Northwest Fire Science Consortium
A JFSP FIRE SCIENCE EXCHANGE NETWORK

FIRE EFFECTS ON STREAM ECOSYSTEM RESPONSES IN WESTERN OREGON WATERSHEDS

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Wildfire is an important landscape disturbance for stream ecosystems as it can have a prominent influence on the recruitment of downed, dead pieces of in-stream large wood (hereafter, LW). LW is important for pool formation, affecting channel morphology and flow conditions, increasing sediment storage and organic matter retention, and providing refugia for fish and amphibians. Wildfire and post-fire forest harvest can influence LW recruitment to streams, which may also vary depending on fire severity and pre-fire stand age. Fire and post-fire forest harvest (salvage logging) have also been shown to affect water quality, stream temperature, periphyton, macroinvertebrates, and amphibian and fish populations.

On 7 September 2020, strong winds in western Oregon ignited and spread many small fires, leading to multiple simultaneous megafires (fires > 404 km2) that burned across multiple land ownerships. These fires burned at differing severities, resulting in a range of post-fire riparian and freshwater conditions and an opportunity to evaluate aquatic and riparian responses to fire across ownerships that vary in elevation, forest stand age, and forest-management strategies. To better understand these dynamics, the authors in this study measured riparian overstory survival, LW, and coarse wood (wood in riparian areas), as well as in-stream physical, chemical, and biological variables to fire severity and pre-fire stand age in 24 streams in western Oregon from 8-11 months following multiple fires, including the Riverside, Beachie, and Holiday Farm Fires.

KEY FINDINGS

- Forested streams, fire, and LW were linked. Fire severity explained more of the variation in LW than pre-fire watershed stand age.
- More severe fires burned more overstory riparian vegetation, leading to:
  - Increased light, dissolved organic matter (DOM) concentrations, macroinvertebrate densities, and fish densities;
  - Reduced canopy cover, LW diameter, macroinvertebrate diversity.
- Expected increases in coarse wood in riparian areas and LW volume along with associated increases in fine sediment were not observed, possibly due to a lack of high intensity rain events in the first year following fire.
- Red alder trees had much greater riparian overstory survival than conifers in burned areas, including in severely burned riparian zones.

The Northwest Fire Science Consortium is a regional fire science delivery system for disseminating knowledge and tools, and a venue for increasing researcher understanding of the needs of practitioners.

RESULTS

Fire severity exerted strong control on stream responses across watersheds, explaining more of the variation in the aquatic ecosystem responses than pre-fire stand age. At higher fire severities, riparian tree mortality, salvage logging, light, DOM concentrations, and fish densities were higher, whereas canopy cover, large wood diameter, and macroinvertebrate diversity were lower. Macroinvertebrates, which are secondary producers, responded to fire severity by exhibiting an increase in density, but there was a decrease in diversity, scrapers, intolerant, and sensitive taxa in more severely burned watersheds. Fish density was higher in more severely burned watersheds across 24 stream reaches and multiple fires. Overstory mortality in burned riparian areas was lower for red alder (12%) than western redcedar (69%). The lack of high-intensity precipitation events may have limited transport of large wood and sediment in the time between the fires and sampling (8 to 11 months). These responses may change in the future when large storm events transport riparian coarse wood to streams in the most severely burned watersheds. The larger size of coarse wood in riparian areas versus large wood in streams suggests potential future recruitment of larger-diameter wood into streams from riparian zones in severely burned watersheds following future high flows.

MANAGEMENT IMPLICATIONS

Management of forests following fires will differ with landowner objectives, leading to different trajectories of stream ecosystem recovery, and warranting monitoring of responses beyond one year post-fire to understand their recovery over time. For example, how do responses of macroinvertebrates, fish, and large wood recruitment change over time? How will recovery differ across gradients of fire severity and pre-fire forest management intensity? Future large wood recruitment may occur as dead standing trees fall and large precipitation events deliver this riparian coarse wood to streams. Whether post-fire salvage logging includes or avoids harvest of large dead trees in riparian areas is likely to influence future and long-term large wood recruitment, but more work is needed to understand the effects of salvage logging across different fire severities. Red alder has an important function in burned riparian zones—as a fire-resistant species, it may provide root strength, bank stability, and help facilitate a more rapid recovery for streams in fire-prone landscapes. This suggests that maintaining overstory species diversity in riparian areas is important. Continued aquatic and riparian ecosystem monitoring of these watersheds will aid in understanding long-term effects of post-fire management activities on aquatic ecosystems, which is expected to affect large wood recruitment to streams for decades.

MORE INFORMATION

This brief is based on the following article:
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This research brief was written by Brooke Penaluna, Ashley Coble, Laura Six, Jake Verschuyl, and Autumn Ellison with review by Carrie Berger and Emily Jane Davis. Photos: Coastal Cutthroat Trout (front top) taken by David Leer, Cripple Creek a year after fire (front bottom) taken by BayLee Laufer, marking wood on Canyon Creek (back) taken by Jake Verschuyl. The Northwest Fire Science Consortium is funded by the Joint Fire Science Program.