

The Effects of Fuel Load Management on Soil Health

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Abstract: Oak woodlands, defined by their distinctive grassland valleys and oak canopies, are critical in supporting biodiversity, maintaining soil health, and promoting ecological stability. However, these landscapes face growing threats from wildfires, drought, conifer encroachment, and land development. These landscape changes have drastically altered fire regimes and increased fuel loads, leading to catastrophic wildfires. Effective management is essential to mitigate fire risks while preserving soil health, a vital component in water retention, nutrient cycling, and overall ecosystem resilience. This research investigates the effects of different fuel reduction methods, including mechanical thinning, prescribed fire, and natural wildfire, on soil health within oak woodland ecosystems. A randomized sampling design, stratified by treatment type and fire history, was used across multiple sites to evaluate the impacts of these fuel reduction methods. Soil samples were analyzed to measure properties such as soil fertility, water infiltration, bulk density, nutrient availability, and microbial activity before and after treatment applications. The study also examines the broader ecological effects, including changes in vegetation structure, biodiversity, and ecosystem recovery. The preliminary data showed that units treated with fire and mastication had higher grass and litter cover with reduced woody presence. In contrast, untreated units exhibited higher woody cover and litter accumulation. The unit impacted by the wildfire in 2020 displayed increased bare ground and higher hydraulic conductivity than other treatments. These initial findings show how different fuel reduction methods influence soil properties and vegetation structure. The study's findings will provide valuable insights into the long-term effects of different fuel reduction strategies on soil quality and ecosystem resilience. The research will help shape sustainable land management practices that enhance fire resilience while minimizing adverse effects on the oak woodland ecosystem. The results will equip land managers with the knowledge to make informed decisions that preserve the ecological balance of oak woodlands and ensure their long-term sustainability.