The Science of 50-foot Riparian Buffers in Headwaters

BY DEANNA (Dede) H. OLSON

One hop and I can cross the stream at many of my managed-forest study sites. These headwaters may appear insubstantial in comparison to the rushing waters downstream, but after 20 years of research the complexities of these small streams and their adjoining riparian zones are being revealed. In western Oregon headwater streams, I have been conducting studies of the effects of alternative riparian buffer widths with upland forest thinning on aquatic and riparian habitats and animals.

A wealth of knowledge continues to emerge from this work, with many different conditions and processes at play around the edges—specifically within 50 feet of the stream edge and 50 feet from the upland buffer edge toward the water. A 50-ft minimum buffer width with upland thinning is gaining support for retaining or restoring a host of aquatic-riparian conditions. For me, that's about 16 steps upslope. For some organisms, it's home territory for a lifetime.

I am part of an interagency team implementing the Density Management and Riparian Buffer Study of western Oregon (see Figure 1). In 1993, we considered what forestry information might be needed in 20 years' time and envisioned the need for more science on the efficacy of different buffer widths around small streams to retain aquatic-riparian values in the context of upland thinning. This need rang true given that much of the moist forest landscape was in early clearcuts, small streams were numerous, and there was uncertainty about exactly what the key ecological values were in those headwater drainages. My contribution has been to design the riparian buffer component and focus on studying the aquatic habitats and vertebrates in those managed headwaters before and after two upland thinnings.

Pre-treatment, we characterized stream habitats and inhabitants at the managed-forest study sites where stands were 30-80 years old, naturally regenerated after clearcutting. We found 15 aquatic-dependent vertebrates in and along banks of our streams, each with unique habitat associations, and most streams were spatially discontinuous, going subsurface for short distances. An upland thinning treatment reduced dense overstories to 80 trees per acre, with skips and gaps for added structural heterogeneity. Along streams, 1 of 4 no-entry buffer zones (see Figure 2) were delineated: the one and two site-potential tree-height buffers of the federal Northwest Forest Plan, and two alternatives—a 50-foot minimum-width buffer that varied in width with site conditions (unique trees, steep slopes, seeps) and a 20-foot buffer designed to retain streambank stability. Also, no-harvest control units were designated, yielding a before-after-control-impact study design implemented at 13 sites from Mount Hood to Coos Bay. Today, 8 sites have persisted through the second thinning (~12 years after the first thinning), reducing the largest overstory trees to 30 trees per acre. In this region, the density of the largest trees in late-successional and old-growth forests can be less than 30 trees per acre. At this entry we aimed to retain accelerated tree growth of under- and over-story trees.

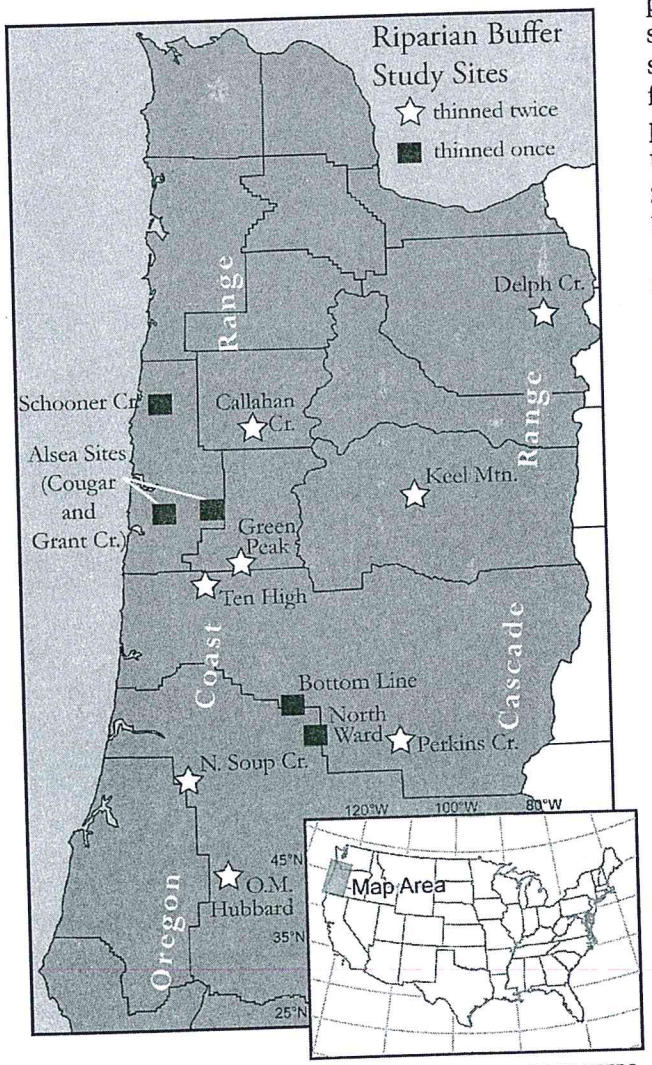
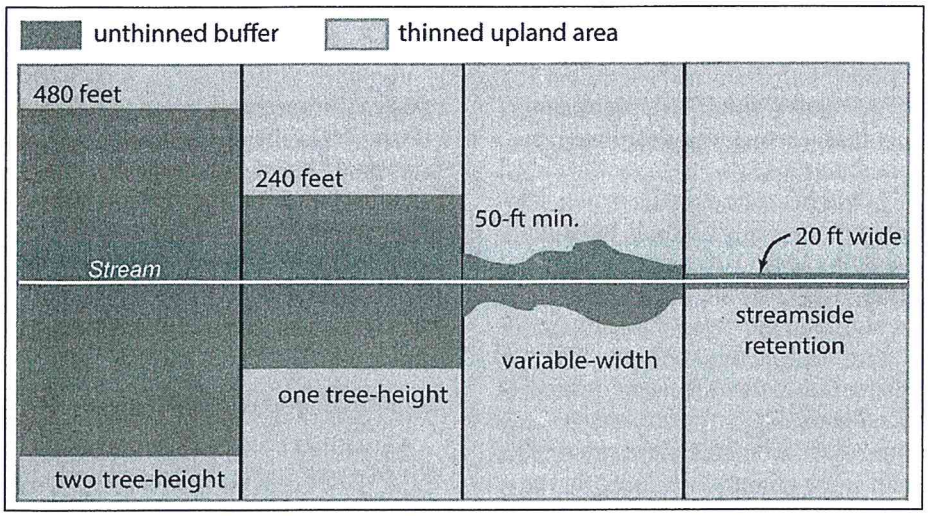


Figure 1.

SOURCE: KATHRYN RONNENBERG, US FOREST SERVICE, PACIFIC NORTHWEST RESEARCH STATION

The value of the 50-foot minimum buffers in the context of this dual thinning harvest has emerged from several related studies. First, we saw a buffer effect on species. Two salamanders exhibited reduced counts in and along streams with the 20-foot buffer: Dunn's salamanders (*Plethodon dunni*) along stream banks within ~6 feet of water 10 years after the first thinning and 1 year after the second thinning and instream torrent salamanders (*Rhyacotriton* spp., Figure 3) 1 year after the second thinning. Both taxa had increased counts along streams with the 50-foot minimum buffer and the one-tree buffer after the second thinning. These salamanders are northwest endemic species of concern. Relative to all the species in our study, torrent salamanders were indicators of discontinuous streams in our headwater systems and downstream they appear to be displaced by predatory coastal



SOURCE: KATHRYN RONNENBERG, US FOREST SERVICE, PACIFIC NORTHWEST RESEARCH STATION

Figure 2. Four stream-riparian buffer widths examined with upland thinning.

giant salamanders (*Dicamptodon tenebrosus*) and fish. Two of the four torrent salamander species in the region are currently under consideration for listing as US threatened or endangered species.

Woodland salamanders (family Plethodontidae) live on the forest floor and never need to be immersed in water. Studies of this assemblage at a subset of our sites revealed a thinning effect 2 years after the first thinning at 1 of 2 sites, and no thinning effect after 5-6 years at 3 sites. Importantly, we found that western red-backed salamanders (*Plethodon vehiculum*) most often occurred within 16 feet of water, and Ensatina (*Ensatina eschscholtzii*) were most often found between 32 and 50 feet from streams. In a mark-recapture study, we found more salamander movements within ~50 feet of streams. The riparian zone within 50 feet of streams appears to be a structured salamander metropolis almost like an I-5 corridor! Centrally nested in food webs, these animals are indicators of a larger community thriving along streams. A 50-foot minimum width no-entry buffer would benefit this riparian assemblage.

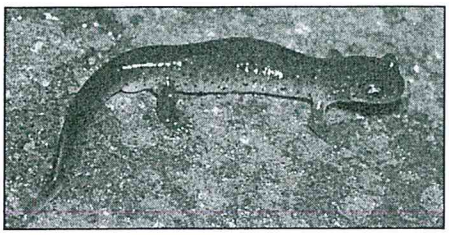


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Figure 3. After two thinning harvests, fewer torrent salamanders (*Rhyacotriton* spp.) were found in streams with the narrowest buffer (20-feet wide), and more were found in streams with the 50-foot minimum-width buffer.

Instream habitats were retained with buffers, with one exception. More early-decay-stage wood was found in streams with the 20-foot buffer. Hence, an expectation that wide buffers would provide down wood by self-thinning over time has not been supported by our study, or at least not yet.

Other "50-foot patterns" have emerged. Over 80% of our instream wood that we could trace to source trees came from within 50 feet of streams. Our study of riparian tree growth detected an edge effect of accelerated growth extending 50-feet into the no-entry buffer from the upland thinning edge. This means that riparian forest restoration can be accelerated by adjacent thinning, for example, growing larger trees faster for future large down wood recruitment. Lastly, microclimate analyses conducted by colleague Paul Anderson of PNW show that there is a zone ~50-feet wide along streams where the steepest "stream effect" gradient occurs, the zone of cool, moist conditions that attenuates as you step away from streams, and that through two thinnings, water temperature has not been affected with any buffer.

Thus, a 50-foot minimum buffer with upland thinning retains or restores several headwater aquatic-riparian values, including animals and habitat conditions. As a scientist, I am ready to test this buffer in different contexts—we have moved one step forward in forest buffer designs and at this reset point, a few more steps up that science slope are now needed.

For more reading visit www.fs.fed.us/pnw/lwm/aem/people/olson.html. ◆

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