BEST PRACTICES

Scientific Research: Integrated Ambient Monitoring in Indian Creek

The Washington State Department of Ecology recently published Phase II of an integrated monitoring approach for assessing the aquatic health of streams. The Phase II study, conducted in Olympia's Indian Creek in spring of 2013, was a follow-up to the pilot study conducted in spring of 2010 in Indian Creek.

The integrated monitoring approach focuses on a stream's ability to support the early lifestages of salmonids and the food they need to survive and grow. The monitoring method includes in-situ (in-stream) toxicity testing with rainbow trout and bioassessments of benthic macroinvertebrates and periphyton (a mix of algae, cyanobacteria, microbes and detritus). Surface water and sediments from the stream are also analyzed for a mix of common pollutants to help identify the chemicals that may be causing stress to the aquatic community, but the biology is the focus for the integrated monitoring approach.

Many toxic pollutants cannot be detected by standard chemical analyses, and little toxicity information is available for many of the detectable chemicals. Mixtures of chemicals can have unpredictable combined effects. However, toxicity tests using living organisms will respond to any toxicant or combination of toxicants.

The in-stream trout toxicity test was borrowed from Environment Canada, which has published toxicity testing methods using early lifestages of rainbow trout. Each lifestage (embryo, alevin and fry) has different sensitivity to different pollutants. A test on all three lifestages is a true chronic test. The biological effects assessed include mortality, failure to hatch, abnormal development and stunted growth. Trout early lifestage testing can be done in streams to directly assess environmental conditions.

In Phase I, two sites on Indian Creek were monitored: 1) upper Indian Creek near the Frederick Street and the Woodland Trail crossing, and 2) lower Indian Creek near Quince Street before Indian Creek is piped under Plum Street and joins with Moxlie Creek. Results indicated good aquatic health at the upper site and impaired aquatic health at the lower site. During Phase I, a stormwater pipe carrying contaminated runoff from nearby parking lots was discovered just upstream from the lower monitoring site. Part of the Phase II monitoring design was to bracket this stormwater pipe by placing additional monitoring stations right above and just below the pipe.

The 2013 results for the instream exposures of rainbow trout embryos showed that survival just downstream of the stormwater pipe was 4% at the alevin lifestage. Survival of alevins right above the pipe was 60%. Fry survival 13 days later at the upper Indian Creek site was 93%. The upstream site has a wooded riparian buffer, along with nearby residential and commercial land uses and a highway (I-5).

Surviving trout were analyzed for six metals. Copper in fish tissue strongly correlated with fry survival. Both tissue zinc and copper correlated moderately with alevin survival. Metals concentrations also increased in trout tissue from lower Indian Creek compared to the upper site.

Benthic macroinvertebrate and periphyton communities at the lower site showed impairment, including an increase in metals-tolerant organisms. There was also an increase in metals concentrations in periphyton biomass in lower Indian Creek compared to the upper site.

Stream, stormwater, groundwater and sediment samples were analyzed for metals and polyaromatic hydrocarbons (PAHs). Stream, stormwater and groundwater samples were also analyzed for oxygenated (ketone- and quinone-substituted) PAHs. In addition, groundwater and sediment samples were analyzed for a large list of base/neutral acid extractable organics.

Results show lower Indian Creek to be unsuitable for salmon reproduction, and the weight of the evidence implicates a mixture of pollutants, with metals and PAHs standing out as contributing toxicants. The stormwater pipe at the lower site is the likely culprit, though there are also signs of moderately degraded water quality upstream of the culvert.

The integrated monitoring approach worked well for assessing the aquatic health of Indian Creek and identified sources of toxicity to the creek. Washington Department of Ecology researchers hope this approach will be considered by others for stream assessment. **The full reports for Phase I and II can be found at the following links:**

Phase I: https://fortress.wa.gov/ecy/publications/summarypages/1203012.html

Phase II: https://fortress.wa.gov/ecy/publications/SummaryPages/1403050.html

These studies are also being prepared for scientific journal publication in 2015.

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