United States
Department of
Agriculture

Forest Service

Pacific Northwest
Research Station

Research Note
PNW-RN-539
March 1999

Effect of Fuels Reduction on American Martens and Their Prey

Evelyn L. Bull and Arlene K. Blumton

Abstract

The effect of a fuels-reduction treatment on small mammals was investigated in lodgepole pine (*Pinus contorta* Dougl. ex Loud.) and mixed-conifer stands by trapping and track surveys in northeastern Oregon. The number of red squirrel (*Tamiasciurus hudsonicus*) and snowshoe hare (*Lepus americanus*) tracks decreased in lodgepole pine treatments after harvest. Only two snowshoe hare tracks were detected in harvested stands of mixed conifer, compared with 46 tracks in unharvested stands. In most treatments, the number of red-backed voles (*Clethrionomys gapperi*) decreased and chipmunks (*Tamius* spp.) increased after harvesting.

Keywords: Fuels reduction, martens, northeastern Oregon, small mammals, track surveys.

Introduction

Fire suppression and insect outbreaks in the last 25 years have resulted in high fuel loadings in some stands in northeastern Oregon (Agee 1994). The risk of wildfire in these stands has generated concern among managers, and various methods of removing some of these fuels are being used.

Many wildlife species depend on downed wood (i.e., logs) for food including the pileated woodpecker (*Dryocopus pileatus*), northern flicker (*Colaptes auratus*), black-backed woodpecker (*Picoides arcticus*), and black bear (*Ursus americanus*) (Bull and others 1997). Most of these species forage on ants and other arthropods in logs. Log-dwelling ants are also important predators of the western spruce budworm (*Choristoneura occidentalis*), one of the most important forest-defoliating insects in the Pacific Northwest (Torgersen and others 1990). Downed wood also provides cover for small mammals, reptiles, amphibians, black bears, and American martens (*Martes americana*). Martens use logs for rest sites, den sites, subnivean (under snow) structures, and hunting. The primary prey of martens in northeastern Oregon, red-backed voles (*Clethrionomys gapperi*) and squirrels, are associated with logs and are available to martens during winter because of subnivean spaces created by logs. Because of the marten's strong association with logs and because the distribution of martens has declined in recent years, we decided to investigate the potential effect of fuels reduction by mechanical means on martens by looking at their mammalian prey.

EVELYN L. BULL is a research wildlife biologist, Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, Oregon 97850-3399; and ARLENE K. BLUMTON is a wildlife biologist, Pacific Northwest Region, Wallowa-Whitman National Forest, La Grande Ranger District, La Grande, Oregon 97850-3399.

Precautions were taken to protect the La Grande City municipal watershed from wildfire because adjacent stands contained high fuel loadings and were prone to lightning. A fuels-reduction treatment was designed to mitigate the potential for rapid fire spread across a ridgetop into the watershed. The overall objectives of the project were to remove down logs to reduce the fire intensity and to manipulate the stem density and structure of living and dead standing trees to reduce the potential of a crown fire. Both treatments were done to enhance the ability to control a fire from spreading from one watershed to another by creating a landscape-level corridor (1,000 feet wide on either side of the road) on the ridge. Mechanical means were used to reduce fuels by removing logs, reducing ladder fuels, and reducing canopy closure.

Our specific objectives were to (1) determine the abundance of small mammals by trapping and winter track surveys in lodgepole pine (*Pinus contorta* Dougl. ex Loud.) stands before and after harvesting and (2) determine the abundance of small mammals by trapping and winter track surveys in harvested and unharvested mixed-conifer stands.

Methods

Study Area

The study was conducted in the Limber Jim watershed, 20 miles southwest of La Grande, Oregon. The stands used in the study were on a ridge at 6,000 feet in elevation and were within 6 miles of each other. Nine stands were in lodgepole pine and six were in mixed-conifer forest types; stands were 10 to 33 acres. Before harvest, the lodgepole pine stands had a mature overstory of lodgepole pine, a dense understory of subalpine fir (*Abies lasiocarpa* (Hook.) Nutt.) and lodgepole pine, and 40 to 68.6 tons of downed wood per acre. Stem densities per acre averaged 1,177 seedings, 985 trees 1 to 7.9 inches diameter at breast height (d.b.h.), and 44 trees 8 inches d.b.h. or larger. Stem densites were determined from stand exams, and woody fuel was measured on three 100-foot lines per stand using the planar intercept method (Brown and Kellogg 1996, McIver 1998).

The mixed-conifer stands were a mixture of subalpine fir, grand fir (*A. grandis* (Dougl. ex D. Don) Lindl.), western larch (*Larix occidentalis* Nutt.), Engelmann spruce (*Picea engelmannii* Parry ex Engelm.), and Douglas-fir (*Psuedotsuga menziesii* (Mirb.) Franco) in the overstory and understory, and had 27.3 to 40.6 tons per acre of downed wood. Stem densities per acre averaged 690 seedlings, 323 trees 1 to 7.9 inches d.b.h., and 119 trees 8 inches d.b.h. or larger.

The stands were harvested in summer 1996 by using a single-grip harvester, forwarder, skidder, and yarder; in addition, half of each mixed-conifer stand was harvested with a skyline system (McIver 1998). The prescription in the mixed-conifer stands was to remove all dead material (standing and down) less than 15 inches in diameter. The following structures were retained: green trees with more than 40 percent crown, any dead standing or down wood larger than 15 inches in diameter, and about 40 logs per acre. The harvest treatment removed 59 percent of the seedlings, 82 percent of trees 1 to 7.9 inches d.b.h., and 62 percent of trees 8 inches d.b.h. or larger. Forty-one percent of the logs 3 inches or larger were removed.

There were three treatments in the lodgepole pine stands: control (no harvest activity), “island” (20 percent of area left in 1-acre islands of no harvest), and “scatter” (40 logs per acre left scattered throughout the unit). During harvest activities in the island treatment, 36 percent of the seedlings, 62 percent of the trees 1 to 7.9 inches d.b.h., and 6 percent of the trees 8 inches d.b.h. or larger were removed. Fifty-nine percent of the logs 3 inches or larger (large-end diameter) were removed. In the scatter treatment, 44 percent of the seedlings, 65 percent of the trees 1 to 7.9 inches d.b.h., and 10 percent of the trees 8 inches d.b.h. or larger were removed. Sixty-nine percent of the logs 3 inches or larger were removed.

Small Mammal Trapping

Small mammals were trapped in nine lodgepole pine stands (i.e., three stands in each of three treatments) between 10 and 14 July 1995 (preharvest) and between 3 and 7 August 1997 (postharvest). In each stand, we trapped along two parallel 660-foot transects 66 feet apart, with trap stations at 66-foot intervals, for four consecutive nights. At each station, two museum specials and one rat trap were set and baited with peanut butter.

Between 18 and 22 August 1997 small mammals were trapped in three mixed-conifer stands that had been harvested the previous summer, and in three stands that had not been harvested. In each stand, we trapped along two parallel 1,320-foot transects 66 feet apart, with trap stations at 66-foot intervals, for four consecutive nights. Two museum specials were set at every other station, and one museum special and one rat trap were set at alternate stations. Traps were baited with peanut butter. Trap stations were checked each morning, and captured individuals were identified to species.

Winter Track Surveys

We conducted eight track surveys on snowmobiles or snowshoes along a 660-foot transect in each of nine lodgepole pine stands (i.e., three stands in each of three treatments) from January through March 1996 (preharvest) and during the same months in 1998 (postharvest). In six mixed-conifer stands (three harvested and three unharvested), eight surveys were conducted along a 1,320-foot transect from January through March 1998. All tracks within 20 feet of either side of the transect were identified. Track surveys were conducted at least 24 hours after a snowfall, and at least 3 days after the previous survey.

Marten Radiotelemetry

Radio collared martens had been monitored in the Limber Jim watershed for 2 years before harvest activities. We located four martens resting or traveling in three of the lodgepole stands and in two of the mixed-conifer stands during 1994 and 1995. We planned to continue monitoring marten use of the stands after harvesting; however, some of the martens in Limber Jim were killed or dispersed to other areas. None of the surviving radio collared martens used the stands after harvesting. The harvested stands, however, comprised such a small proportion of a marten's home range that this behavior cannot be construed as an avoidance of harvested stands.

Results

Small Mammal Trapping

In lodgepole pine stands, the total number of small mammals captured in both years was too low for statistical analyses: 52 chipmunks (*Tamius* spp.), 39 red-backed voles (*Clethrionomys gapperi*), 10 deer mice (*Peromyscus maniculatus*), 9 golden-mantled ground squirrels (*Spermophilus lateralis*), and 8 microtines (*Microtus* spp.). The number of chipmunks increased in all treatments between 1995 and 1997 (fig. 1). The number of red-backed voles declined in the scattered treatment and increased in the control and island treatment. The number of deer mice declined in the island and scattered treatments but increased slightly in the control. *Microtus* spp. and ground squirrels were too scarce to suggest trends. In mixed-conifer stands, harvested stands contained fewer red-backed voles and more chipmunks than unharvested stands (fig. 2).

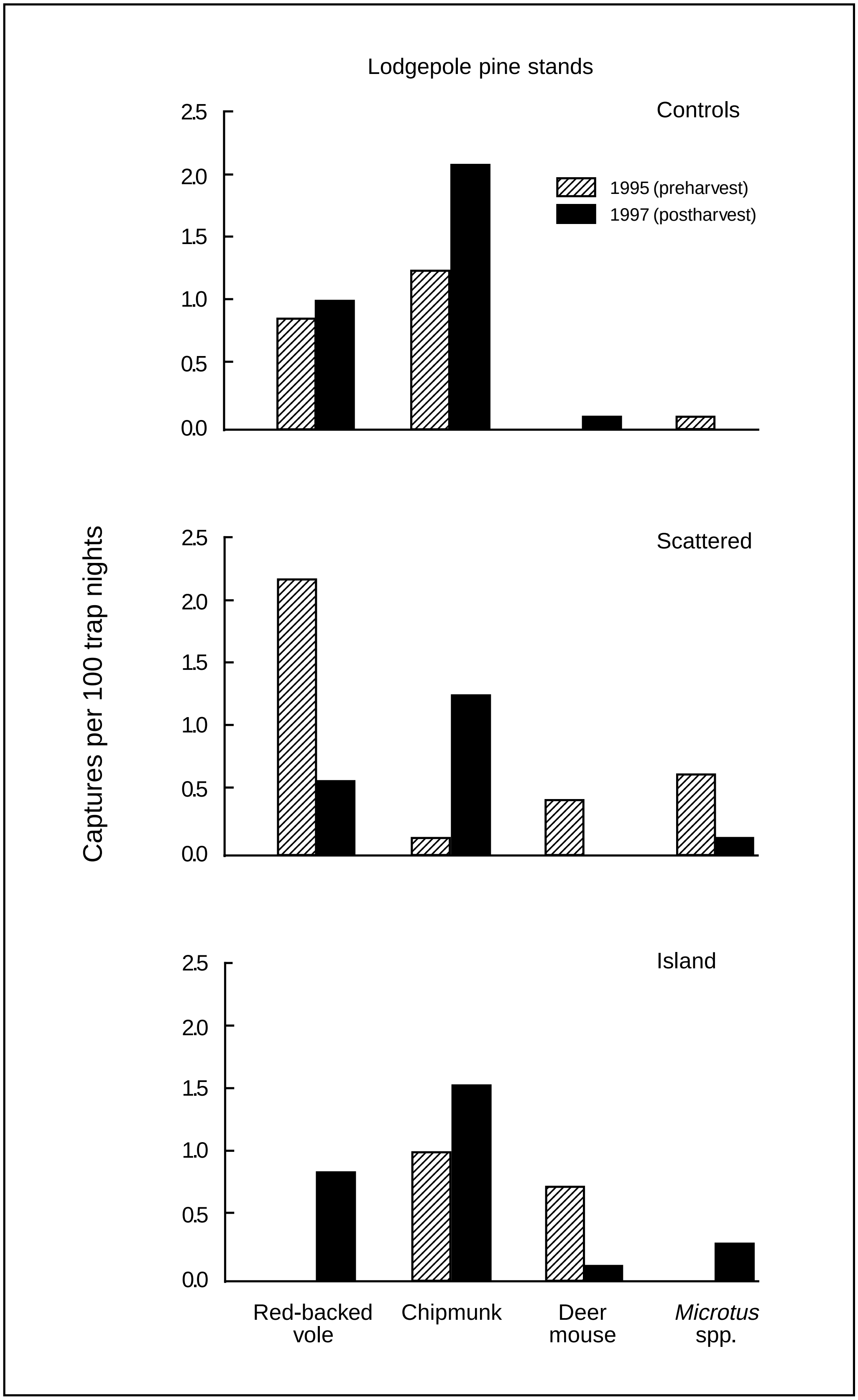

Figure 1—Number of individuals of four small mammal species captured per 100 trap nights before harvest in 1995 and after harvest in 1997 in nine stands of lodgepole pine in Limber Jim watershed. The control treatment had no harvesting; the island treatment retained unharvested 1-acre islands; the scatter treatment retained logs scattered throughout the units.

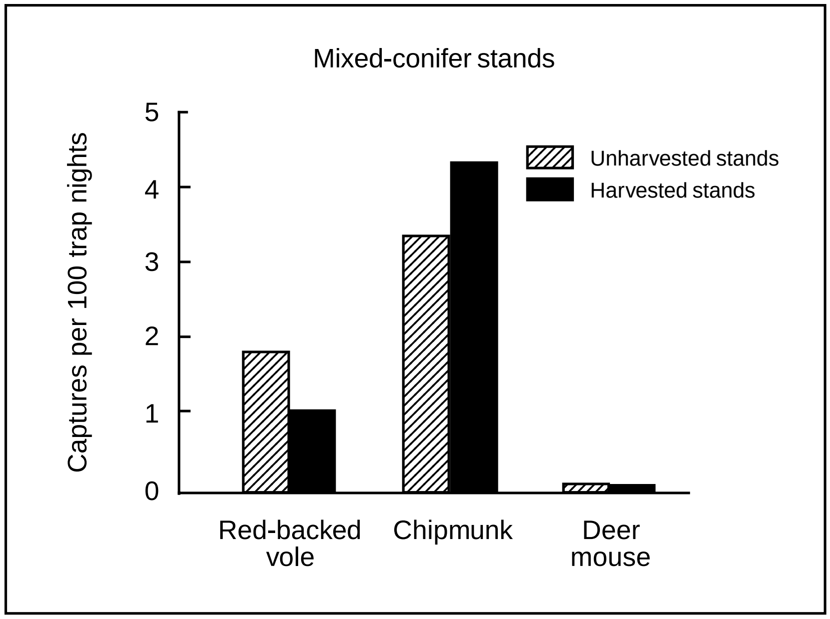

Figure 2—Number of individuals of three small mammal species captured per 100 trap nights in three harvested and three unharvested stands of mixed conifer in 1997 in the Limber Jim watershed.

Winter Track Surveys

In lodgepole pine stands, the number of snowshoe hare (*Lepus americanus*) tracks decreased in all treatments and red squirrel (*Tamiasciurus hudsonicus*) tracks decreased in all but one treatment between the preharvest and postharvest periods (fig. 3). Tracks of coyotes (*Canis latrans*) remained about the same in the island and scatter treatments, but the control treatment had a threefold increase (fig. 3). Tracks of 1 grouse (*Bonasa umbellus*), 5 voles, 7 bobcats (*Lynx rufus*), and 10 weasels (*Mustela* spp.) also were detected in 1996; in 1998, we found tracks of 4 grouse and 1 weasel. Detections of these species were too few to indicate changes.

In mixed-conifer stands, there were only two snowshoe hare tracks in the harvested stands compared with 46 tracks in the unharvested stands (fig. 4). There was little difference in the number of red squirrel and coyote tracks. In addition, one weasel, one grouse, and two vole tracks were detected in harvested stands.

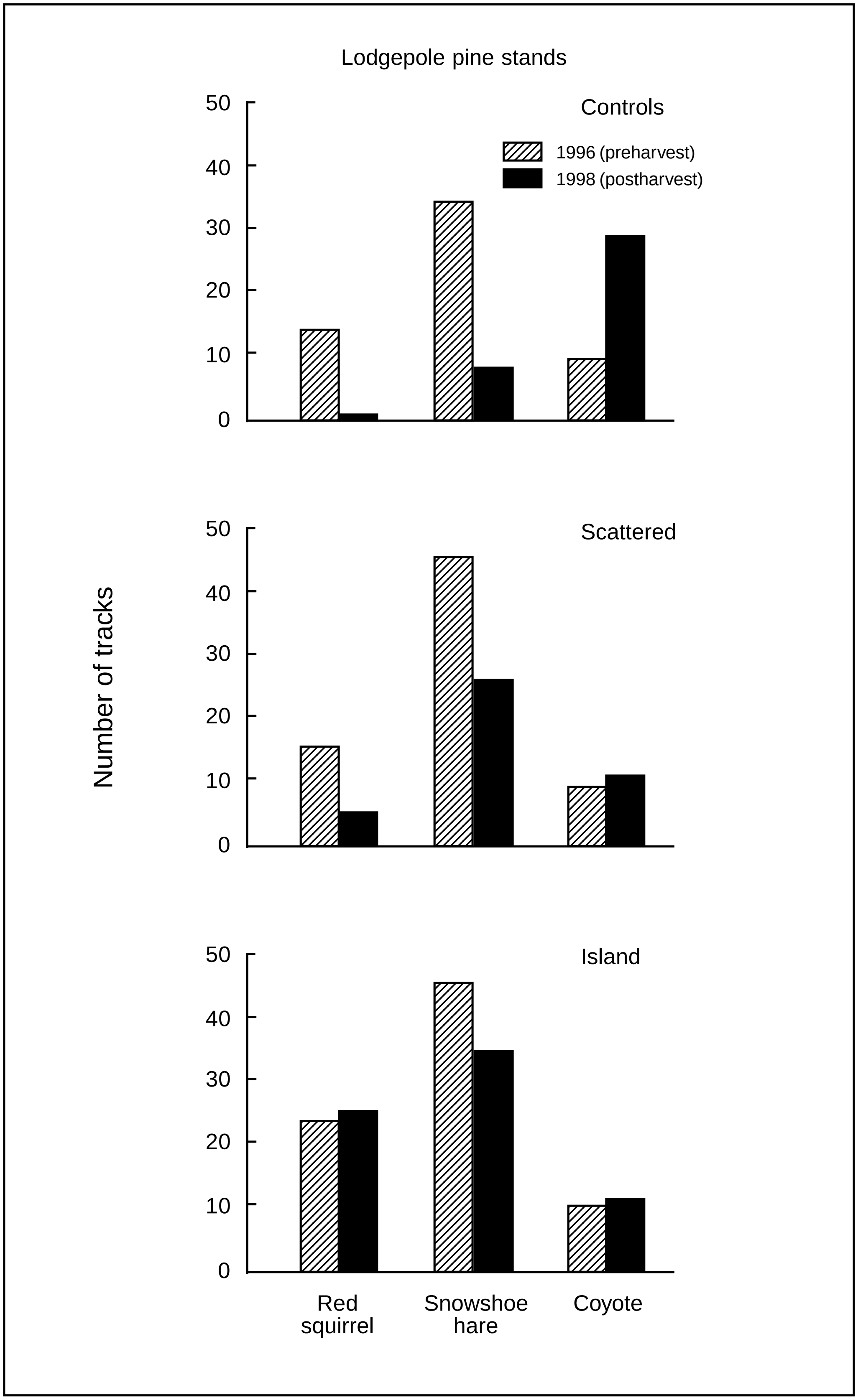

Figure 3—Number of tracks of three species detected in winter 1996 before harvest and in 1998 after harvest in nine stands of lodgepole pine in the Limber Jim watershed.

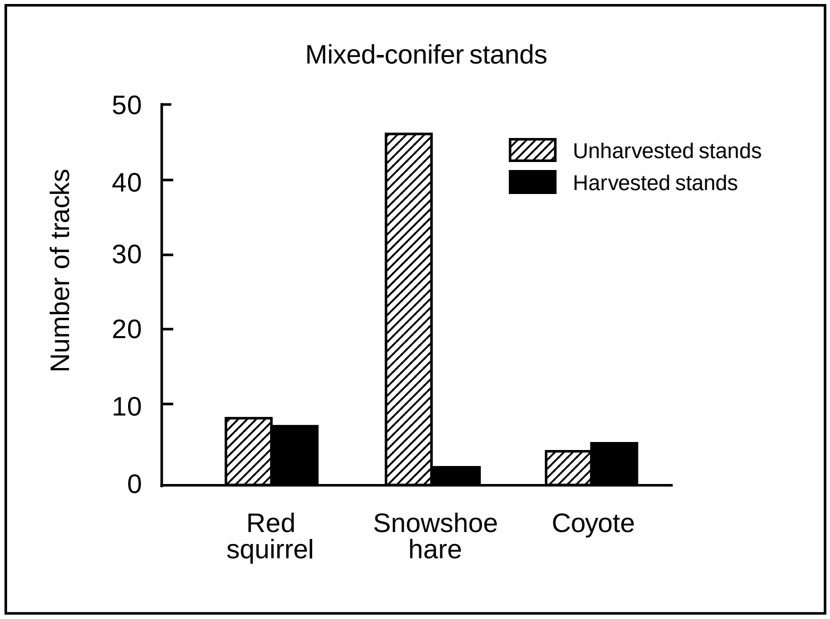

Figure 4—Number of tracks of three species detected in winter 1998 in three harvested and three unharvested stands of mixed conifer in the Limber Jim watershed.

Discussion

The harvest activities in lodgepole pine and mixed-conifer stands in Limber Jim generally resulted in fewer postharvest numbers of red-backed voles and snowshoe hares and in more chipmunks. The same decline in red-backed voles after harvesting was observed by Potvin and Breton (1997). Hargis and Bissonette (1997) reported higher numbers of deer mice and chipmunks in clearcuts compared with dense forests dominated by red-backed voles. We found less of a decline in the number of snowshoe hares, no decline in squirrels, and an increase in red-backed voles in the island treatment compared to the scatter treatment. We suspect the decline in squirrels and hares in the control stands may have resulted from the threefold increase in coyotes, which prey on both these species.

The lack of decline in squirrel detections in the island treatment and in the mixed-conifer harvest suggests that these treatments continued to provide suitable habitat for this species. The island treatments retained islands of logs that provided subnivean structures essential to squirrel survival in winter in this area. The mixed-conifer treatment retained large-diameter trees, which could continue to provide a food source for the squirrels. In addition, all logs larger than 15 inches in large-end diameter were retained in mixed-conifer stands, which could provide subnivean habitat for cone caching and overwintering. The scattered treatment did not provide subnivean habitat because the logs were small in diameter and were lying on the ground, rather than layered above the ground with air pockets underneath as in the island treatment.

It appeared that mixed-conifer stands were no longer suitable for snowshoe hares after harvesting. The island treatment that resulted in less of a decline in hares probably provided better habitat than the scattered treatment because the islands contained undisturbed pockets of regeneration as well as logs—which were both used as cover.

The declines in red-backed voles, red squirrels, and snowshoe hares in the harvested stands would be detrimental to martens because these species are primary prey items for martens. These prey items comprise a majority of marten diet in this area: 30 percent red-backed voles, 25 percent squirrels, and 1 percent hare by frequency; and 5 percent red-backed voles, 43 percent squirrels, and 18 percent hares by biomass (Bull, in prep.). Squirrels and hares are particularly important in winter. The observed increase in chipmunks would be of little value because less than 3 percent of marten diet consists of chipmunks, and chipmunks are likely unavailable as prey in winter because they hibernate.

In winter, martens use subnivean structures for cover and for hunting opportunities (Buskirk and Powell 1994, Chapin and others 1997, Sherburne and Bissonette 1994). It appears that the scatter treatment, which does not provide subnivean habitat, would be unsuitable for martens. We could not determine if the island treatment in lodgepole pine retained enough cover and subnivean structure to provide suitable habitat for martens. It is unlikely a marten would venture into the mixed-conifer stands because of reduced canopy closure and stem density. Radio collared martens in the area avoided all harvested stands and stands with less than 50 percent canopy closure (Bull and Heater, in prep.).

Although it appeared that the island treatment provided better habitat for small mammals than the scatter treatment, we do not recommend extrapolating the data beyond this particular study because the number of individuals captured was low and the sampling period was short because of budget constraints. Changes observed may have been due to treatment affects, but a small sample size, weather, winter tracking conditions, and different observers could have contributed as well. Additional research is needed to investigate different sizes of islands, the amount of area in islands, and connecting islands with no-cut corridors to provide continuity. Ideally, monitoring efforts should extend 5 years after treatment and in stands exceeding 100 acres.

Acknowledgments

Donna Betts, Ted Craddock, Thad Heater, Janet Hohmann, Jay Shepherd, and Dave Wyland assisted with trapping and track surveys. Tracy Kissire, Annette Pepin, and personnel from the La Grande Ranger District provided fuels and stem density data. Tom Burry served as the La Grande District coordinator. Funding was provided by the Blue Mountains Natural Resources Institute, La Grande Ranger District, and Pacific Northwest Research Station.

References

Agee, James K. 1994. Fire and weather disturbances in terrestrial ecosytems of the eastern Cascades. Gen. Tech. Rep. PNW-GTR-320. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p.

Brown, C.G.; Kellogg, L.D. 1996. Harvesting economics and wood fiber utilization in a fuels reduction project: a case study in eastern Oregon. Forest Products Journal. 46: 45-52.

Bull, Evelyn L. [In prep.] Seasonal and sexual differences in the diet of the American marten.

Bull, Evelyn L.; Heater, Thad W. [In prep.] Habitat use of the American marten in northeastern Oregon.

Bull, Evelyn L.; Parks, Catherine G.; Torgersen, Torolf R. 1997. Trees and logs important to wildlife in the interior Columbia River basin. Gen. Tech. Rep. PNW-GTR-391. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 55 p.

Buskirk, Steven. W.; Powell, R.A. 1994. Habitat ecology of fishers and American martens. In: Buskirk, Steven W.; Harestad, Alton S.; Raphael, Martin G.; Powell, Roger A., eds. Martens, sables, and fishers: biology and conservation. Ithaca, NY: Cornell University Press: 283-296.

Chapin, Theodore G.; Phillips, David M.; Harrison, Daniel J.; York, Eric C. 1997. Seasonal selection of habitats by resting martens in Maine. In: Proulx, Gilbert; Bryant, Harold N.; Woodard, Paul M.; eds. *Martes*: taxonomy, ecology, techniques, and management. Edmonton, AB: Provincial Museum of Alberta: 166-181.

Hargis, Christina D.; Bissonette, John A. 1997. Effects of forest fragmentation on populations of American marten in the intermountain West. In: Proulx, Gilbert; Bryant, Harold N.; Woodward, Paul M., eds. *Martes*: taxonomy, ecology, techniques, and management. Edmonton, AB: Provincial Museum of Alberta: 437-451.

McIver, James D. 1998. Economics and environmental effects of fuel reduction at Limber Jim. BMNRI Tech. Note 10. La Grande, OR: U.S. Department of Agriculture, Forest Service, Blue Mountains Natural Resources Institute.

Potvin, Francois; Breton, Laurier. 1997. Short-term effects of clearcutting on martens and their prey in the boreal forest of western Quebec. In: Proulx, Gilbert; Bryant, Harold N.; Woodward, Paul M., eds. *Martes*: taxonomy, ecology, techniques, and management. Edmonton, AB: Provincial Museum of Alberta: 452-474.

Sherburne, Stuart S.; Bissonette, John A. 1994. Marten subnivean access point use: response to subnivean prey levels. Journal of Wildlife Management. 58: 400-405.

Torgersen, Torolf R.; Mason, Richard R.; Campbell, Roy W. 1990. Predation by birds and ants on two forest insect pests in the Pacific Northwest. Studies in Avian Biology. 13: 14-19.

This page has been left blank intentionally.
Document continues on next page.

The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

Pacific Northwest Research Station
333 S.W. First Avenue,
P.O. Box 3890,
Portland, Oregon 97208-3890

U.S. Department of Agriculture
Pacific Northwest Research Station
333 S.W. First Avenue
P.O. Box 3890
Portland, OR 97208