

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 refleja la respuesta hipotesizada 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 Canada (Godfrey 1986). South of the continuous transcontinental band, disjunct populations occur in the

Rocky Mountains extending into northern New Mexico (Palward et al. 1987, Whelinski 1990). Through the owl occurs in a variety of forests: conifer and mixed (Bondrup-Nielsen 1978), temperate (Lane 1988) and subalpine (Hayward et al. 1993). The owl is intimately linked to the dynamics of these forests. In 1993, Hayward and V. distribution and abundance are strongly influenced by

How do population dynamics change? In this paper I provide an alternative approach to understanding the impacts of forest management on Boreal Owls. This paper represents likely to influence the abundance of Boreal Owls, at least in the Rockies, may represent the most universally tied understanding of the population dynamics of Boreal Owls to various changes in forest dynamics is a critical step.

In the U.S., management of Boreal Owls come an important national Forest Regions Forest which represents south of Canada have as a "sensitive species." The Forest System, sensitive species whose population varies by a Regional Forest require special management underway to develop management for Boreal Owls (J. Friedlander 1993).

Unfortunately, the development of a sound management plan (Hayward 1994a). To address the ecological basis of the problem (Bondrup-Nielsen 1978, al. 1992, Hayward et al. 1993) investigations represent ecological questions, to directly address forest management for all extended for 4 yr sufficient to address forest management or the

need thermal cover.

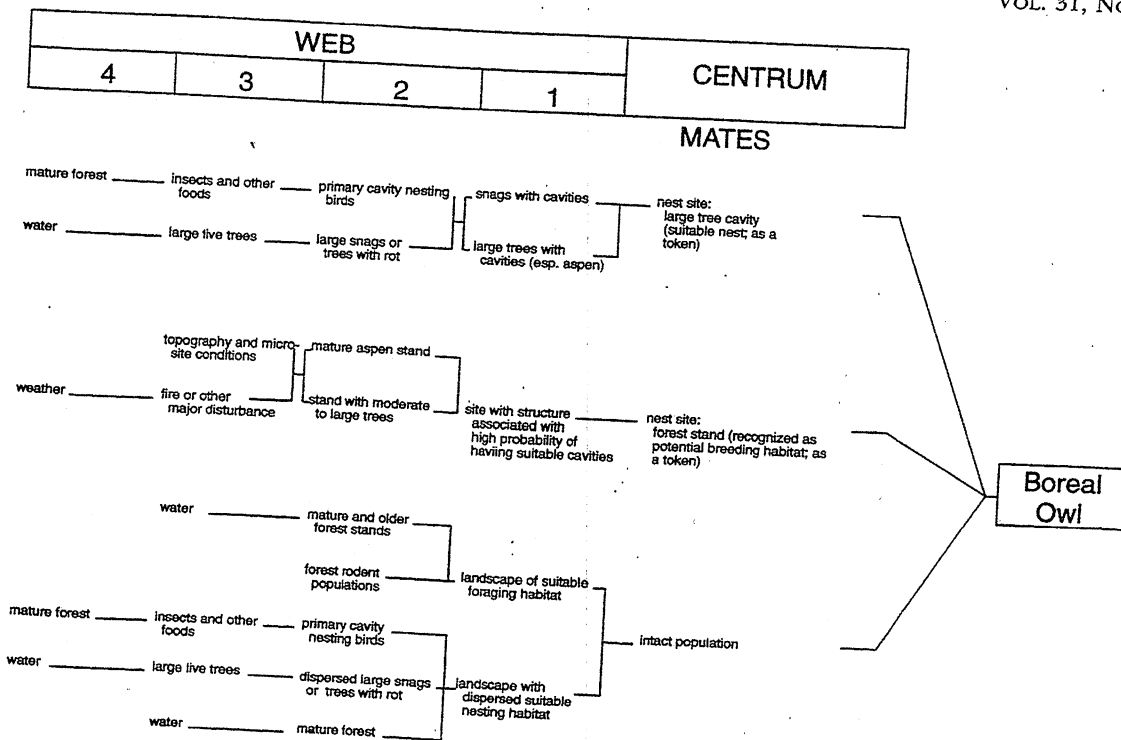


Figure 1. Envirogram (Andrewartha and Birch 1984) illustrating the relationship between Boreal Owls and specific components of the forest system. This portion of a larger envirogram (Hayward 1994b) focuses on Boreal Owl nesting ecology.

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.

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 tempera-

tures 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

in mature forests facilitates movement of Boreal Owls during critical winter months (Sonerud et al. 1986). Significant movement of Boreal Owls during warm winter months became severe.

An envirogram further illustrates the relationship between Boreal Owl foraging and features of the forest system. The envirogram illustrates the relationship between Boreal Owl fitness and abundance and features of the forest system. *Vaccinium* ground cover is influenced by various forest features.

The evidence regarding roosting and foraging at a fine scale, Boreal Owl habitat characteristics of mature forests suggests that level of stands will likely influence Boreal Owls.

Landscape Scale Habitat. Patterns of Boreal Owl landscape patterns is not unique. Indirect evidence from America suggests that among forest habitats, observations of owls in landscapes dominated by those with mature spruce larch (*Larix sp.*), *Picea deroosa* or aspen (*Populus*) the greatest abundance (1992, 1993). In other forests that generally support Boreal Owls, Boreal Owl density and abundance in mature spruce-fir habitat.

More direct evidence suggests that landscape features influence Boreal Owl density and abundance. A portion of Scotch pine forest increased and the proportion of *Picea abies* and *Picea canadensis* quality of territories (Koski et al. 1993) increased (Koski et al. 1993). The proportion of territories with suitable habitat was corroborated by frequency and clutch size.

Regional Scale Habitat. Broad geographic scale patterns of Boreal Owls may also be influenced by landscape features.

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