

Use of Openings in Spruce-Fir Forests
of Arizona by Elk, Deer, and Cattle

Hudson G. Reynolds¹

Spruce-fir forests in Arizona and New Mexico provide important summer range for elk, deer, and cattle. Previous investigations in ponderosa pine forests of Arizona suggest that: (1) natural openings are important to both big game and livestock; (2) timber and range management practices can be modified for game habitat betterment; and (3) special measures can be taken to improve foraging conditions for grazing animals.^{2 3}

This paper reports on the use of natural and created openings in spruce-fir forests by elk, deer, and cattle. Accumulated animal droppings were counted as an assumed index of use. From knowledge of wildlife habitat use, suggestions are made for integrating other land uses, such as timber, water, and recreation, with wildlife habitat improvement.

¹ Principal Wildlife Biologist located at Tempe, in cooperation with Arizona State University; central headquarters are maintained at Fort Collins, in cooperation with Colorado State University.

² Reynolds, Hudson G. Use of natural openings in a ponderosa pine forest of Arizona by deer, elk, and cattle. U. S. Forest Serv. Rocky Mountain Forest and Range Exp. Sta. Res. Note 78, 4 pp. 1962. Fort Collins, Colo.

³ Reynolds, Hudson G. Use of a ponderosa pine forest in Arizona by deer, elk, and cattle. U.S. Forest Serv. Res. Note RM-63, 8 pp., illus. 1966. Rocky Mountain Forest and Range Exp. Sta. Fort Collins, Colo.

Study Areas

Three general areas of spruce-fir were studied: Burro Mountain and Haystack in the White Mountains of east-central Arizona, and the Kaibab Plateau of extreme north-central Arizona. Spruce-fir forests occupy the coldest, wettest, and highest lands (8,500 to 12,000 feet) in Arizona and New Mexico.^{4 5 6} Two tree species, Engelmann spruce (*Picea engelmannii* Parry) and subalpine fir (*Abies lasiocarpa* (Hook.) Nutt.), dominate the forest composition. Other associated conifers include: blue spruce (*Picea pungens* Engelm.), and locally small amounts of white fir (*Abies concolor* (Gord. & Glend.) Lindl.) and Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco). Forest composition varies from pure stands of spruce to a mixture of all of the above species. Herbaceous plants are scarce beneath dense forest stands.

Grasslands are interspersed throughout spruce-fir forests. These plant communities may exist as small openings or as fairly ex-

⁴ Nichol, A. A. The natural vegetation of Arizona. *Ariz. Agr. Exp. Sta. Bull.* 127: 187-230. 1952.

⁵ Castetter, E. F. The vegetation of New Mexico. *N. Mex. Quart.* 26: 257-288. 1956.

⁶ Rasmussen, D. I. Biotic communities of Kaibab Plateau, Arizona. *Ecol. Monog.* 3: 229-275. 1941.

tensive areas. Among the important genera of dominant perennial grasses in dry situations are: Fescues (Festuca spp.), muhlys (Muhlenbergia spp.), bluegrasses (Poa spp.), and needlegrasses (Stipa spp.). The more abundant forbs include genera such as: Pussytoes (Antennaria spp.), buckwheat (Eriogonum spp.), fleabane (Erigeron spp.), phlox (Phlox spp.), cinquefoil (Potentilla spp.), and saxifrage (Saxifraga spp.).

In wet situations the flora is primarily several species of forbs or grasslike plants (Juncus spp. and Carex spp.). Prominent forbs include: Yarrow (Achillea spp.), agoseris (Agoseris spp.), fleabane, cinquefoil, buttercup (Ranunculus spp.), dandelion (Taraxacum spp.), and clover (Trifolium spp.). Although scarce, perennial grasses may include: Hairgrass (Deschampsia spp.), timothy (Phleum spp.), and bluegrass.

Methods

In all, 29 natural or clearcut openings were studied. Openings varied from one-half acre to nearly 100 acres in size. Measurements were initiated near the center of each opening. From here, four random transects were located across each opening; transects were continued into adjacent timber for a distance equal to the radius of the opening.

Transects were divided into contiguous sampling plots of 2 by 100 feet. Accumulated

pellet groups of deer and elk, and droppings of cattle, were counted on each sampling plot. Herbaceous vegetation on each sample plot was classified as to whether dominated by sedges, perennial grasses, or forbs.

Comparative Use of Openings and Forest

Natural Openings

Average numbers of droppings computed for openings and adjacent timber for the three sampling sites were as follows:

	Dropping groups per 100 square feet		
	Cattle	Elk	Deer
North Kaibab:			
Opening	1.29	0	0.74
Forest	.40	0	2.00
Burro Mountain:			
Opening	.84	.29	.23
Forest	.19	.25	.76
Haystack:			
Opening	3.08	.41	.12
Forest	1.11	.48	.88

Droppings of cattle were about three to four-and-a-half times more abundant in openings than within adjacent forest. The opposite relation held for deer--their pellet groups were about three to seven times more abundant in adjacent forest than in openings. Numbers of elk pellet groups did not differ appreciably between adjacent forest and openings.

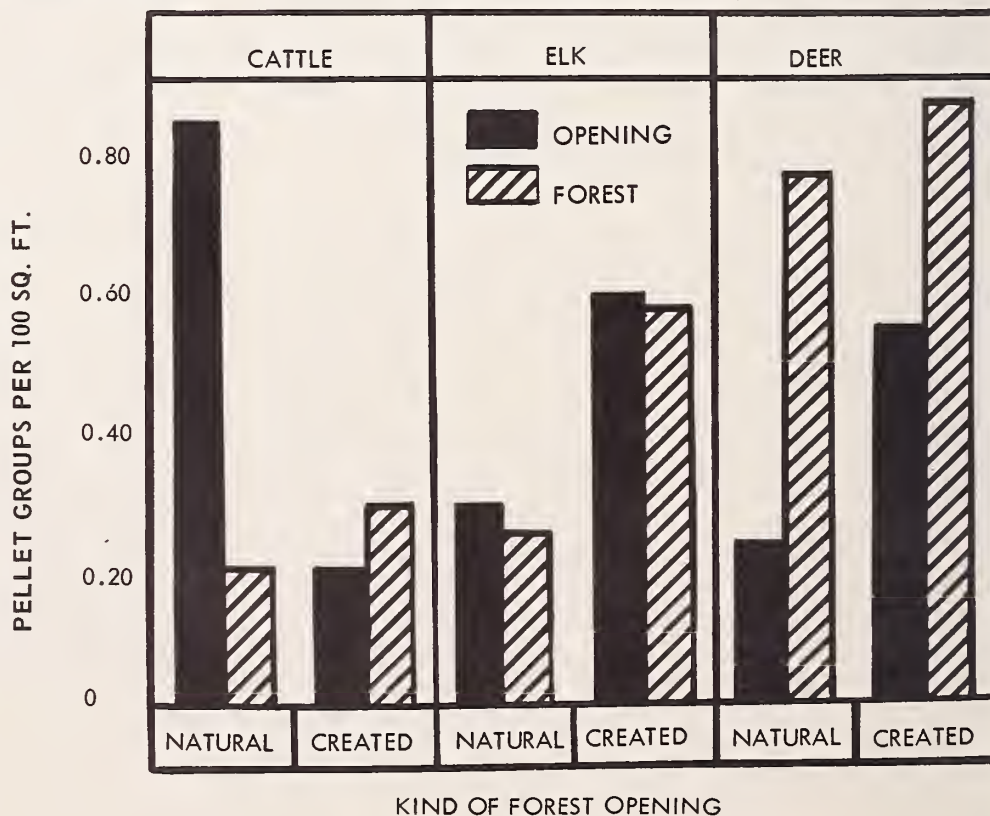


Figure 1.--Comparative numbers of elk, deer, and cattle dropping groups for natural and created openings and adjacent forests on Burro Mountain, Apache National Forest, Arizona.

Created Openings

Created openings in the study consisted of blocks of 10 to 30 acres that had been clear-cut about 6 years previously on Burro Mountain. Dropping group densities in these created openings were compared with those in natural openings on Burro Mountain that were used by the same game population.

For cattle, relative densities of dropping groups in created and natural openings differed strikingly (fig. 1). Natural openings had over four times as many dropping groups as adjacent forest, while the number of dropping groups in created openings and adjacent forests were about the same.

For elk and deer, created openings were preferred to natural; however, relative use between openings and adjacent forest was about the same for both situations. Elk droppings in openings and forests were about equal. Deer dropping groups were more abundant in forest than openings.

Differences in herbaceous plant composition may explain, in part, the situations preferred by elk, deer, and cattle. Perennial grasses made up 98 percent of the composition in natural openings, while in created openings, forbs comprised 68 percent of the

composition. Since cattle are primarily grass eaters, they may have preferred natural to created openings because of the abundance of perennial grass. Physical obstacles of slash and debris in logged areas may also have reduced utilization by cattle.

Forest Border Relations

Forest borders adjacent to natural openings seem to have some special significance, especially for deer (fig. 2). Density of deer dropping groups increased sharply from the border into the forest. Number of groups declined gradually with distance out into openings. Within the forest, density of dropping groups exceeded the average for forest conditions at between 400 to 450 feet from the forest border.

Border use by elk was not as striking as by deer. There was, however, a tendency for dropping groups to be more numerous on both forest and opening sides of the border, with the number of groups decreasing at increasing distance from the border.

In general, density of cattle droppings decreased gradually with distance from the border into the forest, and increased with greater distance into openings.

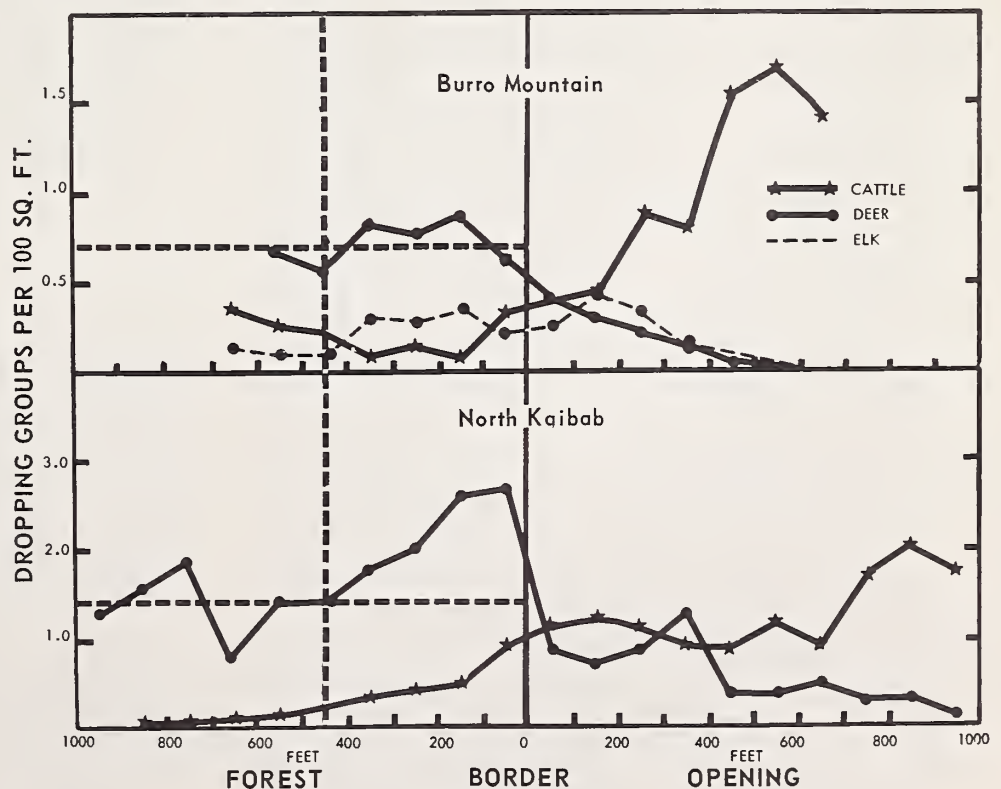


Figure 2.--Relation of abundance of dropping groups to forest borders for deer, elk, and cattle.

Since abundance of dropping groups of both deer and elk decreased with distance from forest border into openings, a maximum size of opening should exist for best use by deer and elk. To estimate best size of opening, abundance of dropping groups was related to size of openings. To adjust for density of animal populations associated with an area, dropping groups were expressed as a ratio between dropping groups of an opening and of adjacent forest.

Relative use by deer and elk declined sharply as size of opening increased. There was little use of areas larger than 20 acres. Conversely, as openings became smaller, relative use increased. Theoretically, circular openings larger than 20 acres would be little used, except next to forest borders.

Conclusions

1. Cattle, elk, and deer use natural grassland openings in spruce-fir forests of Arizona differently, as measured by accumulated dropping groups.
2. Cattle make greater relative use of grassland openings than adjacent forest, elk make about equal use of the two situations, while deer use adjacent forests more than openings.
3. For deer and elk, use of openings relative to adjacent forest is about the same for openings created by clearcutting as for natural grassland openings. Cattle do not use created openings relative to adjacent forest as intensively as natural openings. Possibly the sparsity of perennial grass and the presence of logging debris discourage more intensive use of created openings by cattle.
4. Deer and elk use is higher close to the border, on both forest and opening sides, than in areas more remote from borders. Cattle use increases from borders into openings, and decreases at greater distances from borders into the forest.
5. Openings smaller than 20 acres receive heaviest use by deer and elk. Circular openings larger than 20 acres (526 feet radius) are little used except around perimeters. Cattle preference for openings did not vary with size of opening.

Several management implications can be derived from the above conclusions with regard to coordinating wildlife habitat with timber and range management.

1. Small natural openings (at least up to 20 acres or less than 1/5 mile across) should be maintained in spruce-fir forests. Management practices for preserving natural openings for deer and elk could include:
 - a. Removal of invading timber reproduction.
 - b. Cleanup of logging slash and debris.
 - c. Seeding any disturbed areas to forage plants palatable to deer and elk.
2. Creation of small openings in spruce-fir forests, by cutting in blocks or strips, should be beneficial to both elk and deer.
 - a. Permanent block openings of less than 20 acres or strips less than 1/5 mile across should be most beneficial.
 - b. For best habitat effects in connection with an even-aged system of timber management, clearcut areas should be widely dispersed, less than 20 acres in size if in patches, and less than 1/5 mile across if in strips.
3. Grazing capacity of spruce-fir forests for cattle should be based largely upon natural openings, since cattle make little use of dense timber or created openings.
4. In restoring, stabilizing, or improving natural openings in spruce-fir forests, seeding to perennial grasses should be given preference if cattle use is preferred; seeding to forbs should be emphasized if deer and elk use is to be encouraged.

Summary

Use of natural and created openings by deer, elk, and cattle was studied in spruce-fir forests of Arizona by measuring accumulated dropping groups. Cattle used openings more than adjacent forest, elk use was about the same in the two situations, while deer preferred adjacent forest areas. Cattle made more use of natural than created openings; elk and deer preferred created openings. Openings larger than 20 acres were used little by deer and elk, except near forest borders; all sizes of openings were grazed by cattle. Maintenance of natural openings and creation of small openings by cutting should improve deer and elk habitat.