IMPACTS OF STORMWATER RUNOFF ON COHO SALMON IN RESTORED URBAN STREAMS

Sarah McCarthy, Johann Sproenberg, Jennifer McIntyre, Jana Labenia, Linda Rhodes, John Incadonna, Mark Myers, Gina Yitlado, Tracy Collier, and Nathaniel Scholz
NOAA Fisheries, Northwest Fisheries Science Center, Ecosystems and Environmental Health Program, 2725 Montlake Blvd. E, Seattle, WA 98112

Jay Davis
US Fish and Wildlife Service, Western Washington Fish and Wildlife Office, 510 Diamond Dr. SE Suite 102, Lacey, WA 98503

INTRODUCTION

Beginning in the late 1990s, agencies in the greater Seattle area began conducting fall spawner surveys to evaluate the effectiveness of local stream restoration and water quality efforts. These surveys detected a surprisingly high rate of mortality among migratory coho salmon that were still smolt and had not yet spawned. In addition, adult coho from several different streams showed similar symptoms (pale coloration, rearing, loss of equilibrium, gapping, and rapture) that eventually led to death. In recent years, pre-spawning mortality (PSM) has been observed in many isolated urban streams, with observed rates ranging from ~20-50% of the fall run. Although the precise cause of PSM in urban streams is unknown, conventional water quality parameters (i.e., temperature and dissolved oxygen) and disease do not appear to be causal. Rather, the weight of evidence suggests that adult coho, which enter urban streams following fall storms, are acutely sensitive to non-point source stormwater runoff containing pollutants that typically originate from urban runoff sources and land use activities.

OBJECTIVE

Our ongoing objective is to discover the cause(s) and geographic extent of acute coho salmon mortalities in Puget Sound streams.

METHODS

Daily stream surveys were conducted during fall 2014/15 in an attempt to determine presence of amphibious fish (gaping, loss of equilibrium, fish stretching) in five unfiltered stormwater outfalls. For each stormwater outfall, we recorded the location, species, gender, fork length, weight (with and without gonad), presence or absence of disease, and rearing condition, and percent egg and egg mass mortality. We examined water chemistry for indicators of disease, viz. vitamin deficiencies, pesticide exposures, and hydrarthritis scores. Mortality of established coho populations were conducted in lab settings and PSM showed that COHOS (coho salmon) may exhibit changes in life, survival, and reproductive success in the lab. Acute PSM is defined as adult coho salmon mortality resulting from exposure to urban runoff samples, and chronic PSM is defined as adult coho salmon mortality resulting from exposure to urban runoff samples.

RESULTS

Potential Causes for Pre-Spawn Mortality

- High temperature/Low dissolved oxygen
- Hydrocarbons exposure
- Pathology and pathogens
- Vitamin deficiencies
- Stress and poor condition
- Pesticides exposure
- Other contaminant factors

Bile Analyses for Hydrocarbon Exposure

- Hospital analysis of phenazine equivalents and benzopyrene (PSM) exposure to protection of human health.

CONCLUSIONS

- Approximately 50% of the female coho salmon entering to Longfellow Creek in 2015/16 had pre-spawn mortalities, which are linked with stormwater runoff.
- Affected fish showed a consistent suite of symptoms, including loss of orientation, gaping, rearing, and loss of appetite.
- Exposure to unfiltered stormwater had higher rates of developmental defects and mortality than fish exposed to filtered stormwater.
- Water quality parameters (i.e., temperature, dissolved oxygen, etc.) were within a reasonable range for salmonids.
- Although presence of certain pathogens and tissue lesions were higher at urban sites, exposure to high levels of PSM did not result in lesions or mortality.
- Fish exposed to unfiltered stormwater contained higher levels of PSM than fish exposed to filtered stormwater.
- Best coho models incorporating PSM demonstrate the potential for rapid loss of localized populations in urban habitats from stormwater runoff and stream flow.

ONGOING INVESTIGATIONS

- Study is underway to address the following questions:
  - What are the cumulative effects of contaminated stormwater runoff on salmon that spawn and streamۇ
  - What lead compounds and inorganic compounds were observed in stormwater runoff, and what concentrations were observed in stormwater runoff?
  - What are the relative rates of salmon die-offs in urban settings, and the observed mortality rates?
  - What are the relative rates of salmon die-offs along urbanization gradient in selected wetlands or highly developed wetlands such as Longfellow Creek?