Do the leaves that fall into a stream affect the insects that fly out?

June 20 2016

Credit: Victor Leshyk

When leaves fall in the autumn, they are only just beginning their journey.

Leaves that fall into the water from streamside trees feed not only microbes, but also larval aquatic insects. The insects, in turn, are snatched up for food during all stages of their transformation into adults that fly from the water back to the forest. Is this journey through the riparian food web different for different kinds of leaves?

Northern Arizona University researchers in Jane Marks' lab experimented with cottonwood tree leaf litter to find out whether a tree's genes influenced what kind of aquatic insect community fed and lived on its leaves in the stream. Understanding this potential link has implications for managing streamside ecosystems.

"Leaves are energy and nutrients to aquatic insects, yet no two leaves are alike," said Marks, professor of biology at NAU and lead investigator on the project. "In this work, we tested if slight genetic differences in trees have ripple effects on the communities of insects in rivers."

The study was supported by a $750,000 National Science Foundation grant awarded to the Marks lab to explore a new paradigm for how leaf litter quality affects stream ecosystems. The findings have been published in *Ecosphere*.

Using leaf litter from two different species of cottonwood trees and a hybrid of both, Zacchaeus Compson, a recent Ph.D. graduate who studied with Marks, created genetically distinct leaf packs that represented variation within a tree species and variation between different tree species. Leaf packs were submerged for 12 weeks inside floating cages in Oak Creek, Ariz. Each cage was topped with netting to capture and identify the aquatic insects as they emerged from the water.

The study revealed some new ways in which a plant's genotype can influence its surrounding ecosystem. The leaf litter packs that were most closely related genetically had more similar emerging insect communities. For example, caddisflies as a group were more closely associated with certain genotypes of leaf litter than other genotypes. Insects from those closely related leaf packs also emerged as adults from the water at similar times.

The qualities of leaf litter that linked the plant's genotype with the

resulting insect community were the litter's thickness, nitrogen concentration, fungal community, and rate of decay.

These findings have implications for managing the biodiversity of riparian forests. If the genotype of leaf litter affects the insects that live on it and when those insects emerge from the water, it also indirectly affects their predators. These predators, like dragonflies, fish, bats, and birds count on a sustained pulse of insects for food. A loss of genetic diversity in riparian trees could translate into fewer aquatic insect species and a more limited range of time over which they emerge from the water and become available to predators. Responses of riparian predators, in turn, would have ripple effects throughout the food web.

"Streams and forests form tightly coupled systems, responsive even to small genetic changes in the organisms that live there," said Marks. "The diversity of streamside trees is reflected in the diversity of insects that inhabit and emerge from the water, so one strategy for managing restoration projects for aquatic biodiversity is to maximize the genetic diversity of riparian trees."

More information: Zacchaeus G. Compson et al. Plant genotype influences aquatic-terrestrial ecosystem linkages through timing and composition of insect emergence, *Ecosphere* (2016). DOI: 10.1002/ecs2.1331

Provided by Northern Arizona University