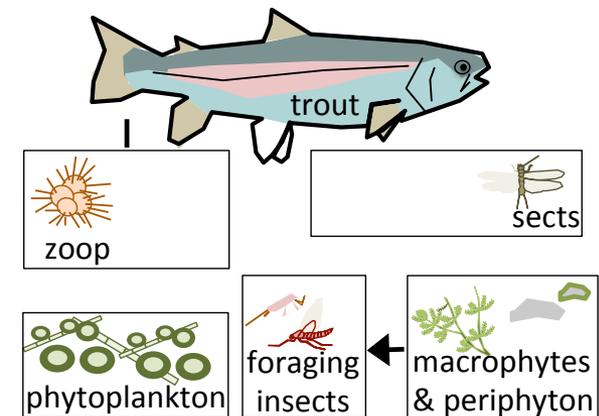
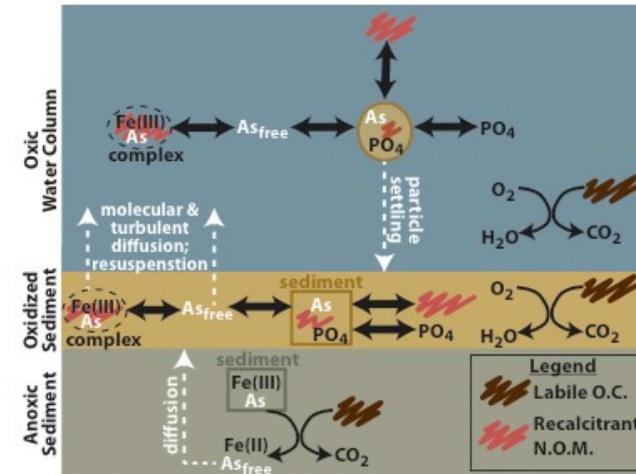


Gawel et al., 2014

Study lake	surface sediment (mg As/kg)	max depth (m)	seasonal stratification
Angle Lake	208	5.8	yes
Lake Killarney	206	4.5	weak/no
North Lake	85	9.0	yes
Steel Lake	48	7.6	weak/no

# Specific Aims for Project 4

1. Identify physical and biogeochemical lake attributes that promote arsenic mobilization from sediments and maintain elevated aqueous concentrations of arsenic in unstratified oxic lakes
2. Determine the physical and biogeochemical factors that control arsenic bioaccumulation through aquatic food webs in both seasonally stratified and unstratified lakes.
3. Assess ecological toxicity of arsenic at different trophic levels within both seasonally stratified and unstratified lakes using established and novel molecular biomarkers that indicate arsenic stress and injury.



# Research Translation Core

Lisa Hayward (Manager)

SRP RTC and NIEHS Center (EDGE)  
CEC

Ph.D. in Environmental Endocrinology

Post-Doctoral work in Conservation Biology

Science and Technology Policy Fellowship with AAAS

Managed Communications for the Department of Interior's  
Northwest Climate Science Center

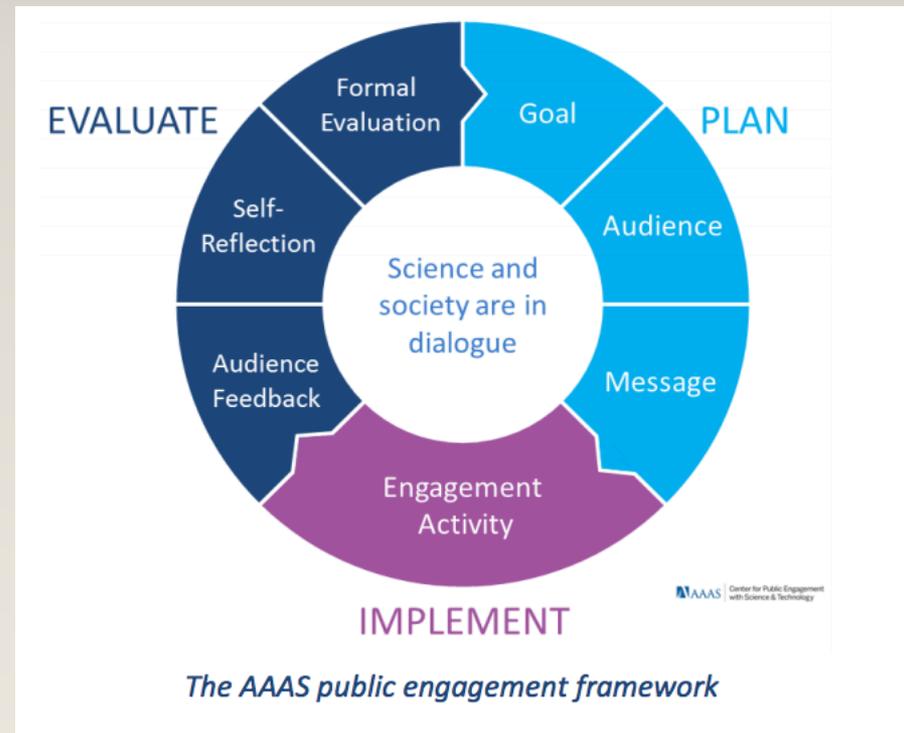


# CREATING INDIVIDUALIZED RESEARCH TRANSLATION PLANS FOR EACH PROJECT

## AAAS Public Engagement Plan Template

Goals, near-term, mid-term, long-term

- **Information sheets for Policy Makers**
- **Continuing Education Classes for Medical Practitioners**
- **Engagement with Local Regulatory Agencies and Lake Association Members**
- **Presentations for Groups such as National Parkinson's Foundation and Partner's in Parkinson's**



# Research Translation Core (RTC)

## RTC Material

**W** UNIVERSITY of WASHINGTON  
Superfund Research Program

Welcome to the University of Washington's  
Superfund Research Program (UW SRP) September  
2017 e-Bulletin!

We offer a few snapshots highlighting some of our program's recent work, as well as providing links to interesting upcoming talks and events. Our Principal Investigator, Dr. Evan Gallagher, and Research Translation and Community Engagement Core Director, Dr. Tom Burbacher, invite you to please read and enjoy the stories that catch your eye.

## E-Bulletin

UW SRP Retweeted

**UW Public Health @uwsph**  
@UWDEOHS's Lucio Costa receives @NIEHS grant to study the links between traffic-related #airpollution and #autism [ow.ly/5sfP30fZTKl](http://ow.ly/5sfP30fZTKl)



Oct 23, 2017

## Tweets

## To the Point

UW-SRP\* Research Snapshots



A fish lives each day by successfully avoiding its predators and by finding food. What can fish, like the Pacific salmon, tell us about the challenges of survival these days? Research scientist, **Evan Gallagher**, looks at olfaction (sense of smell) in fish to answer that question. It is here, with signals from the nervous system, that a fish detects predators and returns to native streams for reproduction. Certain metals and chemicals in our waterways can have harmful impacts on fish olfaction, affecting essential survival skills. Exposure to metals such as copper and cadmium have an adverse effect on survival behaviors such as schooling and the recognition and avoidance of predators.

Dr. Gallagher's research focuses on trace metals found in fish. The decline in salmon populations in the Western United States has been linked to the deterioration of coastal habitat and the contamination of surface water. Greater understanding of these exposures may be integral to fish survival, ecosystem sustainability and to human health through fish consumption.

**What are neurotoxicants?**  
Neurotoxicants include heavy metals, metalloids and chemical compounds that can cause damage to the central nervous system in humans and other animals. Dr. Gallagher's research focuses on copper and cadmium (heavy metals) that enter the aquatic environment.

**How do neurotoxicants enter the environment?**  
Most often these contaminants are products of manufacturing and industrial waste, they can also be found in brake pads or as a component of vehicle exhaust, entering regional waterways as roadway runoff. Tobacco smoke also contains cadmium. Exposure to cadmium and copper may happen by contact with contaminated soil, contact with contaminated water and by inhaling contaminated air particles.

**What does this research have to do with Superfund site hazardous chemicals?**  
Dr. Gallagher's research will include sampling in the Lower Duwamish Waterway Superfund site in Seattle, Washington. The Superfund is a federal program that was established to clean up the nation's priority hazardous wastesites. A list of the most harmful chemicals has been established by the Agency for Toxic Substances and Disease Registry (ATSDR). The Gallagher laboratory studies exposure to copper and cadmium, both identified on the ATSDR list.

**What is already being done to protect the environment?**  
In 2010, Washington State passed a law reducing the use of toxic material in automotive brake pads and shoes. In 2015, use of several heavy metals and asbestos was restricted, along with the phasing out of the use of copper. Dr. Gallagher's research helped inform these state and federal regulatory policies. To learn more about the laws that protect our health see the Toxic Substance Control Act link below.

**Linked resources for further information:**  
University of Washington Superfund Research Program: <http://depts.washington.edu/sfund/>  
NIEHS Superfund Research Program: <http://www.niehs.nih.gov/research/supported/srp/index.cfm>  
ATSDR ToxFAs™: <http://www.atsdr.cdc.gov/substances/toxchemallisting.asp?sysid=39>  
EPA Superfund sites information: <http://www.epa.gov/superfund/sites>  
EPA summary of the Toxic Substances Control Act: <http://www.epa.gov/lawsregs/laws/tcsa.html>

University of Washington Superfund Research Program

## To-the-Point Fact Sheets

# Research Translation Core (RTC)

## RTC Engagement



DEPARTMENT OF ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES  
UNIVERSITY of WASHINGTON - SCHOOL OF PUBLIC HEALTH

### GRAND ROUNDS TRAINING

*Save the Date: January 23, 2018*  
*12pm – 1pm*

**Pediatric Lead Exposure: Diagnosis, Management & Prevention**  
Shoshone Medical Center Outreach Center  
Pinehurst, Idaho

#### COURSE PROGRAM INCLUDES:

**Pediatric Lead Exposure: Diagnosis, Management and Prevention**  
Ada Otter, DNP, ARNP, NW PEHSU (video presentation)

**Overview and History of the Silver Valley Bunker Hill Superfund Site**  
Andy Helkey, Panhandle Health District (video presentation)

**Live Q&A teleconference with NW PEHSU Director**  
Catherine Karr MD, PhD

*Credits available- no fee: CME, CNE, CEHC and CEU*  
*Lunch Provided- details to follow*

Sponsored by:  
University of Washington  
Northwest Pediatric Environmental Health Specialty Unit &  
Superfund Research Program

## Continuing Education



**Tuesday, APR 11 6:30 PM**



**Arsenic & Old Lakes  
with  
Dr. Jim Gawel  
at  
the Swiss**



@sias\_uwt @SwissPub  
#GritCityDrinkThink



<http://www.tacoma.uw.edu/sias/drinkthink>

APR  
11

### Grit City Think N Drink - Arsenic and Old Lakes

Public · Hosted by School of IAS at UW Tacoma and  
Sciences and Mathematics - SAM in the School of IAS at UW  
Tacoma

## Pub Talk

## Lower Duwamish Boat Tours

# Educating Next Generation of Community Leaders



**CAMPUS VISIT FOR BRIDGE (CDC) and SURE-EH (NSF) STUDENTS**

## Duwamish Valley Youth Corps

Conduct tours of SRP labs with investigators and trainees

Meet with Office Minority Affairs

–Education Ambassadors

Career Day



# Community Engagement Core (CEC)

## Goal

The primary goal of the CEC is to work with community stakeholders and federal, state and local agencies to develop intervention strategies to reduce community exposures to hazardous substances in order to improve public health

# Specific Aim 1

Work with community organizations and federal, state and local agencies to develop intervention strategies to reduce exposure to fish contaminants at the Lower Duwamish Waterway (LDW) Superfund Site in Western Washington.



Katie Frevert, CEC Manager  
at Duwamish River Festival



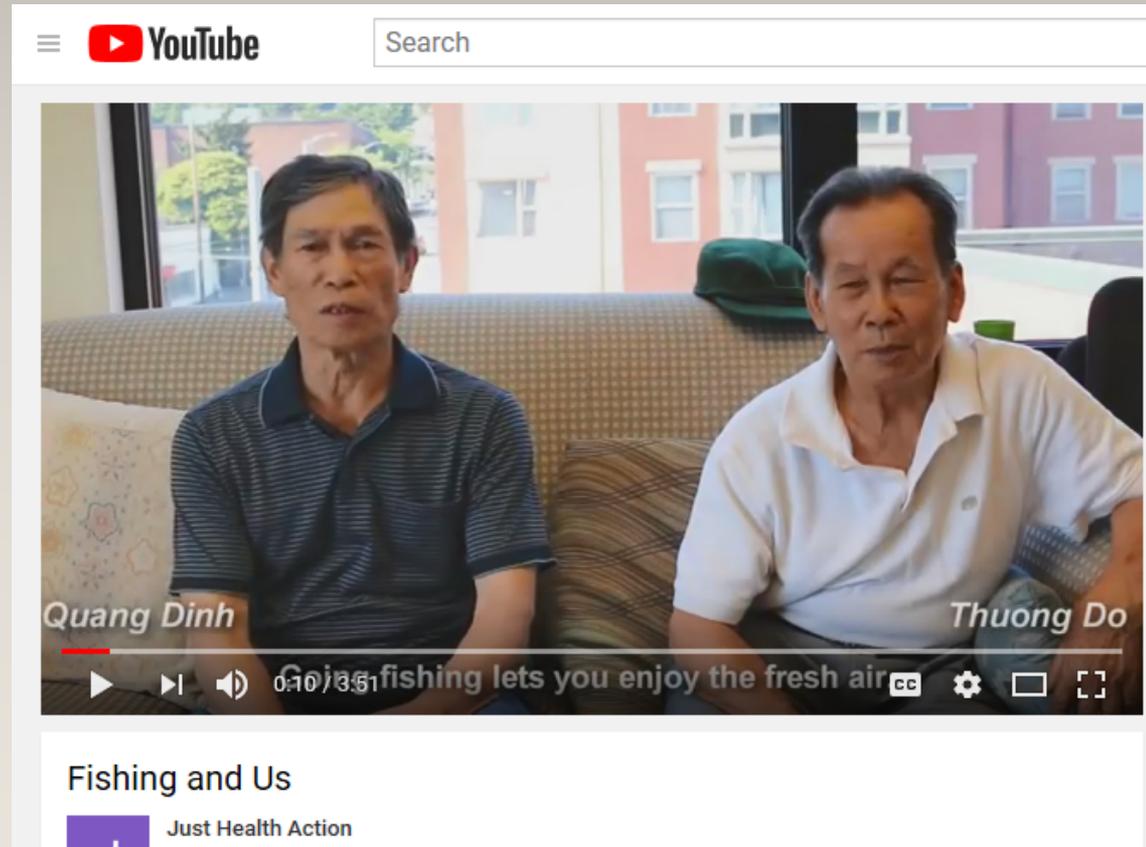
Institutional Controls  
Fish Advisories



Community Health Advocates  
meeting with Fish & Wildlife  
staff

# Community Advocates for Safe Fishing

Collaborating with nonprofit organization Just Health Action led by Linn Gould, MPH FishNet webinar, Using a Community-Based Process to Promote Healthy Fish Consumption within the Lower Duwamish Waterway Superfund Site.



Vietnamese fishers in Seattle share a story about the importance of fishing as a cultural practice, as well as information to the community around the contamination and clean up of the Lower Duwamish River.

<https://www.youtube.com/watch?v=NDmkoBJpKYU>

# Simplifying Fishing Rules and Regulations

## Working with Washington State Department of Fish and Wildlife

### Key Fishing Rules for Elliott Bay, Green (Duwamish) River

**Cardinal Rules:**  
 A Washington State fishing license is required for law to fish in a license. Fishing for U.S. citizens in a licensed license and without a license is a significant offense and will result in a significant fine and/or jail. A fishing license is required for anyone 16 years of age or older.  
 • A Washington State fishing license is required for anyone 16 years of age or older.  
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**Catch Record Card:**  
 What is a Catch Record Card and why do I need one?  
 • The Catch Record Card is the main tool of the Washington Department of Fish and Wildlife to track whether important fish species are over or under harvested.  
 • The Catch Record Card is used to track and record the catch of important fish species in the Puget Sound, Elliott Bay, and Duwamish River.  
 • All fishers are required to fill out a Catch Record Card for every fish they catch and keep it for 30 days after the catch.  
 • A Catch Record Card is a legal document and it is a crime to make, alter or destroy a Catch Record Card.  
 • It is a crime to make, alter or destroy a Catch Record Card.

**Other Rules:**  
 Catch Limit/Fish Size: Fishermen are allowed to catch a certain number of fish of a certain size. Fishermen are allowed to catch a certain number of fish of a certain size. Fishermen are allowed to catch a certain number of fish of a certain size.  
 Gear Rules, Anti-Snagging Rules: Fishermen are allowed to use certain types of gear. Fishermen are allowed to use certain types of gear. Fishermen are allowed to use certain types of gear.  
 Bait: Fishermen are allowed to use certain types of bait. Fishermen are allowed to use certain types of bait. Fishermen are allowed to use certain types of bait.  
 Emergency Rules: Fishermen are allowed to use certain types of emergency rules. Fishermen are allowed to use certain types of emergency rules. Fishermen are allowed to use certain types of emergency rules.  
 Superfund Site: Fishermen are allowed to use certain types of superfund sites. Fishermen are allowed to use certain types of superfund sites. Fishermen are allowed to use certain types of superfund sites.

**Contact Information:**  
 The Washington Department of Fish and Wildlife  
 1600 North Ring Road  
 Everett, WA 98201  
 Phone: 425-353-2222  
 Fax: 425-353-2222  
 Website: [www.wa.gov](http://www.wa.gov)

### Luật Chủ Yếu Khi Câu Cá Tại Elliott Bay, Sông Xanh (Duwamish)

**Luật Căn Bản:**  
 Mọi người cần giấy phép câu cá để câu cá ở các vùng (phần lớn) tại cầu First Ave S Bridge hoặc gần Elliott Bay.  
 • Phải có Giấy Phép Nước Mặn để câu cá tại cầu (phần lớn) tại cầu First Ave S Bridge hoặc gần Elliott Bay.  
 • Phải có Giấy Phép Nước Ngọt để câu cá tại cầu (phần lớn) tại cầu First Ave S Bridge.  
 • Phải có sẵn Giấy Phép "Combination" để câu cá nước ngọt và nước mặn.

**The Chì Sỏi Cá Bật Được:**  
 "Thì Chì Sỏi Cá Bật Được" là gì và tại sao tôi cần nó?  
 • "Thì Chì Sỏi Cá Bật Được" là phương tiện chính của Bộ Ngự Nghiệp và Động Vật Hoang Dã Tiểu Bang Washington, để theo dõi các thông tin quan trọng về hệ thống hồ cá và môi trường sống.  
 • "Thì Chì Sỏi Cá Bật Được" phải để trong minh của bạn và ghi vào ngày khi bắt được cá: Starurgeon, Steelhead, Salmon, Halibut và Puget Sound Dungeness Crab.  
 • Mọi người câu cá bắt buộc ghi vào đây ngày bắt cá và giữ nó tại nhà trong 30 tháng 4 mỗi năm.  
 Xin vui lòng tham khảo tập sách hướng dẫn luật cá và ghi cá của Washington để biết thông tin quan trọng về Thì Chì Sỏi Cá Bật Được.  
 • Trao đổi hay buôn bán bất cứ cá nào bạn bắt được hoặc tôm của bạn là tội phạm.

**Giới Hạn Đánh Bắt và Kích Cỡ Của Cá:**  
 Mọi Người: Câu cá phải tuân theo luật cá của Tiểu Bang Washington. Mọi người câu cá phải tuân theo luật cá của Tiểu Bang Washington. Mọi người câu cá phải tuân theo luật cá của Tiểu Bang Washington.  
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**Luật Dụng Cụ, Chống Câu Giấu:**  
 Mọi Người: Mọi người câu cá phải tuân theo luật cá của Tiểu Bang Washington. Mọi người câu cá phải tuân theo luật cá của Tiểu Bang Washington. Mọi người câu cá phải tuân theo luật cá của Tiểu Bang Washington.  
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**Mỗi Cầu:**  
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**Luật Khẩn Cấp:**  
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**Địa Điểm Đánh Cá Tự Do:**  
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**Contact Information:**  
 The Washington Department of Fish and Wildlife  
 1600 North Ring Road  
 Everett, WA 98201  
 Phone: 425-353-2222  
 Fax: 425-353-2222  
 Website: [www.wa.gov](http://www.wa.gov)

### Reglas para la Pesca en Elliott Bay, Green (Duwamish) River

**Reglas Fundamentales:**  
 Es necesario una licencia de pesca de Washington para pescar en los ríos y lagos de Washington. Es necesario una licencia de pesca de Washington para pescar en los ríos y lagos de Washington. Es necesario una licencia de pesca de Washington para pescar en los ríos y lagos de Washington.  
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 • Es necesario una licencia de pesca de Washington para pescar en los ríos y lagos de Washington.  
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**La Tarjeta para Registro de Pesca:**  
 ¿Qué es una Tarjeta para Registro de Pesca?  
 La Tarjeta para Registro de Pesca es un documento que se utiliza para registrar la pesca de especies importantes que están en peligro de extinción. La Tarjeta para Registro de Pesca es un documento que se utiliza para registrar la pesca de especies importantes que están en peligro de extinción. La Tarjeta para Registro de Pesca es un documento que se utiliza para registrar la pesca de especies importantes que están en peligro de extinción.

**Reglas para equipo, reglas anti-esnagche:**  
 Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca. Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca. Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca.  
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**Reglas de emergencia:**  
 Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca. Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca. Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca.  
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**Site of "Superfund":**  
 Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca. Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca. Los pescadores deben seguir ciertas reglas cuando usan equipo de pesca.  
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**Contact Information:**  
 The Washington Department of Fish and Wildlife  
 1600 North Ring Road  
 Everett, WA 98201  
 Phone: 425-353-2222  
 Fax: 425-353-2222  
 Website: [www.wa.gov](http://www.wa.gov)

English

Vietnamese

Spanish

Maps with fishing locations and regulations

# Simplifying Fishing Rules and Regulations

## Short Educational Videos on Fishing Rules & Health

The themes for these Educational Videos include:

1. Opportunities Available to Fishers in the Duwamish
2. What Do I Need to Know Before Going Out? (Rules/ Regs/Safety/Fish Types)
3. How to Buy a Fishing License
4. What Fishing Gear Do I Need?
5. How to Land a Fish & Clean it Properly
6. Cooking Fish and Health Tips

# Community Engagement Core (CEC)

## Specific Aim 2

Build upon our previous collaborations with the Northwest Toxic Communities Coalition (NWTCC) to address hazardous waste site issues common across neighborhoods and reduce exposures to contaminants in these waste site communities.

### Northwest Toxic Communities Coalition (NWTCC)

The Northwest Toxic Communities Coalition is comprised of non-profit groups from EPA Region 10 areas which address local hazardous substances and environmental health issues. The coalition is an umbrella organization that serves as a conduit of relevant information and resources to its members.



#### What member organizations have to say about the NWTCC:

- *"There is strength in numbers"*
- *"Offers EPA Region 10 an understanding and perspective of our cause"*
- *"It's a unique exchange of ideas"*
- *"There is a willingness to help other organizations"*
- *"It offers smaller organizations a chance to, 'sit at the table'"*

# NORTHWEST TOXIC COMMUNITIES COALITION

# SUMMIT 2018

SILVER VALLEY  
COMMUNITY  
RESOURCE  
CENTER



**DIANA ROHLMAN, PhD**

*Oregon State University, College of Public Health & Human Sciences: New studies on PAH effects, community-engaged health literacy*



**DAVID CARPENTER, PhD**

*University at Albany, State University of NY, Director of U Albany's Institute for Health & the Environment: New studies on PCB effects*



**TOM FOX, MS**

*Environmental engineer and former Water Resource Manager for Seattle Public Utilities: Water use & reclaimed water*



**TODD WILDERMUTH, PhD**

*Director Environmental Law Program  
Policy Director / Regulatory  
Environmental Law and Policy Clinic  
University of Washington School of Law:  
Open topics*



**PATTY MARTIN**

*NWTCC board member, environmental activist and former mayor of Quincy, Washington. As mayor she challenged corporations that dumped toxic waste in fertilizers used in area farms: Community-based strategies.*

# NWTCC Collaborations

## Quarterly Webinars

The image is a screenshot of a webinar interface. At the top left, there is a purple circular logo with a white letter 'W'. To its right, the text 'HOW DO OUR HAZARDOUS WASTE SITE CLEANUPS COMPARE?' is displayed in blue, with 'from UW-SRP' below it. On the right side of the top bar, there are three icons: a heart, a clock, and a paper plane. The main content area shows a presentation slide titled 'A Comparison of Remediation Sites: Contaminants, primary & alternative remediation technologies, and agency interactions.' The slide is attributed to 'Dr. Peter deFur, President, Environmental Stewardship Concepts, LLC'. The slide title is in a large, bold, black font, and the subtitle is in a smaller, regular black font. The speaker's name and title are at the bottom of the slide. In the bottom right corner of the slide, there are navigation controls: a play button, a back button, a forward button, and a refresh button. Below the slide, there is a video feed window titled 'Camera and Voice (1)'. The video feed shows a man with a beard and glasses, wearing a dark suit and tie, sitting at a desk. The name 'User 1' is visible below the video feed. The entire interface is set against a dark background.

# Needs Assessment Outcomes

- Grant Writing Assistance
- Environmental Sampling