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Water Quality

How Toxic Runoff Affects Pacific Salmon & Steelhead

NOAA FISHERIES SERVICE

Development on the West Coast has transformed how and when water moves through the landscape, and how species respond to the physical, chemical, and biological changes in their environment – in short, how our watersheds function. As our human population grows, so do the number of motor vehicles on the roads and types of pollutants released across the landscape. Deposits of pollutants end up on roadways and other surfaces, and are transported to our waterways via runoff. Contaminated runoff poses significant threats to freshwater, estuarine, and marine species, including Pacific salmon and steelhead.

What is stormwater runoff?

Stormwater is rain or snow melt that originates during precipitation events. Stormwater that does not soak into the ground becomes runoff.

How do pollutants enter our waterways?

Pavement is part of our landscape. Roadways and parking lots accumulate a mixture of contaminants, such as metals and petroleum-related compounds. During precipitation events, stormwater runoff transports the pollutants to our rivers, lakes, and estuaries. Agricultural chemicals, such as pesticides, can also seep into waterways where pollutants are transported downstream.

What Science Tells Us About Salmon & Polluted Runoff

Pavement is a prominent feature of the landscape. Roadways and parking lots are impervious and accumulate a mixture of contaminants, including metals (copper, nickel, zinc, cadmium, etc.); petroleum-derived compounds from oil, grease, and vehicle exhaust; and detergents, among others. During rainfall events, stormwater collects these contaminants and transports them to our rivers, lakes, and estuaries. In addition, agricultural practices and landscape maintenance that use pesticides, such as insecticides, herbicides, and fungicides, can also contaminate runoff and compromise the health of watersheds.

When toxics enter our waterways via stormwater runoff, they can cause a variety of adverse effects to aquatic species. In addition to directly impacting salmon and steelhead, toxics can harm or kill the aquatic insects that salmon eat. Pollution risks vary depending on the particular chemical, the amount transported in stormwater, and environmental persistence.

Recent research has shown that common contaminants can impair salmon health in a variety of ways. For example, certain metals and pesticides are toxic to the salmon nervous system, thereby disrupting feeding and predator avoidance. Pesticides and petroleum-derived compounds suppress the immune system, rendering salmon more vulnerable to pathogens that cause lethal diseases. Petrolem-derived compounds are also known to depress growth rate of juvenile salmon, which can affect their survival. Other compounds target the developing cardiovascular system, causing heart failure or permanent heart defects.

Dissolved copper is a particularly pervasive contaminant that threatens salmon and steelhead survival. Copper is used for many industrial, commercial, and residential purposes. These include use in roofing materials, treated wood, and pesticides. It is also a by-product found in the exhaust and brake pads of vehicles. Copper, like many other metals, is toxic to the sensory systems of fish. Dissolved copper specifically impairs salmon and steelhead's ability to detect odors. This sense guides their response to environmental cues and impairment of smell interferes with certain behaviors. Copper can impede predator detection and avoidance, social interaction, prey detection, orientation, and homing, thereby affecting their survival, distribution, and reproductive success.

Copper is just one example of a contaminant in stormwater. In the natural world, fish are exposed to a mixture of chemicals originating from a variety of sources. Although the specific responses of salmon and steelhead to the mixtures present in stormwater are difficult to

predict, they could include many of the effects described above. Research at the Northwest Fisheries Science Center has shown that typical stormwater mixtures affect the survival and development of salmon and steelhead eggs.

Best Practices for Cleaning-Up Toxic Runoff

Using its authority under the Endangered Species Act, NOAA Fisheries has worked with local governments and Federal partners, including the Federal Highway Administration, Federal Transit Authority, and U.S. Department of Housing and Urban Development to improve water quality in salmon habitats by reducing toxic runoff. Some best practices include:

Infiltration: The primary means of treating polluted runoff is infiltration. There are many creative ways to infiltrate polluted runoff into the subsurface where it can be cleaned using natural materials like compost-amended soils. Local developments also are incorporating environmentally sound development techniques, known as "low-impact development," into their buildings and roads. These techniques include things such as adding green roofs, pervious pavement, rain gardens, compost-amended soils, wetlands, and vegetative filter strips along driveways and walkways.

High Efficiency Sweepers: Major cities like Seattle and Portland are using high efficiency sweepers to collect and dispose of runoff pollutants before they are transported into streams and rivers. This approach can remove up to 90% of the pollutants (e.g., copper and zinc) from roadways.

Reduce Pollution at the Source: Source control is the most effective tool for reducing or eliminating toxics in stormwater runoff. For example, Washington State recently passed legislation that will phase out the use of copper and other metals in vehicle brake pads, and some jurisdictions have banned the use of architectural copper (downspouts, etc.). Many local governments have implemented public education campaigns to reduce the use of toxic lawn care products. With the support of over $50 million in Federal grants, Seattle and Portland are piloting the use of electric vehicles and charging stations. This change will reduce the amounts and sources of oil, gas, and metals on our roadways.

For More Information

If you would like to learn more about how polluted runoff affects salmon and steelhead, or if you would like to incorporate best management practices into your projects, please consider the following sources:

NOAA's Coastal Storms Program
https://coast.noaa.gov/csp/successstories.html#stormwater_treatment

NOAA Fisheries' Northwest Fisheries Science Center Research
- www.nwfsc.noaa.gov/research/divisions/ec/ecotox/fishneurobiology/index.cfm

Washington Stormwater Center for Low Impact Development Research & Resources
- www.wastormwatercenter.org/low-impact/

Western Washington State Stormwater Manual
- www.ecy.wa.gov/programs/wq/stormwater/manual.html

City of Portland Stormwater Management Manual
- www.portlandonline.com/bes/index.cfm?c=47952

Environmental Protection Agency for Green Infrastructure Tools
- http://water.epa.gov/infrastructure/greeninfrastructure/

Idaho Department of Environmental Quality
- www.deq.idaho.gov/water-quality/wastewater/stormwater.aspx

Washington State Department of Transportation Stormwater Research
- www.wsdot.wa.gov/Environment/WaterQuality/Research/

Guidance Document for Preparation of the NPDES Stormwater Pollution Control Plan
- www.deq.state.or.us/wq/stormwater/docs/nwr/swpcpguide.pdf

Be the change you want to see!

Take steps to ensure runoff is not polluted because clean water is a matter of health and safety for both fish and people.