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Short- and long-term effects of fire on soils and carbon and nutrient budgets in forests of the eastern Sierra Nevada Mountains, USA

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In this paper, we review studies of both prescribed and wildfire effects on soils and nutrient budgets conducted over the last 15 years in and around the Lake Tahoe Basin in the eastern Sierra Nevada Mountains, USA. Total fire suppression over most of the 20^{th} century has caused a buildup of forest floor and understory fuels such that stand-replacing wildfires are now common. The forest floor buildup is also responsible for significant elevations of dissolved ionic N and P forms in runoff waters, potentially contributing to the pollution of Lake Tahoe. In general, we have found that fire (either prescribed or wildfire) has minimal immediate effects on mineral soil C and nutrients with the exception of increased NH_4^+ and SO_4^{2-} following wildfire. The most significant immediate effect of fire is on the forest floor, where N losses by volatilization and other nutrient transformations from organic to inorganic forms are substantial. Both prescribed and wildfire cause substantial losses of ecosystem N capital, which are calculated to equal over 10,000 years of loss by leaching in these systems. The lost N can be rapidly replenished by the presence of N-fixing shrubs following wildfire, and these shrubs also appear to improve soil base cation status to an even greater extent than the fire itself did. However, N-fixers compete with re-establishing forest vegetation and therefore prevent the recovery of lost ecosystem C. Regular prescribed fire, on the other hand, may preclude the establishment of N-fixers and cause long-term declines in ecosystem N status.