Models show Coho salmon at risk in US urbanizing watersheds

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For a decade researchers in Seattle have worked to solve the mystery of why adult coho salmon are dying prematurely in urban streams when they return from the ocean to mate and spawn. In a study published in *Integrated Environmental Assessment and Management* the team use models to estimate the potential impact of urban land development on the salmon population in the decades ahead.

Stricken coho salmon (*Oncorhynchus kisutch*) show a syndrome of disorientation, equilibrium loss, and other symptoms of acute toxicity, which usually cause death within a few hours. In some watersheds as many as 90% of the returning fish are killed, yet juvenile coho and related salmon species remain unaffected, even in the same streams.

"Forensic evidence currently points to toxic chemical contaminants in urban storm water runoff as the likely cause of the recurrent fish kills," said Dr Julann Spromberg, from the National Marine Fisheries Service. "However, urban runoff is a complex soup containing mixtures of many different chemicals and we've yet to identify the smoking gun. With the forensic story still unfolding, this study looked at how wild coho populations might be affected by an increase in the geographic extent and severity of the spawner mortality syndrome over time."

Dr. Spromberg and her colleague Dr. Nat Scholz focused their study on lowland urban streams around Puget Sound, Washington. As with the rest of the Pacific Northwest this area of lowland watersheds is undergoing substantial human population growth. By 2025, the

population of the Puget Sound region is expected to rise from 4 to 5.4 million people.

"Currently there are many relatively healthy river systems that provide high quality freshwater habitat for wild coho in this area" said Spromberg. "However this may change if these watersheds acquire the urban land use characteristics that typify the Seattle-area urban drainages where coho spawners are currently dying in high proportions."

The authors constructed a virtual coho population, with conventional rates of survival and straying based on the published literature. They then imposed spawner mortality on different segments of the population, based on actual rates observed from spawning surveys of urban creeks in recent years which allowed them to estimate timelines for local population extinction.

The models showed that the proportion of the population affected was a more important factor that the overall rate of mortality. One scenario that simulated rapid urbanization forecast an increase in pre-spawn mortality from 0 to 75% over 20 years. When rates were increased to 75% over 20 years, the model predicted the extinction of a solitary coho population in 30 years. Lastly, the modeling effort revealed how production from high quality habitat areas within large river basins might mask local declines in coho abundance due to spawner losses.

"While our findings are for virtual populations, our models capture the basic dynamics of how wild coho may respond to the mortality syndrome at a population scale. This will help natural resource managers anticipate future threats to coho conservation and recovery in Puget Sound and elsewhere in the Pacific Northwest," concluded Spromberg. "Our next steps include incorporating storm water impacts on embryo and juvenile survival rates as well as refining the models by expanding the range of input data to reflect different types of future land uses."

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