

Wildfire effects on stream food webs and nutrient dynamics in Glacier National Park,  
USA

Craig N. Spencer, Kristin Odney Gabel <sup>2</sup>, and F. Richard Hauer<sup>3</sup>

Biology Department, Augustana College, Sioux Falls, SD 57197, USA

<sup>2</sup> Eden Prairie Public Schools, Central Middle School, 8025 School Rd., Eden  
Prairie, MN 55344, USA

<sup>3</sup> Flathead Lake Biological Station, 311 BioStation Lane, Polson, MT 59860, USA

e-mail: [craig\\_spencer@augie.edu](mailto:craig_spencer@augie.edu)

Tel: 605-274-4716

Fax: 605-274-4718

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## Abstract

We documented immediate and mid-term (5 y) impacts on streams from a large (15,500 ha) wildfire in northwestern Montana. Fire-related impacts were ecosystem-wide, extending from water chemistry to fish. During the initial firestorm, phosphorus and nitrogen levels increased 5- to 60-fold above background levels resulting from aerial deposition from smoke and ash. Nutrients returned to background concentrations within several weeks after the fire. During subsequent years, nutrient concentrations periodically increased in fire-impacted sites compared to reference sites, especially during spring run-off.

Evidence of post-fire changes was also documented in the aquatic food web via stable isotope analyses. Macroinvertebrates and fish from fire-impacted sites were significantly more enriched in  $^{15}\text{N}$  and depleted in  $^{13}\text{C}$  than consumers from forested reference sites ( $P < 0.001$ ). The post-fire isotopic shift in consumers was consistent with increased utilization of algae and/or other autochthonous food sources together with decreased reliance on terrestrial leaf litter and other allochthonous food sources. Such a post-fire shift from a detritus-based to a periphyton-based food web fits predictions of the River Continuum Concept following canopy removal and nutrient enrichment.

Following decades of active fire suppression, forest managers are now contemplating aggressive efforts to reduce the fuel build-up noted in forests throughout the western US. Such efforts could involve increased use of fire and mechanical thinning and harvest. Results from our work and others suggest that expanded fire activity could mobilize substantial quantities of highly available nutrients to lakes and streams. With significant nutrient delivery mechanisms involving water, as well as airborne transport via smoke and ash, the potential for increased nutrient loadings to surface waters could extend well beyond the catchment of any particular fire. As natural

resource managers contemplate expanding the use of fire as a forest restoration tool, they face the dilemma that such efforts could run counter to a decades-long effort to reduce nutrient loadings to lakes and other surface waters threatened by eutrophication.

*Keywords:* wildfire, stream food webs, nutrients, stable isotopes