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RODENT WEIGHTS IN MODIFIED PINYON-JUNIPER WOODLANDS OF SOUTHWESTERN NEW MEXICO

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ABSTRACT.—Changing habitat structure in pinyon (*Pinus edulis*)–one-seed juniper (*Juniperus monosperma*) stands by (1) pushing trees down with a bulldozer and leaving them in place, (2) pushing, then piling and burning slash, or (3) thinning to a spacing of 6.1 m and leaving slash did not affect weights of individuals of nine rodent species. Previous studies have shown that habitat modifications influence kinds of species and numbers of individuals, but changes in total rodent biomass are a function of sizes of different species occupying different habitats, not changes in weights of individuals.

Studies reporting small mammal population changes resulting from habitat alterations are common. Considering only pinyon-juniper woodlands, for example, small mammal density changes due to overstory removal have been reported for Utah (Baker and Frischknecht 1973), Colorado (O'Meara et al. 1981), Arizona (Turkowski and Reynolds 1970), and New Mexico (Severson 1986a).

Information relative to treatment effects on small mammal biomass is less common. Grant et al. (1977, 1982), working on shortgrass prairie, examined effects of water, nitrogen, and grazing treatments on small mammal biomass; and Smith and Urness (1984) studied small mammal biomass and densities on native and altered foothill ranges in Utah. Sullivan (1979) reported weights of individual deer mice (*Peromyscus maniculatus*) from burned and unburned forest in British Columbia. Generally, however, studies reporting effects of habitat treatment on individual weights are lacking. Such information can provide a basis for comparing relative condition of individuals in different habitats and, when considered with densities, can furnish a more complete data base for analysis of effects of habitat manipulation on biomass distribution for energy flow studies (e.g., predator-prey relationships).

This paper describes influences of three pinyon-juniper overstory treatments and untreated control stands on rodent biomass and mean individual weights 13 to 18 years after treatment. Effects of these treatments on rodent densities were reported in an earlier paper (Severson 1986a).

STUDY AREA

This study was conducted on the Fort Bayard Allotment, Gila National Forest, 16 km east of Silver City, New Mexico. Important trees and shrubs are pinyon (*Pinus edulis*), one-seed juniper (*Juniperus monosperma*), alligator juniper (*J. deppeana*), gray oak (*Quercus grisea*), and hairy mountain mahogany (*Cercocarpus breviflorus*). Abundant herbaceous species include blue grama (*Bouteloua gracilis*), sideoats grama (*B. curtipendula*), and globemallow (*Sphaeralcea* spp.). Elevation ranges from 1,806 to 2,070 m. Annual precipitation averages 393 mm, with 55% falling as rain from July through September. Mean annual temperature is 12.8 C, with mean monthly extremes of 3.5 C (January) and 22.6 C (July).

Three pinyon-juniper control treatments and untreated plots, where trees were not disturbed, were randomly established in each of two blocks, one in 1965 and the other in 1970, to determine effects on deer and elk habitat use. Treatments included thinning (pinyons and junipers were cut to a minimum spacing of 6.1 m and left in place), bulldozing (all pinyons and junipers were pushed over and left in place), and bulldozing/piling/burning (all pinyons and junipers were pushed over and piled with a bulldozer, then burned). All plots were about 120 ha.

Pinyon-juniper densities averaged 359, 664, 52, and 74 stems/ha on the untreated, thinned, bulldozed/piled/burned, and bulldozed only plots, respectively, in 1983. Densities of other small trees and shrubs that were

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not controlled, primarily gray oak and hairy mountain mahogany, were 834, 481, 302, and 474 stems/ha in each respective treatment (Severson 1986a). Vegetation of treated areas is more completely described by Short et al. (1977) and Severson (1986b).

Methods

Each plot was divided into six sampling areas, and a set of two transects was randomly placed in each. Beginning points of transects were 50 m apart and extended in opposite directions. Each plot and area were buffered by 100- and 35-m zones, respectively, to insure that transects were no closer than 200 and 70 m between plots or between areas, respectively. Transects consisted of 17 trapping locations spaced 10 m apart. Each location contained two traps—a standard rat trap and a museum special. Traps were baited with a mixture of peanut butter, oatmeal, and an ant repellent, dimethylphthalate (Anderson and Ohmart 1977). Traps were run in one transect within each plot segment in September 1981, the other in September 1982, and the first set again in September 1983. Three transects were trapped in each treatment for four consecutive days; then the traps were moved to the remaining three transects and run for the next four consecutive days. Traps were left set for 24-hour trap sessions and were checked daily. Captured individuals were tagged, double-wrapped in plastic bags, frozen, identified, and weighed after each trapping period. Specimens were weighed in plastic bags, and bag weights deducted, to insure that they were not affected by moisture loss due to freezing.

Analyses

A two-factor (treatments within blocks) multivariate analysis of variance with years as repeated measures was used to test the hypothesis that there were no differences in total weights of all small mammals trapped among treatments or among years. Weights of individuals were analyzed with a one-way analysis of variance to test the hypothesis that there were no differences in weights of individuals within each sex and age class among treatments. Four tests were possible for each species since adults and subadults of each sex were analyzed separately. Only those treatments in which three or more individuals of each species/sex/age class were trapped were included in the analysis. Among-years and between-block differences were tested for adult male and female white-throated woodrats (*Neotoma albigula*) and for adult male and female brush mice (*Peromyscus boylii*). None of these eight tests yielded significant results; therefore, we pooled blocks and years for analysis of individual weights.

Multivariate and one-way analyses of variance were conducted using SPSS/PC+ (Norusis 1986a, 1986b). Mean separation was done using Least Significant Differences method via SPSS/PC+ for individual small mammal weights among treatments (from one-way ANOVA) and via Multiple Comparison Procedures (developed by R. King, Rocky Mtn. For. and Range Expt. Sta., Fort Collins, Colorado) for total weights from multivariate ANOVA.

Results and Discussion

Total biomass of trapped animals was significantly higher ($P < .05$) on the thinned (41.4 kg) and bulldozed-only (42.2 kg) treatments. These two treatments, along with the bulldozed/piled/burned treatment, supported the highest numbers (Severson 1986a). Total biomass on the bulldozed/piled/burned treatments (32.3 kg) was significantly lower because the larger rodents, woodrats (*Neotoma* spp.), were less abundant than on the other two treatments. The smaller species that favored more open habitats, e.g., white-footed mouse (*Peromyscus leucopus*), southern grasshopper mouse (*Onychomys arenicola*), and Ord's kangaroo rat (*Dipodomys ordii*), were relatively more abundant on bulldozed/piled/burned plots (Severson 1986a). Untreated areas produced the lowest total weight (23.5 kg) as well as the fewest animals (Severson 1986a).

Total weight of all rodents trapped in 1981 was 42.2 kg. It increased to 65.8 kg in 1982 but decreased to 31.4 in 1983. This trend generally followed total numbers trapped (381, 849, and 279 individuals in each respective year). All weights among years differed significantly ($P < .05$). The mean weight per individual was lower in 1982, but this is likely attributed to proportionately fewer trappings of the larger

TABLE 1. Mean individual weights of rodent species by sex and age classes, from four pinyon-juniper control treatments, Fort Bayard, New Mexico.

Species	Sex[1]	Age[2]	Pinyon-juniper treatment: Untreated	Thinned	Bulldozed/piled/ burned	Bulldozed only
			grams			
Ord's kangaroo rat (*Dipodomys ordii*)	F	AD	46.6 ± 2.7(5)[3]	49.1 ± 6.5(3)	51.8 ± 5.1(3)	48.4 ± 2.1(5)
	M	AD	52.0 ± 5.5(5)	51.8 ± 5.0(3)	51.6 ± 3.5(14)	47.3 ± 3.8(5)
	F	SA	36.2 ± 6.6(3)	37.6 ± 2.4(4)		
White-throated woodrat (*Neotoma albigula*)	F	AD	172.0 ± 18.6(31)	173.7 ± 20.2(49)	176.4 ± 17.0(37)	176.3 ± 19.5(57)
	M	AD	195.7 ± 23.0(30)	201.7 ± 24.1(54)	201.0 ± 30.9(48)	207.4 ± 21.0(63)
	F	SA	124.8 ± 26.8(35)	130.2 ± 22.0(40)	127.2 ± 20.8(42)	129.9 ± 24.7(45)
	M	SA	136.8 ± 22.1(16)	134.8 ± 24.3(32)	130.7 ± 29.3(20)	138.6 ± 29.5(36)
Mexican woodrat (*Neotoma mexicana*)	M	AD		220.9 ± 23.4(6)		196.7 ± 32.3(4)
Stephen's woodrat (*Neotoma stephensi*)	F	AD	164.3 ± 28.2(4)	162.9 ± 17.8(9)		153.0 ± 10.8(7)
	M	AD	180.5 ± 21.8(4)		177.6 ± 14.9(7)	167.9 ± 14.2(4)
	F	SA		122.6 ± 28.8(6)		129.3 ± 29.8(4)
Southern grasshopper mouse (*Onychomys arenicola*)	F	AD			27.4 ± 3.6(10)	30.9 ± 5.5(12)
	M	AD			26.2 ± 1.4(12)	24.4 ± 1.1(3)
	F	SA	18.4 ± 2.1(6)		21.2 ± 2.9(15)	20.9 ± 2.8(9)
	M	SA			21.8 ± 2.2(22)	20.1 ± 7.7(5)
Brush mouse (*Peromyscus boylii*)	F	AD	31.9 ± 5.2(13)	31.3 ± 4.8(25)	31.0 ± 6.2(11)	29.1 ± 5.4(20)
	M	AD	26.3 ± 2.3(15)	25.8 ± 3.0(35)	26.6 ± 4.6(19)	26.4 ± 3.2(35)
	F	SA	22.0 ± 4.7(3)	21.5 ± 4.4(16)	20.5 ± 4.6(10)	21.1 ± 4.7(12)
	M	SA	19.8 ± 3.4(9)	21.2 ± 3.6(17)	22.4 ± 3.3(4)	21.3 ± 2.5(16)
Rock mouse (*Peromyscus difficilis*)	F	AD		30.2 ± 2.3(3)		28.9 ± 1.7(4)
White-footed mouse (*Peromyscus leucopus*)	F	AD		30.5 ± 3.2(6)[4]	37.7 ± 3.0(16)[4]	
	M	AD	29.2 ± 2.0(4)	28.4 ± 1.5(6)	29.3 ± 2.7(21)	25.2 ± 4.3(4)
Pinyon mouse (*Peromyscus truei*)	F	AD	33.0 ± 7.0(8)	34.2 ± 3.8(16)		
	M	AD	27.3 ± 2.7(10)	28.2 ± 2.1(17)		
	M	SA	21.8 ± 1.9(5)	20.9 ± 3.0(7)		
Western harvest mouse (*Reithrodontomys megalotis*)	F	AD			13.5 ± 3.5(7)	14.3 ± 1.8(14)
	M	AD	11.8 ± 0.7(3)	12.1 ± 0.9(4)	12.4 ± 1.2(12)	12.9 ± 1.2(13)
	M	SA			8.7 ± 2.8(6)	10.1 ± 0.7(13)

[1]F female, M male.
[2]AD adult, SA subadult.
[3]Mean ± standard deviation (sample size).
[4]Means are significantly different (P < .05).

woodrats (62%, 39%, and 63% in each respective year).

Mean weights of individuals within sex and age classes were generally not significantly different among treatments (P < .05; Table 1). Of the 28 tests, only one (female, adult white-footed mouse) demonstrated a significant difference between treatments; those from the bulldozed/piled/burned plots were heavier than those from thinned plots (P < .05; Table 1).

Habitat modifications can influence kinds of species and number of individuals (Severson 1986a). Total rodent biomass can also be affected, but generally as a function of sizes of different species occupying different habitats. Changing habitat, such as eliminating or altering overstory, does not appear to influence weights of individual animals. These results are in general agreement with those of Sullivan (1979).

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LITERATURE CITED

ANDERSON, B. W., AND R. D. OHMART. 1977. Rodent bait additive which repels insects. J. Mamm. 58: 242.

BAKER, M. F., AND N. C. FRISCHKNECHT. 1973. Small mammals increase on recently cleared and seeded juniper rangeland. J. Range Manage. 26: 101–103.

GRANT, W. E., E. C. BIRNEY, N. R. FRENCH, AND D. M. SWIFT. 1982. Structure and productivity of grassland small mammal communities related to grazing induced changes in vegetative cover. J. Mamm. 63: 248–260.

GRANT, W. E., N. R. FRENCH, AND D. M. SWIFT. 1977. Response of a small mammal community to water and nitrogen treatments in a shortgrass prairie ecosystem. J. Mamm. 58: 637–652.

NICKERSON, M. F., G. E. BRINK, AND C. FEDDEMA. 1976. Principle range plants of the central and southern Rocky Mountains: names and symbols. USDA Forest Serv. Gen. Tech. Rept. RM-20. 121 pp.

NORUSIS, M. J. 1986a. SPSS/PC+ for the IBM PL/XT/AT. SPSS Inc., 444 N. Michigan Ave., Chicago, Illinois.

———. 1986b. Advanced statistics, SPSS/PC+ for the IBM PC/XT/AT. SPSS Inc., 444 N. Michigan Ave., Chicago, Illinois.

O'MEARA, T. E., J. B. HAUFLER, L. H. STELTER, AND J. G. NAGY. 1981. Nongame responses to chaining of pinyon-juniper woodland. J. Wildl. Manage. 45: 381–389.

SEVERSON, K. E. 1986a. Small mammals in modified pinyon-juniper woodlands, New Mexico. J. Range Manage. 39: 31–34.

———. 1986b. Woody plant reestablishment in modified pinyon-juniper woodlands, New Mexico. J. Range Manage. 39: 438–442.

SHORT, H. L., W. EVANS, AND E. L. BOEKER. 1977. The use of natural and modified pinyon pine–juniper woodlands by deer and elk. J. Wildl. Manage. 41: 453–459.

SMITH, C. B., AND P. J. URNESS. 1984. Small mammal abundance on native and improved foothill ranges, Utah. J. Range Manage. 37: 353–357.

SULLIVAN, T. P. 1979. Demography of populations of deer mice in coastal forest and clear-cut (logged) habitats. Canadian J. Zool. 57: 1636–1648.

TURKOWSKI, F. J., AND H. G. REYNOLDS. 1970. Response of some rodent populations to pinyon-juniper reductions on the Kaibab Plateau, Arizona. Southwest. Natur. 15: 23–27.