Variable Retention Harvests & Wildlife Habitat

Stand Structure and Vegetation
Abundance and Diversity of Small Mammals
Habitat Use by Deer

Variable Retention Harvests

Variable retention harvests or "green-tree retention systems" are becoming a standard component of harvest prescriptions for temperate zone coniferous forests. This gradient of tree retention utilizes variations of silvicultural systems from seed tree, shelterwood, patch and selection cutting. Conventional silvicultural systems evolved to manage forests sustainably, but unfortunately the methods have not come near their potential application, particularly in North America. Forest harvesting has been dominated by clearcutting, but variable retention harvests have become more common over the past decade.

Harvesting and Natural Disturbance

Historically, wildfires in the Pacific Northwest of North America were highly variable, ranging from low-frequency, stand-replacing fires in coastal areas to high-frequency, variable-intensity fires in interior regions. Some individual trees or groups of trees survived these fire events and moderate-intensity windthrow. As well, variable amounts of woody debris in the form of logs and snags were often left following fire. These surviving residual features have structural and compositional attributes that may differ markedly from those left by conventional clearcutting.

Green-tree Retention

Forest harvesting systems are now designed to more closely mimic the processes and outcomes of natural disturbance and succession by retaining structural characteristics of the former forest such as large live trees or "green-trees," snags and logs. These techniques are designed to maintain ecosystem structure and function, provide regenerating stands with structural features that would otherwise be absent, and enhance connectivity across the landscape. The conceptual basis for green-tree retention lies in the strong functional links among forest structures, ecological processes and biological diversity found in natural forest ecosystems.

Small Mammals

Forest floor small mammal communities may provide a measure of ecosystem function within temperate coniferous forests. There are several ecological roles associated with small mammals such as consumption of invertebrates, distribution of beneficial mycorrhizal fungi, consumption of plants and plant products, and serving as prey for a wide variety of avian, reptilian and mammalian predators. Thus, abundance and diversity of forest floor small mammals, as a group, may serve as indicators of change in forest structure.

Scientific Studies

This brochure reports on three studies:

A. Variable retention harvests in mixed stands of Douglas-fir and lodgepole pine in the Okanagan
B. Even-aged shelterwood systems in Douglas-fir forests in the Cariboo
C. Clearcutting and burning of northern spruce-fir forests in northwestern BC.

Study A

Study A tested the hypotheses that (i) abundance and diversity of stand structure attributes (species diversity and structural diversity of herb, shrub and tree layers), (ii) abundance and diversity of forest floor small mammal communities, and (iii) relative habitat use by mule deer, will decline with decreasing levels of tree retention.

This ongoing study was located near Summerland in mixed Douglas-fir and lodgepole pine forest. There were five treatments of variable retention harvests: clearcut, single seed tree, group seed tree, patch cut and uncut forest.

Clearcut

Single seed tree

Group seed tree

Patch cut

Uncut forest

Aerial view of patch cut (average opening 0.70 ha)

Aerial view of group seed tree (average aggregate of trees 0.70

This study covered the period from retention of structural features at the time of harvest (1996) through the first three post-harvest years of early successional change. Structural elements that define variable retention harvests included large-diameter live Douglas-fir trees, some with large limbs and clusters of limbs, some snags (one to five per ha), down wood in various stages of decay and understorey vegetation. A fifth criterion, undisturbed layers of forest floor, was present in the patch cut and uncut forest sites, but not in the other sites which had been mechanically site prepared for planting of tree seedlings.

Snag with down wood and understorey vegetation

Large Douglas-fir and down wood

Aggregate retention with new

Snags are important to a wide variety of cavity-using and roosting wildlife species. Down wood provides small mammals and other wildlife species with cover, transportation routes, nest sites and potential food sources from ectomycorrhizal fungi which will colonize coarse woody debris.

Stand Structure

Coniferous Trees

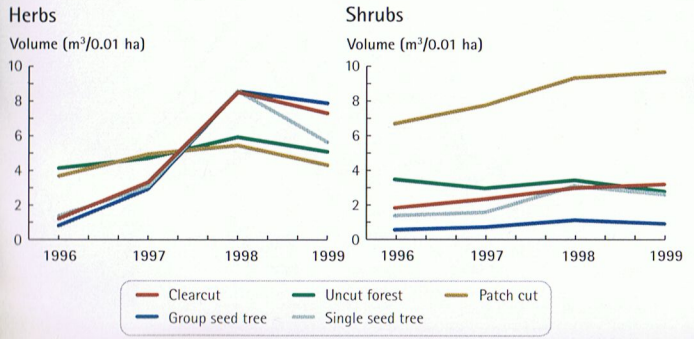
Mean values	Clearcut	Single seed tree	Group seed tree	Patch cut	Uncut forest
Basal area (m^2/ha)	0.1	0.7	2.5	23.4	39.0
Density (stems/ha)	0.7	9.0	16.3	769.4	2050.0
Cover (%)	0.7	4.1	8.4	34.1	32.9
Volume (m^3/ha) of down wood	136.1	116.7	179.7	210.2	140.9

There are increasing levels of basal area (BA), density and cover of residual trees across the five treatments. This range was widened to 0.1–13.2 m^2/ha if the BA for the group seed tree sites was calculated over the aggregate of trees rather than the overall site. Similarly, the range of density of residual trees increased to 0.7–72.2 trees/ha. The single seed tree sites represented a dispersed, and the group seed tree sites an aggregated, pattern of retention. Mean area of the three aggregate groups of trees on these sites was 0.70 ha, which was in the range of 0.05 to 1.0 ha, typical of aggregates in the Pacific Northwest. These harvesting treatments provided similar levels of down wood.

Vegetation

Amount of Vegetation

Across treatments herb biomass was similar, but increased significantly through time, particularly on clearcut and seed tree sites. Shrub biomass was higher in the patch cuts than in other sites. There was no change in shrub biomass with time.

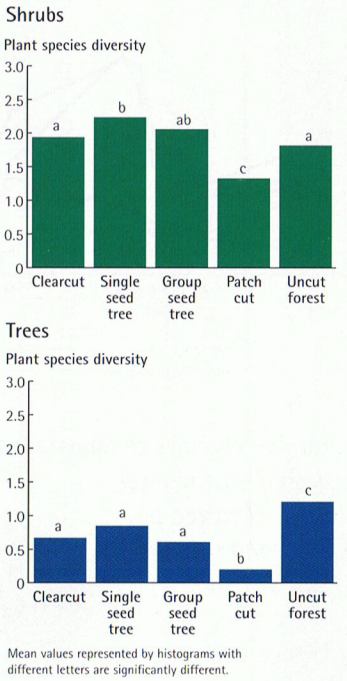


Biomass of mosses was highest in uncut forest and similar across other sites. Biomass of lichens was highest in the patch cut and uncut forest sites. The decline in abundance of mosses on all harvested sites, and lichens on clearcut and seed tree sites, was not surprising. Microclimate conditions were presumably changed such that these non-vascular plants did not have sufficient shade and moisture to maintain the abundance levels recorded in uncut forest.

Species Richness and Diversity

A total of 45 herb species, 26 shrub species and six tree species were sampled. Richness and diversity of herbs were similar across sites and over time.

Species diversity of shrubs was highest in the seed tree and lowest in the patch cut sites, with no differences over time. Diversity of trees was highest in uncut forest, followed by clearcut and seed tree, and then patch cut sites. Tree diversity increased with time because Douglas-fir, lodgepole pine and interior spruce seedlings were planted on clearcut and seed tree sites.

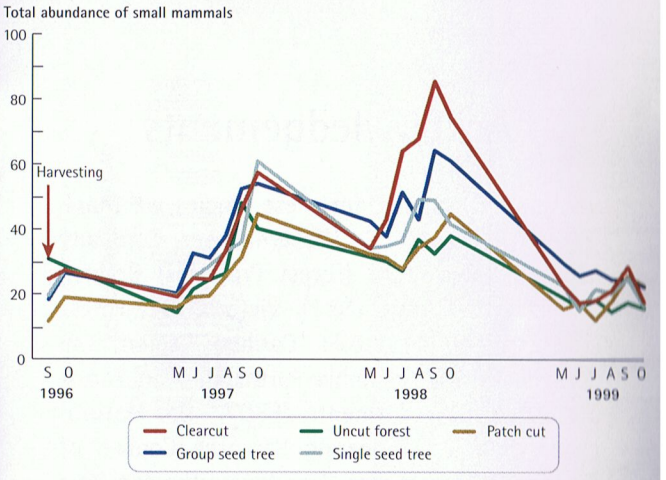


Mean values represented by histograms with different letters are significantly different.

Small Mammal Communities

Abundance and Diversity

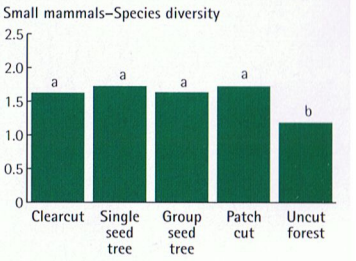
Mean total abundance of small mammals/ha was significantly different among sites with the clearcut (37.6) and group seed tree (36.4) at higher levels than the patch cut (24.2) and uncut forest (26.5) sites.



Responses (overall mean values, n=20 trapping periods) of small mamma communities to variable retention harvests 1996–99

Average abundance/ha	Clearcut	Single seed tree	Group seed tree	Patch cut	Uncu fores
Red-backed vole	4.20	2.68	10.00	6.42	16.2
Long-tailed vole	4.77	5.40	3.37	1.41	0.1
Meadow vole	6.48	0.58	0.50	0.38	0.0
Deer mouse	14.73	10.14	10.60	8.54	7.2
Northwestern chipmunk	5.64	9.47	10.66	6.72	2.6
Heather vole	0.62	0.82	0.30	0.20	0.0
Jumping mouse	0.00	0.00	0.00	0.00	0.0
Montane shrew	0.92	0.75	0.83	0.33	0.1
Common shrew	0.15	0.15	0.15	0.10	0.1
Short-tailed weasel	0.07	0.22	0.02	0.07	0.0
Total	**37.58**	**30.21**	**36.43**	**24.17**	**26.5**

The prevalence of early successional species across the harvested sites resulted in higher levels of both species richness and diversity on those sites.



Acknowledgements

For funding support for these studies we thank Forest Renewal BC; Weyerhaeuser Company Limited; Silviculture (Forest Practices) Branch, Ministry of Forests (MoF), Victoria, BC; Forest Sciences Section (MoF), Cariboo Region; the Canada-British Columbia Partnership on Forest Resource Development (FRDA I); Natural Sciences and Engineering Research Council of Canada; Weldwood of Canada; Northwood Pulp and Timber Ltd.; Houston Forest Products Ltd.; Alex Fraser Research Forest (University of BC); and Gorman Bros. Lumber Ltd. for considerable logistical assistance. Many thanks to all the field assistants associated with these projects.

This brochure was designed and produced by TM COMMUNICATIONS of Victoria.

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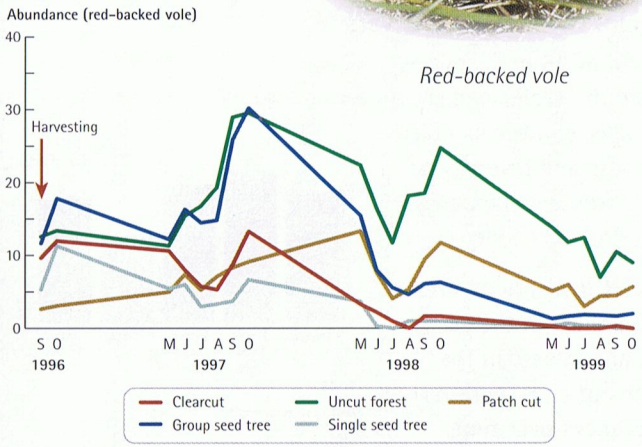
FOREST RENEWAL BC

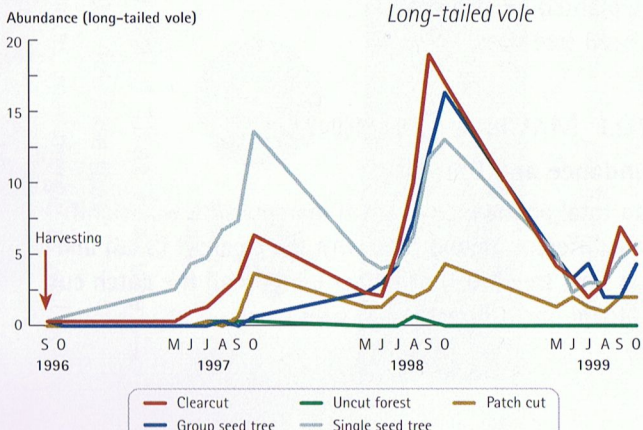
Abundance of red-backed voles was significantly different among sites with highest mean numbers occurring in the uncut forest (16.2/ha) followed by the group seed tree (10.0/ha), and then the other three sites (2.7–6.4/ha). Populations of red-backed voles were at their highest levels in 1996 and 1997 shortly after harvesting and before declining in 1998 and 1999.

Red-backed vole



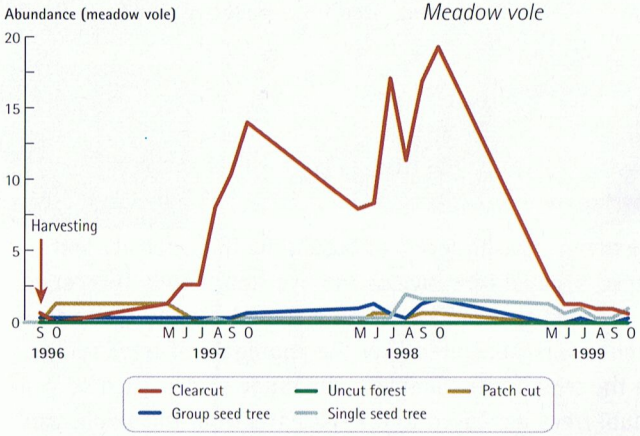
Population changes of long-tailed voles suggested that highest numbers occurred on clearcut and seed tree sites in all years; however, this difference was not significant.

Long-tailed vole



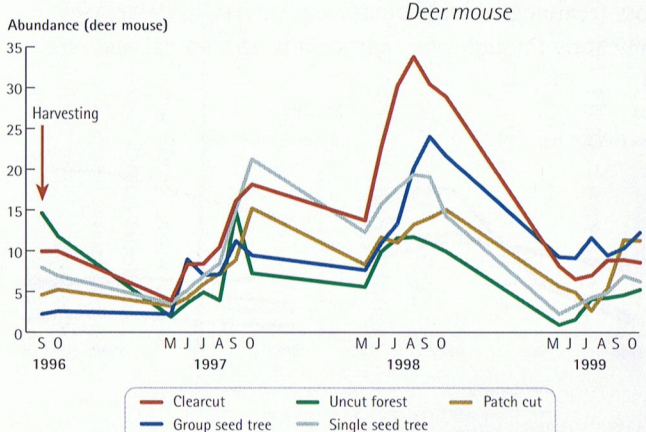
Population changes of meadow voles tended to follow those of long-tailed voles, but with a clear pattern of higher numbers of meadow voles on clearcut sites than on any of the other treatment sites. Both species of vole were at high numbers in 1998 compared with the other three years.

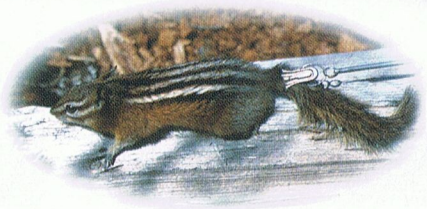
Meadow vole



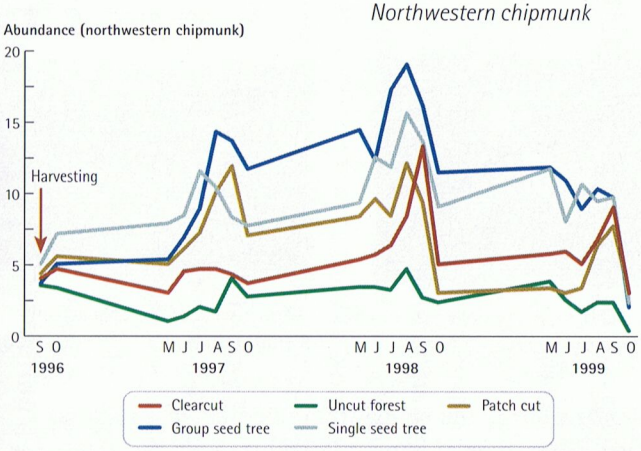
Abundance of the deer mouse was significantly different among sites, with the highest density on clearcut compared with other sites. Northwest chipmunk abundance was also significantly different among sites, with highest numbers on the seed tree sites.

Deer mouse



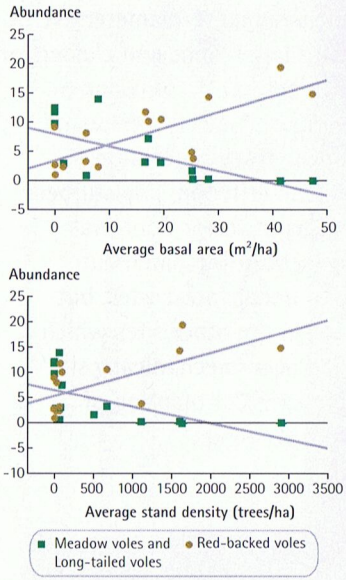


Northwestern chipmunk



Red-backed Voles and Habitat

Voles were inversely related, and red-backed voles positively related, to basal area of residual trees. Similar relationships were recorded for density, percentage ground cover and mean crown volume index.



The red-backed vole was the major species occupying our uncut forest sites and its persistence in the group seed tree sites, albeit at lower abundance than in the uncut forest, suggested that aggregated retention of green trees might maintain this species on harvested sites. Thus, this aggregate of residual trees may have a "lifeboating" function providing at least some level of climatic protection along with the required structures. The importance of red-backed voles to the ecological functions of late successional forest development include dispersal of

mycorrhizal fungi (a major food supply for them) and as prey for several carnivores. Maintenance of red-backed voles in variable retention harvest forests should also have potentially favourable impacts on predator populations.

Study B

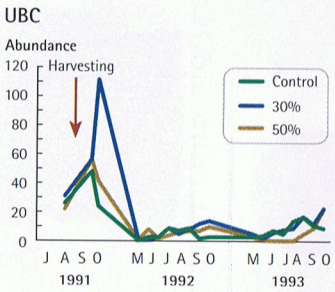
30% BA removal

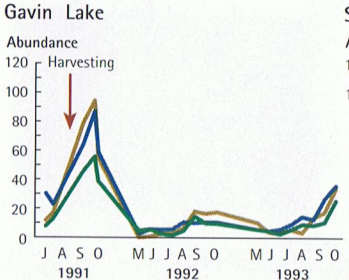
50% BA removal

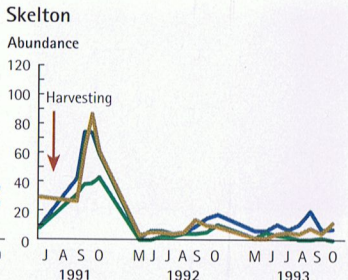
Dispersed retention of trees in shelterwoods (range of BA retained 32–46 m^2/ha).

Red-backed voles occurred at higher abundance immediately post-harvest in uniform shelterwood stands than in uncut control stands. Comparable numbers of this rodent were then recorded in shelterwood and uncut stands in subsequent post-harvest years.

Uncut forest



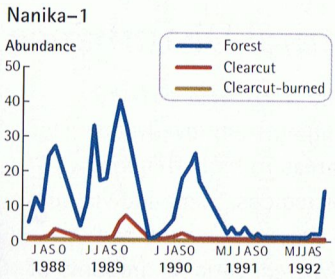


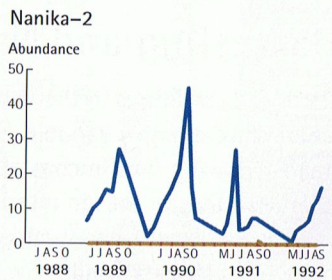


Study C

A reduction in moisture and insufficient tree cover result in extirpation of red-backed voles from recent clearcuts. This pattern was evident in study A, and also study C in northwestern BC.

Aerial view of forest, clearcut and clearcut-burned sites

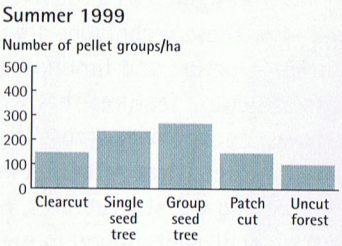


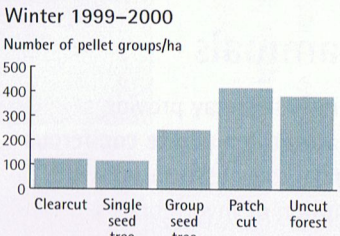


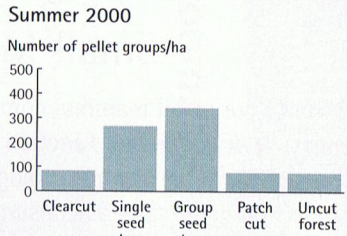
Mule Deer

Relative habitat use by deer was similar across treatment sites of the variable retention harvests (study A) during summer 1999 and winter 1999–2000. Winter use of patch cut and uncut forest sites was highly variable. Habitat use appeared higher in the seed tree than other stands in summer 2000.

Mule deer







Management Implications

1. Retention of live trees appeared to have little effect on total species richness of plants but did provide suitable conditions for some forest interior herbs and shrubs to persist, at least up to three years post-harvest. Conversely, some forest interior plants were maintained on clearcuts during this period.
2. Abundance and species richness and diversity of small mammals were maintained on all harvested sites, primarily because of habitat generalist and early successional species. Late successional forest species such as the red-backed vole and the early successional, but mycophagist, northwestern chipmunk, persisted on the group seed tree sites.
3. Relative habitat use by deer was either similar across sites or tended to be higher in group seed tree sites during summer.
4. This ongoing study (A) represents an initial "snapshot" in time and future monitoring of these sites over many years will determine if these trends continue.
5. Patch cuts which leave 60–70% BA of uncut forest, and some group seed tree harvest prescriptions which leave at least 15 m^2/ha BA in patches of residual trees, should provide habitat for red-backed voles and perhaps mule deer.
6. Investigation of the responses of other wildlife communities such as birds, amphibians and invertebrates would be prudent since they might have different responses to these forest conditions.

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