

BURNING UNDER OLD-GROWTH PONDEROSA PINES ON LAVA SOILS



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Every year, fire managers successfully restore surface fires to ponderosa pine forests that have not burned for a century or more. Nevertheless, the power of fire can have unanticipated effects on stressed trees. In northern Arizona, an episode of unusual old-growth tree mortality, after two prescribed burns on shallow volcanic soils, provided managers with a learning opportunity and a lesson in caution.

High Tree Mortality

Ponderosa pine forests at the base of Mt. Trumbull in the Grand Canyon–Parashant National Monument have been the focus of extensive research in ecological restoration since 1995. Sponsored by the USDI Bureau of Land Management, Arizona Game and Fish Department, and Northern Arizona University, the research gives managers information about how to restore natural surface fire regimes and open forest conditions using productive native vegetation. Since 1995, 650 acres (260 ha) have been treated with thinning, fuel reduction, and prescribed fire. An additional 396 acres (160 ha) have been treated with fire alone.

Most treatments in the forest have had good initial results (Fulé and others 2001). However, two prescribed burns resulted in the death

Prescribed burning on volcanic soils in the Grand Canyon's Parashant National Monument produced unanticipated results.

of an alarming amount of old-growth ponderosa pines. In October 1999, 5 acres (2 ha) at the Old Folks Home site were burned and in March 2000, 25 acres (10 ha) at experimental block (EB) 1 were burned. The sites were on two edges of a large, shallow-soiled lava flow, which historically had high-frequency, low-intensity surface fire regimes but had remained largely fire free for 130 years. The area had experienced severe drought in 1977, 1989, 1996, and 2000.

Before conducting the burns, all old-growth trees at both sites were protected against heat damage to the cambium layer by raking accumulated forest floor litter away from the tree trunks; research has shown that removal of deep forest floors prevents tree girdling by fire (Sackett and others 1996). The 1999 burn site had no tree thinning before burning, whereas the 2000 burn site was previously thinned to help restore the conditions that existed before the frequent fire regimes were disrupted (Covington and others 1997).

Shortly after the 2000 fire, postburn measurements at EB1 indicated minimal fire effects; however, field observation in May 2001 showed that many old trees were dying. Mortality of the large trees was also

observed in 2001 at the Old Folks Home site (figs. 1 and 2). Younger ponderosa pine trees at both burn sites were not killed.

The unusual mortality seemed confined to the lava flow region. High mortality was not observed on the adjacent thinned 650 acres (260 ha) or unthinned 396 acres (160 ha), which were burned between 1996 and 2001. However, Swezy and Agee (1991) found high old-growth ponderosa pine mortality following a fire at Crater Lake, OR, in another ponderosa forest on shallow lava soils. They suggested that the cause was heat injury to fine roots (fig. 3). Other hypotheses include reduced tree vigor, drought stress, or lack of wind to disperse heat during the Old Folks Home burn.

A census of trees greater than 5.9 inches (15 cm) in diameter was conducted on the site of the Old Folks Home burn on June 5 and 6, 2001 (fig. 4). Of 247 ponderosa pine trees, 91 (37 percent) were dead. Five of the dead trees had great decay, suggesting that they probably died before the prescribed burn. Not counting these trees, the mortality rate was 35 percent. The pattern of mortality varied with tree size. Only 19 percent of the trees that were less than 20 inches (50 cm) died, compared with a 67-percent mortal-

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Figure 1—Mortality of mature trees on lava soils at the Old Folks Home burn site at the base of Mt. Trumbull, AZ. The burn occurred in October 1999. Photo: Greg Verkamp, Ecological Restoration Institute and School of Forestry, Northern Arizona University Flagstaff, AZ, 2001.



Figure 2—Large trees dying after prescribed burning on lava soils in an unthinned stand. Note the surviving trees in background and at left. Photo: Greg Verkamp, Ecological Restoration Institute and School of Forestry, Northern Arizona University, Flagstaff, AZ, 2001.

ity rate for trees that were greater than 20 inches (50 cm) in diameter. A similar comparison will be done at EB1 in a few years, when the fire-caused mortality is fully evident.

Future Trends

Conservation of the old-growth trees that are scattered across the landscape is an important project goal. The Old Folks Home and EB1 sites make up less than 3 percent of the total area burned at Mt. Trumbull, so the death of old trees is not widespread. However, it might be necessary to stop burning on the lava flow pending further information from both experimental sites. Researchers might repeat pre- and postburn measurements on permanent monitoring plots and compare them with a nearby control site; they might also study fine-root mortality and drought stress on old-growth trees in the lava area. Additionally, managers should consider using only nonfire treatments, such as thinning alone, for forests on lava soils.

Unfortunately, the true extent of tree mortality on the EB1 and Old Folks Home experimental sites remains unknown. Several years might pass before needles on the remaining large ponderosa pine trees, which appear to be alive and well, begin prematurely to brown and fall.

References

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Figure 3—Exposed tree root on shallow soils. A mix of dying and surviving trees is evident in the background. Photo: Greg Verkamp, Ecological Restoration Institute and School of Forestry, Northern Arizona University, Flagstaff, AZ, 2001.

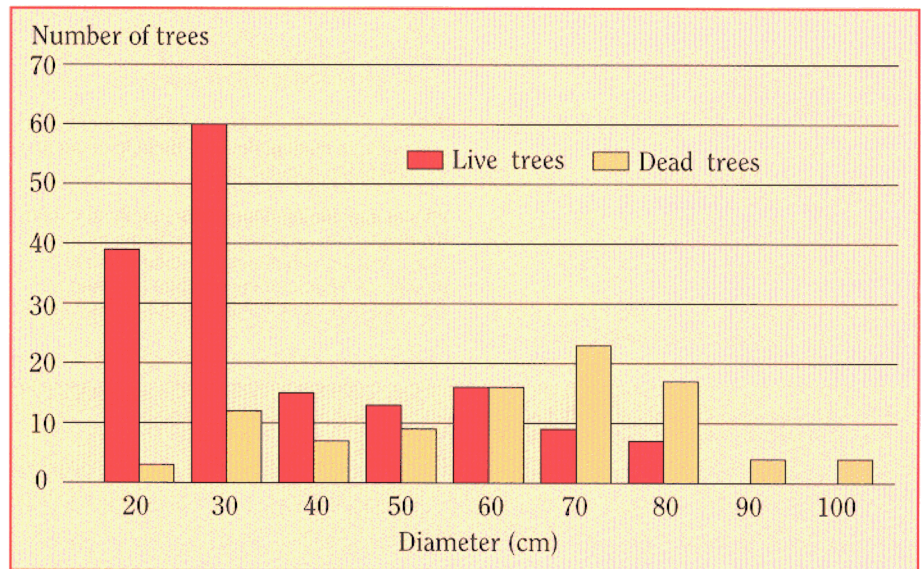


Figure 4—Diameters of living and dead ponderosa pine trees at the Old Folks Home burn site. Most large trees were killed, whereas most small trees survived.