

Lodgepole Pine, Red Squirrels, and Diversionary Food

**Managed Stand of
Lodgepole Pine**



Red Squirrel



Identifying Squirrel Damage

The red squirrel

The red squirrel feeds on the vascular tissues of young lodgepole pine in western North America from May to early July, when other natural foods are not available. This is also a period when sugar concentration in sap is high and the bark is easy to remove.

Squirrels strip bark from a stem to feed on the cambium and the exposed sapwood. Identifying characteristics of squirrel debarking are:

- the indistinct toothmarks on the sapwood; and
- the presence of bark strips (3 x 8 cm) which accumulate on the ground under the injured tree.

Damaged stems are usually >6.0 cm dbh.

These bark strips are often the only evidence to distinguish squirrel damage from similar crown girdling injuries made by porcupine. Squirrels can damage any part of a tree, whereas snowshoe hares feed near the snow surface.



Debarking damage to lodgepole pine sapling by red squirrel.

Extensive damage to stem of lodgepole pine by red squirrel.



The hare

Hares remove bark from the base of stems and from low branches of large seedlings and saplings (<6.0 cm dbh) of lodgepole pine and sometimes Douglas-fir. Trees with dbh >6.0 cm are not susceptible. Feeding damage may occur higher on the stem and branches depending on snow depth. The gnawed sapwood has a shaggy or ragged appearance, and complete girdling of the stem may occur. Toothmarks are indistinct, with an average width of 2 mm in a horizontal or diagonal configuration on exposed sapwood. Fecal droppings, slightly flattened circular pellets 10 mm in diameter, are usually present at feeding sites. These barking and girdling injuries occur mainly in winter and early spring (November to April). In general, overstocked pine stands provide optimum winter habitat for snowshoe hares. It is during the peak in abundance every 9–10 years when hares cause serious damage to crop trees in natural and thinned stands of lodgepole pine.



Debarking damage to lodgepole pine sapling by snowshoe hare.



Ragged appearance of gnawed sapwood of lodgepole pine from feeding by snowshoe hare.



Porcupine damage to lodgepole pine.

The porcupine

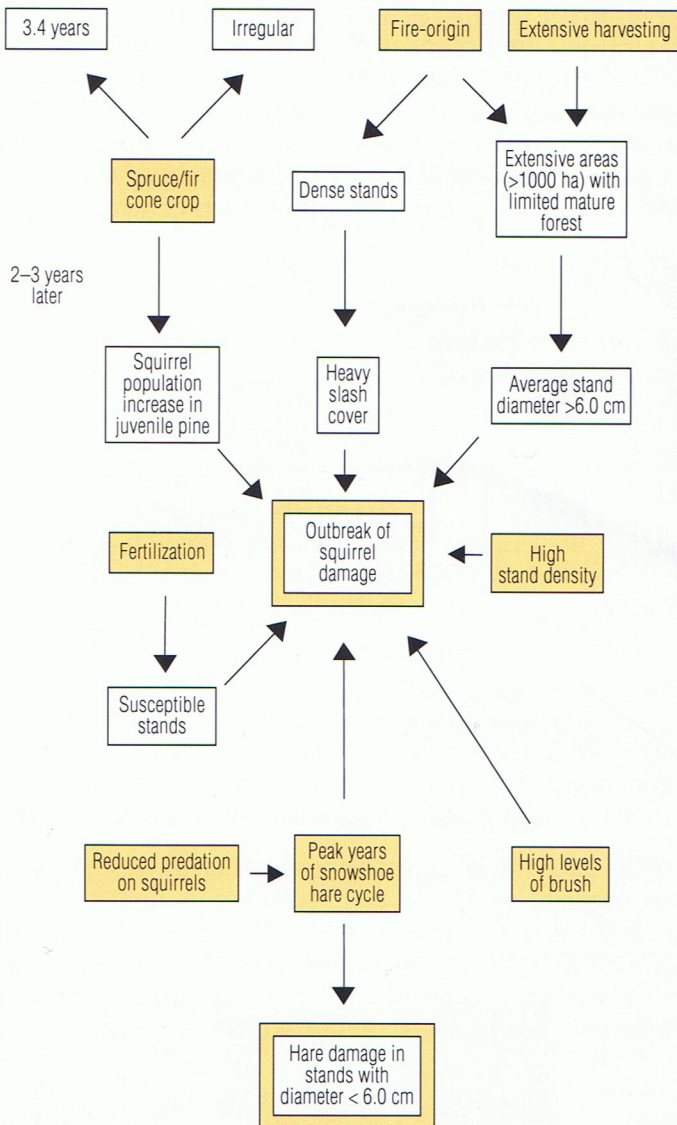
The porcupine gnaws bark and vascular tissues from stems of lodgepole pine and other coniferous saplings. Porcupine feeding damage can be identified by the broad (2.5 mm), prominent vertical and diagonal incisor marks on the exposed sapwood. Basal girdling is common on smaller trees, while debarking is common on the upper bole and major branches of larger trees.

Identifying Susceptible Stands

Squirrel damage to lodgepole pine is locally present in most Forest Regions within British Columbia. In managed stands that are susceptible to feeding attacks, the incidence of damage to trees ranges from 30% to 96%.

A diagram displaying the interrelationship of factors to predict when and where squirrel damage will occur is illustrated below.

Interrelationship of Factors



The two major factors are:

1. an extensive (>1000 ha) fire-origin or post-harvest stand or mosaic of stands with limited areas of mature forest; and
2. the frequency of interior spruce and Douglas-fir cone crops leading to subsequent squirrel population increases in stands of juvenile pine.

Fire-origin stands tend to have high densities of stems which leave large volumes of slash after spacing. This slash load presumably provides good cover for squirrels.

Susceptible stands have average diameters > 6.0 cm.

Additional factors that may contribute to an outbreak of damage include:

- a predator switch from squirrels to hares during peak years of the hare cycle; and
- high levels of brush that provide cover for squirrels.

A decision-making profile, as below, provides an assessment of the risk of squirrel damage when a pre-spacing survey is conducted. Three levels of risk are based on nine factors. Stands with a high-risk rating would be suitable for application of diversionary food.

Decision-making Profile Prior to Spacing

Risk Assessment Checklist to Identify Susceptible Stands

When	Where
<input type="checkbox"/> Is there a regular cone crop in nearby mature forest? ↓ Spruce ↓ Fir	<input type="checkbox"/> Extensive stands (>1000 ha)
<input type="checkbox"/> Peak years (± 2 years from expected peak) of snowshoe hare cycle (reduced predation on squirrels)	<input type="checkbox"/> Incidence of attack >15% in unspaced stand
<input type="checkbox"/> Average stand diameter (>6.0 cm dbh)	<input type="checkbox"/> High slash load after spacing
<input type="checkbox"/> Age classes 1 & 2 (10-40 years)	<input type="checkbox"/> High levels of brush
	<input type="checkbox"/> Fertilization planned

Checklist Score
(maximum of 9)

1-2
3-5
6-9

Degree of Risk

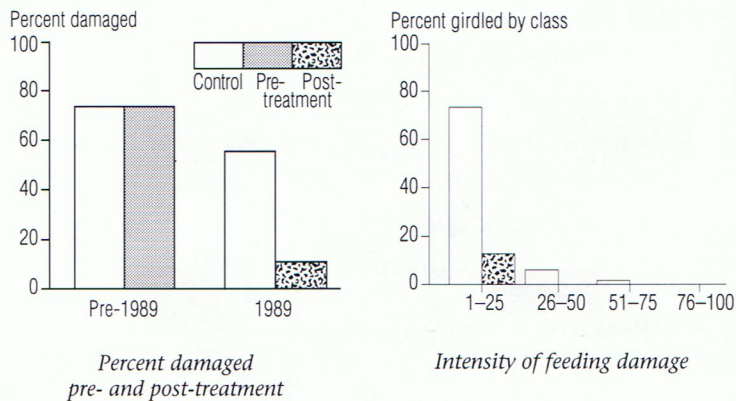
low
moderate
high

Red Squirrels and Diversionary Food

Red squirrel feeding damage occurs during a relatively short period in the spring, when food is in short supply. A study was undertaken to evaluate the effect on squirrel feeding damage of providing diversionary food during the spring feeding period.

The Study

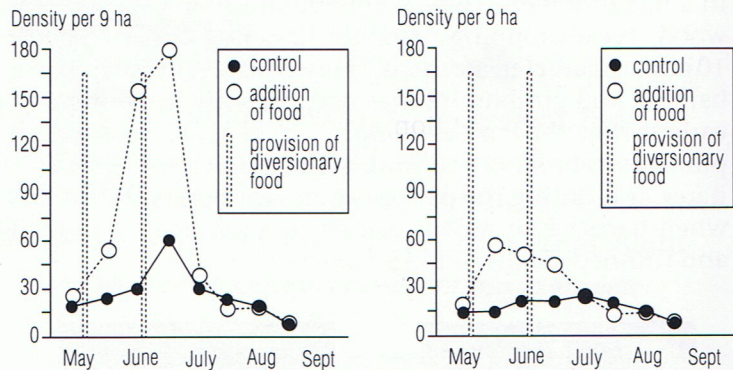
Sunflower seeds were manually applied to a 20-ha stand of pine, which had a history of severe damage, near Vernon. Damage in the treatment block was significantly reduced compared with the untreated control (11.3% vs. 57.5% of trees attacked). In addition, the intensity of feeding, with respect to the number of wounds, was significantly lower in the treatment than control block. In terms of the percentage of stem circumference girdled, feeding in the treatment block was restricted to the 1–25% class only, with more intense feeding by squirrels in the control. Comparison of the average degree of girdling for plot trees indicated significantly less feeding in the treatment than control.



A major question was raised prior to conducting the study: Will this diversionary food increase squirrel populations and create an even more severe damage problem? This question was addressed at the Vernon study area.

The addition of diversionary food resulted in a significant increase in the overall population density of red squirrels on the treatment areas. This increase in density was temporary, and population levels declined to control levels within six weeks of the second addition of supplemental food.

When transient animals (single captures) are excluded from the analysis, a different pattern emerged. The addition of diversionary food had little effect on density: one fed population increased, the other remained at control levels. Within one month after the second food addition, control and fed populations were both at similar levels. These results indicated that the short-term provision of diversionary food attracted foraging animals to the area temporarily, but did not lead to a long-term increase in the population density of residents.



All squirrels captured 1990

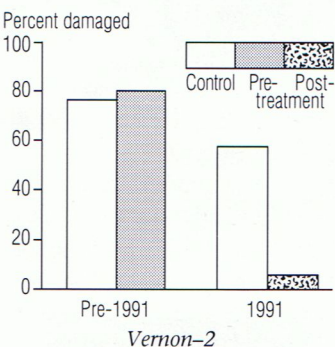
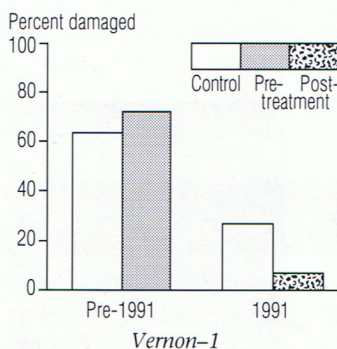
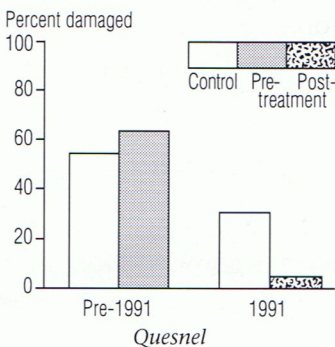
Resident squirrels only 1990



Sunflower seeds are an ideal alternative food, since they are available commercially and closely simulate conifer seed, the principal food for red squirrels.

Once the positive effects of diversionary food in reducing tree damage and causing only a temporary increase in squirrel populations were demonstrated, operational applications of sunflower seed via helicopter were implemented.

Application of sunflower seed on an operational basis in 1991 significantly reduced damage by squirrels in treatment stands at three study areas. Cumulative incidence of damage prior to this experiment was similar in control and treatment stands (average of 64.8% vs. 71.2% of trees attacked). Intensity of feeding damage in this experiment also followed the pattern of reduced attack by squirrels where an alternative food was provided.



Availability of alternative food clearly reduced feeding on lodgepole pine trees during the damage periods. This reduction was accomplished by either manual or aerial application of seed. When the operational applications are considered, this result was achieved in three different ecological zones or regions: Interior Cedar Hemlock, Montane Spruce and Engelmann Spruce-Subalpine fir, and Sub-Boreal Spruce. Squirrels presumably do not require pine vascular tissues as an essential source of nutrition. They apparently experience a food shortage during May and June which can be accommodated by an artificial food source such as sunflower seeds.

Application of Diversionary Food

The aerial method of application, with its uniform distribution, makes sunflower seed readily available to squirrels and other seed-eating species at both an individual animal and population level. Seed must be applied in late April or early May to be effective in reducing damage. Clearly, if several stands require protection, then aerial application is the most efficient method to cover large areas as quickly as possible.

The question of how many years lodgepole pine trees require protection is of critical importance. Squirrels begin attacking pine at an average dbh of 6 cm, and their feeding appears to decline at about 20 cm dbh. Some trees of ≥ 20 cm dbh are still attacked, but the occurrence of feeding is small, particularly with respect to percentage of stem circumference girdled.

Therefore, a management strategy may be to enhance tree growth to reach beyond the 20 cm dbh threshold as quickly as possible. Alternative foods could be used to protect trees during the intervening vulnerable years. Costs of annual food supplementation for several years would be offset by the protection provided for these intensively managed and highly valuable pine stands.

Logistics and Costs

The cost of aerial application of sunflower seed to lodgepole pine stands on an operational basis ranged from \$40.67 to \$45.77 per ha. These prices include seed, helicopter time and organization/ground assistance. Thus, considering the \$2000+/ha invested in intensively managed (planting, weeding/brushing, thinning and fertilization) stands of lodgepole pine, an additional expenditure of \$40 – \$50/ha per year to protect that investment is clearly reasonable. Even if the seeding is required for five (\$200–\$250/ha) or ten years (\$400–\$500/ha), this effort would be worthwhile.

	Vernon		Quesnel
	Bigg Creek ¹	McGregor Creek ²	West Fire ³
Sunflower seed (retail)	27.55	27.55	25.21
Helicopter & seeding bucket ⁴	16.89	13.36	14.21
Supervision ⁵ & organization	1.33	1.33	1.25
Total	45.77	42.24	40.67

Note: Number of ha treated: ¹ 120; ² 120; ³ 200; ⁴ slight increase in cost if larger helicopter such as Jet Ranger III is used; ⁵ one person-day @ \$160/day

Costs per hectare (in dollars) of aerial application of sunflower seed on an operational basis at Vernon and Quesnel study areas in 1991.

Operational Guidelines

1. Determine if lodgepole pine stands are susceptible to feeding damage by red squirrels, based on decision-making profile.
2. Plan a single application of sunflower seed for May 1 so seed is available at start of the period of feeding damage.
3. Sunflower seed should be uniformly distributed by helicopter and seeding bucket at the rate of 20 kg/ha (available commercially in 20 or 22.7 kg bags).
4. Seed can be trucked to a suitable landing near the treatment stand, where the helicopter and seeding bucket can be efficiently and safely loaded.
5. No permits or registration are required, as provision of diversionary food is a biological technique that enhances wildlife habitat while protecting lodgepole pine stands.

Acknowledgements

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