STORMWATER RESEARCH OVERVIEW

Washington Stormwater Center
Washington State University

Lisa Rozmyn & Chelsea Mitchell
THE WASHINGTON STORMWATER CENTER WAS CREATED THROUGH A STATE LEGISLATIVE MANDATE (R.C.W. 90.48.545) FOR A STORMWATER TECHNICAL AND EDUCATIONAL RESOURCE CENTER FOR ALL STORMWATER PERMIT HOLDERS IN THE STATE

A JOINT CENTER BETWEEN UW-TACOMA AND WSU-PUYALLUP DEVELOPED IN 2010
WHAT WE DO

Evaluate Green Stormwater Infrastructure

Research on polluted runoff & effects on aquatic life

Stormwater Permit Assistance

Industrial, Municipal & Construction

Education & outreach

15th Annual Conference
Las Vegas, Nevada
Stormwater Partners and Funders
THE PROBLEM: STORMWATER TOXICITY
Urban stormwater runoff transports toxic chemicals to waterways

Stormwater outfall in Puget Sound
Urban stormwater runoff kills coho salmon spawners

High rates of pre-spawn mortality in urban creeks

Scholz et al. 2011. PLoS ONE
Urban stormwater runoff kills coho salmon spawners

Death by pollution
Coho are dying before they can even spawn as they encounter the pollution in urban streams.

Feist et al. 2011

Predicted mortality
- Less than 10%
- 10 to 40%
- Greater than 40%

Sources: Esri, NOAA Fisheries

MARK NOWLIN / THE SEATTLE TIMES
What about other salmonids?

Untreated runoff is NOT lethal to adult chum salmon

McIntyre et al. 2018
What about other salmonids?

Steelhead are vulnerable to the syndrome

All experiments on juvenile salmonids

Scholz et al. 2019 presentation;
Unpublished research, WSU; US Fish & Wildlife; NOAA Fisheries
An urban stormwater runoff mortality syndrome in juvenile coho salmon

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Chow et al. 2018
Even diluted to just 5% runoff, stormwater can kill up to 60% of exposed coho

Pratt 2019, Masters thesis
Plasma leakage in coho brain exposed to highway runoff and tire leachate

Brain plasma leakage concurrent with hematocrit rise

Control

Tire Leachate

Fluorescent tracer (EBD)  Color image
THE CAUSE: TRACKING POLLUTANTS BACK TO THE SOURCE
The chemistry of stormwater runoff

Thousands of unique chemicals are present in urban road runoff
*Du et al. 2017. Env. Sci. Processes and Impacts*

Relatively few of them are identified
*Peter et al. 2018. ES&T*

The chemicals that we know don’t appear to cause the observed toxicity

- Nutrients
- Bacteria
- Metals
- Some phthalates
- Some pesticides
- Some hydrocarbons
Coho spawner mortality associated with road traffic in watersheds

Tire Wear

Exhaust

Brakes

Washer Fluid

Automobile Leaks:
• Fuel
• Engine Oil
• Brake Fluid
• Engine Coolant
• Transmission Fluid
Test toxicity of individual sources to fish

Diagram showing sources of pollution:
- Antifreeze
- Used motor oil
- Washer Fluid
- Transmission Fluid
- Brake Fluid
- Tire Dust
- Exhaust Particles

Proportion of sources:
- Validate mixture
Tire leachate is toxic to coho

24-h LC50 = 0.14 g/L

Acute lethality to tire leachate was similar in juveniles and adults
Non-target chemistry shows similar features in tire wear particles and stormwater.

Peter et al. 2018. ES&T
Roofing materials leach metals

Material age = strongest predictor of metal concentration in runoff for most materials

10-year extrapolation predicted 8 materials would still leach metals
THE SOLUTION: GREEN INFRASTRUCTURE
Carbon Fiber Enhanced permeable pavements

WSC
Researching ways to improve permeable pavements

The Boeing Co
Looking for uses for scrap carbon fiber

= Carbon fiber enhanced pavements!
The process

- Pavement engineers at WSU formulated mixtures of both asphalt and concrete in varying sizes of cf material and amounts
- Made cores and tested them for tensile and compressive strength
- Sent samples to our Aquatic Toxicology Lab for tox testing
- Install in a real-world setting
Results

- Carbon fiber increased tensile and compressive strength and improved infiltration
- Addition of carbon fiber to permeable asphalt reduced toxicity to *C. dubia*
- Carbon fiber enhanced permeable pavements for future stormwater management
Fungi and plants in bioretention

Net export of nutrients

Amendments

- Less P export with fungi
- No observed benefit of plants
- Inconsistent removal of toxicity

Attribute
- Soil
- Plants
- Fungus
- Plant.Fungus
Depths of bioretention and longevity of treatment

Research questions:
• What depths of bioretention are necessary to treat runoff?
• For how long are they effective?

Accelerated Aging:
• 10 water years across 2-yr study
• Assess chemical and biological performance at end of every water year
Can novel bioretention amendments (biochar and fungi) to improve removal of Polycyclic aromatic hydrocarbons and Bacterial pathogens?

Investigate fate and biodegradation of PAHs in bioretention columns with and without amendments.
How much stormwater do mature native trees mitigate?

Model stormwater benefits and compare to other green stormwater infrastructure.
Thank you!

Visit our website
Wastormwatercenter.org

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REFERENCES


