Influence of Range Seeding on Rodent Populations in the Interior of British Columbia

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Abstract

This study was designed to determine the influence of range seeding on rodent populations inhabiting cutover lodgepole pine forest land in the interior of British Columbia, Canada. Both deer mice and voles were strongly attracted to an area seeded with grass mixture in the early spring, even though overwinter mortality had dramatically reduced the average density to ≤2 animals/ha. Five rodents as well as several seed-eating birds appeared on this seeded area while no animals were recorded on a nearby control. Subsequent seeding experiments in the summer also produced significant increases (2 to 2.2 times) in rodent populations. Success of range seeding in B.C. can be quite variable, possibly due to seed predation by mice and voles. Consequently, both the quality and quantity of seed remaining for germination and forage production may be radically altered.

Grass seeding of cutover forest land is designed to improve range conditions for cattle grazing in many parts of western Canada and the United States. These seedings are successful in some areas but do not produce the expected growth of forage in other localities. There are probably several factors responsible for this inconsistency, but one potential problem is rodent predation on the grass seed.

Seed predation by the deer mouse *(Peromyscus maniculatus)* has contributed to the failure of several range seeding projects (Howard 1950, Casebeer 1954, Johnson 1961, Nord 1965, Nelson et al. 1970). Everett et al. (1978) have reviewed the range seed preferences of deer mice. Voles of the genus *Microtus* spp. also harvest large quantities of grass seed (Batzli and Pitelka 1970, Marshall and Jain 1970, Borchert and Jain 1978). These microtines usually inhabit grassland areas but may also occur on interior logged sites (Radvanyi 1973, Sullivan and Sullivan 1982).

Little quantitative information is available on the response of rodent populations to range seedings. To determine the influence of range seeding on deer mice and voles and devise suitable control methodology for reduction of seed predation, a preliminary assessment of rodent populations is required. This study was designed to monitor rodent populations before and after grass seeding of cutover lodgepole pine *(Pinus contorta)* forest lands.

Methods

Study Areas

This study was located at 2 areas in the south-central interior of British Columbia, Canada. The Okanagan study area was 30 km northwest of Summerland adjacent to the Okanagan Valley in the Kamloops Forest Region. The forest type corresponds to the Interior Douglas fir *(Pseudotsuga menziesii)* biogeoclimatic zone (Krajina 1969) and the dominant lodgepole pine was logged in 1978. Groundcover included slash with pinegrass *(Calamogrostis rubescens)* and lupine (*Lupinus* spp.).

The Chilcotin study area was 53 km west of Williams Lake in the Cariboo Forest Region. This area is classified as the Douglas fir-pinegrass subzone (northern phase) (Annas and Coupe 1979) of the Interior Douglas fir biogeoclimatic zone. The forest was logged in 1977 and burnt in the spring of 1978. Ground-cover included burnt slash, pinegrass, and a variety of early successional herbs.

All experimental sites were on relatively flat terrain with little discernible aspect. Both clearcut blocks were approximately 10 ha in area.

Rodent Populations

Two 1-ha matrix grids 1 control (A) and 1 experimental (B)) were established at the Okanagan, and 3 identical grids 1 control (A) and 2 experimental (B and C)) at the Chilcotin study area. Grids were centrally located on each study area and were separated from each other by at least 200 m to minimize recapture of animals moving between sampling areas. All grids had 49 trap stations (7 × 7) located at 15.2-m intervals. Grids were trapped at 3-week intervals from August 1979 to August 1980 in the Chilcotin and May to September 1980 in the Okanagan. One Longworth live-trap was located within a 2-m radius of each station. Traps were baited with peanut butter, Purina Lab Chow® or whole oats, and cotton was supplied as bedding. Traps were set on day 1, checked on days 2 and 3, and then locked open between trapping periods.

All rodents captured were ear-tagged with serial-numbered fingerling fish tags. Population densities were determined by number of individuals caught (for low sample sizes) or by the enumeration technique of minimum number of animals known to be alive (MNA) (Hilborn et al. 1976) at each 3-week interval. If x number of animals captured at time t are not caught at t+1 but are recaptured at t+2, then these x animals are alive but not censused at t+1 and so should be included in the density estimate for that time.

Grass Seeding

The grass seed mixture used in this study was composed of 26% 'hay' orchard grass *(Dactylis glomerata)*, 10% climax timothy *(Phleum pratense)*, 15% bromegrass (*Bromus* spp.), 15% intermediate wheatgrass *(Agropyron intermedium)*, 10% perennial ryegrass *(Lolium perenne)*, 12% white clover *(Trifolium repens)*, and 12% alsike clover *(Trifolium hybridum)*. In experiment 1 in the Chilcotin, this mixture was uniformly distributed over a 4-ha block which included the centrally located 1-ha area of grid B. Cyclone seeders were used to disperse seed onto snow (depth of 30 to 45 cm) on March 28, 1980, at a seeding rate of 5 kg/ha. This spring period was typical for range seedings on the interior of B.C., which vary from just before snowfall to late spring before snowmelt. This seed was distributed approximately 1 month prior to the first possible post-seeding trapping period (late April 1980).

Experiment 2 in the Chilcotin commenced on June 18, 1980' when 10 kg of grass seed was manually distributed over the 1-ha

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The authors wish to thank A. Vyse and W. Mitchell of the British Columbia Ministry of Forests for assistance and the Applied Mammal Research Institute for financial support.

area of grid C. Experiment 3 in the Okanagan replicated this summer seeding with 10 kg of grass seed manually dispersed over the 1-ha area of grid B on June 28, 1980.

Results and Discussion

Experiment 1–Spring Seeding

The effect of spring grass seeding on rodent populations at the Chilcotin study area is illustrated in Figure 1. The first trapping

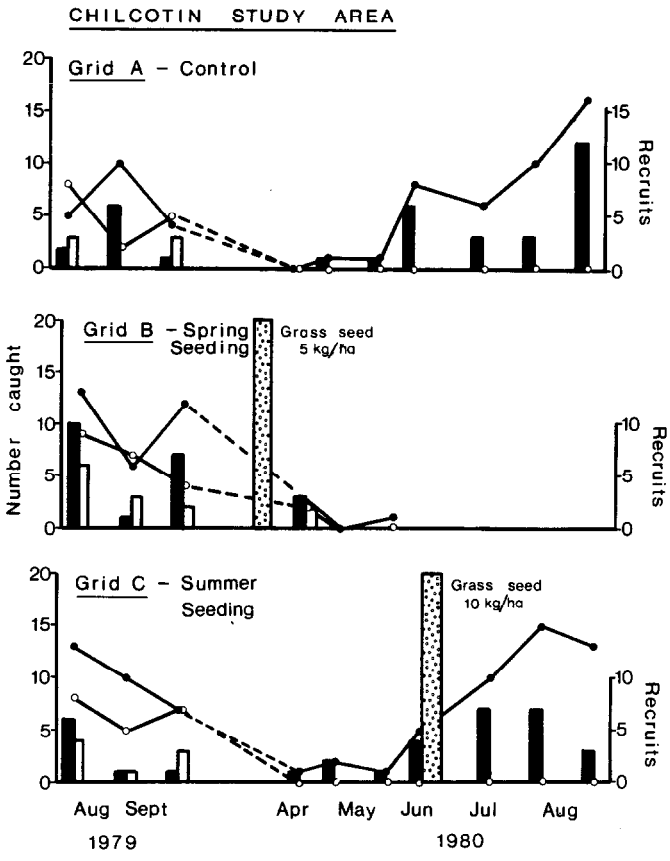

Fig. 1. *Population densities of* Peromyscus maniculatus *(closed circles) and the voles* Phenacomys intermedius *and* Microtus pennsylvanicus *(open circles) at the Chilcotin study area during the fall of 1979 and spring and summer of 1980. Histograms indicate number of deer mice (shaded) and new voles (unshaded) recruited into populations. Grass seed mixture was applied to grid B on March 28, 1980 and to grid C on June 18, 1980.*

period in 1980 occurred 4 weeks after seeding and 5 new animals: 3 deer mice *(Peromyscus maniculatus)* and 2 heather voles *(Phenacomys intermedius)* were captured on the seeded area (grid B). No rodents were captured on control grid A. The 3 deer mice captured on grid B were all tagged animals which had emigrated from grid A, a distance of approximately 350 m. These deer mice were presumably attracted to the seeded area because of the artificial food supply. Their average home range size was 0.06 ha prior to seeding, and this range expanded to 1.7 ha after seeding.

In general, the populations of deer mice and voles *(Microtus pennsylvanicus* and *P. intermedius)* on both grids declined dramatically over the winter of 1979-1980 to an average density ≤ 2 animals/ha. This is consistent with that reported by Sullivan and Sullivan (1982) for rodent populations on interior cutover forest land in British Columbia. No meadow voles *(M. pennsylvanicus)* were captured in 1980, which represented a low year in the 3–4 year cyclic fluctuation in abundance of this microtine.

Small sample size precluded statistical analysis of this rodent response to grass seeding. However, the capture of 5 animals on the seeded grid compared with a total of only 2 other mice captured 1 deer mouse on grid C and 1 heather vole on a fourth grid) strongly suggests that the grass seed attracted rodents. It is very likely that the majority of mice on the clearcut block (10-ha area) were concentrated on the seeded area during the 4- week period after seeding.

Several white-crowned sparrows *(Zonotrichia leucophrys)* and dark-eyed juncos *(Junco oreganus)* were observed in grid B during the first trapping period in late April. These seed-eating birds were consuming the grass seed as has been documented for granivorous birds in other range seeding projects (Goebel and Berry 1976). Thus, both rodents and seed-eating birds congregated on the seeded area. They presumably had a serious impact on the quantity and perhaps quality of grass seed remaining for germination and forage production.

Experiment 2–Chilcotin Summer Seeding

If the rodent populations are influenced by range seeding during the winter and spring, then application of a large amount (10 kg/ha) of grass seed should provide a significant response. To rigorously analyze this predicted response, a summer seeding experiment was conducted at the Chilcotin study area. This time period allowed for assessment of the number of rodents immediately before and after seeding. The results of this experiment are illustrated in Figure 1. While the control population declined from 8 deer mice to 6 during the first post-seeding trapping period, the grid C population doubled in density (from 5 to 10). This increase was followed by another burst of recruitment up to a density of 15 deer mice per ha on the seeded area. The response was not statistically significant ($p = 0.20$; chi-square) but may be biologically significant in terms of deer mice appearing on the area to utilize the seed as a food source.

Experiment 3–Okanagan Summer Seeding

This summer seeding (10 kg/ha) experiment was replicated at the Okanagan study area where the rodent community was dominated by the long-tailed vole *(M. longicaudus)* and the meadow vole. Deer mice were present but at considerably lower densities than the voles. The results of grass seeding are illustrated in Figure 2. Prior to seeding, the grid B vole population declined from 31 to 12 animals/ha. This drop was not related to trapability since the enumeration technique of minimum number alive was employed for the populations. The control population of voles was increasing at this time before stabilizing at 28 to 34 animals/ha. Recruitment of new animals was generally consistent throughout the summer. Application of grass seed to grid B resulted in more than a doubling of vole numbers (from 12 to 27). Of these new voles, 92% were adults colonizing the seeded area. Five new deer mice also appeared on the area even though only 1 deer mouse was captured in the 4 trapping periods prior to seeding.

The dramatic increase in voles on the seeded area was statistically significantly ($p = 0.02$; chi-square) when compared with the control population. This result is not surprising since *Microtus* spp. readily harvest various species of grass seed (Batzli and Pitelka 1970, Marshall and Jain 1970, Borchert and Jain 1978).

Conclusions

We conclude that range seeding of cutover forest land may strongly influence rodent populations. Both voles and deer mice respond positively by their attraction to seeded areas. Since range seed is readily consumed by rodents, the quality (species) and quantity of seed remaining for germination and forage production may be radically altered. Deer mouse and vole preference for certain grass and forb seed species has been documented (Borchert and Jain 1978, Everett et al. 1978).

Our studies were conducted in the southern and central interior of British Columbia where range seeding and cattle production are concentrated. In general, the success of range seeding projects can be quite variable. Factors which affect seeding success include weather, soil, and related site components, as well as predation by rodents. Additional replication in our experimental design would

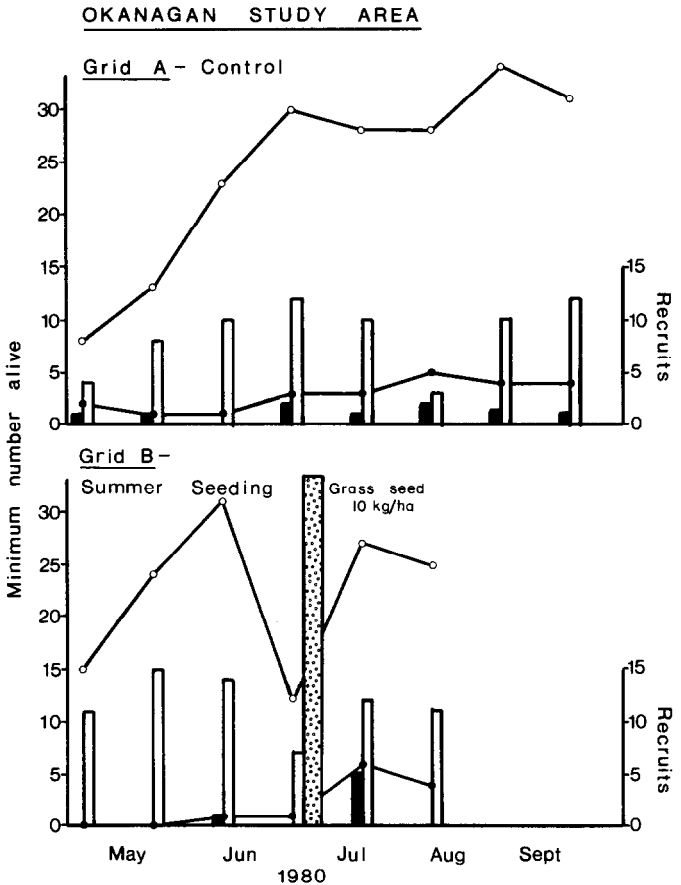

Fig. 2. *Population densities of* Peromyscus maniculatus *(closed circles) and the voles* Microtus pennsylvanicus *and* M. longicaudus *(open circles) at the Okanagan study area during the spring and summer of 1980. Histograms indicate number of new deer mice (shaded) and now voles (unshaded) recruited into populations. Grass seed mixture was applied to grid B on June 28, 1980.*

have provided a more rigorous analysis of the rodent response. However, since mice and voles are attracted to seeded areas and presumably consume seed, we advocate further study of seed species preference and forage production in areas with rodent populations.

Literature Cited

Annas, R.M., and R. Coupe. (eds). 1979. Biogeoclimatic zones and subzones of the Cariboo Forest Region. Cariboo Region. Research Advisory Committee. B.C. Ministry of Forests.

Batzli, G.O., and F.A. Pitelka. 1970. Influence of meadow mouse populations on California annual and grassland. Ecology 51:1027-1039.

Borchert, M.I., and S.K. Jain. 1978. The effect of rodent seed predation on four species of California annual grasses. Oecologia 33:101-113.

Casebeer, R.L. 1954. The use of tetramine in bitterbrush revegetation. J. For. 152:829-830.

Everett, R.L., R.O. Meeuwig, and R. Stevens. 1978. Deer mouse preference for seed of commonly planted species, indigenous weed seed, and sacrifice foods. J. Range Manage. 31:70-73.

Goebel, C.J., and G. Berry. 1976. Selectivity of range grass seeds by local birds. J. Range Manage. 29:293-295.

Hilborn, R., J.A. Redfield, and C.J. Krebs. 1976. On the reliability of enumeration for mark and recapture census for voles. Can. J. Zool. 54:1019-1024.

Howard, W.E. 1950. Wildlife depredations in broadcast seeding of burned brushlands. J. Range Manage. 3:291-298.

Johnson, D.R. 1961. The food habits of rodents on rangelands of southern Idaho. Ecology 42:407-410.

Krajina, V.J. 1969. Ecology of forest trees in British Columbia. Ecology of W. North America. 2:1-147.

Marshall, D.R., and S.K. Jain. 1970. Seed predation and dormancy in the population dynamics of *Avena fatua* and *Avena barbata.* Ecology 51:886-891.

Nelson, J.R., A.M. Wilson, and C.J. Goebel. 1970. Factors influencing broadcast seeding in bunchgrass range. J. Range Manage. 23:163-170.

Nord, E.C. 1965. Autecology of bitterbrush in California. Ecol. Monogr. 35:307-334.

Radvanyi, A. 1973. Seed losses to small mammals and birds. Direct Seeding Symposium. (Ed. by J.H. Cayford), p. 67-75. Dept. of Environment, Canadian Forestry Service Service Pub. No. 1339.

Sullivan, T.P., and D.S. Sullivan. 1982. The use of alternative foods to reduce lodgepole pine seed predation by small mammals. J. Appl. Ecol. 19:33-45.