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Manipulation of Flood Meadow Vegetation and Observations on Small Mammal Populations

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One of the primary goals at Malheur National Wildlife Refuge (NWR) is the maintenance of quality nesting habitat for ground nesting birds. Impacts of vegetation manipulation on plants and small mammal populations are important considerations.

Flood meadow vegetation responds rapidly to changes in land use practices. These responses are evident in changing yield, structure, and species composition. Traditionally, flood meadow vegetation in eastern Oregon has been hayed and the aftermath grazed annually. Annual cover removal is considered detrimental to the production of many upland nesting birds, but nesting habitats cannot be maintained in good condition without periodic disturbance (Kirsh et al. 1978). Britton and Sneva (1979) reported that retention of residual vegetation through non-use at Malheur NWR depressed subsequent herbaceous production and altered plant species composition. After a period of non-use, the depression of herbaceous production resulted in areas where the residual vegetation is no longer erect. This habitat with low vertical structure provides inadequate cover for some upland nesting bird species. These areas of residual vegetation are also hunted extensively by marsh hawks (*Circus cyaneus*) and rough-legged hawks (*Buteo lagopus*) during the winter. Response of small mammal populations to vegetation manipulation are relatively unknown for this refuge.

The objectives of this study were to compare effects of vegetation manipulation by burning and grazing of areas which had been in non-use to areas that had been hayed annually or left in non-use for four years. Small mammal populations were monitored in the four areas to evaluate the influence of different land use practices on a portion of the raptor food base.

STUDY AREA AND METHODS

The study area was located at Malheur National Wildlife Refuge, about 50 km south of Burns, Oregon. Precipitation averages about 30 cm per year and occurs primarily as snow. The native meadows receive additional water through flooding during late spring and early summer. Flooding typically starts in late April and peaks in late May at a depth of 10-15 cm. Surface water disappears in early June.

Soils, generally unclassified, are mainly Fluventic and Cumulic Haplaquolls (Gomm 1979). Soil profiles, which are variants of Damon, Stanfield, and Silvies series, have low chromas, mottling, and dark surface horizons high in organic matter. They are predominantly silt loams and are basic in reaction.

Flood meadow vegetation is composed of grasses, sedges, rushes, and forbs. Dominant grasses are redtop (*Agrostic alba*), sloughgrass (*Beckmannia syzigachne*), creeping wildrye (*Elymus triticoides*), meadow barley (*Hordeum brachyantherum*), timothy (*Phleum pratense*) and Nevada bluegrass (*Poa nevadensis*); dominant sedges are slenderbeak sedge (*Carex othrostachya*), narrowleaf sedge (*C. stenophylla*), rusty sedge (*C. subfuca*), common spike-rush (*Eleocharis palustris*), and small spike-rush (*E. parvula*); dominant rushes are Baltic rush (*Juncus balticus*), and Nevada rush (*J. nevadensis*); and dominant forbs are western yarrow (*Achillea millefolium*), borage (*Borago officinalis*), cinquefoil (*Potentilla anserina*), northwest cinquefoil (*P. gracilis*), western dock (*Rumex occidentalis*), and chaffweed (*Centunculuc minimus*). Small mammals present on the study area include vagrant shrew (*Sorex vagrans*), deer mouse (*Peromyscus maniculatus*), and montane vole (*Microtus montanus*).

A portion of a field with a history of annual haying was divided into two areas in 1976. One half continued to be hayed in August while the other was placed in non-use for a period covering three growing seasons. In the fall of 1978, the non-use area was separated into three, 0.5-ha plots which were burned, grazed, or left in non-use. Burning was done in early November. The burned and non-use plots were fenced, then cattle annually grazed in the mowed plot and in the plot which had been non-use for three years.

Vegetation measurements were made during mid-July at peak standing crop of the growing season. Herbage yield was estimated by clipping 15, 0.5-m^2 circular quadrats in each area. Clipped samples were dried at 60°C for 48 hours then weighed to the nearest 1.0 g. A completely random design was used and means were separated by Duncan's procedure ($P < 0.05$).

Vegetation structure was measured using a modified Robel pole technique (Robel et al. 1970). Parameters measured included maximum height and height at which vegetation completely obstructed the pole. Twenty random measurements were made in each plot. Species composition was determined using an inclined 10-point frame. In each plot, 2,000 points were examined and recorded as being sedges, rushes, grasses, forbs, bare ground, or litter. Frequency data were tested using a Chi-square test ($P < 0.5$). A completely random design was used for structure and means were separated using Duncan's procedure ($P < 0.05$).

Small mammal trapping configuration was a 7 X 7 grid with assessment lines (Smith et al. 1975, O'Farrell et al. 1977). Trapping stations, 10 m apart, were marked with numbered stakes. One aluminum Sherman live-trap was set at each station and baited with rolled oats. The traps on the grid remained open day and night and were checked between 0800 - 0900 hrs and 1530 - 1630 hrs daily. Each small mammal captured was marked by toe-clipping, sexed, aged, checked for reproductive condition, and released. The grid was trapped until 10% or less of the animals captured at a given trap check were unmarked. Traps were then transferred to eight assessment lines consisting of 10-trap stations. Assessment line traps were checked for three days at 0800 - 0900 hrs. Small mammal densities were calculated using the formulas of O'Farrell et al. (1977).

In October 1978, prior to treatments, grids were trapped in the non-use and adjacent hayed area. After burning in early November, one grid was trapped in the burned plot. The four treatment areas were trapped in the spring of 1979. A final trapping of one grid on each of the four treatment areas was conducted in January 1980. By this time the hayed and grazed treatments had been repeated during the fall of 1979. Small mammal data were not tested and are presented for relative comparison.

RESULTS

Non-use resulted in the lowest herbage yield compared to the other treatments at 5,436 kg/ha (Fig. 1). Grazing and haying resulted in similar yields at 7,096 and 7,297 kg/ha, respectively. The burned plots produced the most herbage with a yield of 8,105 kg/ha.

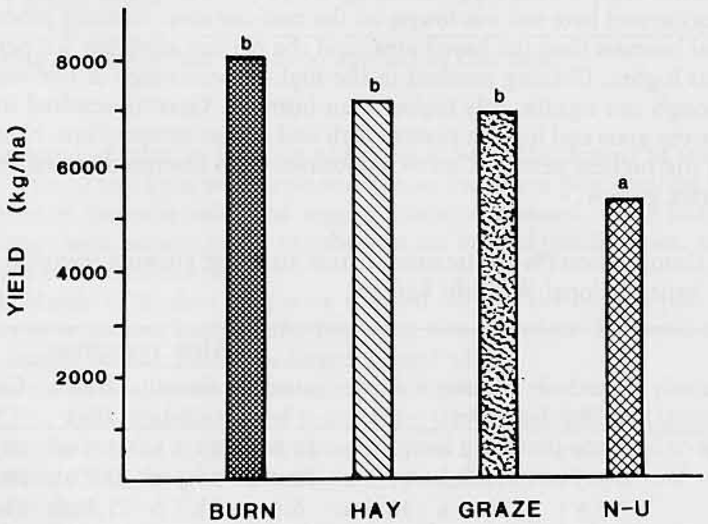

Fig. 1. Average herbaceous yield of flood meadow vegetation one growing season after treatment. Bars separated by letter at the top are significantly different ($P < 0.05$).

Structure of the vegetation was altered by the treatments (Fig. 2). Burning resulted in the greatest maximum height (12.4 dm). Grazing produced the highest 100% obstruction height with 8.4 dm. Non-use gave the lowest maximum height and 100% obstruction height at 10.1 dm and 6.5 dm, respectively. Haying resulted in intermediate values.

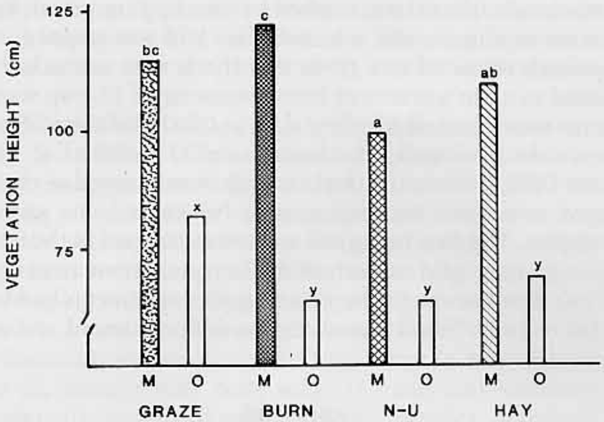

Fig. 2. Maximum (M) and 100% obstruction(O) height of vegetation for the various treatments. Bars separated by letters at the top are significantly different ($P < 0.05$).

Vegetation composition (%) was changed by treatments (Table 1). Percent live vegetation and bare soil was lowest on the non-use area. Burning produced more aerial biomass than the hayed area, and the percent alive was 1.6 percentage points higher. Grazing resulted in the highest percentage of live vegetation, although not significantly higher than burning. Grazing resulted in the lowest percent grass and highest percent forb and *Juncus* composition. Non-use produced the highest percent *Carex* composition with intermediate values for other species groups.

Table 1. Composition (%) of treatment areas after one growing season at Malheur National Wildlife Refuge.

Treatment	Bare soil (%)	Litter (%)	Alive (%)	Alive vegetation Juncus (%)	Grass (%)	Forb (%)	Carex (%)
None-use	13.8 a[1]	74.2 c	12.0 a	15.0 b	23.3 b	23.3 a	38.4 a
Hay	73.6 c	11.4 a	15.0 a	20.0 b	21.3 b	30.7 ab	28.0 a
Burn	72.6 c	10.8 a	16.6 a	6.0 a	33.7 b	25.3 ab	35.0 a
Graze	57.4 b	25.8 b	16.8 a	22.6 b	8.3 a	39.3 b	29.8 a

[1]Means over treatment within a column followed by the same letter are not significantly different at the 0.05 level.

Density estimates of small mammals are presented in Table 2. In 1978, trapping was completed on the non-use plot and hayed plot prior to burning. This was done to avoid the possibility of small mammals moving from the burn plot to adjacent plots and biasing the estimates. Following the fire, the burned plot was trapped.

Table 2. Estimated small mammal populations (N/ha) for three periods following vegetation manipulation of the Malheur National Wildlife Refuge.

Date sampled	Treatments			
Species (N/ha)	Non-use	Burn	Hayed	Grazed
October/November 1978				
Montane vole	69.4	8.3	36.1	—[1]
Deer mouse	25.0	5.6	0	—[1]
Vagrant shrew	13.9	0	8.3	—[1]
March 1979				
Montane vole	2.8	0	0	0
Deer mouse	0	11.1	0	0
Vagrant Shrew	2.8	5.6	0	0
January 1980				
Montane vole	40.0	125.0	0	0
Deer mouse	16.0	62.5	0	0
Vagrant shrew	12.0	31.3	0	0

[1]Grazing treatment had not been applied at this time.

Removal of cover by burning or haying reduced the density of small mammals. The 12 to 15 cm vegetative stubble on the hayed plot resulted in higher densities of montane voles and vagrant shrews contrasted to the burned plot. Deer mice were present in low numbers on the burned plot however, more were trapped on the hayed plot.

By March 1979, deer mice were trapped only on the burned plot. Vagrant shrews were present both on the burn and non-use plots. No small mammals were caught on the grazed or hayed/grazed plots.

Estimated small mammal densities were highest on the burned plot in January 1980. No small mammals were trapped on the grazed or hayed/grazed plots. This emphasizes the cover dependency of small mammals observed in this study. In January 1980, the plot burned in 1978 had the highest weight of vegetation per unit area.

Most deer mice captured during this study were trapped at or near the edge of a plot, especially the east edge of the burn and non-use plots. This edge was adjacent to a row of willows lining the bank of a slough. Deer mice were not captured in hayed, grazed, or hayed/grazed plots during any census period.

DISCUSSION

On productive sites, such as the flood irrigated meadows at Malheur NWR, non-use results in the rapid build-up of litter and standing dead vegetation. This accumulation of residual vegetation and litter depresses subsequent plant yield (Britton and Sneva 1979) which is apparently related to the balance between accumulation and decomposition of litter (Dyksterhuis and Schmutz 1947). A number of upland nesting birds prefer to nest in fields of tall, dense residual vegetation (Kirsh et al. 1978). Therefore, annual manipulation of vegetation is undesirable where maintenance of nesting cover has a high priority. After a period of non-use, the height of the vegetation may be reduced to the point where it no longer provides adequate nesting cover. How soon this occurs is a function of site productivity, plant species composition, and the type of manipulation.

Although grazing produced the highest 100% obstruction height at the time of peak standing crop, the grazed plot had the lowest percentage of grasses. Grasses tend to remain more erect through the winter than do forbs and sedges and thus provide better residual cover in the following spring. Burning, grazing, and haying all showed greater vegetation yield and maximum height of the vegetation as contrasted to the non-use plot. Additional investigation is needed to evaluate the persistence of favorable habitat structure through several growing seasons. Frequency of manipulation should be related to the productivity of the site (Kirsh et al. 1978).

Burning resulted in an immediate reduction in small mammal numbers. No direct mortality was noted. Most work attributes similar population reductions to the obvious fire induced habitat change (Tester 1965, Schramm 1968, Beck and Vogl 1972, Krefting and Ahlgren 1974, Buech et al. 1978). Weather may have influenced the small mammal population. Minimum temperatures in the winter of 1978-1979 were below average. This could have resulted in greater small mammal mortality and contributed to the low density estimated in March 1979. In contrast, temperatures during the winter of 1979-1980 were above average and may have contributed to the greater densities estimated January 1980.

Annual haying and grazing depressed the numbers of all small mammals observed. Results from the burn plot suggest that small mammals are capable of inhabiting an area the first growing season post-burn.

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