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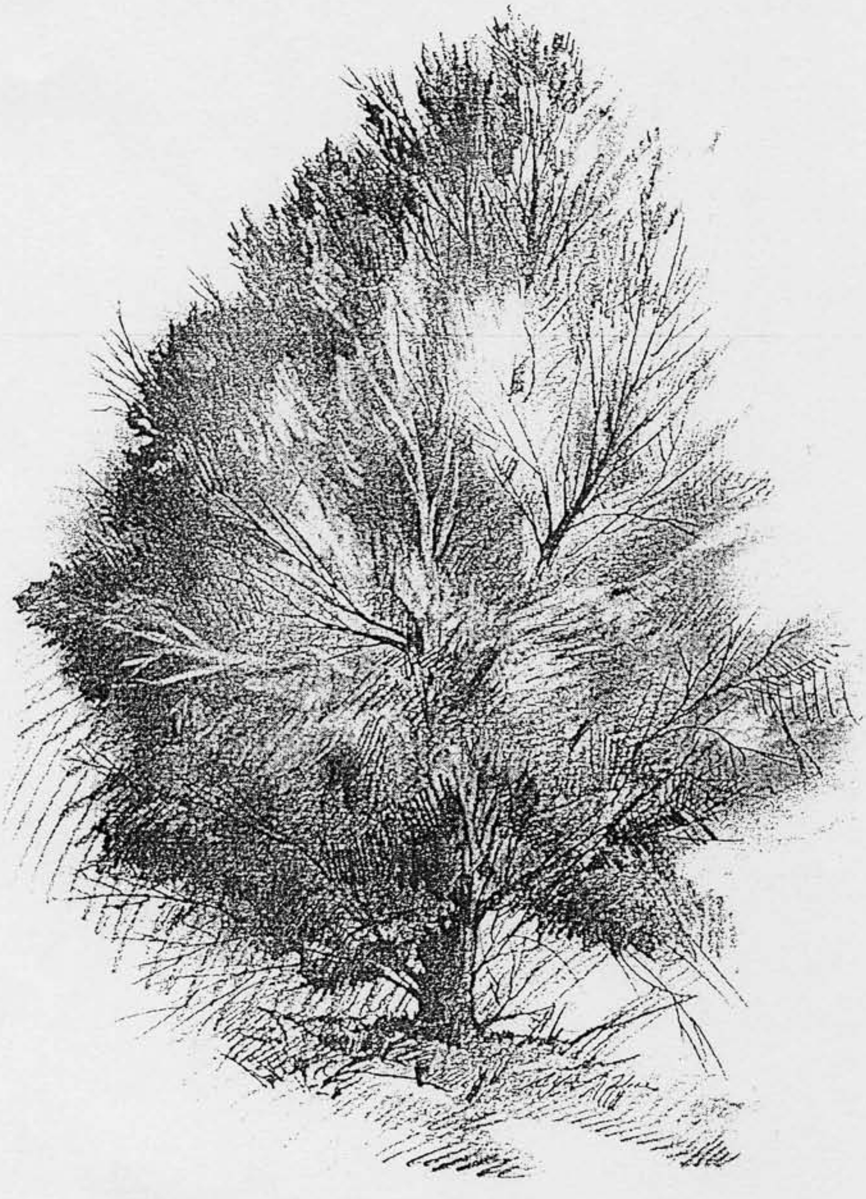
Proceedings: Ecology and Management of Pinyon-Juniper Communities Within the Interior West



Sustaining and Restoring a Diverse Ecosystem

Importance of Western Juniper Communities to Small Mammals

Mitchell J. Willis
Richard F. Miller

Abstract: We investigated the composition and relative abundance of small mammals in western juniper (*Juniperus occidentalis*) woodlands of southeast Oregon in the spring of 1993 and 1995-97 by snap trapping recently cut woodlands, shrub dominated sites, and adjacent uncut (both mid-successional and old-growth) juniper sites. The number of captures were almost always 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 compared to 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.

The issue of juniper (*Juniperus* sp.) encroachment, conversion, and subsequent impacts 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 and others 1984), 95 have been reported to occur in juniper steppe (Puchy and Marshall 1993). Juniper steppe is defined as western juniper woodlands, typically having a sagebrush (*Artemisia* sp.) understory. The western juniper/sagebrush/bunchgrass community had the third largest number of the 341 total wildlife species from the 16 general plant communities Maser and others (1984) described in southeastern Oregon. Puchy and Marshall (1993) also reported large numbers of wildlife use juniper steppe. However, both of these reports were based on minimal data and written as guidelines. These reports lumped a broad range of transitional phases of juniper succession in shrub steppe across a wide variety of environmental variables, both of which affect plant community structure, composition, and function (Miller and others, this symposium). Juniper-shrub steppe communities described in the literature are typically shrub-steppe communities in various stages of woodland conversion. Shrubs and some perennial grasses and forbs are lost as woodlands approach full development, changing the structural characteristics of the understory (Miller and others, this symposium).

Few studies have evaluated the effects of juniper woodland development or conversion in shrub steppe communities on nongame use, and most of these have been conducted in pinyon (*Pinus* sp.)-juniper communities. Baker and Frischknecht (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 three 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 over untreated plots three years after treatment in the same type on the Kaibab Plateau in Arizona. In pinyon-juniper woodlands of northeast Nevada, Mason (1981) found 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. O'Meara and others (1981) noted small mammal abundance in Colorado was higher in chained pinyon-juniper woodland than in control plots. They suggested adverse effects on nongame wildlife could be minimized by favoring survival of shrubs and young trees, retaining selected cavity trees, and limiting widths of clearings when chaining. O'Meara and others (1981) also found higher bird densities in unchained areas than in chained areas. Sedgwick and Ryder (1987) found small mammal species richness and total captures 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 species used the chained plot more. Severson (1986) found total numbers of small mammal species significantly greater on all treated areas compared to untreated pinyon-juniper woodlands 13-18 years post-treatment. Individual species and groups responded differently to the tree removal manipulations and methods of slash disposal. Grassland rodents as a group 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 mouse (*P. trueii*) and rock mouse (*P. difficilus*) preferred the thinned site, where slash remained on site. Austin and Urness (1976) found few differences with respect to total rodent numbers and weight in a comparison among seven pinyon-juniper types.

The apparent conflicting results of small mammal and bird responses to woodland treatment is probably largely due to the limited vegetation data collected in these studies.

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Mitchell J. Willis is a Wildlife Biologist and Richard F. Miller is a Professor of Range Management, Eastern Oregon Agricultural Research Center, Oregon State University, HC71, 4.51 Hwy 205, Burns, OR 97720.

Juniper and pinyon-juniper woodlands occur across a wide variety of spatial and temporal conditions in the Intermountain west (Miller and others, this symposium; Tausch and others, this symposium). Woodland structure and composition prior to treatment, and succession following treatment will likely significantly affect small mammal and avian populations.

We investigated small mammal and bird composition and relative abundance in southeast and central Oregon, northwest Nevada, and northeast 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 southeast and central Oregon.

Study Areas

Page Ranch: Closed Woodland vs. Cut

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 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-Shrub Steppe vs. Thinned

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, 7-15 percent shrub cover, and 5-10 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 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 10-15 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 10-15 percent.

Methods

Small mammal trapping was conducted in permanently marked grids centered within each site. Museum Special traps were set within 1 m of flags placed in a 10 x 10 array at 5 m intervals totaling 100 traps/grid. Traps were baited with peanut butter and rolled oats. At each study area, treatments and controls were repeated three times resulting in 3,000 trap-nights for each study area. Traps were set on day 1, checked in the early morning on days 2-4, and pulled after checking on day 5. Trapping was conducted May-early July. The status of each trap was recorded daily. 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.

Museum Special snap traps were used in lieu of livetraps. While capture selectivity may exist among trap types (Fowle and Edwards 1954), snap traps have been utilized extensively and effectively (Johnson and Keller 1983). Snap traps were found more effective than pitfall traps for deer mice and chipmunks (*Tamias* sp.) (McComb and others 1991), both common to juniper woodlands (Johnson and Keller 1983). Hayward and Hayward (1995) found capture rates between pit and snap traps were generally quite similar for the most common species in their work in central Idaho. We would have used pitfall and rat-traps as well, but logistics and finances limited effort to museum specials.

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 (n = 122; 13.6 percent, and Great Basin pocket mouse (n = 81; 9 percent).

Cut versus Uncut

Seven trapping sessions were conducted comparing cut versus uncut sites (Page Ranch and Krumbo Ridge). Although the difference was not significant (P = 0.11), between cut and uncut sites across the two study locations, in all but one instance (Krumbo Ridge 1995), there were more

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

Location	1993		1995		1996		1997	
Page Ranch (Uncut vs. cut)								
Long-tailed meadow mouse	0	0	1	0	0	0	0	0
Montane meadow mouse	0	1	2	34[a]	0	5[b]	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[c]	35	72[d]	9	18
Great Basin pocket mouse	1	1	2	5	1	4	0	3
Yellow pine chipmunk	0	4	1	15[e]	1[f]	11	2	3
U‡rthern 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			1	0	2	0	0	0
Western jumping mouse			0	0	1	0	0	0
Juniper Mountain (Shrub vs. Tree)								
Long-tailed meadow mouse					0	0	3	0
Montane meadow mouse					2	0	5	0[i]
Ermine					0	0	1	0
White-footed deer mouse					59	47	26	11
Great Basin pocket mouse					9	2[g]	12	1[j]
Yellow pine chipmunk					3	4	1	16[k]
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[l]
Great Basin pocket mouse							12	2[m]
Yellow pine chipmunk							1	19[n]

[a]Significantly different. P = 0.005
[b]Significantly different. P = 0.0132
[c]Significantly different. P = 0.0001
[d]Significantly different. P = 0.0011
[e]Significantly different. P = 0.0476
[f]Significantly different. P = 0.0047
[g]Significantly different. P = 0.0187
[h]Significantly different. P = 0.0187
[i]Significantly different. P = 0.0457
[j]Significantly different. P = 0.0059
[k]Significantly different. P = 0.0122
[l]Significantly different. P = 0.0086
[m]Significantly different. P = 0.0276
[n]Significantly different. P = 0.0005

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 (2 other uncut treatments at Page Ranch, 1993,1997). 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 show 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 significantly (P = 0.005, 0.0001, and 0.0476 respectively) more common in cut sites in 1995. This pattern held in 1996 as well (P = 0.0132, 0.0011, and 0.0047). There were consistently (but non-significant, P = 0.125) 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 significantly (P = 0.032) 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 significantly more Great Basin pocket mice in the shrub sites in 1996 (P = 0.0187). In 1997, there were significantly more montane meadow mice (P = 0.0457), Great Basin pocket mice (P = 0.0059), and fewer yellow pine chipmunks (P = 0.0122) in the shrub sites. Although not significant, there were more white footed deer mice in the shrub sites both years (59 vs. 47 captures in 1996, and 26 vs. 11 in 1997).

At Green Mountain, fewer white footed deer mice (P = 0.0086), more Great Basin pocket mice (P = 0.0276), and fewer yellow pine chipmunks were found in the shrub sites.

Post-settlement versus Old Growth Juniper Woodland

Five different species were captured in old growth sites and three in mid-successional sites in 1997. At old growth sites, there were significantly (P = 0.0001) more yellow pine chipmunks than in post-settlement woodlands in 1997 (n = 5 mid, 35 old growth). There were generally more Great Basin pocket mice in the mid-successional woodland sites which contained a shrub understory (n = 6) than in the old growth (n = 3). White footed deer mice were about equal between the two types (n= 34 and 35 for mid versus old respectively).

Conclusions

Our capture rates were highly variable among sites within treatments, among years, and among areas. This undoubtedly caused the lack of significance among many comparisons. With four 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 their pinyon-juniper sampling, and cited several others who had documented similar results. We hope to periodically sample at least the Page Ranch site to search for longer term trends, as those found by Severson (1986) who reported total numbers higher in manipulated sites, but a variety of individual species responses in New Mexico 18 years post-treatment. Baker and Frischknect (1973) snap-trapped a chained and seeded pinyon-juniper range, and concluded that deer mice and pocket mice populations increased through the second year post-treatment, and then dropped to levels still above uncontrolled. This pattern may have occurred at Page Ranch, but we couldn't separate population patterns from noise. O'Meara and others (1981) found higher small mammal abundance (but fewer species) in 1, 8, and 15 year old chained sites over controls. They also pointed out that leaving blocks of unchained vegetation within pinyon-juniper control areas should maintain 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), although their work was in pinyon-juniper, and the treatments were chainings.

Although we have no data on optimal size of treatment area, our findings concur with others that small openings in pinyon-juniper woodlands (Albert and others 1994), and in aspen (*Populus tremuloides*) (Christian and others 1996), can benefit a variety of wildlife. Smallwood (1994) expressed concern that habitat fragmentation might increase site invasibility by exotic birds and mammals through decreased indigenous species richness and abundance. In the case of fragmenting young and mid-aged western juniper woodlands, 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 preferred structure to the uncut sites which was provided by increased vigor (cover and height) of herbaceous species, increased seed production in the cut sites (Bates and others in press), greater species richness, and juniper slash which has persisted five years without noticeable change in size and shape. 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 and others, this symposium).

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 stands, shrub steppe communities should be managed through early- to mid-woodland succession (Miller and others, this symposium). 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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