Effect of 70 years of recreational car camping on vigor of old growth coast redwood and Douglas-fir

Steven R. Martin
Professor
Dept. of Environmental and Natural Resource Sciences
Humboldt State University
Arcata, CA

John D. Stuart
Professor
Dept. of Forestry and Watershed Management
Humboldt State University
Arcata, CA

Portia Halbert
Resource Management Specialist
Big Basin Redwoods State Park
Santa Cruz, CA

Mark A. Rizzardi
Associate Professor
Department of Mathematics
Humboldt State University
Arcata, CA

1. Introduction Recreationists have been car camping at Blooms Creek campground in Big Basin Redwoods state park annually for 70 years. Park managers are interested in better understanding the effects that such long-term recreational use may have on the health and vigor of the forest overstory.

2. The Problem Trampling and vehicle use are major causes of impacts to soils in wildland recreation areas, including soil compaction, increased soil density, reduced macroporosity and aeration, changes in soil structure and stability, reduced litter and humus layers, reduced infiltration rates, increased runoff and erosion, changes in soil temperature regimes, a reduction in soil microorganisms, and changes in soil chemistry and available nutrients; these impacts are usually assumed to adversely affect plant vigor.

Concern over the effects of long-term recreational trampling on the vigor of mature redwoods has existed since the early days of the redwood state parks, but the few investigations into those perceived impacts have been inconclusive. This investigation seeks to measure more directly and quantitatively the vigor of mature redwoods and Douglas-fir in a campground that has withstood more than 70 years of recreational trampling.

3. Methods The study was conducted in Big Basin Redwoods State Park. Study sites were located in the Blooms Creek campground and along the relatively untrammeled Opal Creek. The Blooms Creek campground was opened in the 1930s and consists of 48 drive-in campsites and 4 walk-in sites. The Opal Creek site has a narrow, lightly used trail running through it with no evidence of off-trail use, and served as the control site.

Study sites were located in alluvial redwood forests with redwood and Douglas-fir as the dominant or co-dominant species. In each of the two study sites, we sampled all of the redwood and Douglas-fir trees that were emergent or dominant crown class. This resulted in sample sizes of 35 redwood and 22 Douglas-fir trees sampled in the campground, and 19 redwood and 12 Douglas-fir trees in the control site.

For each sampled tree we measured height and crown length, circumference of the tree, sapwood thickness and bark thickness. We used these measurements to calculate live crown percent, diameter, radius inside the bark, total basal area at breast height, heartwood basal area, and sapwood basal area. We then calculated crown length to sapwood basal area (CL/SBA) as an index measure of crown density, our chosen indicator of tree vigor.

4. Results A Mann-Whitney test for equality of medians was performed to compare redwoods in the campground and control sites, and also to compare Douglas-firs in both sites. For redwoods, there was no significant difference (at $\alpha = .05$) in height, diameter, crown length, live crown percent, sapwood basal area, or the CL/SBA index measure of crown density between the campground and control study sites. For Douglas-fir, the only significant differences between the campground and control sites were for length of live crown and live crown percent, with Douglas-firs in the control site possessing a longer live crown and a larger live crown percent; there was no significant difference for crown density.

To further test for a campground effect controlling for tree height and diameter, separate linear regression models were constructed for each tree species. There was no statistically significant campground effect for the redwoods (P=0.79) and Douglas-firs (P=0.94) after controlling for tree height and diameter. (Model: $\log(CSI) = \beta_0 + \beta_1 \log(Diameter) + \beta_2 \log(Height) + \beta_3 Campground$)

5. Conclusions Despite intuitive concerns expressed by academics and resource managers alike regarding the detrimental effects of recreational trampling on the health and vigor of mature trees in recreational areas, our study of coast redwoods and Douglas-firs in a California state park recreational campground used annually for more than 70 years found no significant difference in crown sparseness between overstory redwoods and Douglas-firs in the campground with those in an untrampled control plot.