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Cottontail Responses to Forest Management in Southwestern Ponderosa Pine

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Cottontail populations increased only in a clearcut area, where ponderosa pine regeneration provided sufficient food and cover. Windrowing slash and encouraging dense tree regeneration or shrubby and herbaceous undergrowth should improve cottontail habitat under shelterwood and group selection systems also.

Keywords: Wildlife habitat, *Pinus ponderosa* type, *Sylvilagus* spp.

The cottontail (*Sylvilagus* spp.) has been extensively studied in other regions, but its relationship to the ponderosa pine (*Pinus ponderosa*) forests of the Southwest has received little attention. Within these forests, cottontails are often harvested as a "secondary" resource by hunters pursuing other game species. Thus, the cottontail should be considered for fuller habitat management. Because the effects of various silvicultural methods applied in ponderosa pine forests are unknown, this study was initiated to determine cottontail responses to various forest management practices.

Study Areas

Beaver Creek Watersheds

Data were obtained from six watersheds on Beaver Creek, located on the Coconino National Forest, approximately 30 miles south of Flagstaff in north-central Arizona (fig. 1). Elevations range from 6,800 to 8,000 feet; drainage is to the south and southwest. Slopes vary from 0 to 10 percent and soils are of volcanic origin (Williams and Anderson 1967). Overstory vegetation consists of ponderosa pine, alligator juniper (*Juniperus deppeana*), and Gambel oak (*Quercus gambelii*), while perennial grasses, forbs, and shrubs comprise the understory.

Management treatments on the six watersheds are described in table 1.

Heber Watersheds

Data were also gathered on four watersheds near Heber on the Apache-Sitgreaves National Forest in east-central Arizona (fig. 1). Watersheds 3 and 4 are located 6 miles southwest of Heber; watersheds 1 and 2 are 5 miles farther southwest. The watersheds range in elevation from 6,900 to 7,700 feet. Slopes vary between 0 and 40 percent, and soils are of sandstone origin. Overstory vegetation includes ponderosa pine, Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), alligator juniper, and Gambel oak; understory vegetation consists of perennial grasses, forbs, and shrubs.

Timber on all four watersheds had been harvested twice by group selection. At the time of this study, watershed 1 (20 acres) contained 68 square feet of ponderosa pine basal area per acre, 6 square feet of Douglas-fir and white fir, and 3 square feet of Gambel oak. On watershed 2 (28 acres), ponderosa pine accounted for 67 square feet of basal area per acre, while Douglas-fir, white fir, and Gambel oak

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Table 1.--Management treatments on Beaver Creek watersheds

Watershed no. and management treatments	Size	Description
	Acres	
8 Silvicultural improvement	1,802	Residual densities of 60 sq ft of basal area in size classes 10 in d.b.h. and less, 70 sq ft in 12-22-in d.b.h. classes; stands averaging 24 in d.b.h. and larger cut in a shelterwood system.
10 Big-game improvement	571	Irregular openings (1 to 10 acres); logging debris piled and, in some cases, burned; timber in leave areas cut in similar manner as watershed 8.
12 Timber cleared	455	All timber clearcut; logging debris piled in long, narrow windrows 100 ft apart.
13 Group selection	867	Residual density of 99 sq ft of basal area per acre; logging debris piled and, in some cases, burned.
14 Irregular strip shelterbelt	1,267	One-third of the area cleared in irregular strips averaging 60 ft wide; intervening leave strips thinned to 60 sq ft of basal are per acre; logging debris piled and burned; Gambel oak less than 15 in d.b.h. left for mast.
17 Severe thinning	299	Residual density of 30 sq ft of basal area per acre; logging debris piled in windrows; Gambel oak less than 15 in d.b.h. left for mast.

totaled 2 square feet. Timber densities on watershed 3 (60 acres) were 58 square feet of ponderosa pine basal area per acre, 8 square feet of Gambel oak, and 0.5 square foot of alligator juniper. Watershed 4 (61 acres) supported 89 square feet of basal area of ponderosa pine per acre, 7 square feet of Gambel oak, and 2 square feet of alligator juniper.

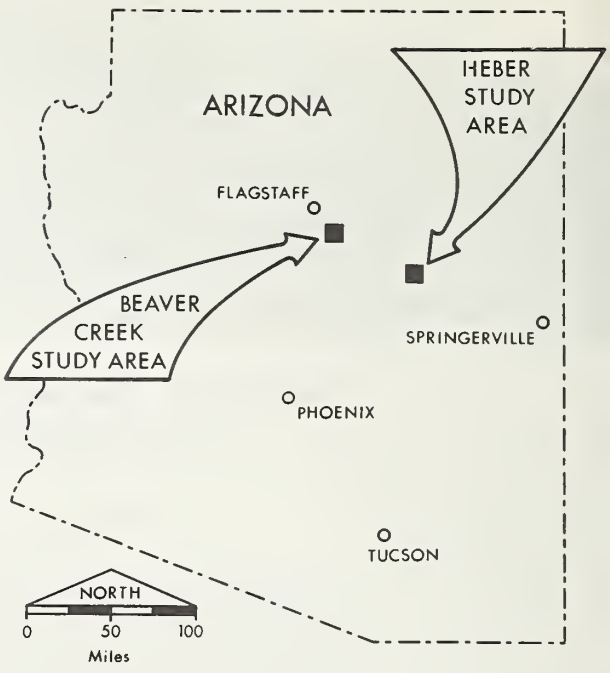

Figure 1.—Location of study areas.

Methods

Individual fecal pellets were counted to determine the habitat preferences of rabbit populations. On the Beaver Creek watersheds, a systematic sampling design with multiple random starts was used. Primary sampling units consisted of 1/100-acre circular plots (11.8 feet in radius) arranged in lines perpendicular to the major drainage. The number of plots per watershed varied from 145 to 200. On each of the Heber watersheds, 30 clusters of three 1/100-acre plots similarly arranged in lines perpendicular to the drainage were sampled.

Cottontail pellets were counted and cleared from all plots on the 10 watersheds during the spring and fall of each sample year. Sampling started in 1972 and was terminated in 1975.

The mean number of pellets per 1/100-acre plot for each watershed was used as a measure of cottontail response to the forest management practices evaluated. Statistical inferences were tested at the 0.10 alpha level. A two-tailed analysis of variance was used to test for differences among cottontail responses for each sampling period. If the F test was significant, Tukey's w-procedure was implemented to assess which of the treatment means was significantly different.

Results and Discussion

On Beaver Creek, cottontail populations were not affected by stripcuts, shelterwood cuts, patchcuts, or group selection harvesting. Populations increased after clearcutting. During the study, the mean number of pellets on the treatments, other than the clearcut, averaged 0.36 per plot, and ranged from 0.11 to 0.90. The number of pellets on watershed 12 averaged 12.4 per plot, ranging from 7.4 to 17.1.

The increased number of cottontail pellets on the clearcut area was probably due to increases in both cover and herbage production. Native herbaceous and shrubby plants increased an average of 504 pounds per acre in the initial 5 posttreatment years (Brown et al. 1974). Apparently, the other treatments did not provide the proper distribution or large enough quantities of cover and food for increased cottontail use. The clearcut contained abundant cover, provided by slash piles and numerous thickets of Gambel oak sprouts (fig. 2). Various investigators have suggested that slash and brush piles provide necessary cover for cottontails (Haugen 1942, Bowers 1954, Redd 1956, Kundaeli and Reynolds 1972, Perkins 1974).

While increased cover was probably the most important factor in the positive response of cottontails on watershed 12, the increased herbage production and subsequent food supply created by clearcutting was undoubtedly beneficial. Other investigators have found that the desert cottontail consumes a large variety of vegetation (Fitch 1947, Turkowski 1975). The cottontail's ability to adapt to different food sources was evident during the winter months of 1974 and 1975 when accumulated snow often covered a majority of the grasses and forbs. During these months, casual observations indicated that Gambel oak sprouts were used relatively heavily as a food source.

On the Heber study area, cottontail populations were significantly higher only on a 4-acre corner of watershed 1 that had roughly 50 percent more reproduction about 4½ feet tall (933 stems per acre vs. 642, fig 3). Although this area contained only 18 of the 90 sample plots, these plots contributed 75 and 87 percent of the total pellet counts in 1974 and 1975, respectively. Dense ponderosa pine regeneration seemed to provide sufficient summer and breeding cover, as well as food, for increased cottontail use. Other investigators have stated, however, that young conifer stands lose their effectiveness as cover at about 10 years of age (Allen 1939, Webb 1949).

The positive responses of cottontails on Beaver Creek watershed 12 and on Heber watershed 1 could be attributed to the increase in yearlong cover. Although it has been suggested that winter cover is more important than summer cover for cottontails in the ponderosa pine forest (Lowe 1975), the general absence of any sufficient cover in the typical open ponderosa pine forest is apparently the limiting factor.

Management Implications

Although there are various alternatives for managing Arizona ponderosa pine forests, apparently only one system, clearcutting, has a long-term beneficial effect on the desert cottontail. Cottontail populations during the summer increased when dense ponderosa pine reproduction was reestablished.

When managing the ponderosa pine for timber production, which is probably best accomplished by a shelterwood or group selection system (Schubert

Figure 2.—Windrowed slash and Gambel oak thickets on Beaver Creek watershed 12, the clearcut study area.

Figure 3.—Dense stand of ponderosa pine reproduction on Heber watershed 1.

1974), cottontail numbers can be increased by encouraging dense natural or artificial regeneration.

If clearcutting is used to increase forage production, cottontail use can be increased by windrowing the slash and encouraging herbaceous and shrubby growth through soil preparation procedures.

A ranked response model for evaluating alternative forest management practices with respect to cottontail use was developed from the results of this study (table 2). While not complete, the examples presented may aid a manager in identifying and evaluating potential cottontail habitat within ponderosa pine forests.

Table 2.--Ranked response model for cottontail in ponderosa pine forests

Management system and residual basal area (sq ft/ acre)	Ponderosa pine reproduction[1]	Slash	Habitat potential (ranked response)
Clearcut			
0	High	Windrowed	+
	High	Cleared	+
	Low	Windrowed	++
	Low	Cleared	0
Group selection with silvicultural thinning			
30	High	Windrowed	+
	High	Cleared	+
	Low	Windrowed	0
	Low	Cleared	0
60-70	High	--	+
	Low	--	0
125	Low	--	0
Strip shelterwood with silvicultural thinning			
60	High	Windrowed	+
	High	Cleared	+
	Low	Windrowed	0
	Low	Cleared	0
Shelterwood with silvicultural thinning			
65	High	--	+
	Low	--	0
Patchcut (1/5 of area) Silvicultural thinning			
	High	Piled	+
	High	Cleared	+
	Low	Piled	0
	Low	Cleared	0

[1]"High" reproduction is 900 stems per acre.

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