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## **STUDY LOOKS AT HOW INTERACTION OF LEAF LITTER, SALMON CARCASSES IMPACTS NUTRIENTS IN SALMON SPAWNING**

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The two major sources of nutrients and energy in streams where salmon spawn are leaf litter from riparian trees and the carcasses of salmon in the water after they are spent by spawning.

According to a recent study, the interaction of the two nutrients – leaf litter and salmon carcasses – in the shady headwaters of Northwest streams will actually speed decomposition of leaf litter in the stream, stimulate fungal biomass and the synergy between the two nutrients will also change the makeup of macro-invertebrates that reside within the litter, sometimes reducing the diversity of aquatic insects in that litter, although not their abundance.

“This study explored the interactions between these energy sources and found that mixtures of leaf litter types can lead to slower than expected leaf decomposition by in-stream fungi and shredding invertebrates, but that this effect switches to faster than expected decomposition when salmon carcasses are also present,” said Carri J. LeRoy, assistant professor, freshwater ecology, at Washington State’s Evergreen State College.

The study, done from January to early April in 2009 in McKenna Creek, a tributary of the Nisqually River in Washington, and published online Nov. 18, 2015, in the Canadian Journal of Fisheries and Aquatic Sciences, was part of an undergraduate environmental analysis science class at Evergreen State College in Olympia, Wash. It was completed in collaboration with the Nisqually Indian Tribe and the Nisqually Land Trust, according to LeRoy.

“The project involved 65 students and hundreds of leaf litter bags and two of those students continued to work on the project and are co-authors on the paper,” she said.

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“Salmon carcasses influence genetic linkages between forests and streams” can be found at [http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2015-0439#.Vqe\\_XSorLIU](http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2015-0439#.Vqe_XSorLIU)

LeRoy’s co-authors are Dylan G. Fischer, associate professor, Walton M. Andrews, undergraduate student, Lisa Belleveau, undergraduate student, Clyde H. Barlow, professor emeritus, all with Evergreen State College; Jennifer A. Schweitzer, associate professor, and Joseph K. Bailey, associate professor, both with the University of Tennessee; Jane C. Marks, professor, Northern Arizona University; and Jeff C. Kallestad, research assistant, Washington State University.

In its methods of using diverse sources of leaf litter, the study also considered the influence of forest genetics on in-stream systems, LeRoy said. The litter types came from different genetic individuals of the common black cottonwood tree.

“When we look at a forest of trees, we can’t see many differences among individuals, but they are as different as we all are to each other,” LeRoy said. Scientists are working to understand how genetic differences among organisms can influence other organisms, whole communities, and ecosystem processes.

“In this case, the genetic differences among trees can change the rate at which those leaves are used by in-stream organisms like aquatic insects, major sources of food for juvenile salmon,” she said.

The study found a significant change in the diversity of aquatic insects residing in the litter, although not abundance of the insects.

“While litter genotype (types of leaves present) was a driver of patterns in litter mass loss and aquatic fungal biomass, stream invertebrates were more sensitive to salmon carcass presence,” the study says. “Specifically, the presence of salmon carcasses had a negative influence on the richness, evenness, and diversity of the macroinvertebrates that colonized leaf surfaces.”

Although there was not a change in micro-invertebrate abundance, there was a change in the overall community structure of aquatic insects within the leaf litter, according to the study.

One reason for this change in community and lower diversity could have been the time of year of the study. Leaves fall into the stream in October and November, also a time when salmon are spawning. The study was conducted in the winter. Leaf litter was added to streams in bundles and coupled with the presence or not of salmon carcasses. In addition, the presence of macro-invertebrates may be different in winter than in fall, the study says.

The synergy between leaf litter and salmon carcasses could be more complicated. Salmon-derived nitrogen to a limited extent provides nutrients for trees and plants growing in riparian zones.

“The interaction between salmon carcasses and riparian trees could result in a feedback to litter quality and potentially further influence litter dynamics, especially in systems with healthy salmon runs,” the study says.

Of course not all streams have healthy runs of spawning salmon. “In the Pacific Northwest, it is thought that many salmon are spawning at rates of about 6% of historic runs,” LeRoy said. “This represents a large reduction in the number of returning spawners and a huge deficit of marine-derived nutrients (nutrients and energy the spawning salmon bring upstream from the ocean).”

She said that studies have shown “reductions in the productivity of in-stream and riparian organisms following the reduction of carcass inputs.”

She added that new studies in the Elwa River on the northern side of the Olympic Peninsula, “following the return of salmon carcasses to the watershed after a hundred year absence are showing rapid utilization of marine-derived nutrients by stream-dependent organisms like water ouzels (Tonra et al. 2015).”

“The reliance of stream systems on salmon carcasses gives us even more reason to work to improve salmon and steelhead runs, reduce habitat loss, and avoid over-fishing,” LeRoy said. “Entire watersheds are dependent on the energy these organisms return from the sea. Salmon recovery is much more than a political issue. It is also a key ecological issue in this part of the biosphere.”

For more information about the study and the Evergreen College class “environmental analysis, see:

<http://photo.evergreen.edu/portal/slideshows/Envanalysis/index.html>

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