

Effects of precommercial thinning on snowshoe hare habitat use during winter in low-elevation montane forests

David E. Ausband and G. Ross Baty

Abstract: We assessed snowshoe hare (*Lepus americanus* L.) habitat use during winter on two precommercial thinning treatments in sapling stands in northwestern Montana, USA. One treatment type retained 0.2-ha patches of unthinned saplings, representing 8% of the total stand area, and the second retained 0.8-ha patches of unthinned saplings, representing 35% of the stand area. Snowshoe hare habitat use was also estimated within a nearby control sapling stand and mature conifer stands. We used snow tracking and fecal pellet counts to estimate use before and after thinning treatments were applied. Although we did not find a conclusive trend in hare use of sapling stands after thinning, use within the control stand and adjacent mature stands suggested there was considerable movement of hares to nearby untreated stands after thinning. Hares used retention patches regardless of size, even though large retention patches were four times larger than small retention patches. Because hares demonstrated an affinity for dense patches of residual forest, any retention of untreated saplings may be beneficial for hares during winter when applying precommercial thinning treatments in areas where stand sizes are relatively small (10–14 ha), and the resulting thinned matrix is less harsh than in larger thinned stands. Use within thinned portions of the stand and unthinned remnant blocks suggests that over the winter hares may also benefit from a connectivity of dense cover.

Résumé : Les auteurs ont évalué l'utilisation de l'habitat en hiver par le lièvre d'Amérique (*Lepus americanus* L.) après deux traitements d'éclaircie précommerciale dans des peuplements au stade de gaulis situés dans le nord-ouest du Montana, aux É.-U. Les deux types de traitements consistaient à conserver des îlots de gaulis non éclaircis de 0,2 ou 0,8 ha couvrant respectivement 8 % et 35 % de la superficie totale du peuplement. L'utilisation de l'habitat fut aussi estimée dans un peuplement témoin de gaulis situé à proximité et dans des peuplements matures de conifères. Ils ont utilisé le pistage sur la neige et le comptage de fèces pour estimer l'utilisation avant et après les éclaircies. Ils n'ont pas observé de tendance claire dans l'utilisation par les lièvres des peuplements traités; toutefois, l'utilisation de l'habitat dans le peuplement témoin et dans les peuplements matures adjacents suggère qu'il y a eu des déplacements considérables des lièvres vers les peuplements non traités après les éclaircies. Les lièvres ont utilisé les îlots de rétention sans égard à leur superficie, même si les grands îlots étaient quatre fois plus grands que les petits. Étant donné que les lièvres montrent une affinité pour les îlots de forêt résiduelle dense, toute rétention de gaulis non traités peut être bénéfique pour les lièvres en hiver là où sont pratiquées des éclaircies précommerciales dans des peuplements relativement petits (10–14 ha) et où la matrice des éclaircies qui en résulte est moins inhospitalière que dans le cas des plus grands peuplements. Dans les peuplements traités, les patrons d'utilisation de l'habitat dans les portions éclaircies et les îlots résiduels non éclaircis suggèrent que les lièvres peuvent aussi bénéficier de la connectivité d'un couvert dense en hiver.

[Traduit par la Rédaction]

Introduction

The snowshoe hare (*Lepus americanus* L.) is an integral part of the biota in forested northwestern Montana and is relied upon by many species as a source of food. Great horned

owls (*Bubo virginianus*) (Rohner and Krebs 1996), coyotes (*Canis latrans*) (O' Donoghue et al. 1998), fishers (*Martes pennanti*) (Kuehn 1989), and Canada lynx (*Lynx canadensis*) (Ruggiero et al. 2000) are just a few of the species that prey heavily upon hares. In particular, the Canada lynx, which is

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federally listed in the United States as a threatened species, preys almost exclusively on snowshoe hares, and lynx populations can be negatively affected by decreases in the hare population (Koehler and Brittell 1990; Ruediger et al. 2000).

Forest management practices and, in particular, precommercial thinning treatments in coniferous sapling stands and subsequent effects on snowshoe hare abundance have been a recent area of concern since the listing of the lynx (Koehler and Brittell 1990; Ruediger et al. 2000). Foresters precommercially thin dense stands of young sapling and smaller pole-sized timber to encourage growth and maintenance of desired tree species, and shorten the rotation length for commercial timber production (Smith et al. 1997). Thinning of densely stocked sapling stands may have adverse effects on hare populations, and hence, their predators (Sullivan and Sullivan 1988; Koehler and Brittell 1990; Ferron et al. 1998; de Bellefeuille et al. 2001), because hares use stands of dense conifer regeneration for forage and security from predators (Litvaitis et al. 1985; Koehler 1990; Hodges 2000; de Bellefeuille et al. 2001). Also, because hares use dense conifer regeneration, retaining patches of unthinned habitat may be beneficial to hare populations when thinning young stands. Although retaining patches of young stands was suggested as a tool to maintain hares in commercially harvested boreal forest (de Bellefeuille et al. 2001), it is not known how hares use these residual patches during winter in montane forests. In this study, we evaluated the efficacy of 8% and 35% retention of sapling habitat within a matrix of precommercially thinned forest.

Because snowshoe hares demonstrate an affinity for dense cover, we hypothesized that use of sapling stands by hares would decline after precommercial thinning, regardless of the level of saplings retained, but that hares would use retained patches of unthinned saplings preferentially after thinning.

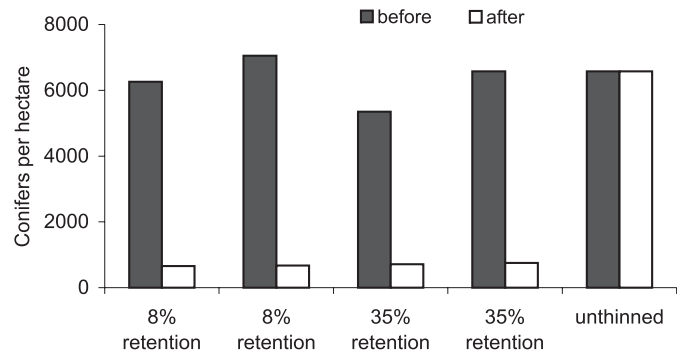
Materials and methods

Study area

This study was conducted on the Stillwater State Forest (SSF), which is administered by the Montana Department of Natural Resources and Conservation. The study area was located approximately 29 km north of Whitefish, Montana, USA. The SSF is an intensely managed contiguous tract of forest land set in a matrix of forested US Forest Service land. The five sapling stands selected for this study were seed-tree cut in 1985 and allowed to naturally regenerate. Two adjacent sampled mature stands represented preharvest conditions. The remaining forest stands surrounding the study site were a mosaic of mixed conifer, mature forest ranging in age from 75 to 150 years. All stands were within a 6.5-km² area, with slopes ranging from 0% to 10% and elevations ranging from 1034 to 1140 m. Temperature from December through March averaged -6 to -3.8 °C (National Climatic Data Center). During the winter of 2002, snow depth averaged 47.5 and 69.0 cm for the mature and young stands, respectively. Snow depth averaged 28.5 cm in the mature stands and 49.0 cm in the young stands during the winter of 2003.

Young conifer stands contained 40%–50% western larch (*Larix occidentalis*), 20%–30% lodgepole pine (*Pinus contorta*), 10%–20% Douglas-fir (*Pseudotsuga menziesii*), 5%–10%

Fig. 1. Density of conifer saplings <12.7 cm dbh/ha before (2001–2002) and after precommercial thinning (2002–2003) in northwest Montana, USA. The term “retention” refers to the percentage of the stand retained as unthinned saplings after precommercial thinning.



western red cedar (*Thuja plicata*), 5%–10% subalpine fir (*Abies lasiocarpa*), and 1%–5% western white pine (*Pinus monticola*). Density of conifers (<12.7 cm dbh) in each stand ranged from 5350–7050 trees/ha before thinning to 656–750 trees/ha after treatment (Fig. 1). Sapling density within retention patches was identical to prethinning densities.

Experimental design

We selected five sapling stands of equal age (approx. 18 years old), similar tree density, and similar size (10.5–14.0 ha) for sampling. We randomly selected sapling stands for experimental treatments. One of the sapling stands served as a control and remained unthinned throughout the study. Snowshoe hare habitat use was also estimated within two untreated mature conifer stands. The mature stands were chosen because of their proximity to thinned and control units to facilitate sampling, and reduce climate or other location-related bias. Preharvest snow track observations and pellet density data were collected within all seven sample stands during the winter prior to precommercial thinning of four sapling stands. During the winter following thinning of the four sapling stands, all seven stands were resampled.

The four precommercially thinned stands were thinned in June 2002. Retention percentages were randomly assigned, and retention patches were established within each of the stands such that 8% retention occurred with five 0.2-ha blocks and 35% retention occurred with five 0.8-ha blocks. This design was selected to evaluate whether snowshoe hare habitat use was influenced by patch size rather than the number of patches. Retention patches were evenly spaced within each stand, ≥ 50 m from the edge of the stand, as well as from any other retention unit.

Tracks and pellets

We established three to five transect segments, ranging in length from 100 to 525 m, for a stand transect total of 1250 m in each stand to survey snowshoe hare tracks in winter. Following thinning treatments, transects intersected both thinned and unthinned habitat patches. We placed transects ≥ 50 m apart and ≥ 50 m from stand edges to document use

clearly occurring within the stand and avoid double counting of hare tracks. We also counted tracks along transects within all seven stands on the same day to reduce bias associated with additional snowfall, wind, and melting. Because the SSF receives ample snowfall and sampling was conducted once a month from December through March, we assumed that any track crossing the transect was a track not recorded in the previous month's count. In addition, we sampled stands during the new moon to minimize lunar phase effects on animal movements (Price et al. 1984; Kolb 1992). Average tracks tallied per kilometre of transect served as an index of hare use.

We conducted fecal pellet counts pre- and post-thinning by placing approximately 50 perforated, plastic potting trays (28 cm × 56 cm) in each stand at 25-m intervals along each transect in November of each year. We placed trays 2 m off of each transect to reduce the possibility that observer trails would bias pellet count data. Trays were left under the snow pack through April, allowing hare pellets to accumulate during that period and settle into trays during snowmelt (Griffin 2003).

Analysis

We compared habitat use by hares before and after thinning within stands using χ^2 analyses. Tracks/km and total pellets counted within each stand served as the data points for χ^2 tests. We also used a χ^2 analysis to test for differences in pellet counts within retention sapling patches and the thinned matrix. In addition, we performed a *t* test for differences to compare track counts within retention patches versus surrounding thinned habitat. Results were considered significant if $P < 0.05$.

Results

The control stand had the fewest snowshoe hare tracks before thinning (28.8 ± 7.6 tracks/km; mean \pm SE), and an adjacent mature stand had the highest number of tracks observed (80.3 ± 37.3 tracks/km) (Fig. 2). Mature stands showed higher track counts relative to sapling stands prior to thinning (range = 62.9 ± 31.3 , 80.3 ± 37.3 tracks/km) (Fig. 2). Three of the four sapling stands increased in tracks/km after thinning as did the control and both mature stands ($\chi^2 = 55.399$, $df = 3$, $P < 0.001$).

The number of pellets collected from pellet trays ranged from 8 to 105 prior to thinning, with a 35% retention stand having the fewest pellets and a second 35% retention stand having the highest number of pellets (Fig. 3). Three of four sapling stands showed declines in pellet counts after thinning, although this trend was not significant ($\chi^2 = 0.434$, $df = 1$, $P = 0.510$). One stand that had 35% of the unit retained showed an increase in pellet counts post-thinning. The sapling control stand that was not thinned showed an increase in pellet counts, as did adjacent mature stands (Fig. 3).

Hares used retention patches more relative to the thinned matrix under both track (8% retention, $t = 2.52$, $P = 0.043$; 35% retention, $t = 3.84$, $P = 0.016$) (Fig. 4) and pellet metrics ($\chi^2 = 32.292$, $df = 1$, $P < 0.001$) (Fig. 5). Although retention patches within the 8% retention stands were four

Fig. 2. Snowshoe hare track counts before (2001–2002) and after precommercial thinning (2002–2003) in northwest Montana, USA. Estimates are from counts of tracks in snow tallied from December through March. The term “retention” refers to the percentage of the stand retained as unthinned saplings after precommercial thinning. Error bars represent the SE of average number of tracks per kilometre among months.

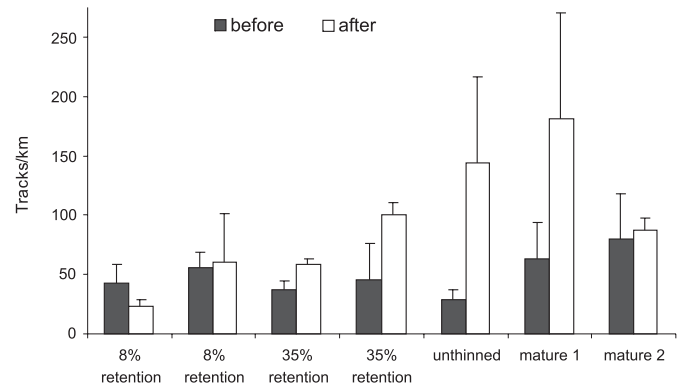
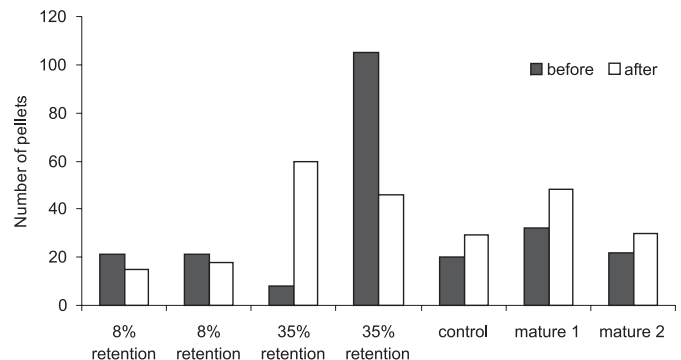


Fig. 3. Snowshoe hare pellets collected from pellet trays within conifer stands before (2001–2002) and after precommercial thinning (2002–2003) in northwest Montana, USA. Collection trays were in place under snow from November through April during 2001–2002 and 2002–2003. The term “retention” refers to the percentage of the stand retained as unthinned saplings after precommercial thinning.



times smaller than those within the 35% stands, both track and pellet counts were similar in these small retention patches.

Discussion

The results of our study are best viewed at two levels. First, at the forest stand level, our results from pellet and track counts lead to disparate conclusions regarding the efficacy of retaining patches of unthinned forest for hares when precommercially thinning sapling stands in montane forests. In general, hare use estimated from pellet counts suggests a slight decline or no effect on hare habitat use from differential thinning treatments; however, track counts suggest hare use of stands may have increased in certain stands after thinning. It is difficult to reach any conclusion as to whether retaining unthinned blocks within sapling stands provided enough in-

Fig. 4. Snowshoe hare track counts in thinned areas and unthinned remnant blocks within thinned stands in northwest Montana, USA. Estimates are from counts of tracks in snow tallied from December 2002 through March 2003. The 8% retention stands had 0.2-ha retention patches, while the 35% retention stands had 0.8-ha patches. Error bars represent the SE of the average number of tracks per kilometre among the two stands.

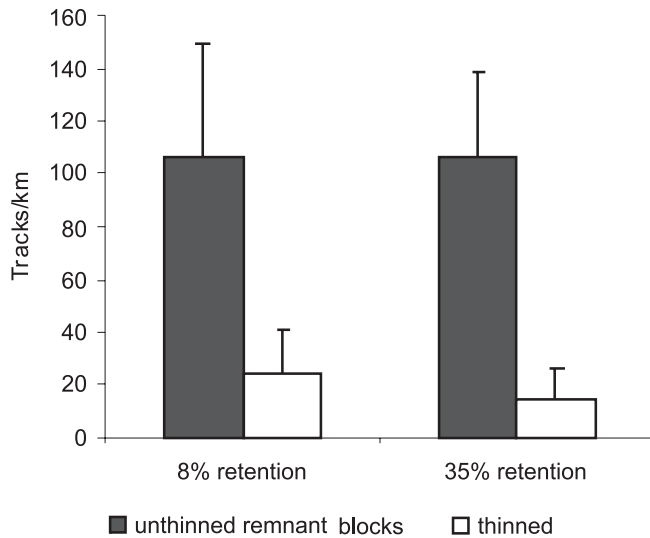
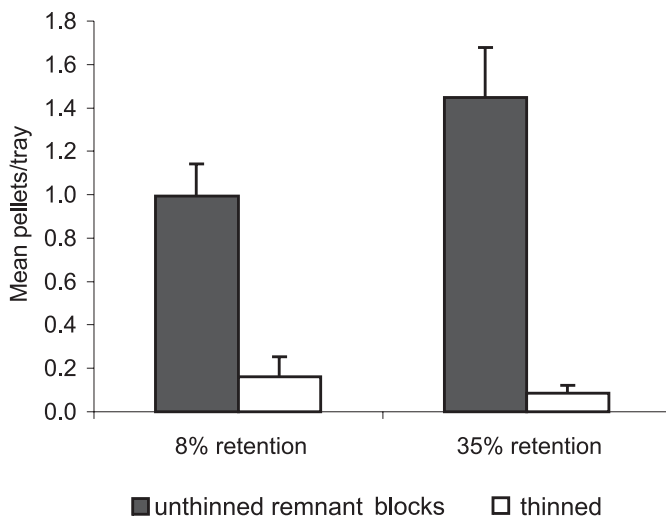


Fig. 5. The average number of pellets per tray in thinned areas and unthinned remnant blocks within thinned sapling stands in northwest Montana, USA. Pellet collection trays were in place under snow from November 2002 through April 2003. Error bars represent the SE of the average number of pellets per tray among the two stands.



tact habitat so thinning would not appreciably influence hare habitat use.

Track counts indicate hares may have moved from thinned stands to nearby unthinned control and mature stands (Fig. 2), and pellet counts also suggest movement of hares into intact control and adjacent mature stands the winter after thinning (Fig. 3). We should note that the forest stands we sampled were relatively small (10.5–14 ha) compared with more typi-

cal stand sizes of 25 ha. Perhaps hares were able to move across a relatively small and less harsh matrix to find cover and forage in nearby forests. In addition, not every adjacent forest stand surrounding the thinned stands was sampled for hare use. It is quite plausible that these unsampled adjacent stands provided winter habitat for hares after thinning as well.

When we consider the results at a narrower scale within the individual forest stands, use of retention blocks and the thinned matrix demonstrated that hares had a significant affinity for dense, unthinned sapling patches. Both track and pellet counts indicated that snowshoe hares used retention patches regardless of size, even though patches in 35% retention stands were four times larger than patches in 8% retention stands. Because hares demonstrated a high affinity for dense patches of residual forest, any retention of untreated sapling patches may be beneficial for hares when thinning relatively small (10.5–14 ha) young stands. Due to disparate levels of snowshoe hare use within retention patches and the thinned matrix, it appears that hares may benefit over winter from a connectivity of dense patches of forest. Results from other studies also suggest connectivity of dense cover may benefit hares (Monthey 1986; Scott and Yahner 1989; Ferron et al. 1998; Wirsing et al. 2002).

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