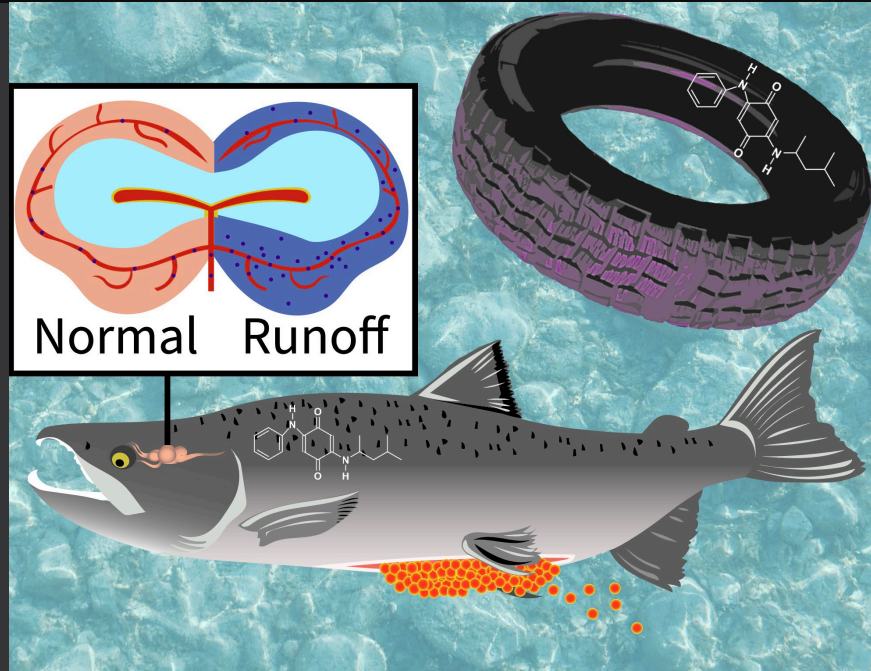


# Mechanisms of toxicity in coho urban runoff mortality syndrome (URMS)



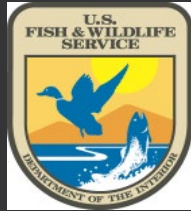
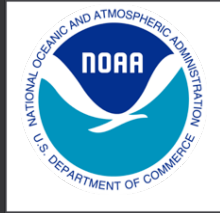
Stephanie Blair, PhD Candidate  
WSU Puyallup Research and Extension Center, Puyallup, WA



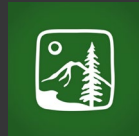
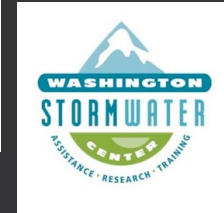
# Core Research Team



WASHINGTON STATE  
UNIVERSITY



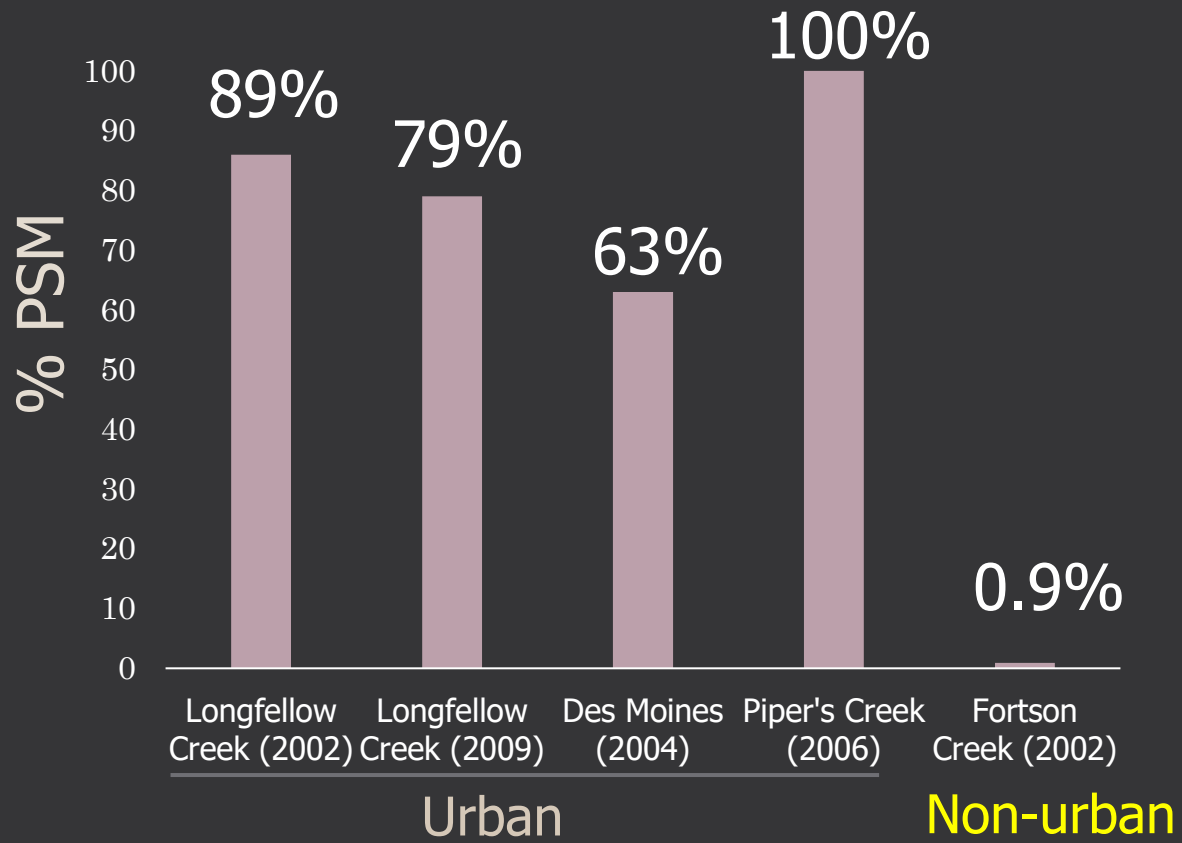
THE  
PUYALLUP TRIBE  
OF INDIANS

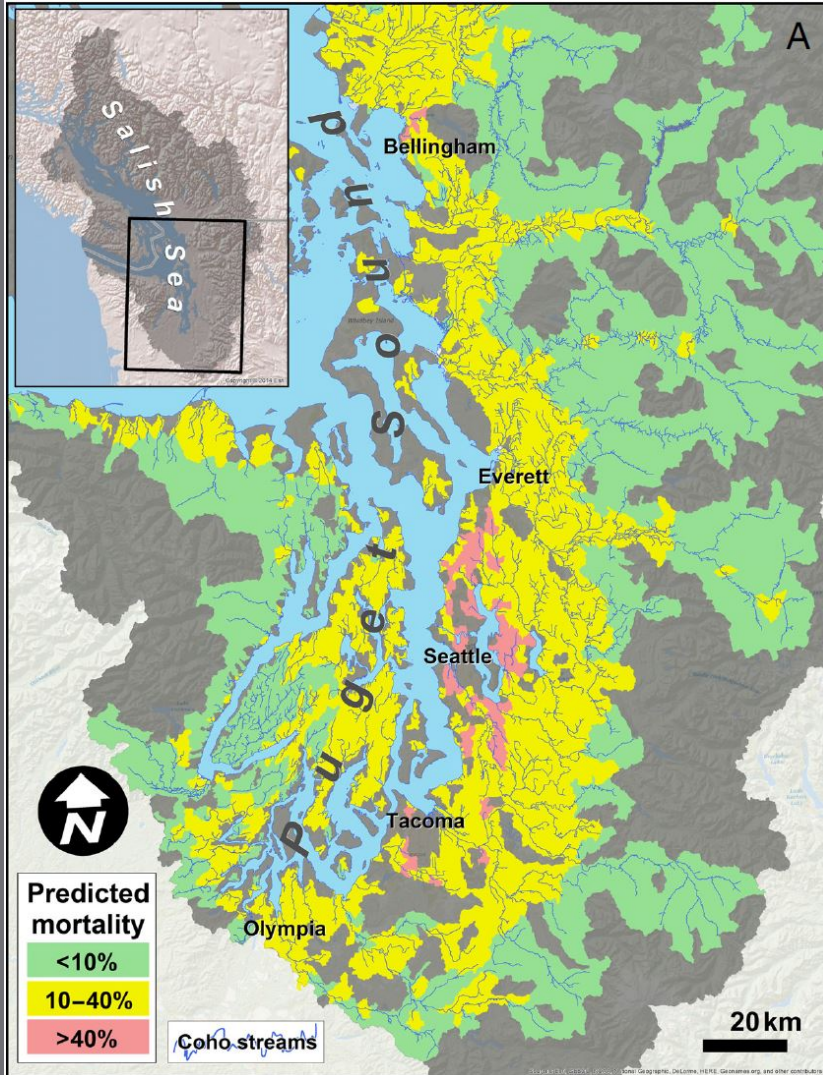


Prespawn mortality: high  
egg retention

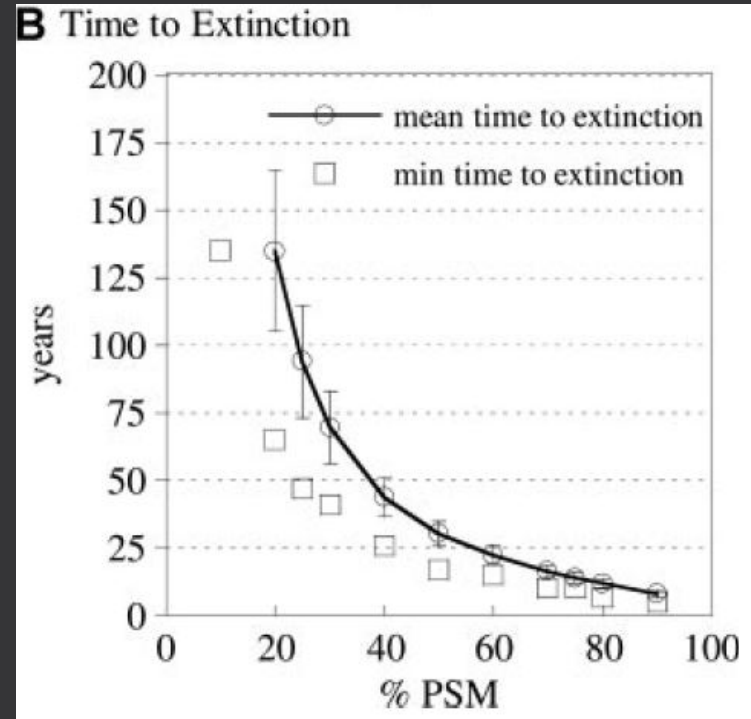


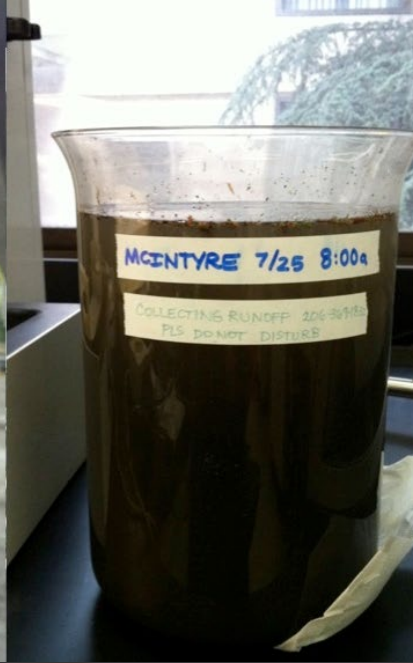
# High coho prespawn mortality (PSM) in urban areas





Coho at risk for extinction when PSM rates above 10%





Coho are an indicator for vehicle-related contaminants

# Exposing coho spawners to roadway runoff



# Bioretention treatment of stormwater prevents toxicity



Control



Runoff



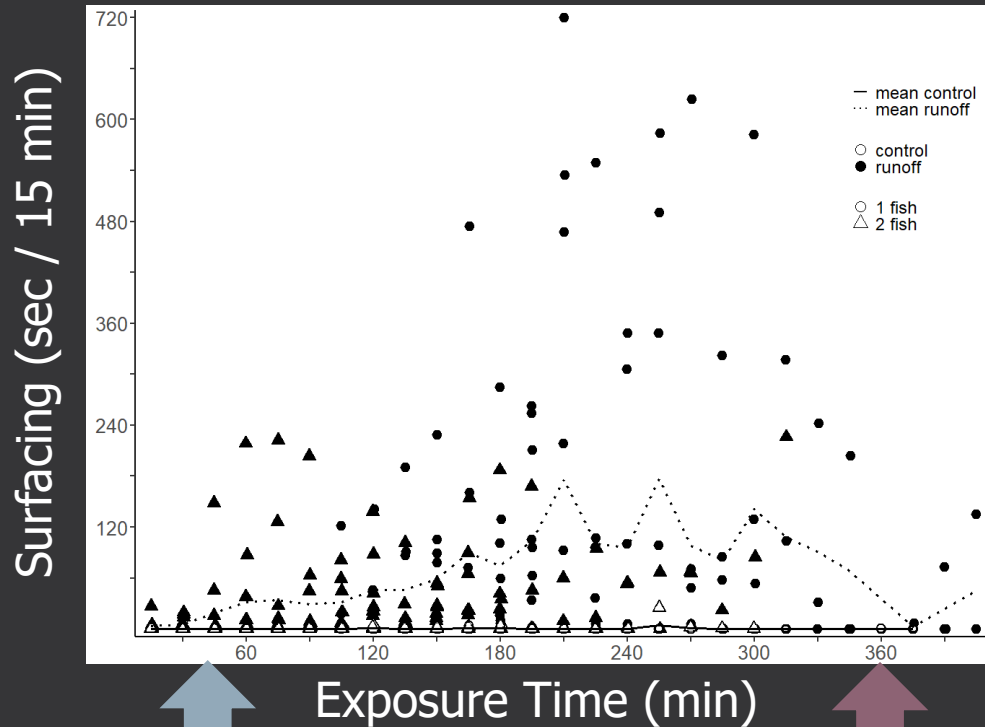
Bioretention-  
filtered runoff

*Spromberg et al. 2016. J. Applied Ecology*

Videos: <https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2664.12534>



# Juvenile and adult coho are sensitive to runoff

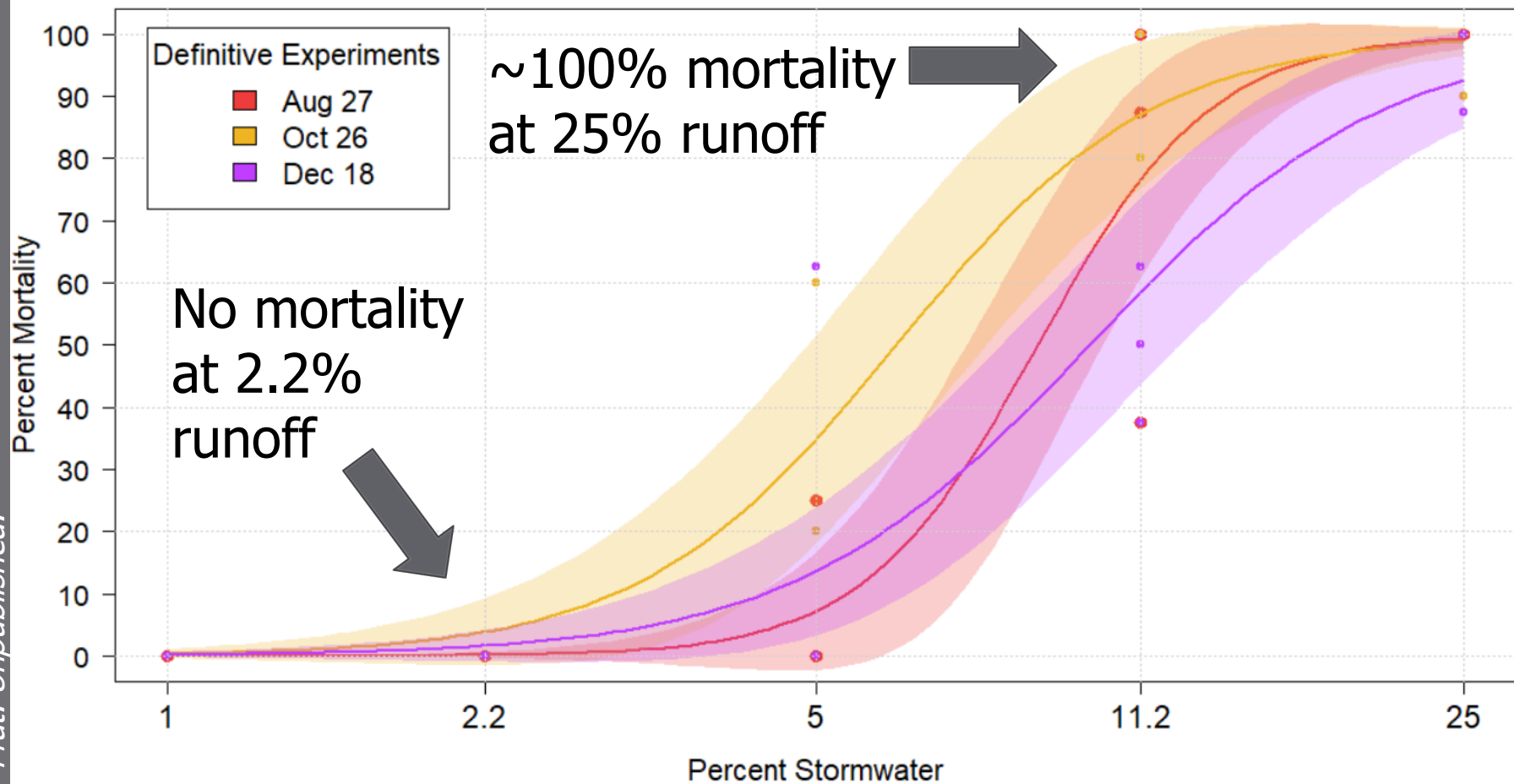


Transfer to clean water does not prevent death

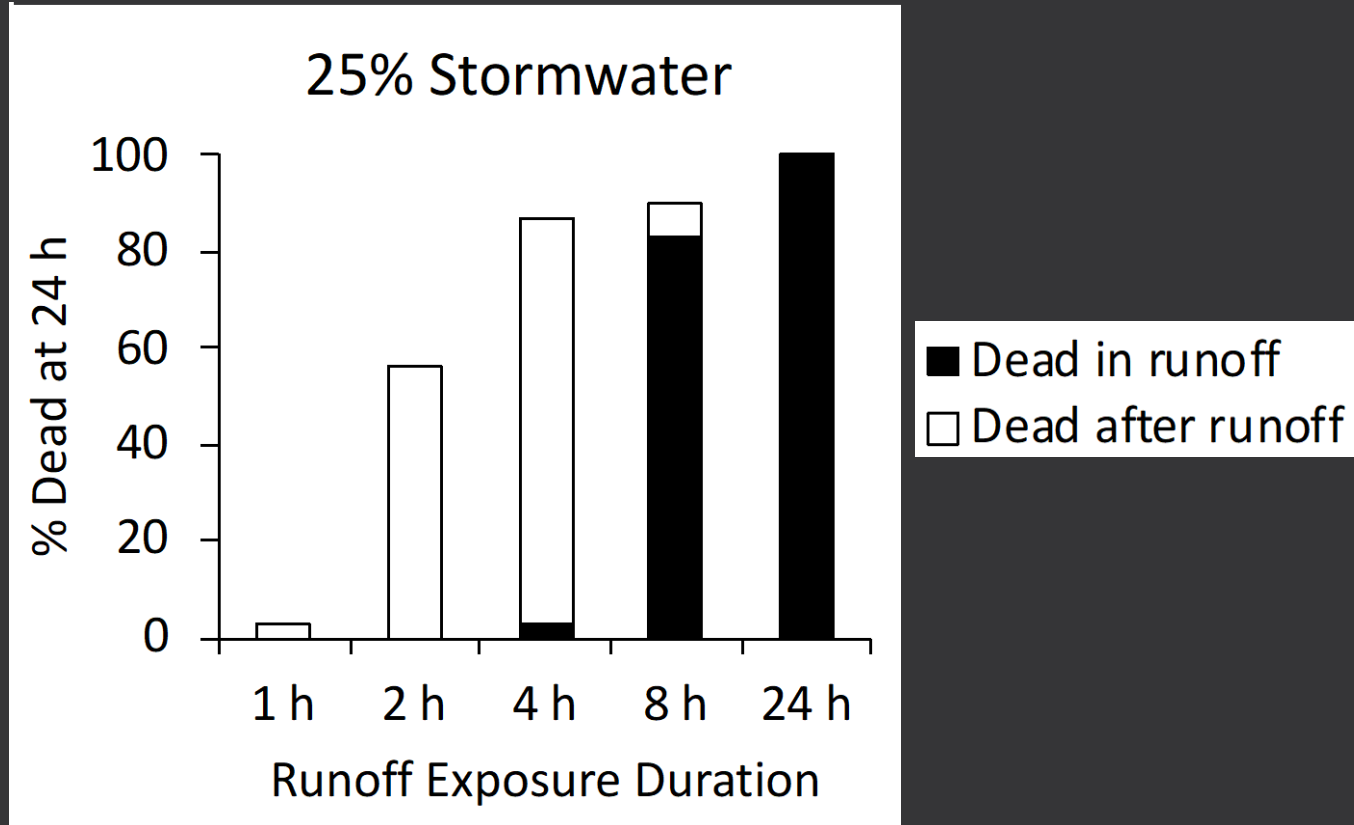
Surfacing

Death

# 24h Mortality Curve



# 1-2 hour runoff exposure causes juvenile coho deaths

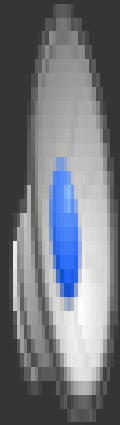


# Behavioral symptoms of coho urban runoff mortality syndrome (URMS)



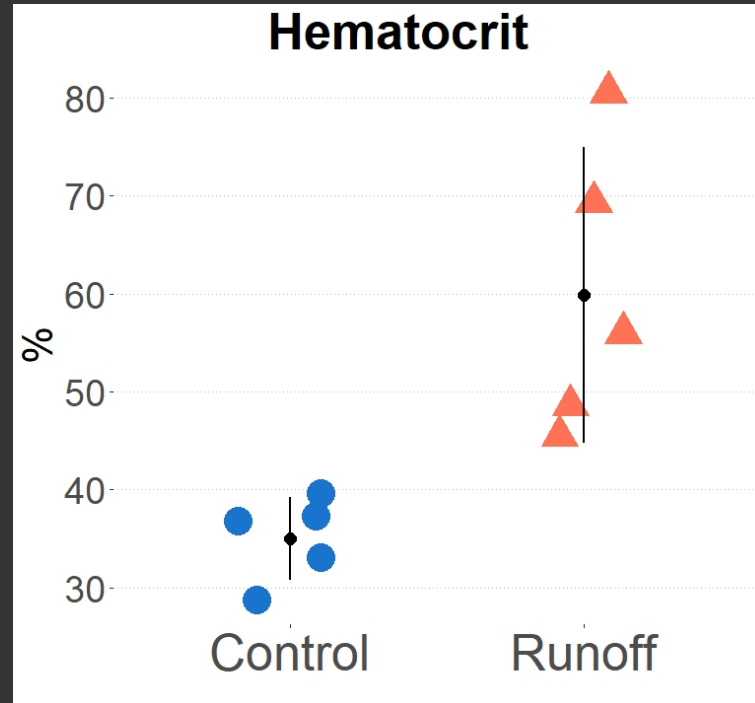
*Puget SoundKeeper's Alliance, 2014*

1. Loss of orientation + surface swimming
2. Loss of equilibrium
3. Death within 4-7 hours

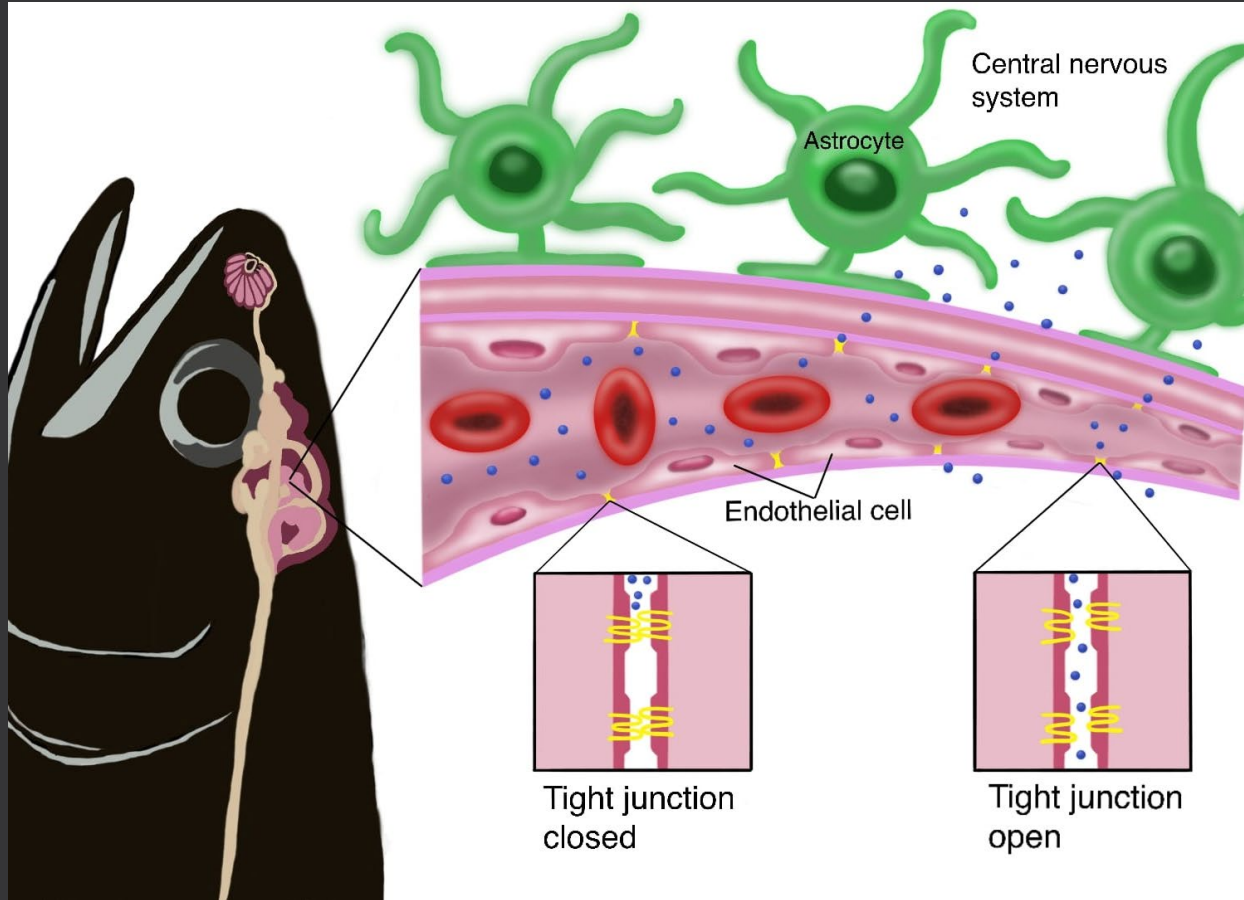


# Key symptom: severe thickening of blood

Hematocrit:  
Percent red blood cells  
by blood volume



# Runoff compromises the blood-brain barrier of coho



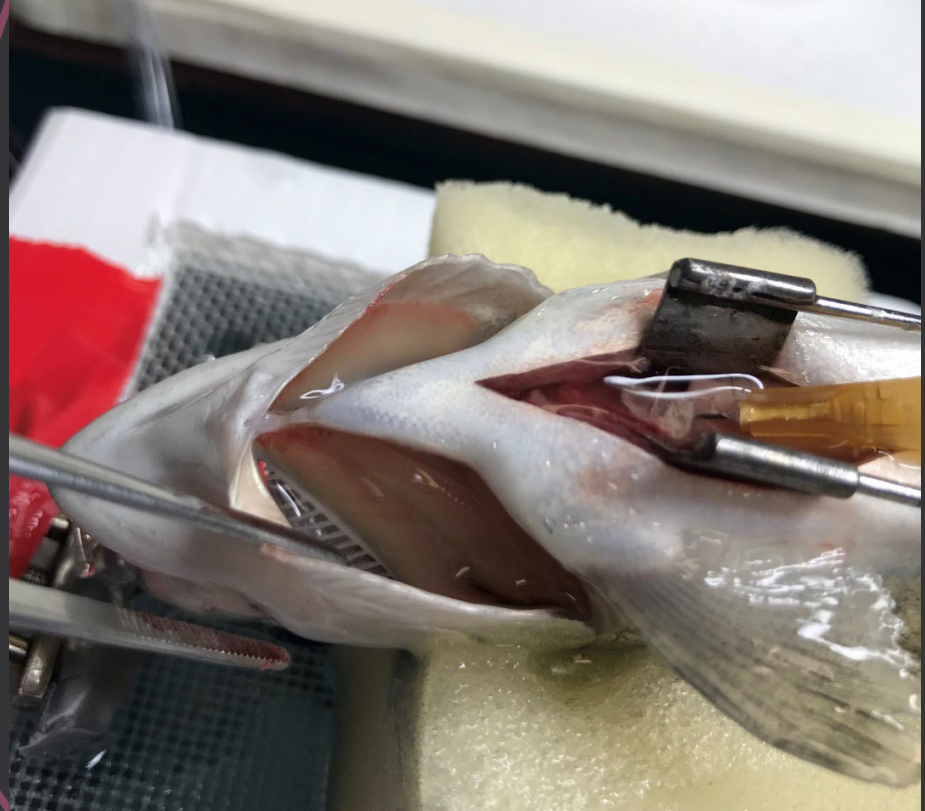
Runoff  
exposure

Loss-of-  
equilibrium

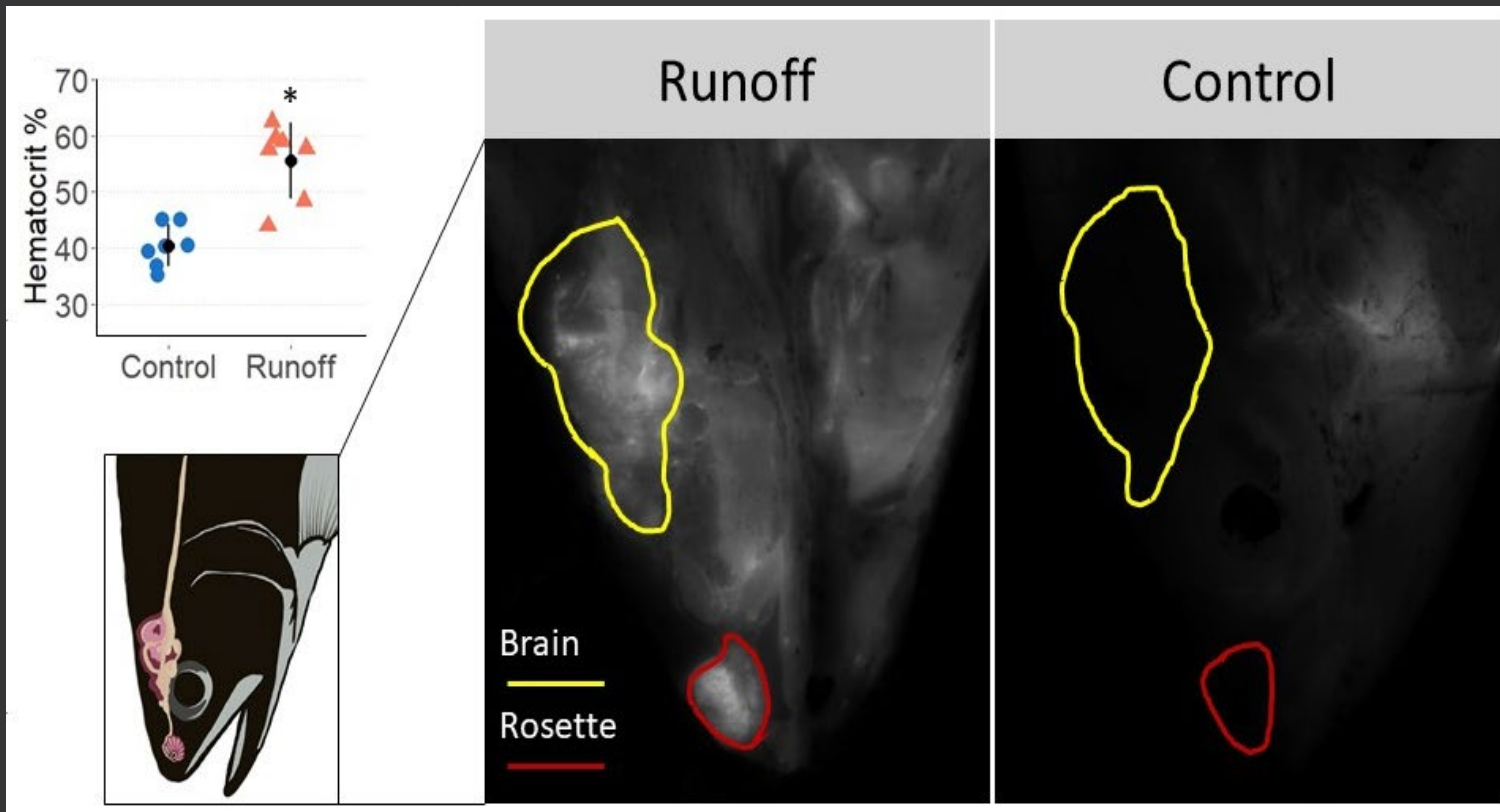
Tracer  
injection

Washout  
blood vessels

Heads frozen  
& imaged

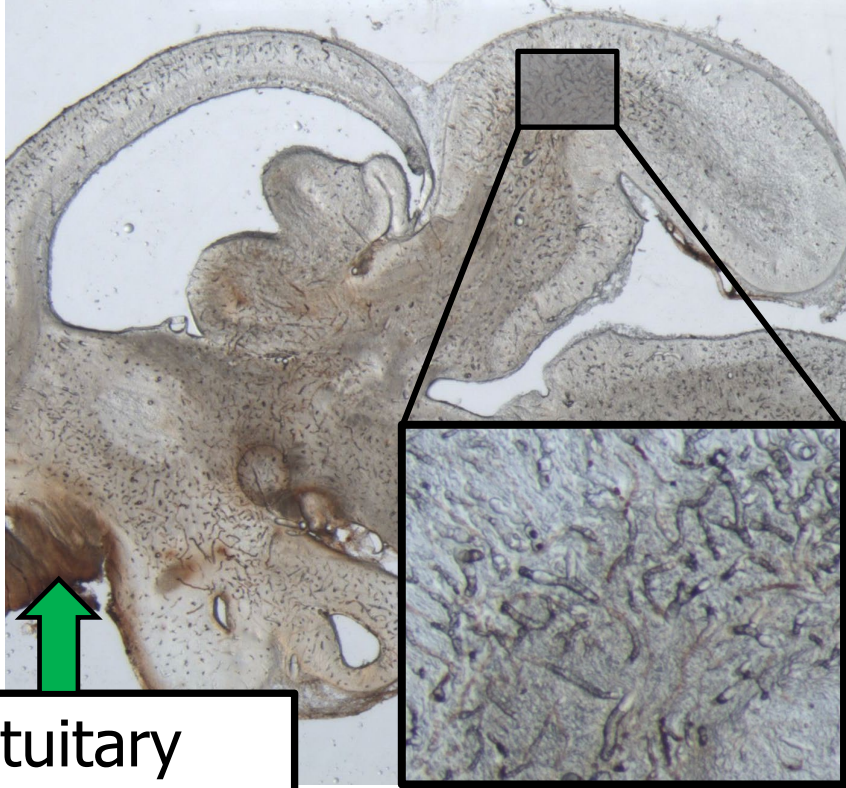


# Accumulation of tracer in brain due to blood-brain barrier breakdown



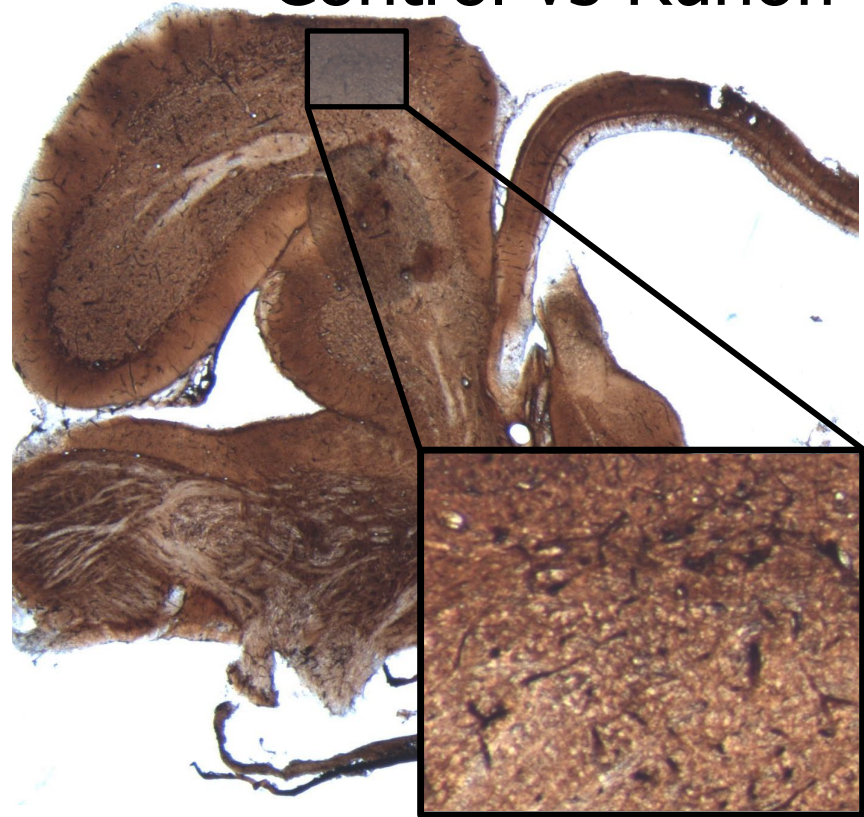


Control



Pituitary  
(+ control)

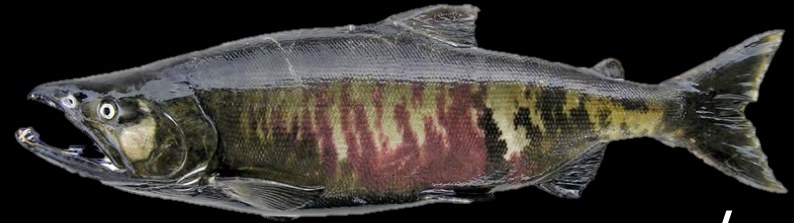
Control vs Runoff



# Sensitivity to stormwater varies among species



*coho*



*chum*



*coho*



*steelhead*



*Chinook*

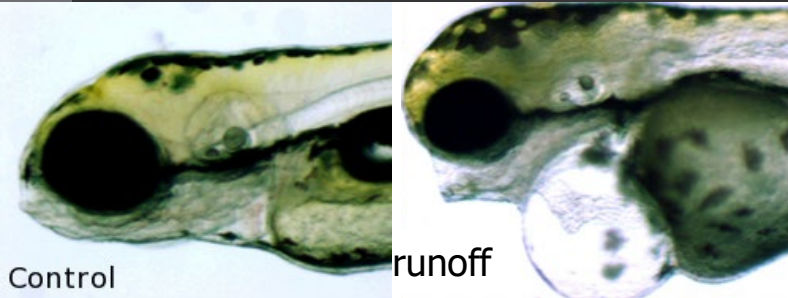


*sockeye*

Coho > Steelhead > Chinook > Sockeye = Chum

*French et al. In Prep.*

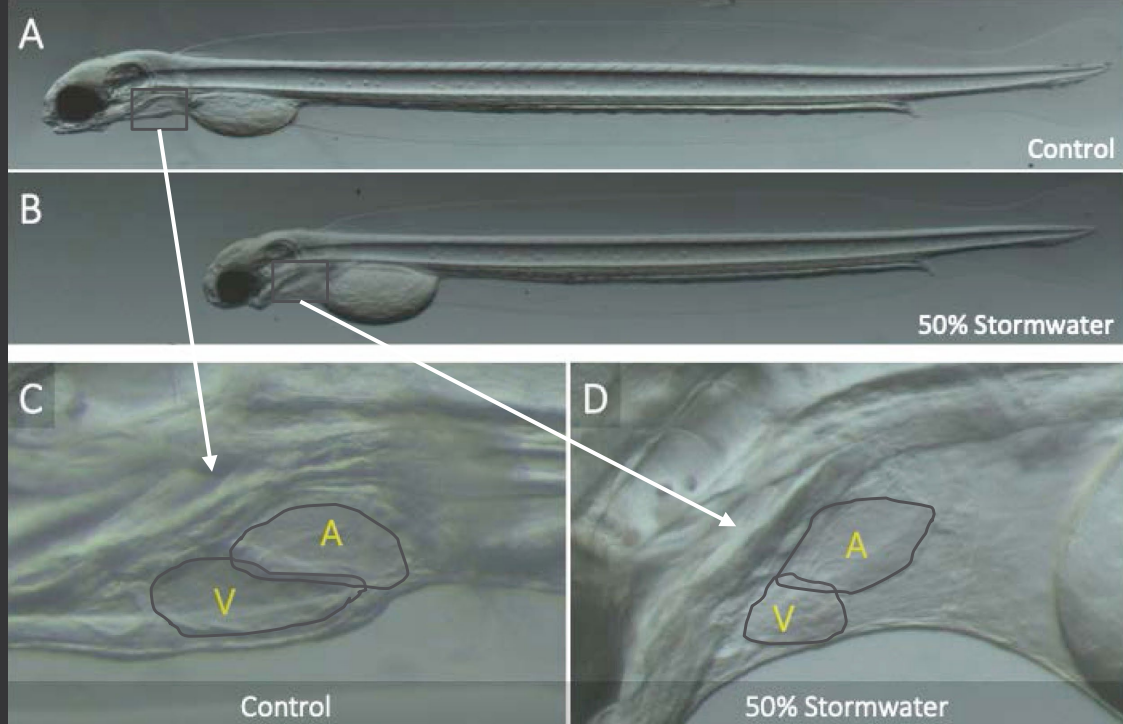
# Runoff sublethally affects zebrafish and herring embryos



*McIntyre et al. 2014. STOTEN*

## Runoff exposure causes:

- Impaired growth & development
- Craniofacial deformities
- Cardiovascular abnormalities



*Harding et al. 2020. J. Aquat. Tox*

# Summary

- Coho are highly sensitive to road runoff containing 6PPD-quinone
- Blood-brain barrier disruption likely cause of death in coho exposed to runoff
- Sublethal effects in zebrafish and herring embryos
- Some lethal effects in juvenile Chinook and steelhead
- Future studies must evaluate whether 6PPD-quinone is driving effects in species other than coho

A close-up photograph of a salmon's mouth open in a stream, with water splashing around it. The salmon's mouth is a vibrant red color, and its tongue is visible. The water is clear and flowing, with some rocks visible in the background.

Closing

**Thank you for  
listening**

**Questions?**