IMPORTANCE OF WESTERN JUNIPER COMMUNITIES TO SMALL MAMMALS

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SUMMARY

We investigated the composition and relative abundance of small mammals in the western juniper *(Juniperus occidentalis)* woodlands of southeast Oregon in the spring of 1993 and in 1995-97, by snap-trapping recently cut sites, shrub dominated sites, and adjacent uncut (both mid-successional and old-growth) juniper woodland sites. The number of captures was usually higher in the cut sites than in the uncut sites, but results were mixed in the shrub-tree comparisons. The number of species captured was higher in shrub sites over old-growth woodland sites. We believe structure provided by robust understory vegetation and the overhanging juniper skeletons provided superior security and forage for small mammals in the cut and dropped sites.

INTRODUCTION

The issue of juniper *(Juniperus sp.)* encroachment, conversion, and subsequent affects of community structural changes on small mammals has been of increasing interest by resource managers in recent years. Although research has been conducted on the direct effects of juniper on forage productivity, plant composition and structure, and impacts on big game, little has been directed toward small mammals associated with western juniper *(J. occidentalis)*.

Of the estimated 341 animal species found in southeastern Oregon (Maser et al.,1984), 95 have been reported to occur in juniper-steppe (western juniper woodlands, typically having a sagebrush [*Artemisia sp.]* understory) (Puchy and Marshall, 1993). Western juniper/sagebrush/bunchgrass communities have the third-largest number of the 341 total wildlife species from the 16 general plant communities that Maser et al. (1984) described for southeastern Oregon.

Few studies have evaluated the effects of juniper woodland development or conversion in shrub-steppe communities on nongame use; of these, most have been conducted in pinyon-juniper *(Pinus sp.)* communities. Baker and Frishknecht (1973) examined small mammal changes relative to clearing and seeding in pinyon-juniper communities in Utah. They found large increases in white-footed deer mice *(Peromyscus maniculatus)* and Great Basin pocket mice *(Perognathus parvus)* in cut areas for the first 3 years after treatment, followed by a reduction to a population level still above that before treatment. Turkowski and Reynolds (1970) found 1.2 - 4.0 times as many rodents on treated (cut) plots compared to untreated plots 3 years after treatment in the same type on the Kaibab Plateau in Arizona. In pinyon-juniper woodlands of northeast Nevada, rodent numbers increased while species diversity decreased on burned pinyon-juniper sites during the first two years following treatment; both bird numbers and diversity increased on burned areas in these woodlands over comparable unburned areas (Mason 1981). O'Meara et al. (1981) noted small mammal abundance in Colorado was higher in chained pinyon-juniper woodland than in control plots. Adverse effects on nongame wildlife was minimized by favoring survival of shrubs and young trees, retaining selected cavity trees, and limiting widths of clearings when chaining. O'Meara et al. (1981) also found higher bird densities in unchained areas than in chained areas. Sedgwick and Ryder (1986) found small-mammal species richness and total captures were greater on chained versus unchained plots of pinyon-juniper in Colorado. Seven of the 16 most common bird species in the area used the control plot more, while only one used the chained plot more. Effects can be relatively long-lasting; numbers of small mammals were greater on all treated areas compared to untreated pinyon-juniper woodlands 13-18 years post-treatment in New Mexico (Severson 1986). Individual species and groups responded differently to the tree removal manipulations and methods of slash disposal. As a group, grassland rodents were more abundant where the overstory and slash had been removed, however, wood rats *(Neotoma sp.)* and brush mice *(Peromyscus boylii)* were greatest where the slash remained on the site. Pinyon *(P. trueii)* and rock mice *(P. difficilus)* preferred the thinned site, where slash remained on site.

The apparent conflicting results of small mammal and bird responses to woodland treatment are probably due to the limited vegetation data collected in these studies. Juniper and pinyon-juniper woodlands occur across a wide variety of spatial and temporal conditions in the Intermountain west (Miller et al., in press). Woodland structure and composition prior to treatment, and succession following treatment will likely substantially affect small mammal and avian populations.

We investigated small mammal and bird composition and relative abundance in southeast and central Oregon, northwestern Nevada, and northeastern California in 1993, and 1995-97. In this paper we compare small mammal populations between cut and uncut stands of mid-aged western juniper woodlands, old-growth woodlands with adjacent shrubland, and also mid-aged stands with the old-growth stands in southeastern and central Oregon.

STUDY AREAS

Page Ranch: Closed Woodland vs. Cut Stands

The Page Ranch study area was located in Grant County, Oregon, along Warren Creek at about 4,600 ft. with northwest 20-percent slopes. Treated sites were about 25 acres in size. Vegetation was a mountain big sagebrush *(Artemisia tridentata ssp. vaseyana)*/ Idaho fescue *(Festuca idahoensis)* community. The juniper stand was fully developed, about 40-percent canopy cover, 100-130 trees/acre, with sparse understory shrubs. Perennial grasses and forbs had higher cover values in cut sites but were common on both. Three-treatment blocks were cut, and the trees were left in place during the fall of 1992. Sampling commenced in the spring of 1993, and was repeated in 1995-97.

Krumbo Ridge: Mid-transitional Juniper Woodlands vs. Thinned Stands

The Krumbo Ridge study area was located at about 5,000 ft on Steens Mountain, Harney County, Oregon. Slopes were generally northerly and less than 2 percent. The three uncut sites were mid-transitional woodlands with 10-20 percent tree-canopy cover and 100 trees/acre, 7 to15-percent shrub cover, and 5 to10-percent perennial herbaceous cover. The three cut sites were thinned to 2-3 trees/acre (1-2 percent canopy cover) in the spring of 1995. Understory vegetation was characterized by mountain big sagebrush and Idaho fescue.

Juniper Mountain: Old Growth Woodlands vs. Shrub Steppe

The Juniper Mountain study area was located in Harney and Lake counties at about 6,000 ft. All sites were on southeast aspects with 20-percent slopes. The woodland sites were old-growth ranging from 400 to 1,000 years old and had 30-35-percent crown closure. Dead-and-down material was relatively abundant with many cavities. Shrub cover under the trees was less than 1 percent. The shrub sites had 35-percent cover of mountain big sagebrush. Abundant herbaceous plants were bluebunch wheatgrass *(Agropyron spicatum),* Thurber's needlegrass *(Stipa thurberiana),* and bottlebrush squirreltail *(Sitanian hystrix).*

Green Mountain: Old-Growth Juniper Woodland vs. Shrub Steppe

The Green Mountain study area was located in Lake County, Oregon, at 5,000 ft. Sites were southeast aspects with < 5-percent slopes. The woodland canopy was more open with slightly less dead-and-down woody material and fewer cavities than Juniper Mountain. Tree canopy ranged from 10 to15 percent, shrub cover was < 1 percent, and herbaceous cover 10 percent. The adjacent shrub sites burned about 50 years ago. Shrub cover was 15 percent and herbaceous cover was 10 to15 percent.

METHODS

Small mammal trapping was conducted in permanently marked grids centered within each site. Museum Special traps were set next to flags placed in a 10 x 10 grid for 100 traps/grid. While we recognize trap-type bias may exist (Fowle and Edwards, 1954) and would like to have used pitfall and rat-traps as well, logistics and finances limited effort to museum specials. Traps were baited with peanut butter and rolled oats. At each study area, treatments and controls were repeated three times, which resulted in 3,000 trap-nights for each study area. Trapping was conducted from May to early July. The status of each trap was recorded daily for 5 days. Captured mammals other than white-footed deer mice were placed in plastic bags with plot number, treatment, station, and date recorded on the outside, cooled on ice, and later identified. White- footed deer mice were removed from traps and left in the area in deference to hantavirus concerns.

RESULTS

Fourteen species representing four orders of small mammals were captured (Table 1) from the 30,000 trap-nights of study. We had 898 total captures ($\bar{x}$ = 34 trap-nights/capture, range = 16-86). The white-footed deer mouse was the most often captured species (n = 614; 68.4 percent), followed by yellow pine chipmunk (122; 13.6 percent, and Great Basin pocket mouse (81; 9 percent).

Table 1. Small mammals captured at Page Ranch, Krumbo Ridge, Juniper Mountain, and Green Mountain in Eastern Oregon, 1993, 1995-97.

Page Ranch (uncut vs. cut)	1993		1995		1996		1997	
Long-tailed meadow mouse	0	0	1	0	0	0	0	0
Montane meadow mouse	0	1	2	34*	0	5*	0	0
Bushy-tailed wood rat	0	0	1	0	0	0	0	0
Canyon mouse	0	0	1	1	0	0	0	0
White-footed deer mouse	19	23	36	86*	35	72*	9	18
Great Basin pocket mouse	1	1	2	5	1	4	0	3
Yellow pine chipmunk	0	4	1	15*	1*	11	2	3
Northern pocket gopher	0	0	1	0	1	0	0	0
Western jumping mouse	0	0	0	0	0	0	0	0
Krumbo Ridge (uncut vs. cut)								
Long-tailed meadow mouse			0	0	0	3	0	2
Montane meadow mouse			1	1	1	1	0	1
White-footed deer mouse			15	12	25	35	25	27
Great Basin pocket mouse			2	1	8	6	6	3
Vagrant shrew			0	0	0	1	0	0
Yellow pine chipmunk			5	8	13	8	3	4
Mountain cottontail			0	0	0	0	0	3
Northern pocket gopher			0	0	2	0	0	0
Western jumping mouse			0	0	0	0	0	0
Juniper Mountain (Shrub vs. Tree)								
Long-tailed meadow mouse					0	0	3	0
Montane meadow mouse					2	0	5	0*
Ermine					0	0	1	0
White-footed deer mouse					59	47	26	11
Great Basin pocket mouse					9	2*	12	1*
Yellow pine chipmunk					3	4	1	16*
Northern pocket gopher					1	0	0	1
Green Mountain (Shrub vs. Tree)								
Ord kangaroo rat							1	0
Desert wood rat							0	1
White-footed deer mouse							10	24*
Great Basin pocket mouse							12	2*
Yellow pine chipmunk							1	19*

* Indicates significant differences (P=0.05) between treatments for that year

Cut versus Uncut

Seven trapping sessions were conducted comparing cut versus uncut sites (Page Ranch and Krumbo Ridge). In all but one instance (Krumbo Ridge, 1995), there were more captures in the cut blocks (uncut $\bar{x} = 31.71$, cut $\bar{x} = 57.43$). The number of species encountered (species richness) in trapping sessions was greater three times in cut sites, two times in uncut sites, and tied twice. The greatest number of species encountered (uncut treatment at Page Ranch 1995) was eight, and two was the lowest. Mountain pocket gophers *(Thomomys talpoides)* and western jumping mice *(Zapus princeps)* were not caught in cut sites.

The lack of response of small mammals to cutting across the two areas is partially due to differences in woodland structures between the two locations. When evaluated within location, differences in small mammal abundance and diversity showed up where the juniper woodland is fully developed and shrubs have been lost in the understory.

Eight different species were captured over the four years of study in the closed post-settlement juniper woodland and adjacent cut plots at Page Ranch. Montane meadow mice, white-footed deer mice, and yellow pine chipmunks were more common in cut sites in 1995 and in 1996. There were consistently more captures in the cut blocks (uncut $\bar{x} = 28.5$, cut $\bar{x} = 71.5$) over the four years of study. However, in the mid-transitional juniper-shrub steppe and thinned sites at Krumbo Ridge, no distinctions or consistent patterns were noted between treatments or years. Shrub-steppe structural characteristics were present in both treatments. Nine different species were captured over the three years of study

Shrub versus Woodland

Three trapping sessions were conducted comparing shrub-dominated sites with adjacent old-growth juniper woodlands. There were more mammals captured in shrub sites at Juniper Mountain (shrub $\bar{x} = 61$ captures, woodland $\bar{x} = 41$ captures), while at Green Mountain, more were taken in woodland sites (shrub = 61 captures, woodland = 41 captures). Eight species were captured in shrub sites, and five in woodland sites.

At the Juniper Mountain area, there were more Great Basin pocket mice in the shrub sites in 1996, and in 1997 there were more Montane meadow mice, Great Basin pocket mice, and fewer yellow pine chipmunks in the shrub sites. There were more white footed deer mice in the shrub sites both years.

At Green Mountain, fewer white-footed deer mice and yellow pine chipmunks and more Great Basin pocket mice were found in the shrub sites.

Post-settlement versus Old-Growth Juniper Woodland

Five species were captured in old-growth sites and three in mid-successional sites in 1997. At old-growth sites, there were more yellow pine chipmunks than in post-settlement woodlands in 1997 (5 mid, 35 old-growth). There were generally more Great Basin pocket mice in the mid-successional woodland sites, which contained a shrub understory (6) than in the old-growth (3). White-footed deer mice were about equal between the two types (34 and 35 for mid versus old-growth, respectively).

CONCLUSIONS

Our capture rates were highly variable among sites within treatments, among years, and among areas. With 4 successional years of sampling at Page Ranch, we hoped to find trends in composition and abundance of small mammals post-cutting. We expected some sampling "noise" but not of the magnitude encountered. Sedgwick and Ryder (1986) encountered 11-fold changes in capture rates among years in pinyon-juniper sampling and cited several others with similar results. We hope to periodically sample at least the Page Ranch site to search for longer-term trends such as found in a New Mexico pinyon-juniper range by Severson (1986), He noted total numbers higher in manipulated areas, but individual species response 18-years post-treatment. Baker and Frischknecht (1973) concluded deer mice and pocket mice populations increased through the second year post-treatment, and then dropped to levels still above untreated blocks . This pattern may have occurred at Page Ranch, but we couldn't separate population patterns from noise. O'Meara et al. (1981) found higher small mammal abundance (but fewer species) in 1, 8, and 15-year old chained sites over controls. Leaving blocks of unchained vegetation within pinyon-juniper control areas maintained woodland-dependent species, while providing increased total numbers of small mammals in treated areas.

The total captures and the number of species captured in our study were higher in the cut sites than in the uncut sites, comparable to the findings of Sedgwick and Ryder (1986) and Severson (1986) working on chainings in pinyon-juniper woodlands.

Although we have no data on optimal size of treatment area, our findings concur with others that small openings in woodlands can benefit a variety of wildlife (Albert et al. 1994, Christian et al., 1996). Concern that habitat fragmentation might promote the increase of exotic birds and mammals (Smallwood, 1994) is unfounded in young and mid-aged western juniper woodlands. In fact, our work with small mammals suggests that potential site invasibility by exotics may actually be diminished because of increased abundance and richness of indigenous species.

We believe the cut sites, particularly at Page Ranch, had better structure than the uncut sites. Increased vigor (cover and height) of herbaceous species, increased seed production in the cut sites, greater species richness, and juniper slash that has persisted 5 years without noticeable change in size and shape have all contributed. We propose these sites generally provide increased security and forage for small mammals. The lack of differences at Krumbo Ridge was probably due to understory structure being similar between the two treatments; woodland conversion had not progressed sufficiently to exclude shrubs. Old-growth sites typically had a greater variety of species than young juniper woodlands. This may be attributable to the more structurally complex vegetation compared to closed post-settlement woodlands (Miller et al., in press).

In our opinion, opening stands of western juniper in southeast Oregon by cutting down and leaving trees or thinning does not substantially affect the small mammal component in the area. The Great Basin pocket mouse appears to be the most sensitive species to the loss of shrubs during the latter stages of concern from shrub steppe to juniper woodland. However, other species such as wood rats are favored by the presence of juniper trees in the stand. For the maintenance of maximum structural diversity in post-settlement woodlands, shrub-steppe communities should be managed through early- to mid-woodland succession (Miller et al. In press). If conversion crosses a threshold, moving into late and closed woodlands, structural complexity and plant species diversity in the understory decline, resulting in shifts in small mammal population dynamics.

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