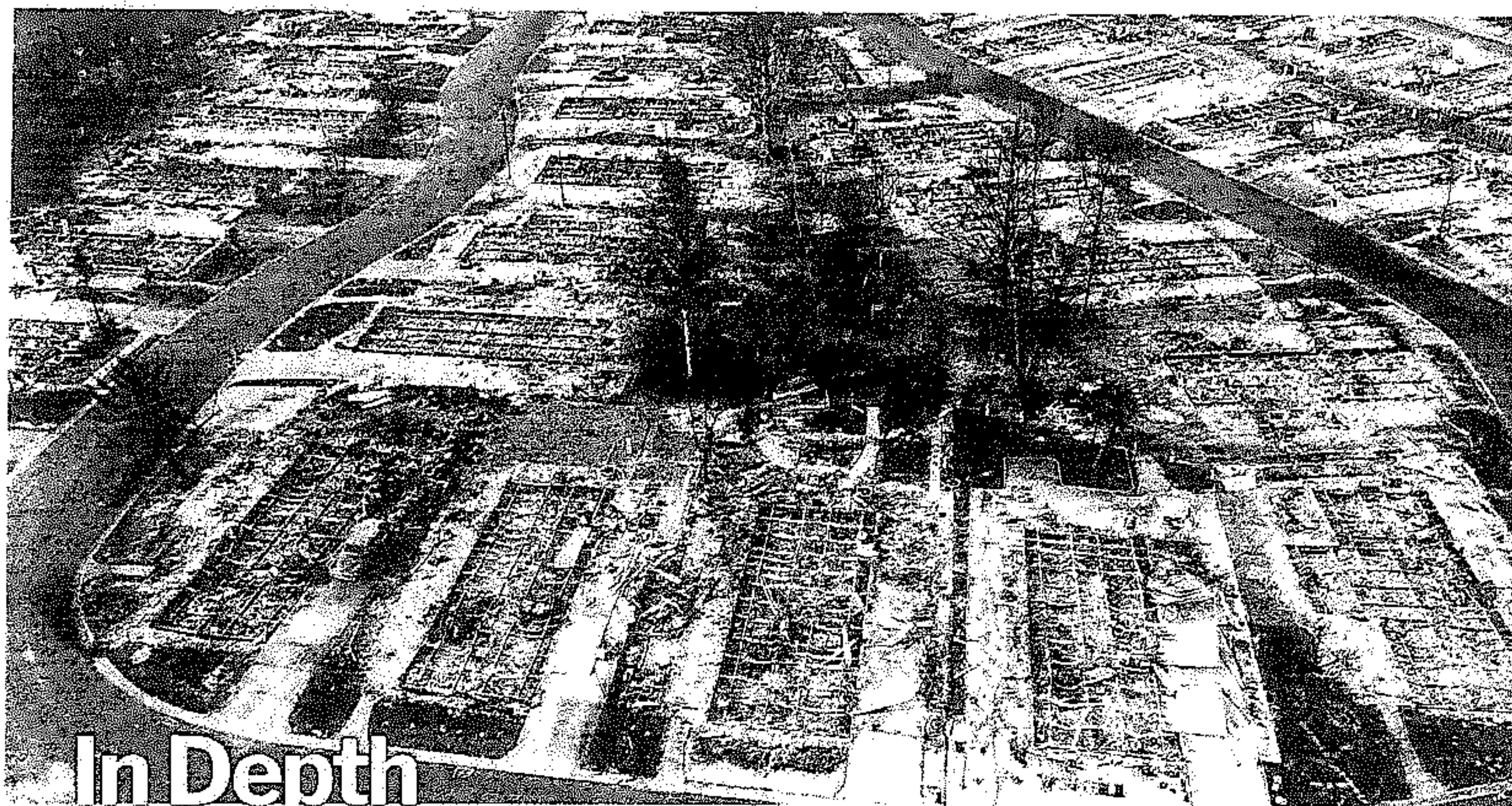


The 2020 Almeda fire in southern Oregon decimated residential neighborhoods.

Wildfire Mitigation

The 2020 wildfire season set a record for acres burned in the U.S. since 1983, and fire season started early for 2021 with drought conditions continuing across most of the country. At this writing, the U.S. Drought Monitor shows much of the West experiencing extreme and exceptional drought along with temperatures of 4-15 degrees above normal. In addition to ramping up firefighting resources, the Forest Service, other federal agencies, state agencies, and local governments are responding to the wildfire threat with increased spending for mitigation projects.

California allocated more than $500 million on wildfire prevention efforts just for springtime projects. Congress is getting involved with various pieces of legislation, and President Biden's budget request calls for spending $1.7 billion "for high-priority hazardous fuels and forest resilience projects," an increase of $476 million. If we learned nothing else from last year's fires, it's that weather-driven fires are unstoppable, which raises questions. Will this increased spending on fire mitigation benefit our forests? Will it benefit at-risk communities?

Most of our readers are likely familiar with the root problem. A century of fire suppression produced dense, overgrown forests that have proven more susceptible to pests, disease, drought, and catastrophic wildfire. The commonsense solution would seem to be simply thinning the forests to reduce wildfire risks, but fire ecologists say the issue is more complicated than that. A 2008 report by Reinhardt, Keane, Calkin, and Cohen cautions against acting on misconceptions about fuel treatments and their use as "a panacea for fire hazard reduction. ... Given the right conditions, wildlands will inevitably burn."

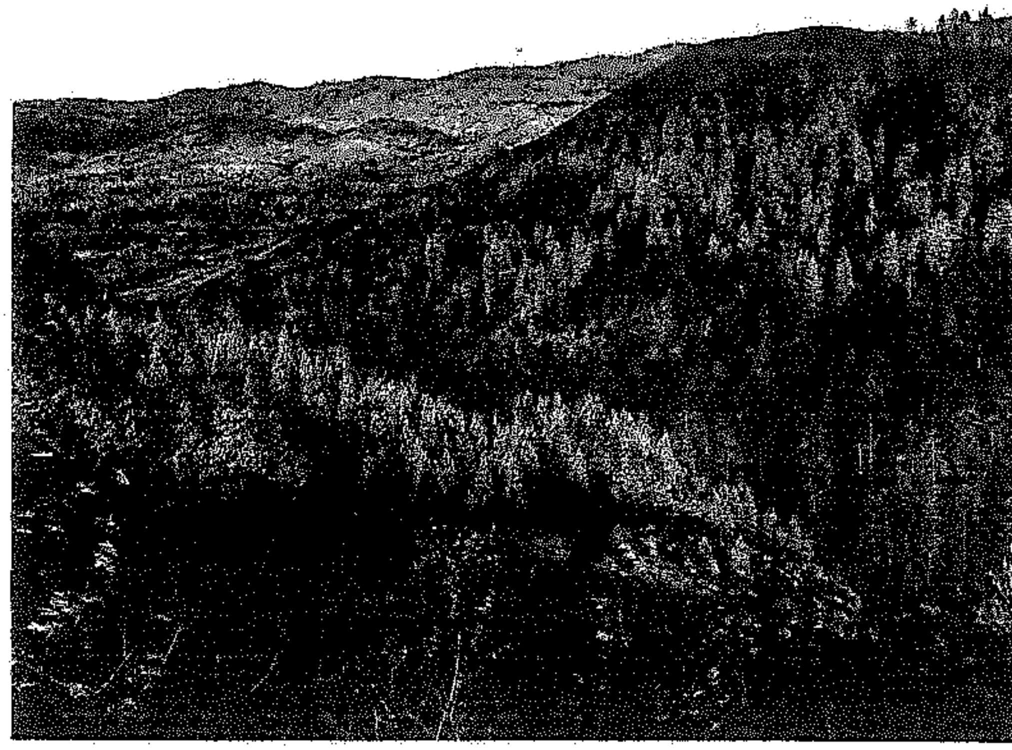
As the 2020 fires demonstrated, those conditions — high temps, low humidity, high wind — have become more common across the West, producing ever larger fires that account for the vast majority of acres burned each year. When fire conditions prevail, high winds carry embers for miles, jumping rivers, lakes, and fire lines.

Reinhardt et al. also note that these fires burn through areas that have been thinned. In fact, without follow-up treatments, thinning can increase the intensity of large fires. The lower density of trees allows winds to blow with less obstruction, and more sunlight on the forest floor dries the ground and encourages flammable shrubs and invasive plants to grow and spread more rapidly. Maintaining the desired conditions requires ongoing, labor-intensive management and, according to a 1994 report by W.L. Baker, may take up to seven treatments before conditions resemble pre-fire-suppression forests.

John Muir Project Director Chad Hanson, a forest ecologist, said a growing body of research suggests that removing trees doesn't protect forests from wildfire but may contribute to more intense wildfires. He and his fellow researchers have conducted multiple studies that support his opposition to logging and mechanical thinning of forests. A 2016 report that he co-authored concludes, "Forests with the highest levels of protection from logging tend to burn least severely."

Mark Finney, a Forest Service research forester, studies the physical processes of fire spread. He led a team that studied the Hayman fire, which was then the largest Colorado wildfire on record. Finney's team determined, "Fuel breaks and treatments were breached by massive spotting and intense surface fires. ... Extreme environmental conditions ... overwhelmed most fuel treatment effects. ... Suppression efforts had little benefit from fuel modifications." The team concluded that the primary objective of fuel treatments should be to make wildfire "less severe, rather than to reduce wildfire extent or make it easier to suppress."

Finney promotes restoring

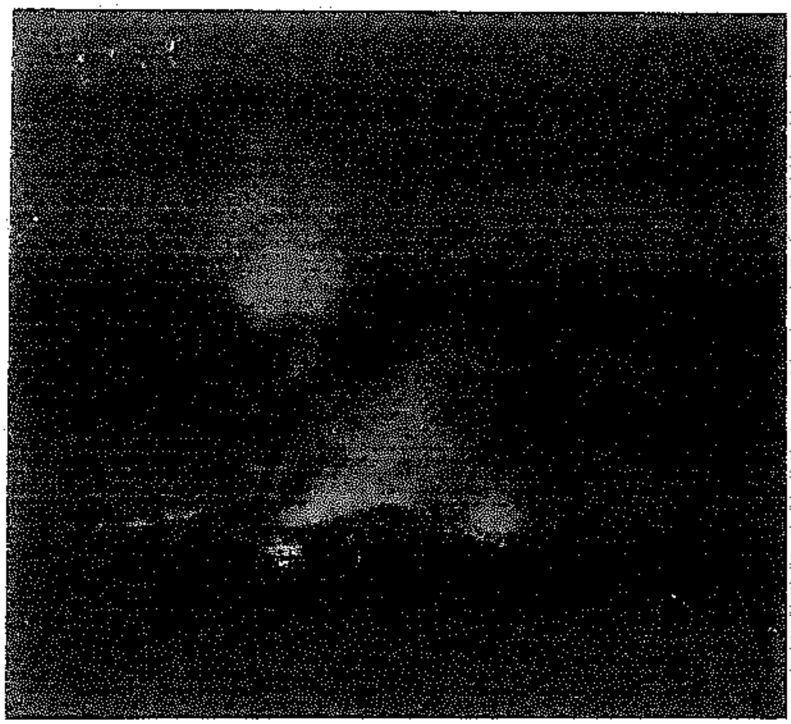


The Camp Fire in California, which destroyed the town of Paradise, burned more intensely in a previously logged area (foreground) than in an adjacent section of unlogged forest where mature trees survived the blaze (photo by Chad Hanson).

fire-prone forests to conditions that mimic the forest structure prior to fire suppression policies. For millennia, he points out, Native American communities in fire-prone regions used fires to manage the landscape, shaping forests and grasslands in ways that minimized the community risk from fires as well as the likelihood of high-severity fires. Because our frequent-fire forests have changed so much since fire was removed from the landscape, Finney advocates for "structural restoration" as a way of returning western U.S. forests to "something that is sustainable." The key, he asserts, is prescribed fire. "Drier forest types were sustained by periodic burning."

As the local tribes recognized, the forest needs repeated management, "not one and done," Finney remarked. "We get all wrapped around the axle because we're not considering the maintenance. The only way to maintain a forest in a low-hazard condition is through repeated burning ... but you can't introduce fire without some mechanical treatment first. ... You can't restore structure without mechanical means."

As Finney elaborates in a recent paper, "We believe that the primary goal of fuel treatment should be to create landscapes in which fire can occur without devastating consequences. Once these conditions have been achieved, wildfire need not be as vigorously suppressed and can itself play a role in maintaining these landscapes. Fuel treatments should not be used to reduce or eliminate fire



The 2020 CZU Lightning Complex fire burns in California's Santa Cruz Mountains. The fire grew to more than 85,000 acres and destroyed over 900 structures (photo by Inklein, Wikipedia).

from landscapes. Fuel treatment programs should ... encourage a return of fire to the landscape and improve the resilience and sustainability of U.S. ecosystems."

For Finney, the bottom line is that we're playing catch-up, and we've got a lot of catching up to do. "We've been ignoring this for a long time. We need to get millions of acres under a treatment regime, and we need to think at landscape scales. We need to strategically begin to introduce treatments onto the landscape to obstruct fires from traveling so far."

Finney contributed to a 2018 study addressing fuel loads in Sierra Nevada forests where severe drought "compounded by forest densification from decades of fire suppression" produced "unprecedented" tree mortality. The study concludes that wildfire severity "may be little affected" in the first decade following widespread tree mortality from bark beetles or drought. However, "extensive loading of large-sized woody fuels in future decades may contribute to dangerous mass fires. ... Such intense fires could prevent forests from becoming re-established."

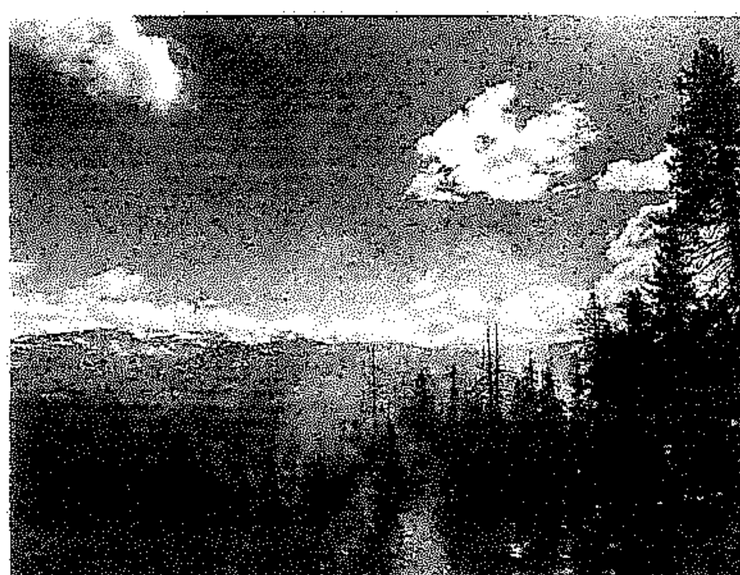
Finney emphasizes that the combination of historical fire suppression combined with climate change create a lot of unknowns. "Our forests currently have high densities of susceptible trees. It's unprecedented. ... To do nothing would be very naive. ... It's also important to have private landowners doing their part," which finally gets us to the second question: How much will fire mitigation efforts benefit our communities?

In his most recent paper, Finney observes, "Engineering solutions to reduce vulnerability of buildings and other infrastructure to wildfires face few technical obstacles," yet issues like cost and enforcement challenges "impede widespread adoption of changes in building design and materials."

In this regard, Finney and Hanson agree. In fact, Hanson said fire mitigation efforts should start with homes and be limited to a 100-foot radius around each home. "We need to work from the home out to the forest." After fireproofing homes and other buildings by cleaning gutters, installing metal roofs, and so forth, Hanson emphasizes defensible space, especially the 30-foot radius closest to the building, where dry grasses and small trees should be removed. He questions the value of "vegetation management" beyond 100 feet from the house but believes that, with a relatively small investment, most homeowners could be 95 percent effective at saving their homes from wildfire.

Without doubt, the wildfire situation is complicated, largely because more than a century of fire suppression has taken our forests into uncharted territory, but it has become clear to ecologists that fire is an integral part of our forests. As Finney said, "Fire is an excellent ally, and we've not taken advantage of that, partially through fear. ... We're more vulnerable to fire than the native peoples who had none of our technology. They used it routinely, and they persisted here for upwards of 10,000 years."

A prescribed fire in Yosemite National Park removes flammable undergrowth to mitigate the risk of catastrophic wildfire.



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FOREST MANAGEMENT AND CONSERVATION OF BOREAL OWLS IN NORTH AMERICA

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ABSTRACT.—Boreal Owls (*Aegolius funereus*) in North America occur throughout the boreal forests of Canada and Alaska and in subalpine forests of the Rocky Mountains north of central New Mexico. A recent assessment of Boreal Owl conservation status in the western mountains of North America suggested that Boreal Owls were not in immediate peril. However, in the long-term and in selected local areas, Boreal Owls likely face conservation problems. This conclusion reflects the hypothesized response of Boreal Owls to the type and pattern of forest harvest that occurred in the past and may occur in the future. Over the last 40 yr, a majority of timber harvest occurred as clear-cutting that removed the older, more diverse forest stands. Forest structure influences the availability of suitable cavities, the quality of roost sites, the foraging movements of individual owls and prey availability. Components of mature and older forests are especially important to Boreal Owl habitat quality; the owls nest in large tree cavities and prey populations are most abundant in older forest stands. Clear-cut sites will remain unsuitable for roosting or foraging for a century or more and new nest trees will not develop in some situations for two centuries or longer. Timber harvest which maintains components of mature forest well dispersed across the landscape may be compatible with conservation of Boreal Owls. In particular, forest management must consider the consequences of management decisions across broad spatial scales and over a long-term horizon. Metapopulation modeling and experimentation through adaptive management will be necessary to develop timber harvest practices compatible with conservation of Boreal Owls.

KEY WORDS: *forest management; Boreal Owl;* Aegolius funereus; *woodpeckers; small mammals; adaptive management.*

Administración Forestales y Conservación de Búhos Boreal en Norte América

RESUMEN.—El Búho Boreal *Aegolius funereus* en norte américa ocurre en todas partes de bosques boreal en Canadá y Alaska y en bosques sub-alpino en las montañas Rocosas norte de centro Nuevo México. Una evaluación reciente del estado de conservación del Búho Boreal en las montañas del oeste en norte américa sugiera que el Búho Boreal no está en peligro inmediato. Sin embargo, en la larga duración, y en áreas seleccionadas en el local, Búho Boreal pueden encontrarse con problemas de conservación. Esta conclusión reflecta la respuesta hipotesisada del búho boreal para el tipo y ejemplo de cosechas de bosque que ocurrió en el pasado y puede ocurrir en el futuro. En los últimos 40 años una mayoría de cosechas de madera ocurrió en el corte-completo que quito áreas de bosque maduros y de mas diversidad. La estructura de bosque influencia la disponibilidad de parcelas suficiente, la calidad de perchas, los movimientos de forraje de búhos solitarios, y la disponibilidad de cazar. Componente de bosques maduros y viejos son especialmente importante al hábitat del Búho Boreal. Los búhos hacen nidos en cavidades grandes de los árboles y poblaciones de cazar son mas abundante en parcelas de bosque viejas. Sitios cortados-completo se quedaran inconveniente para perchas o forraje para un siglo o más y árboles con nidos nuevos no se desarrollan en unos situaciones por dos siglos o mas. Cosecha de maderas que mantienen componente de bosques maduros bien dispersos a través el paisaje puede estar compatible con la conservación de Búhos Boreal. En particular la administración de bosques necesita considerar las consecuencias de las decisiones que hace a través de la escala de espacio amplio y sobre suficiente tiempo con perspectiva. Modelos de meta-población y experimentación a través de administración adoptivo va ser necesario para desarrollar costumbres compatible de cosechas de madera con conservación de Búhos Boreal.

[Traducción de Raúl De La Garza, Jr.]

The North American distribution for Boreal Owls (*Aegolius funereus*) forms a relatively continuous band extending from the Pacific to Atlantic coasts in the boreal forests of Alaska and Canac (Godfrey 1986). South of the continuous transcontinental band, disjunct populations occur in the

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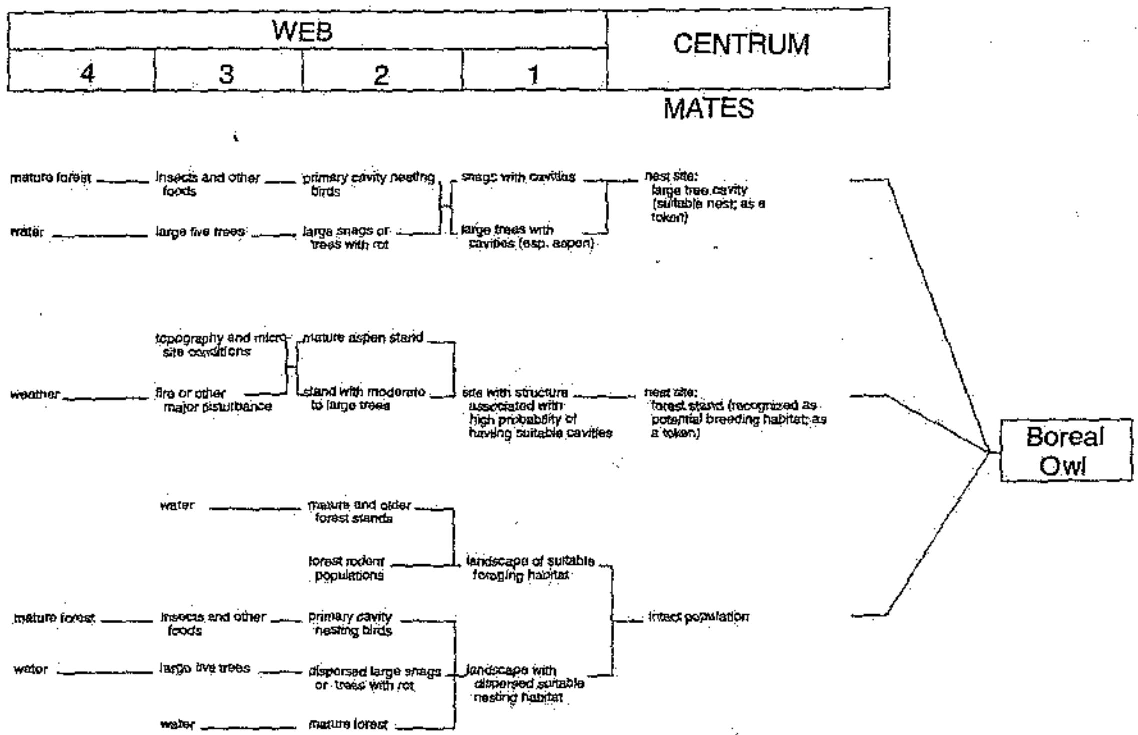

Figure 1. Envirogram (Andrewartha and Birch 1984) illustrating the relationship between Boreal Owls and specific components of the forest system. This portion of a larger envirogram (Hayward 1994b) focuses on Boreal Owl nesting ecology.

based more on efficiency in finding a cavity than increased survival after locating a nest.

The same studies in Idaho suggest that patch size may not be an important characteristic of nest stands. Nest stands ranged in size from 0.8 to 14.6 ha and averaged 7.6 ha.

thermal cover

Roosting habitat. Patterns of roosting habitat use also suggest these owls choose forests with particular structural features during certain times of the year. In Idaho, forest structure at summer roost sites differed substantially from paired random sites. Roost sites had higher canopy cover, basal area, and maybe most important, were significantly cooler microsites (Hotelling's T^2, $P < 0.001$) (Hayward et al. 1993). In summer, and particularly in the southern portion of their range, Boreal Owls find roost sites to minimize heat stress. We witnessed owls gular fluttering and other behaviors associated with heat stress when the temperature was as mild as 18°C. I hypothesize that the elevational distribution of Boreal Owls in the Rockies may be determined, in part, by summer temperatures and the availability of cool microsites for roosting. Forest structure, then, may influence the distribution of Boreal Owls through an interaction with limitation by heat stress.

Foraging habitat. A variety of evidence suggests that Boreal Owls in the Rockies forage principally in mature and older forest, especially spruce-fir forests (Hayward 1987). These observations are corroborated by evidence that red-backed voles (*Clethrionomys gapperi*) represent a dominant prey for Boreal Owls throughout their range in North America (Bondrup-Nielsen 1978, Palmer 1986, Hayward and Garton 1988, Hayward et al. 1993). Red-backed voles are principally forest voles (Hayward and Hayward 1995). Our studies of small mammals in Idaho found redbacks were up to nine times more abundant in mature spruce-fir forest than other forest habitats (Hayward et al. 1993). The argument for the importance of mature forest for foraging stems also from observations of snow characteristics in openings, young forest and mature forests. Snow crusting is significantly reduced

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