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L. M. Kunzler
Brigham Young University

K. T. Harper
Brigham Young University

RECOVERY OF GAMBEL OAK AFTER FIRE IN CENTRAL UTAH

L. M. Kunzler[1] and K. T. Harper[1]

Abstract.— The height of oak (*Quercus gambelii* Nutt.) stems was measured on several fire scars within the Uinta National Forest and vicinity and compared with the height of oak stems on adjacent, nonburned areas. A significant relationship exists between the recovery rate of oak after fire and elevation, with the recovery rate being greatest at low elevations. A trend also exists showing that recovery tends to be greater on south to westerly exposures than on north to easterly exposures.

Gambel oak (*Quercus gambelii* Nutt.) is an important species of the deer winter ranges of central Utah, providing both food and cover for deer (Allman 1952, Smith 1949). However, because of its growth habit, it often forms impenetrable thickets (Allman 1952, Baker 1949, Dills 1970, Marquiss 1972, McKell 1950). This, coupled with its height, places most of the available browse out of reach of big game (Plummer et al. 1966, 1970). By treating these dense stands of oak with chemical herbicides, fire, or machinery to break them up, the stands can be opened up and made available to browsing animals (Anon. 1966, Dills 1970, Hallisey et al. 1976, Marquiss 1971, 1972, Plummer et al. 1966, 1970, Price 1938). Because oak stands recover rather rapidly after these treatments, it is necessary to determine a rotation period for treatment to maintain an optimum amount of browse for wildlife (McKell 1950, Plummer et al. 1966, 1970).

Literature Review

In central Utah, Gambel oak has been reported to occur in almost pure stands from 5000 (1525 m) to 8000 (2440 m) feet elevation along the Wasatch Range (Allman 1952, Baker 1949, McKell 1950). This area constitutes a large portion of the deer winter range in the area (Allman 1952, Anon. 1966, Dills 1970, Hallisey et al. 1976, Plummer et al. 1966, 1970, Smith 1949).

Treatments of oak using fire, herbicides, or machinery to destroy the oak canopy result in prolific sprouting, with several stems replacing each preexisting stem. Impenetrable thickets often result from such treatments (Allman 1952, Baker 1949, Dills 1970, Marquiss 1972, McKell 1950). Yet, treatments can be effective in improving deer range. When a follow-up program is used, such as seeding with competitive herbs and grasses, the benefits of the treatment can be prolonged for over 15 years (Anon. 1966, Dills 1970, Hallisey et al. 1976, Marquiss 1971, 1972, Plummer et al. 1966, 1970, Price 1938). By treating oak, deer use can be increased up to four times, but deer use declines as the time from treatment increases (Anon. 1966, Hallisey et al. 1976, Price 1938).

Methods

The height of oak stems was measured on several stands within the Uinta National Forest and vicinity. One half of these stands were located in oak stands that had burned 3 to 15 years ago. The other half of the stands were located in nonburned areas adjacent to each burned stand considered. Unburned stands were selected so as to have the same slope, exposure, and elevation as the burned stand that each was paired with. Measurements were taken along a 100-foot transect at 16-foot intervals, with the oak stem that was nearest to the point being measured. Slope varied from 20 to 70 percent and elevation ranged from 5100 feet (1555 m) to 6800 feet

[1]Department of Botany and Range Science, Brigham Young University, Provo, Utah 84602.

(2070 m) in elevation among the stand pairs considered. Exposure also varied, with one-half of the stands having a south to west exposure and the other half having a north to east exposure. A percent recovery value was calculated for each pair by dividing the average height of the oak in the fire scar by the average height of the oak in the nonburned area. A recovery rate was then calculated by dividing the percent recovery value by the age of the fire scar (Table 1). To minimize the variation among recovery rates caused by the nuisance factors of age, elevation, slope, and site, recovery rates were also calculated on a uniform hill within the Wallsburg Burn (Table 2). Three transects were placed in the burned area at 500-foot (152 m) intervals in elevation.

RESULTS

In comparing the recovery rates from the stands throughout the Uinta National Forest and vicinity, a significant correlation (power equation) exists between elevation and oak recovery rates ($r = -.85$, $.01 < P < .05$, Fig. 1). Using data collected from the Wallsburg Burn, a similar analysis confirms that a significant correlation (linear equation) exists between elevation and the recovery rates of oak stems ($r = .99$, $P < .01$, Fig. 2). Both sets of data show that, as elevation is increased, the recovery rates decrease. Although there is indication that stands on south to west exposures have faster recovery rates, the difference between the recovery rates of these stands and those with north to east exposures is not significant (Fig. 3).

DISCUSSION

Comparing the results of the two sets of data, it seems clear that elevation has a strong influence on oak's rate of recovery following fire. The variation between recovery rates in Figure 2 is primarily due to elevation

TABLE 1. Annual recovery rates in percent for oak on burns scattered throughout the Uinta National Forest and nearby areas.

Stand #	Elevation (m)	Exposure	Age of burn (years)	Average height of oak on burn (cm)	Average height of oak in non-burned area (cm)	Percent recovery	Recovery rate (percent)
1	1,740	East	3	77	579	13.3	4.4
2	1,800	North	15	140	320	43.7	2.9
3	1,560	South	3	145	274	52.8	17.6
4	1,770	South	4	83	343	24.2	6.1
5	1,650	East	3	84	290	28.9	9.6
6	1,680	West	3	61	135	45.0	15.0
7	1,680	East	3	83	290	28.5	9.5
8	1,770	West	4	88	399	22.1	5.5
9	1,860	East	6	116	533	21.7	3.6
10	2,070	West	4	37	320	11.4	2.9

TABLE 2. Percent recovery values for oak on a uniform hill in the Wallsburg Burn. This stand had burned four years earlier.

Transect	Elevation	Status	Average height	Percent recovery
1	1,770 m	Burned	88.4 cm	22.2
1-a	1,770 m	Unburned	398.8 cm	
2	1,920 m	Burned	59.9 cm	16.8
2-a	1,920 m	Unburned	356.6 cm	
3	2,070 m	Burned	36.6 cm	11.4
3-a	2,070 m	Unburned	320.0 cm	

alone. Even with the nuisance variables mentioned earlier, it will be noted that elevation is a significant factor for recovery rates of oak (Fig. 1).

Possible reasons for the change in oak recovery rates with elevation include the following: (1) the species is approaching its upper elevational limit on some of the burns and, because of this, its growth may be slower; (2) more moisture and nutrients may be available to plants at the bottom of slopes because of precipitation's surface runoff and attendant erosion, nutrient transport, and resultant differences in soil depth at the top and bottom of the slope; and (3) the shorter growing season at the higher elevations gives less time for growth there. There may be other reasons or a combination of reasons for this phenomenon. In any event, the relationship is strong and has management implications.

In the winter, deer in the Uinta National Forest and nearby areas primarily use south- and west-facing slopes at lower elevations (Bruce Giunta and Jordon Pederson, Utah Division of Wildlife Resources, and Juan Spillett, Uinta National Forest, pers. comm.). Such areas coincide with situations where oak recovery is most rapid. Thus, management programs to regenerate oakbrush on deer winter ranges in our area may be short-lived. If Gambel oak is to be manipulated to improve deer range using conventional methods in this area, a follow-up program that will retard oak recovery should be used. The significant increase in time between major treatments will thus minimize management costs.

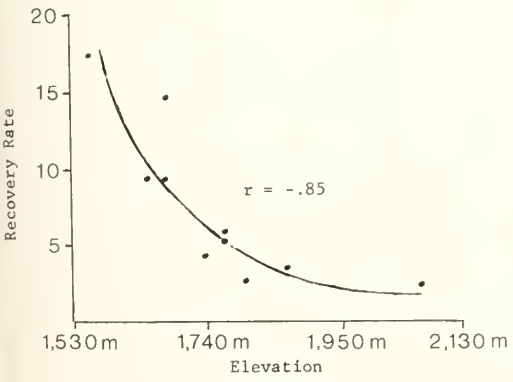

Fig. 1. The relationship between recovery rates of oak and elevation on various burns throughout the Uinta National Forest and nearby areas.

CONCLUSIONS

Elevation is a significant factor in affecting the recovery rate of oak after fire, with higher elevation stands recovering more slowly. Recovery takes from 6 to 35 years in this area, with a modal recovery time of about 15 years.

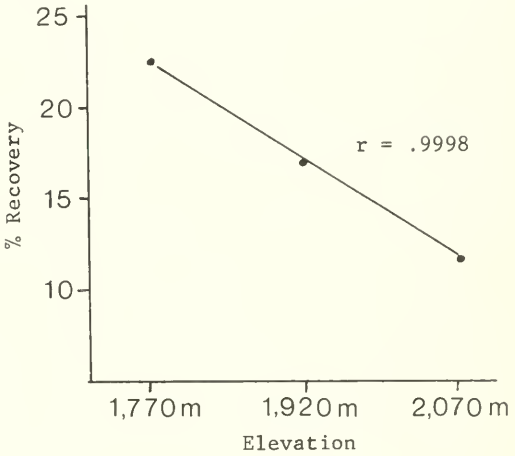

Fig. 2. The relationship between recovery rate and elevation for oak in the Wallsburg Burn area.

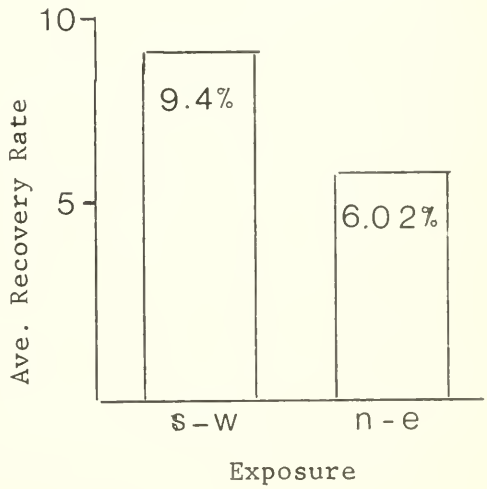

Fig. 3. Histograph of the average recovery rate of oak stands with south to west exposures and north to east exposures on burns throughout the Uinta National Forest and nearby areas.

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