

Forest-stream Interactions on Dynamic Landscapes of Eastern North America

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Forests in eastern North America continue to recover from 19th century clearing and are increasingly influenced by a variety of natural disturbance types and intensities. As these forests change and develop along multiple pathways, the ways in which they interact with stream systems will shift accordingly and dynamically. Important forest stream-interactions, such as large woody debris inputs, controls on light availability and related in-stream autotrophic production, structural influences on stream channel geomorphology, in-stream nutrient processing, and carbon storage are likely to change with late-successional forest stand development. Our research in the Adirondack Mountains (New York), at the Hubbard Brook Experimental Forest (New Hampshire), and across northern New England (USA) has: 1) described structural attributes and gap dynamics associated with old-growth riparian forests; 2) assessed linkages between these characteristics and in-stream habitat structure, light availability, and autotrophic production; 3) investigated in-stream nutrient processing and retention; and 4) assessed carbon accumulation in large stream wood in mature and old-growth streams. Our results indicate that old-growth riparian forest structure is more complex than in mature forests and exhibits significantly greater aboveground tree biomass, both living and dead. In-stream large woody debris volumes and biomass were significantly greater at old-growth sites compared to mature sites and were strongly related to the basal area of adjacent forests as well as the densities of large legacy trees (retained within secondary forests). In-stream large log densities correlated strongly with debris dam density, although boulder density and stream size were also important variables. Canopy gaps are abundant, positively correlated with concave landforms, and well-distributed along stream reaches. Heterogeneous light environments translate into spatially variable periphyton production, with implications for our understanding of energy dynamics in low order streams. Collectively, our research has shown that old-growth riparian forests have pronounced effects on stream ecosystems, resulting in exceptionally high large woody debris volumes, higher densities of woody debris dams, greater channel roughness and possibly flood resilience, spatially complex light environments and food webs, and greater rates of in-stream nutrient spiraling, uptake, and retention. Our most recent research suggests that redeveloping late-successional stream corridors represent an under-appreciated carbon sink. Old-growth riparian forests provide in-stream habitat features that have not been widely recognized in eastern North America. There is now an opportunity to encourage redevelopment of these features in some areas. Careful and judicious management for, and/or conservation, of structurally complex riparian forests will yield high quality stream habitats, enhanced carbon storage, resilience to extreme precipitation events, and other stream ecosystem functions that are currently under-represented on forest landscapes in eastern North America.

BIO

Dr. William Keeton is a Professor (Full) of Forest Ecology and Forestry at the University of Vermont. There he directs the Carbon Dynamics Laboratory and is a Fellow in the Gund Institute for Environment. He is deputy-chair of the IUFRO (International Union of Forest Research Organizations) Working Group on Old-growth Forests and just stepped down from nine years on the Board of Trustees for the Vermont Land Trust. Since 2012 he has served on the Scientific Board for Science for the Carpathians. Dr. Keeton has authored over 120 peer-reviewed publications, including more than 100 journal papers. Dr. Keeton served as a Fulbright Specialist in Ukraine (2008) and as a Fulbright Scholar in Austria (2021). He is a Mercator Fellow at Albert-Ludwigs-Universität Freiburg, Germany and Professor Honoris Causa at the Faculty of Geography, University of Bucharest, Romania. His co-edited the book “[*Ecology and Recovery of Eastern Old-Growth Forests*](#),” was published by Island Press in 2018. Dr. Keeton holds a B.S. in Natural Resources from Cornell University ('90), a Masters in Conservation Biology and Policy from Yale University ('94), and a Ph.D. in Forest Ecology from the University of Washington (2000).

