Woody Debris, Wildlife Habitat & Biodiversity

Piles, Windrows & Habitat Networks

WOODY DEBRIS

Coarse woody debris (CWD) on the floor of coniferous, deciduous, and mixed-wood forests provides many important components:

- Wildlife habitat
- Reservoir of nutrients + water
- Microsites and substrates for seedlings and fungi
- Long-term site productivity
- Biodiversity and sustainability

These attributes of woody debris have major roles in ecosystem function and are essential to maintenance of forest biodiversity and long-term productivity. Woody debris is created by natural and human disturbances and may affect ecosystem response to disturbance, particularly the timing and severity of wildfire and insect outbreaks. It is this role in disturbance regimes, and our utilitarian outlook, that has generated a definition of woody debris as "wood waste", particularly the residue (slash) occurring after conventional and salvage harvesting of forests.

Questions?

- How much downed wood to leave and its distribution?
- And what about the perceived surplus?
- What to do with these piles of debris?

Debris piles at harvested site

Management of Downed Wood?

- Burn it?
- Feedstocks for bioenergy?
- Habitat?

Burning of debris piles

Chipping of debris for biomass

What about Habitat?

- Could debris piles on cutblocks act as den sites, cover, travel corridors?
- Predators: weasels, marten, lynx, others
- Small mammal prey
- Role of "middens" or "tree-falls"

Den in a pile

Forest-floor small mammals

On the forest floor, communities of small mammals may serve as ecological indicators of significant change in forest structure and function. These terrestrial mammals are widespread across temperate and boreal forest ecosystems and have a variety of functions, including prey for many predators, distribution of beneficial mycorrhizal fungi, and consumers of plants, plant products, and invertebrates.

Red-backed voles

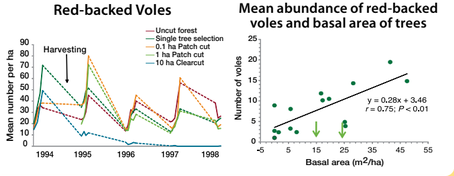
- Closed-canopy indicator species
- Seems to like downed wood, cone middens
- Feeds on fungi, seeds, berries
- Prey species for many predators
- Highly sensitive to harvesting practices

Red-backed vole

Why do we care?

- If red-backed voles are an indicator of older forest conditions, then are we closer to managing for some components of biodiversity and sustainability?
- Network of food sources
- Network of predators

Clearcutting of forests remains the dominant silvicultural system in much of North America and northern Europe. Green-tree retention helps to ameliorate the impacts of this practice on some components of biodiversity. Studies in coniferous and mixed coniferous-deciduous forests reported dramatic declines of the southern red-backed vole on clearcuts. However, populations of red-backed voles have been maintained, up to 3 years post-harvest, in western coniferous forests that have partial cutting systems leaving at least 15-25 m^2/ha basal area of tree cover or 30% of uncut forest. Although these partial cutting results are encouraging for maintenance of red-backed voles, clearcutting still dominates as a harvesting system, even with some degree of green-tree retention.



Is there a habitat management tool that might ameliorate the negative impact of clearcutting on red-backed voles and other members of the mammal community? This is particularly relevant in those areas where large-scale salvage harvesting is done in response to wildfire and insect (e.g., mountain pine beetle) outbreaks.

IF WE BUILD HABITAT, WILL THEY COME?

Red-backed vole

American marten

DO WE WANT TO LEARN BY DOING?
→ Adaptive Management

STUDY DESIGN

3 replicate sites

Dispersed Piles Windrows Forest

Dispersed

Piles

Windrows

Uncut forest

at each of 3 study areas:

- China Valley (west of Salmon Arm)
- Aberdeen Plateau (southeast of Vernon)
- Summerland (Upper Trout Creek)

Construct piles and windrows at time of harvest and log processing

Creation of piles and windrows at time of harvesting and log processing

METHODS

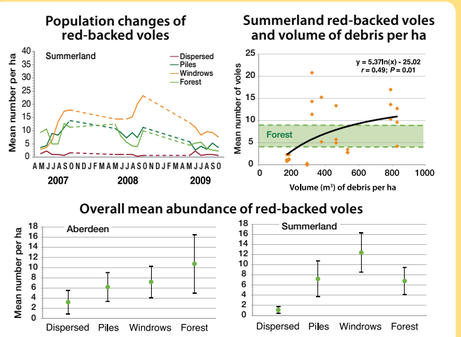
- Live-trapping of small mammals in summer
- Snow tracking of predators and other mammal species in winter

RESULTS

Red-backed Voles

At Summerland, mean abundance of red-backed voles was significantly different among sites with the highest number of this microtine in the windrows, followed by similar numbers in the piles and forest, and lowest in the dispersed treatment. Vole populations were consistently higher in the windrows than other sites throughout the three years of study, whereas voles in the piles and forest were quite similar in their population changes. Abundance of this closed-canopy specialist appeared to decline with time at Summerland.

At Aberdeen, mean abundance of red-backed voles was similar among treatment sites, but did decline with time, at least in the debris sites. There was a consistent trend for higher numbers in the piles and windrows than dispersed wood treatments.



There was a positive relationship between mean abundance of red-backed voles and mean volume of CWD per ha across the dispersed, piles, and windrow treatments at Summerland. Mean numbers of red-backed voles ranged from 4.0 to 9.0 in mature forest, with voles in piles and windrows near or above this range of abundance at least during this 3-year post-harvest period. A range of 300-600 m^3/ha of CWD in piles or windrows seems necessary to provide habitat for the persistence of red-backed voles on clearcuts.

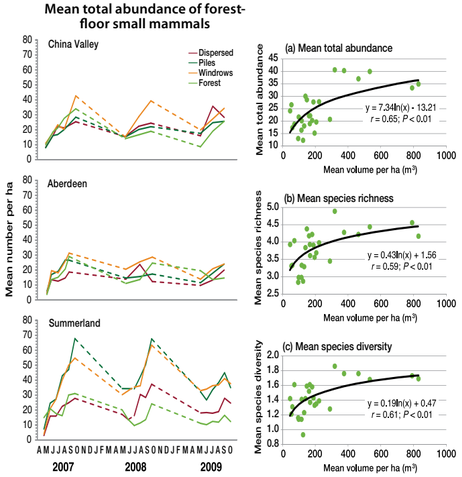
Forest-Floor Small Mammals

Mean total abundance of small mammals was higher in the piles and windrows than the dispersed CWD and forest treatments. Mean species richness and diversity also followed this pattern. The most dramatic results were recorded at Summerland where mean total abundance averaged 1.8 to 2.3 times higher in the piles and windrows than dispersed and forest treatments. Mean total abundance reached annual peaks ranging from 55 to 68 animals/ha in the piles and windrows in 2007 and 2008. There was a positive relationship between mean abundance of small mammals and mean volume of CWD per ha across the dispersed, piles, and windrow treatments at all three study areas. Similar relationships were shown for mean species richness and diversity with mean volume of CWD per ha.

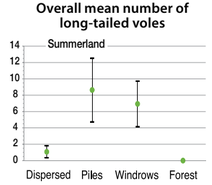
Deer mouse

Northwestern chipmunk

Long-tailed vole



The long-tailed vole was common at Summerland, but not at the other two study areas. This microtine was at higher numbers in the piles and windrows than the other two treatments. Even though this vole may feed on newly planted tree seedlings, we recorded < 5% damage to trees at these sites.



Populations of deer mice generally showed no difference among treatments. Mean abundance of northwestern chipmunks was similar among treatments at Aberdeen, but generally appeared more often in the CWD treatments than forest at China Valley and Summerland.

Uncommon mammals observed at piles and windrows included the American pika and bushy-tailed woodrat.

American pika

Bushy-tailed woodrat

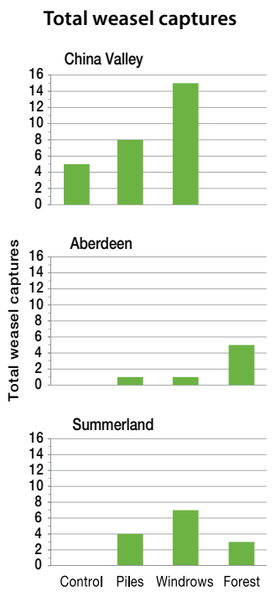
Winter Snow Tracking of Predators and other Mammals

Permanent snow-track transects were installed at all study areas in January 2008 and sampled for three winters. Coyotes and weasels were the two most common carnivores encountered during winter track counts. In an analysis of all three study areas, the piles treatment had higher coyote activity than the forest, with the dispersed, windrows, and forest being similar. Total captures of weasels was relatively higher in piles and windrows than dispersed sites at China Valley and Summerland.

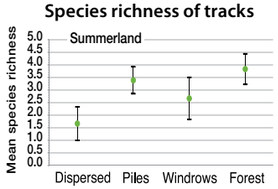
Short-tailed weasel

American marten

Coyote



At Summerland, overall species richness was higher in piles and windrows than dispersed CWD; relative abundance of coyotes and weasels also followed this pattern. The other species encountered were either herbivores (hare, deer, moose) or omnivores (red squirrel) and primarily were recorded in the forest with occasional forays out into the openings with their respective CWD structures.



Other predators including lynx, fox, cougar, wolf, and marten were present in the general study areas, but did not selectively choose among our CWD structures. However, **marten** did increase in occurrence on all 3 study areas; perhaps an indication of: "**if we build habitat, they will come**".

Marten Tracks

	Winter 1 *2007-08*	Winter 2 *2008-09*	Winter 3 *2009-10*
China Valley			
Dispersed	–	–	–
Piles	–	–	★
Windrows	–	–	–
Forest	★	★	★
Aberdeen			
Dispersed	–	–	–
Piles	–	–	★
Windrows	–	–	–
Forest	★	★	★
Summerland			
Dispersed	–	–	★
Piles	–	–	–
Windrows	–	–	–
Forest	–	★	★

Habitat Structural Attributes for Marten

- Resting and den sites are associated with large snags, live trees, squirrel middens, downed hollow logs, underground (especially in winter), and in piles and windrows of woody debris
- Suitable corridors, such as riparian areas, connecting to mature/old-growth forest (preferred marten habitat) are required to reduce fragmentation on large areas
- Clearcuts with CWD sticking above snow level in piles and windrows encourages marten activity by allowing access below snow cover
- Distances up to 400 m on clearcuts may be crossed by marten using windrows
- Piles used by marten are usually in conjunction with riparian areas or on routes < 135 m across clearcuts
- Piles and windrows provide a prey base of small mammals, particularly red-backed voles, and allows access to this food source

CONCLUSIONS

- First time red-backed voles maintained on clearcuts, at abundances comparable to uncut forest, for periods longer than 1 year
- Total abundance, species richness, and species diversity of forest-floor small mammals were higher in the piles and windrows than the dispersed CWD and forest treatments
- Predators (marten, coyote, weasels) and uncommon species (pika, woodrat) also seem to be active at piles and windrows

Woody debris?

- Habitat readily created during forest operations
- Forest products from woody debris?
- Red-backed voles and predators are also products!
- Carbon credits; why not Habitat credits? Biodiversity credits?

What to do? When and Where?

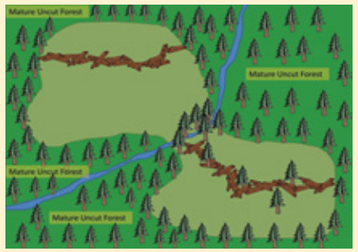
Plan piles and windrows for habitat structure and connectivity

- Structures need to be created at the time of forest harvesting and log processing to reduce costs, maintain continuity of habitat, and provide sufficient CWD for at least 300 m^3/ha
- Create CWD structures as piles or windrows at least 2 m in height and 5 m in width or diameter
- Position wherever possible, particularly on sites ***remote*** from processing facilities + less fire danger from people
- At least one windrow or a series of piles should ***connect*** patches of mature forest and riparian areas to allow red-backed voles, marten, and other species to access and traverse clearcut openings
- Windrows should have openings about every 100 m to allow passageways for ungulates and silviculture activities
- Where possible, harvesting plans will maximize retention of piles and windrows when operational roads are ***perpendicular*** to the main haul road system
- Strategic need for habitat is particularly important on large openings (> 10 ha) in conventional, but also much larger (> 100 ha) salvage harvesting operations in beetle-killed as well as burned forests

Connectivity to forest

Connectivity to riparian areas

Connectivity across an opening to forest



Connectivity with windrows

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