

# Natural Reforestation in the Northern Sierra Nevada-Donner Ridge Burn

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THE CONIFEROUS forests of the northern Sierra Nevada usually are described as pine (*Pinus*) or fir (*Abies*) dominated. The pines of this region are designated as fire-type vegetation because pine seed germination after fires is common. There are many statements in the literature about this natural process of reforestation, but we have found little or no quantitative data on the phenomenon. In this study we have attempted to gather detailed information on conifer regeneration on the Donner Ridge burn, near the University of California Sagehen Creek Field Station, Nevada County, California.

## HISTORY OF THE FIRE

A great deal of slash accumulated during the construction of Interstate Highway 80 over Donner Summit in the northern Sierra Nevada in the spring and summer of 1960. The Highway Depart-

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ment obtained a permit from the U.S. Forest Service, and at 2:30 P.M. on August 19, 1960, set a fire to eliminate this slash. Fanned by sudden westerly wind reaching 70 mph, the fire quickly escaped into the surrounding forests. Four days and 39,460 acres later, the Donner Ridge fire was controlled north of Reno, Nevada, after destroying many acres of prime timber and numerous vacation homes.

The Sagehen Creek Field Station is located 12 miles north of Truckee, California, and about 10 miles northeast of Donner Summit. Early reports were that the station had been destroyed, but these proved largely erroneous. Only one outlying building was lost, although the fire did pass within several hundred yards of the station headquarters and destroyed much of the surrounding forest.

After the fire the Sagehen Creek area was seeded by the U.S. Forest Service with 1080 rodent poison mixed with various grass seeds (e.g., *Phleum pratense* and *Dactyllis glomerata*).

### ENVIRONMENTAL PARAMETERS

The Sagehen Creek Field Station is situated on the eastern side of the Sierran Crest at an elevation of approximately 1950 meters (6400 feet), on the north side of the Sagehen Creek basin. Precipitation in the area is highly variable, ranging from 20 to 40 inches (50.8–101.6 cm) annually. Usually about two-thirds of this precipitation falls in the form of winter snow. The soils of the area are slightly acidic, well drained, and formed on andesite or andesitic breccia (Johnson and Needham, 1966). In the winter, temperatures seldom fall much below 0°F (−17.8°C), although they remain below freezing for prolonged periods of time. In summer there is a great diurnal temperature variation; a range from below freezing at night to the mid-70's or higher during the day is common.

The area which we studied has been logged and burned in the past, although exact records were not available. Records of the nearby Truckee Ranger Station indicate that neither logging nor burning has occurred in the general area since 1930. It seems likely that prior to the Donner Ridge fire the Sagehen Creek study area had not burned since before the turn of the century.

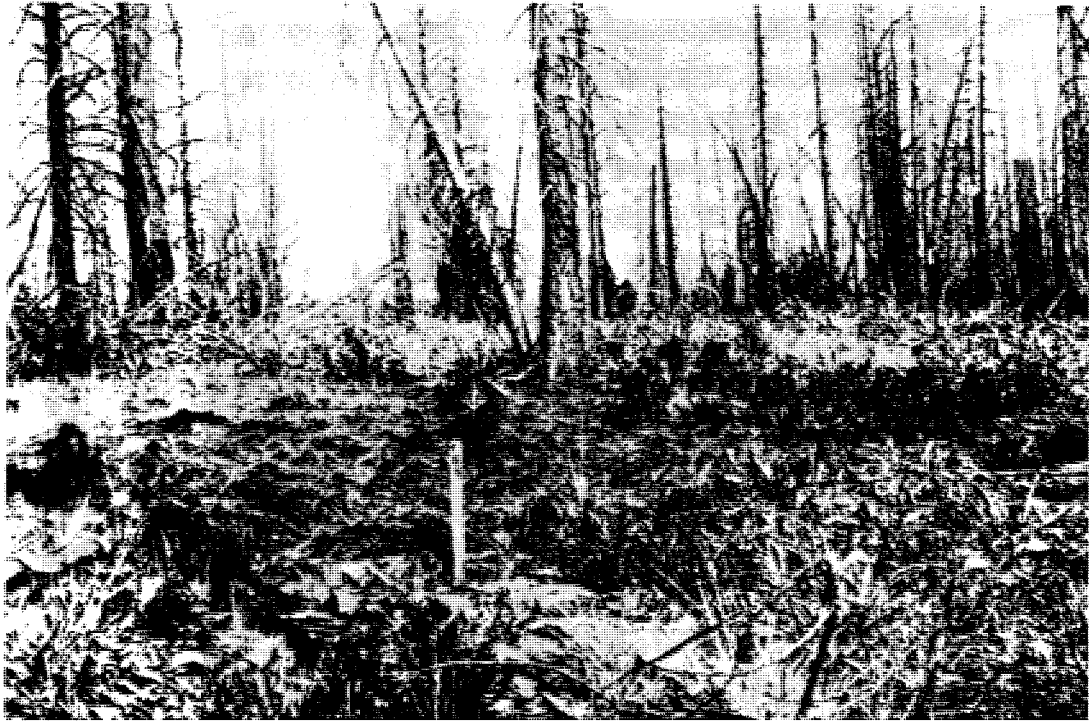


FIG. 1. Photograph of the burned study plot, Sagehen Creek, California, taken in October, 1966. Note young pines in foreground.

## METHODS

In 1965, 5 years after the fire, two permanent 20-acre study plots were established near the field station, one on the burn and one in the adjacent unburned forest. Each plot was divided into sub-plots 100 feet (30.5m) on the side, with steel fenceposts at each grid intersection. All woody vegetation was destroyed on the burned plot except for a few mature trees nearest the unburned forest (Fig. 1). On the unburned plot a mature conifer forest predominates (Fig. 2). Studies of the plant and animal life of the two plots were initiated in 1965 and are continuing (Bock and Lynch, 1970).

Conifers in the Sagehen Creek area include Jeffrey pine (*Pinus jeffreyi*), lodgepole pine (*P. murrayana*), sugarpine (*P. lambertiana*), white fir (*Abies concolor*), and red fir (*A. magnifica*). By direct counting of all trees on randomly selected sub-plots, we gathered data on the numbers and kinds of conifers comprising the mature



FIG. 2. Photograph of the unburned study plot, Sagehen Creek, California, taken in December, 1966.

forest and the post-fire vegetation. Ten sub-plots on the unburned study area were censused, while 13 sub-plots were counted on the burn. We counted a total of 3097 trees. These were divided into three categories: mature (more than 25cm dbh); immature (less than 25cm dbh but more than 2cm in diameter); and seedlings (less than 2cm in diameter). *Abies* seedlings were identified only to genus level; all other individuals were identified to species (Munz and Keck, 1959).

In order to investigate survival of conifer seedlings on the burned plot from the fifth year after the fire, 103 seedlings were tagged in the summer of 1965.

## RESULTS

On the unburned study plot (Table 1), pines were the most common mature tree (53.9 percent), but they comprised a considerably

TABLE 1

RESULTS OF COUNTS OF ALL CONIFERS ON 10 SAMPLE PLOTS IN THE UNBURNED FOREST, SAGEHEN CREEK, CALIFORNIA (N = 2504 PLANTS)

<i>Species</i>	<i>Mature Trees</i>	<i>Immature Trees</i>	<i>Seedlings</i>
<i>Abies concolor</i>	80	1155	—
<i>A. magnifica</i>	9	63	—
<i>Pinus jeffreyi</i>	101	381	1
<i>P. lambertiana</i>	3	22	1
<i>P. murrayana</i>	0	6	0
	89	1218	682
	104	409	2

<i>Species</i>	% <i>Mature</i>	% <i>Immature</i>	% <i>Seedlings</i>
<i>Abies concolor</i>	41.5	70.9	—
<i>A. magnifica</i>	4.6	4.0	—
<i>Pinus jeffreyi</i>	52.3	23.4	—
<i>P. lambertiana</i>	1.6	1.4	—
<i>P. murrayana</i>	0.0	.3	—
	46.1	74.9	99.7
	53.9	25.1	0.3

smaller portion of the immature tree flora (25.1 percent), and the seedlings counted were 99.7 percent fir. By way of contrast, in the census on the burned plot (Table 2) pines represented 93.8 percent of the sample of post-fire seedlings.

TABLE 2

RESULTS OF COUNTS OF ALL CONIFER REGENERATION ON 13 SAMPLE PLOTS ON THE DONNER RIDGE BURN, SAGEHEN CREEK, CALIFORNIA (N = 593 PLANTS)

<i>Species</i>	<i>Number</i>	<i>Percent</i>
<i>Abies</i> spp.	37	6.2
<i>Pinus jeffreyi</i>	496	83.6
<i>P. murrayana</i>	60	10.2
	556	93.8

Fifteen of the tagged seedlings on the burn were lost in the winter of 1965–66 due to faulty labelling. Of the remaining 88, 100 percent were still alive in 1968, although two pines and one fir appeared to be in poor condition. These data suggest a high rate of survival once the seedlings became established on the burned study area.



FIG. 3. Photograph of an immature Jeffrey pine on the unburned study plot, showing spindly condition.

### DISCUSSION AND CONCLUSIONS

The results of counting in the unburned area clearly appear to represent the ecological phenomenon of plant succession (Table 1). Pines are the more common mature trees, but red and white fir have been responsible for most of the conifer reproduction. Not only are immature firs more common, but they appeared to us to be generally more robust than the immature pines present. The pines were very spindly by comparison (Fig. 3). It is clear that when the immature trees on the plot mature, fir will become the predominant conifer. Species composition in the seedling sample suggests that further in the future an almost pure stand of fir will cover the area.

Our predictions regarding the fate of the unburned plot require one critical assumption—that the area will not burn—and we know that in the Sierra Nevada this assumption is quite wrong because

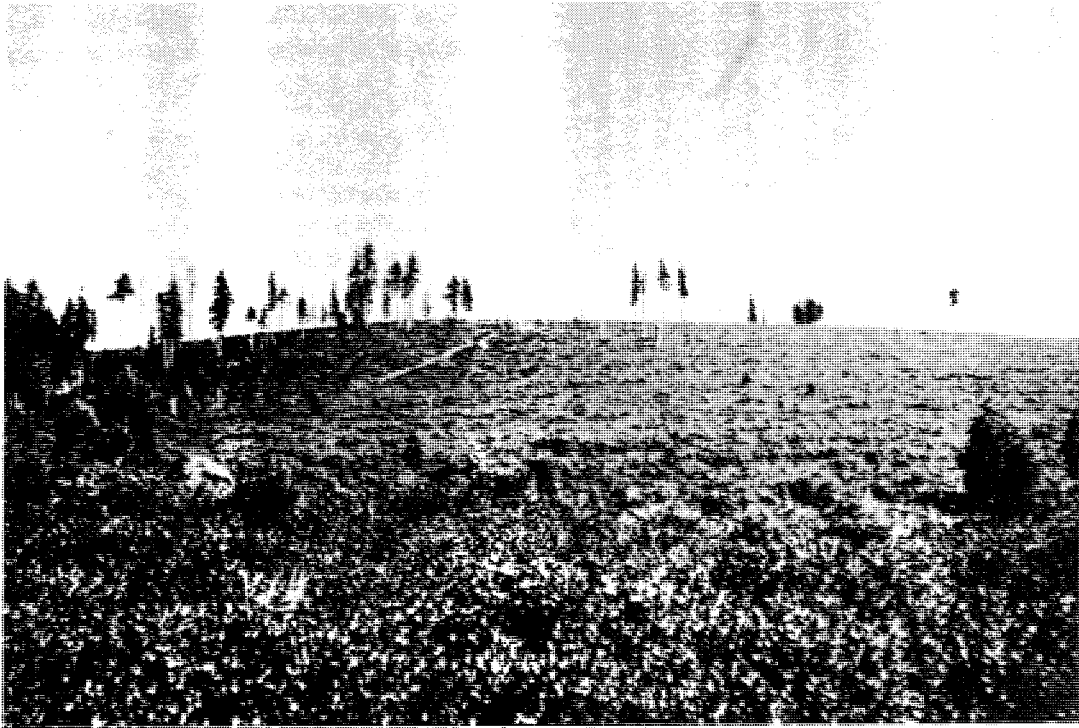


FIG. 4. Brushfield at the head of Sagehen Creek basin. The most common species is *Ceanothus velutinus*.

wildfires are commonplace. Our data from the burned study plot indicate that, should a fire pass through the unburned area, an almost pure stand of pine will result and the succession toward fir would begin again.

The notion of any sort of final successional stage, or "climax vegetation," could not have arisen from the study of plant life in the northern Sierra Nevada. Climax vegetation seems to us to imply a static concept of nature which is not a very accurate description of vegetation anywhere, and especially not in the area of this study. At the present time, and according to the scanty geological record for the past few thousand years, there has been a rather clearcut *cycle* of fires and revegetation rather than any sort of *linear* succession leading to a final permanent stage. This cycle is regenerated at any time by fire, whether the forest has had time to become dominated by firs or is still in the pine stage; it is obviously meaningless to refer

to fir as a "climax" species under these conditions. There is some evidence (Wilken, 1967) that if fires occur frequently enough, *all* conifers may die out and more or less permanent brushfields, predominated by genera such as *Ceanothus* and *Arctostaphylos*, may develop (Fig. 4).

#### ACKNOWLEDGMENTS

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