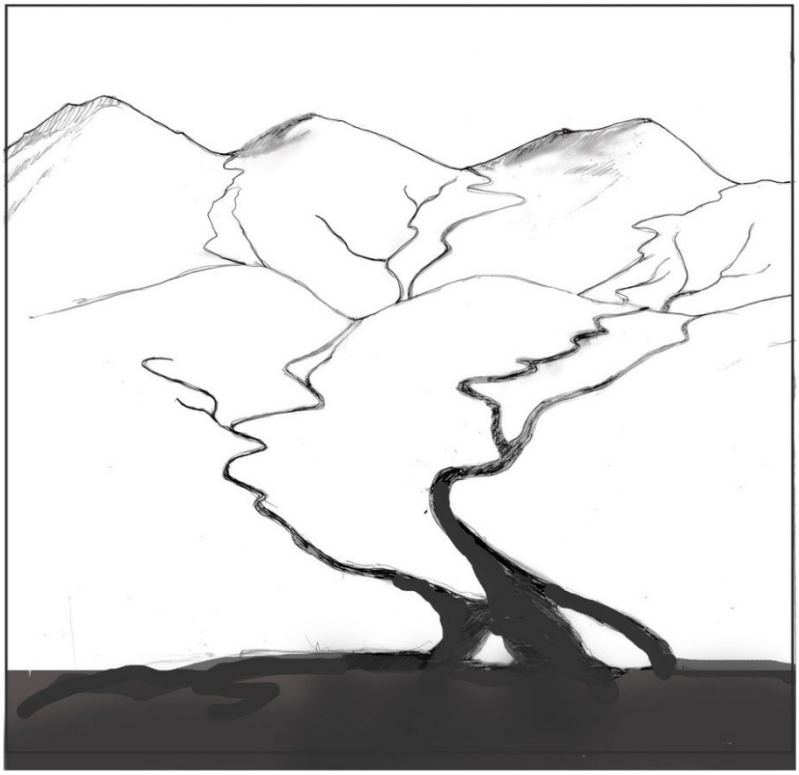
The Outside Story

Headwater Streams Are Vital Sources of Clean Water

By Barry J. Wicklow



For nearly 15 years, I have been exploring the headwaters of a river near my home. The entire drainage area, encompassing all the streams, rainfall, and snowmelt that pass into a single river, is called a watershed. Within each watershed, a system of rivers and streams forms a network, in which small first-order streams (headwaters) meet to form second-order streams that converge to form third-order streams, and so on.

While headwater streams are the smallest in this hierarchical network, they comprise a whopping 70 percent of the drainage area – and nearly 80 percent of stream length in watersheds. They are the capillaries of the watershed's circulatory system and critical to the health of the entire stream network.

These streams provide cold, high-quality water to the river system; they regulate the downstream flow of nutrients, the transport of sediment, and distribution of organic matter. They also intercept rain and slow flood waters, remove pollutants, and provide fish and wildlife habitat. Additionally, headwater streams serve as ground water facilitators, acting both as gathering sites for ground water replenishment after precipitation and as the suppliers of surplus ground water, surface runoff, and snowmelt downstream.

Headwater streams are the stream network's strongest defense against climate change. For example, headwater streams provide cold water refugia for downstream species during warm periods and provide spawning habitat for species, such as the eastern brook trout, which is declining drastically throughout its native range.

Temperature is a primary variable in stream ecosystems. Stream ecologists J. David Allan and Maria Castillo have determined that water temperature influences the distribution, metabolic rates, physiology, life cycle, fertility, and growth of stream species, as well as stream processes such as biological production, leaf breakdown, and nutrient uptake. Self-sustaining populations of brook trout, for example, require water temperatures at or below 64 degrees.

The ground water and shade of trees along the banks of headwaters keep these streams cool. Dusky salamanders, two-lined salamanders, and spring salamanders live in headwater streams. Birds, such as the

winter wren and Louisiana waterthrush, nest along the stream banks. Mink, otters, and bats use headwater streams as travel corridors. The streams also harbor a unique and diverse aquatic insect community.

I discovered this community early in life. One of my favorite places to sit as a boy was a fallen tree trunk that arched over a small headwater brook. From my perch, I could look through the cool, clear water to see small critters scurry across the sand and over and under rocks. These were cold-adapted aquatic insects that thrive in headwater streams. For instance, many species of stoneflies require cold, clean, highly oxygenated water to survive; a single headwater stream may harbor several stonefly species. (In addition to being an integral part of the food chain, stoneflies, mayflies, and caddisflies serve as important bioindicators of water quality. Stoneflies are now considered one the world's most endangered faunas.)

Because headwater streams are small and have low water volumes, they are extremely sensitive to disturbance. And there are no regulations that protect these vital streams. Development, impervious surfaces, runoff, pollution, loss of the tree buffer along the stream, and loss of connectivity endanger our headwater streams and, as a result, jeopardize larger streams and rivers. Harm to headwater streams echoes throughout the entire stream network.

In an effort to share the importance of these streams and boost conservation around them, in 2010, my research students and I began a long-term study of 12 tributaries of the Piscataquog River in Francestown, New Hampshire. We recorded hourly air and water temperatures and measured water quality, identified stream insects, and determined the genetic structure of resident brook trout populations. Some of our findings have shown that populations in our headwater streams are wild, *native* brook trout (without hatchery influence). Moreover, each headwater stream population is genetically distinct. This data has been used to inform landowners and to protect our local headwater streams through conservation.

These days, in my visits to the headwaters of the Piscataquog River, the sound of the flowing waters, the scent of ferns and moss, and the rich life in and around these headwaters give me a sense of well-being. The more I study these streams, the more I understand the importance of their clean, cold waters.

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