NOTES ON FOOD HABITS OF SMALL MAMMALS OF THE WHITE SPRUCE FOREST¹

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ABSTRACT

Cage feeding of deer mice, *Peromyscus maniculatus*, and red-backed mice, *Clethrionomys gapperi*, showed a daily maximum seed consumption of lodgepole pine, *Pinus contorta* var. *latifolia*, of about 1,000 seeds and of white spruce, *Picea glauca*, of 2,000 seeds. There was no difference in the amount of seed consumed by the two species of mice. Lodgepole pine seed was preferred over white spruce.

Meadow voles, *Microtus* spp., readily ate lodgepole pine and white spruce seedlings following germination. Red-backed mice also ate seedlings but not to the same degree as the meadow voles. The deer mouse was not tested.

CONCLUSIONS ET RESUME

La souris à dos roux est un petit rongeur commun qui forme parfois une forte proportion de la population de petits mammifères des forêts d'épinette blanche. Des expériences d'alimentation de souris à dos roux et de souris à pattes blanches en cage ont révélé que ces rongeurs consommaient quotidiennement au plus 1,000 graines de pin de Murray et 2,000 graines d'épinette blanche. Nous n'avons constaté aucune différence marquée de la consommation de graines entre ces deux espèces, bien que la souris à dos roux ait semblé moins satisfaite que la souris à pattes blanches d'un régime formé uniquement de graines. Les deux espèces de souris préféraient les graines de pin de Murray à celles d'épinette blanche.

Les campagnols des champs et les campagnols à queue longue consommaient volontiers aussi bien des cotylédons de pin de Murray que ceux d'épinette blanche au cours de leur première saison de croissance. Les souris à dos roux mangeaient aussi de ces plantules, mais pas autant que les campagnols. Cette expérience n'a pas été faite avec des souris à pattes blanches.

Du fait que ces petits mammifères ont été soumis aux expériences dans des conditions artificielles, on ne peut présumer que les résultats obtenus correspondent à leur consommation de graines en forêt. Dans la nature, la survivance des graines d'arbres aux ravages des petits mammifères dépend de facteurs tels que la densité et l'activité des mammifères, la densité des graines, la diversité d'autres matières nutritives et nombre d'autres. Ce n'est que par une vaste étude d'ensemble qu'on pourra préciser suffisamment l'influence des petits mammifères sur la régénération dans les forêts d'épinette blanche.

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INTRODUCTION

During studies of white spruce regeneration in Wood Buffalo National Park in 1959 it was noticed that deer mice and red-backed mice were abundant on clear-cut areas. Similar populations were found at Hinton, Alberta, the following season.

Deer mice and chipmunks are known to be detrimental to forest regeneration, but the role of red-backed mice is not as well known (Smith and Aldous 1947). Deer mice appear to prefer tree seed for food; whereas red-backed mice and chipmunks feed on seeds and succulent vegetation (Bailey 1936, Smith and Aldous 1947).

During the summer of 1960 cage-feeding studies were conducted at Hinton, Alberta with deer mice and red-backed mice to establish the maximum sustained consumption of lodgepole pine and white spruce seed, the relative seed consumption by the two species of mice, and their preference for the two species of tree seed. Other observations were made on feeding habits of the mice in the field and on other small mammals.

CAGE FEEDINGS OF SEED

In the feeding tests the animals were placed in cylindrical cages, which were 18 inches high and 9 inches in diameter, and constructed of hardware cloth with the floor of the same material situated two inches above the base of the cylinder. A pan was placed on the top as a cover and one was placed underneath the cage to catch the seed and hulls that dropped through the floor.

The animals had access to water at all times but were provided only seed for food. From cutting tests the white spruce seed was 97 per cent sound and the lodgepole pine 99 per cent.

Maximum Seed Consumption

In tests for daily maximum seed consumption the animals, after capture in live traps, were placed directly into the feeding cages.

TABLE 1
DAILY CONSUMPTION OF 2,000 WHITE SPRUCE SEED

Species	Animal No.	1st Day			2nd Day			3rd Day			Mean
		Ate	Lost	Remain	Ate	Lost	Remain	Ate	Lost	Remain	
Deer mouse	9	1660	323	17	1928	67	5	1930	65	5	1839
	11	1804	182	14	1812	187	1	1713	146	141	1776
	8	1846	141	13	1868	132	0	1992	8	0	1902
	mean	1770	—	—	1869	—	—	1878	—	—	1839
Red-backed mouse	19	1667	333	0	1919	81	0	1960	40	0	1849
	22	1762	235	3	1796	203	1	1875	3	122	1811
	23	1810	180	10	1834	164	2	1749	250	1	1798
	mean	1746	—	—	1850	—	—	1861	—	—	1819
Least chip'unk	16	1542	458	0	1698	302	0	1922	78	0	1721
	24	1587	323	90	1743	257	0	1831	168	1	1720
	mean	1564	—	—	1720	—	—	1876	—	—	1720

The average seed consumption per day was: deer mouse, 1839; red-backed mouse, 1819; and least chipmunk, *Eutamias minimus* (Bachman), 1720.

The seeds tabulated as lost fell into the pan below the floor of the cage and were not available to the animal; the other remaining seeds were either in the feeding dish or in the bedding provided for the animal.

In a further study, three deer mice, three red-backed mice and one least chipmunk were fed at the rate of 1,000 lodgepole pine seeds a day for three consecutive days. The daily rate of consumption is presented in Table 2.

TABLE 2
DAILY CONSUMPTION OF 1,000 LODGEPOLE PINE SEED

Species	Animal No.	1st Day			2nd Day			3rd Day			Mean
		Ate	Lost	Remain	Ate	Lost	Remain	Ate	Lost	Remain	Ate
Deer mouse	1	999	1	0	997	1	2	1000	0	0	999
	4	994	4	2	986	13	1	999	1	0	993
	21	992	7	1	995	4	1	997	2	1	995
	mean	995	—	—	993	—	—	999	—	—	995
Red-backed mouse	5	899	27	74	405	496	99	890	79	31	731
	10	904	96	0	802	198	0	856	144	0	854
	12	690	310	0	887	52	61	885	91	24	821
	mean	831	—	—	698	—	—	877	—	—	802
Least chip'unk	3	981	19	0	1,000	0	0	891	102	7	957

The average seed consumption for the three-day period was the deer mouse, 995; the red-backed mouse, 802; and the least chipmunk, 957. One other deer mouse which was fed 1,500 lodgepole pine seeds a day had an average daily consumption of 1168 seeds.

It is difficult to state from the feeding tests whether the deer mouse will eat more seed than will the red-backed mouse because the preponderance of the uneaten seed was scattered from the feeding dishes and fell through the floor of the cage. The red-backed mouse wasted more lodgepole pine seed than the deer mouse, perhaps indicating it was less satisfied with a pure seed diet. Both species lost more white spruce seed than lodgepole pine seed.

The 1,000 seeds of lodgepole pine per day and 2,000 seeds of white spruce appear to be near the maximum limit of daily consumption by the two species. In cage tests Willis (1914) found that deer mice ate 300 Douglas fir, *Pseudotsuga menziesii* (Mirb.) Franco, seeds daily. Abbott (1961) found that the average daily consumption was 109 eastern white pine, *Pinus strobus* L., seeds for *Peromyscus leucopus* (Raf.) and 97 seeds for the red-backed mouse.

The least chipmunks, being larger than mice and extremely active in the small cages, lost considerable seed through the floor of the cages. Consumption was similar to that of mice, but due to the inadequate size of cages, the tests were discontinued after feeding the first animals.

Seed Preference

To evaluate seed preferences, three mice of each species were fed a mixture, of 1,000 white spruce and 1,000 lodgepole pine seeds and given two days to eat the mixture. The mice of each species were selected as follows: one from the previous feedings of lodgepole pine, one from the feedings of white spruce seed and one directly from a live trap in the field. Seed consumption rates are presented in Table 3 for the deer mice and the red-backed mice.

Both species showed a preference for lodgepole pine seed although, during the first day, feeding was not restricted to lodgepole pine. Horn (1939) found that mice and chipmunks preferred seed from large-seeded species over seed from small-seeded species, but that size was not the determining factor because the same order of preference prevailed when the seeds were made into a paste.

The first day's consumption of the combined seed was higher than in the previous cage feedings of lodgepole pine seed, being 1064 for the deer mice in contrast to 995 seeds; and 1,345 for red-backed mice as opposed to 802 seeds per day. This would further substantiate the conclusion that 1,000 lodgepole pine seeds are near the maximum daily consumption for these mice.

Notes On A Cinereus Shrew and Red Squirrel

One cinereus shrew, *Sorex cinereus* (Kerr), kept alive on immature ants and other insects, would accept lodgepole pine seed when the insect food was depleted. The shrew died after being fed for one day 200 seeds of lodgepole pine but did not die before 127 seeds were chipped into and some of the kernels partially eaten. When the seed was broken in two, the seed coat showed irregular serrations on the margin, and the kernel of the seed eaten. In other cases only a small fragment of the seed coat was removed leaving the exposed kernel intact. The importance of shrews in forest regeneration has already been discussed by Moore (1940), Kangur (1954) and others.

A mature red squirrel, *Tamiasciurus hudsonicus* (Erxleben), was fed 50 staminate cones of white spruce in various stages of development in addition to the regular diet of seed, oatmeal and vegetables for three days. Although younger staminate cones were preferred, the squirrel ate all cones up to the pollen shedding stage. On the fourth day it was fed 500 staminate cones only, and ate 350 which corresponds with the figures given for *Sciurus vulgaris* L. by Novikov (1953). The animal became sick and later died.

At Hinton, Alberta, red squirrels were observed cutting the lateral and terminal twigs and feeding on the vegetative and flower buds of white spruce (cf. e.g. Balch 1942, Lundberg 1946, Metzger 1946, Rowe 1952 and Adams 1955).

MOUSE DAMAGE TO SEEDLINGS

An enclosure was used to observe the feeding habits of red-backed mice and meadow voles and to determine if these species would damage white spruce and lodgepole pine seedlings. The enclosure 8 feet by 16 feet, placed in a cut-over area, was partly on an undisturbed habitat and partly on previously prepared seedbeds. Screens covered the seedbeds to prevent damage to the seedlings until the appropriate time.

TABLE 3
RATE OF CONSUMPTION OF 1,000 WHITE SPRUCE AND 1,000 LODGEPOLE
PINE SEEDS BY THE DEER MOUSE AND THE RED-BACKED MOUSE

History	Animal No.	1st Day						2nd Day						Total			
		White spruce			Lodgepole pine			White spruce			Lodgepole pine			Spruce Ate	Pine Ate		
		Ate	Lost	Remain	Ate	Lost	Remain	Ate	Lost	Remain	Ate	Lost	Remain				
Deer mouse																	
Without prior	15	441	203	356	775	225	0	537	22	0	222	3	0	978	997		
cage feeding																	
Fed previously	1	87	0	913	933	0	67	872	34	7	67	0	0	959	1,000		
lodgepole pine																	
Fed previously	8	109	0	891	847	0	153	885	6	0	153	0	0	994	1,000		
white spruce																	
mean	212	—	—	—	852	—	—	765	—	—	147	—	—	977	999		
Red-backed mouse																	
Without prior	24	207	59	734	869	126	5	717	76	0	119	12	0	924	988		
cage feeding																	
Fed previously	12	398	289	313	722	276	2	393	209	0	253	25	0	791	975		
lodgepole pine																	
Fed previously	19	927	64	9	911	86	3	73	0	0	89	0	0	1,000	1,000		
white spruce																	
mean	511	—	—	—	834	—	—	394	—	—	154	—	—	905	988

FIGURE 1. Sheet metal and hardware cloth enclosure.

FIGURE 2. The red-backed mouse chewing on the cotyledons of lodgepole pine seedlings.

FIGURE 3. A short-tailed meadow vole eating a lodgepole pine seedling.

FIGURE 4. Damage to lodgepole pine seedlings by the long-tailed meadow vole.

An inside corner of the enclosure is shown in Figure 1. The 18-inch wide hardware cloth, which formed the lower sidewall, was set 4 inches in the ground with another 4 inches bent at a right angle toward the center of the enclosure. A strip of sheet metal 12 inches wide was fastened to the top of the hardware cloth. The frame-work consisted of wooden posts placed on the outside of each corner and wood strips along each side which joined the hardware cloth and sheet metal.

After most of the seed coats had fallen from the seedlings, two mice of the same species were introduced into the enclosures. These were left for two days and fed, in addition to the food they could forage, oatmeal, vegetables and water. At the end of two days, the screens were removed from the seedlings. After the first pair of mice had been observed two others of the same or different species were introduced.

Although the red-backed mice ate some white spruce and lodgepole pine germinants they showed a preference for *Equisetum scirpoides* Michx. where it was associated with the seedlings. As in Figure 2, the red-backed mouse ate downward from the tips of the cotyledons.

The short-tailed meadow vole, *Microtus pennsylvanicus* (Ord), voraciously ate all lodgepole pine and white spruce seedlings available. These animals pulled the seedlings from the ground, held them between their front feet (Figure 3), and consumed the entire seedlings. Each group of seedlings was eaten completely in a rapid and systematic manner.

The only specimen of long-tailed meadow vole, *Microtus longicaudus* (Merriam), observed, either nipped the seedling off near the ground or chewed the cotyledons like the red-backed mouse. Figure 4 shows some damaged lodgepole pine seedlings.

Neither the long-tailed nor short-tailed meadow voles ate or damaged older seedlings during August in the enclosure at Hinton. These mice had access to other food, and the bark of the older seedlings may have been undesirable to them at this season. Cogshall (1928) mentions that deer mice will sometimes eat the bark and buds of Scots pine, *Pinus sylvestris* L.; and it might be assumed that meadow voles will eat the bark and buds of white spruce and lodgepole pine.

The damage to white spruce shown in Figure 5, may be ascribed to meadow voles in lieu of more complete knowledge. This type of damage was noted on groups of seedlings in favorable meadow vole habitats, and appeared to be the result of either biting or stripping the bark in the winter or early spring. The damage occurred over several seasons.

FIGURE 5. Damage to the bark and cambium of small white spruce at ground level.

CONCLUSIONS AND SUMMARY

The red-backed mouse is a common and sometimes abundant member of the small mammal population in the white spruce forest. Cage-feeding studies with the red-backed mouse and the deer mouse showed the daily maximum consumption of lodgepole pine to be about 1,000 seeds and of white spruce 2,000 seeds. There was not an obvious difference in the consumption rates although the red-backed mouse appeared less satisfied with a pure seed diet than the deer mouse. Both species of mice preferred lodgepole pine seed to white spruce.

The short-tailed and long-tailed meadow voles readily ate both lodgepole pine and white spruce seedlings during the first growing season. The red-backed mouse also ate young seedlings but not to the same degree as the meadow voles. The deer mouse was not tested.

Since the small mammals were studied under artificial conditions, it is not possible to interpret the results in terms of seed consumption in the field. Under natural conditions the survival of tree seed from small mammal depredation is dependent upon such factors as: mammal density, mammal activity, seed density, variety of alternative foods and many others. It would only be after a comprehensive study that the role of small mammals in white spruce regeneration silviculture can be adequately stated.

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