

during the early evening hours (1900-2400). Use of broadcast calls as described for great horned owls applies following the specific nesting chronology and within suitable habitat for barred owls.

Flammulated Owl (*Otus flammeolus*)

The flammulated owl nests locally from southern British Columbia through the interior mountains of western United States into Mexico. This species has not been reported west to the Pacific coast ranges (McCallum 1994). Thought to be migratory, though lacking data from marked birds, the flammulated owl has been observed in the winter in Mexico south to Guatemala and El Salvador (Winter 1974, Johnsgard 1988). The species is associated with mid-elevational open ponderosa pine, Douglas fir, and successional aspen forests (Reynolds and Linkart 1987a). The population status of this species is not well understood, in part because it is highly nocturnal, a cavity nester and migratory (Marcot and Hill 1980). It has more recently been described as an abundant raptor species in some areas (McCallum 1994). It is listed as a sensitive species in Idaho by the U. S. Forest Service, and a species of special concern by Idaho Department of Fish and Game.

Local Occurrence

We have found this species within the study area in Douglas-fir/aspen communities along the South Fork just outside of our immediate sample areas. We have documented nesting season use of one BLM area from 1992-1994. We expect flammulated owls to nest in mixed forests that feature Douglas fir and aspen on relatively dry, foothill areas. Habitat suitable for flammulated owls occurs around the fringes of the study area on BLM holdings and the lower edge of the national forest.

Reproductive Biology

Singing birds have been documented on

summer habitat by late April and early May (Reynolds and Linkhart 1987b, Cannings and Cannings 1982, Bull et al. 1992). Flammulated owls initiate incubation in the western Rockies from May through June (Bent 1938, Bull and Anderson 1978, Reynolds and Linkhart 1987a, McCallum 1994). In 1992-94, we have heard singing flammulated owls, presumably courting males, throughout June (unpaired males have been heard singing) (Goggan 1986, Reynolds and Linkhart 1987b). Clutches average 2-4 eggs. Flammulated owls incubate for approximately 22-25 days, mid-June to early July (Goggans 1986, Reynolds and Linkhart 1987a), and the young fledge about 25-32 nights after hatching (Goggans 1986, Reynolds and Linkart 1987a). The young are fed by the adults for another 35-40 nights after fledging, and then begin to disperse from their natal areas in mid- to late August. The adults likely depart from the region by mid-October (Reynolds and Linkhart 1987a). Flammulated owls have been described as having low reproductive rates (McCallum 1994). To date, we have not found any flammulated owl nesting cavities.

Ecology and Habitat Relationships

This species is a secondary cavity nester using cavities excavated by pileated and other large woodpeckers, northern flickers and sapsucker (Bull et al. 1990) and natural holes in snags in aspen or conifers. Most evidence points to the flammulated owl as primarily preying on invertebrates, particularly lepidoptera (butterflies and moths), orthoptera (grasshoppers), and coleoptera (beetles) during the summer months. During the cold temperature periods of spring, noctuid moths are seen as the only available food source to flammulated owls (Reynolds and Linkhart 1987a). Flammulated owls favor old ponderosa pine and Douglas-fir forest and south facing slopes, ridges and plateaus (Marcot and Hill 1980, Goggan 1986, Bull and Anderson 1987, Howie and Ritcey 1987, Reynolds and Linkhart 1987a, Bull et al. 1990). This preference is thought to be linked to prey availability as dry site Dou-

glas-fir and pine have an abundance of lepidoptera (Reynolds and Linkhart 1992). The open-stem nature of these sites is thought to enhance foraging, which is performed by aerial insect hawking and needle gleaning (Linkhart 1984). Goggan (1986) also identified foraging along forest edge grass areas. Summer roosts have been located in dense mixed conifer forests and regeneration stands which often have dense, sprawling forms (Goggan 1986, Howie and Ritcey 1987). Population densities, in general, do not exceed 1 territory per 40 ha (McCallum 1994). Post incubation and pre-fledging home ranges have been estimated at 10 to 14 ha, respectively (Goggans 1986, Reynolds and Linkhart 1987a). Flammulated owls have been referred to as "loosely colonial"; this behavior is disputed and unsubstantiated by actual nest location data (McCallum 1994).

Detection Methods

Flammulated owls are surveyed by ground and the use of conspecific territorial adult calls. Since flammulated owls are thought to be neotropical migrants, surveys are initiated upon their arrival in approximately late April. Detection of breeding flammulated owls starts with broadcasting the territorial vocalization of adult territorial males from early May through June and possibly to the end of July (Reynolds and Linkart 1984, USDA 1993). Broadcast calls should be played from 1/2 hour before dusk and into the night for about 3 hours. Broadcast calling is valuable in determining presence of species. Absence is much more difficult to determine and should not be inferred from survey data until at least 3 years of systematic surveying has been conducted within the same area. Since non-breeding males may respond more than nesting, territorial males, breeding status of responding owls cannot be determined without follow-up ground surveys for nests or young owlets (Reynold and Linkart 1984, Hayward 1989). The chances of locating nests can be enhanced by listening for the food solicitation (begging) call of

the female and response call of the male, since both are generally found within the vicinity of nests prior to egg laying.

Nests searches are performed as a follow-up to surveys that detect calling flammulated owls. All song-trees from which calling flammulated owls are heard should be marked and mapped. Triangulation of points and multiple vocalizing owls will help pinpoint each location. Upon returning to these marked song-trees, cavities with entrances greater than 4 cm in diameter are located. Occupancy of a cavity is determined with 10-15 minute observations during the first three hours after dusk. Look for approaching males as they bring food to a vocalizing female. Young owlets close to fledging age can be quite vocal and detection of their food begging calls can direct an observer to the adults. The nest may also be located as young owls stayed within 100 m of their nest upon first fledging (Reynolds and Linkart 1984). Young owlets will continue to move out from the nest site as time passes. The rate of movement is thought to be dependent upon availability of food resources and is thus not determinant.

Flammulated owls have low, soft calls and therefore broadcast calls should be used only on still nights when there is no precipitation, wind or other sound (automobiles, barking dogs or coyotes). Calling stations should be placed 600-800 m (.5 miles) apart and no closer than 400 m (.25 miles), even in broken topography. Territory boundaries have been located along ridge tops and thus survey routes can be placed along similar features. Placing calling routes along ridge tops may increase the projection of the vocalization to both owls and surveyor, ease travel, and may expose the surveyor to more than one territory.

Over-estimation of owl numbers can occur should a vocal owl follow the observer and his tape player along the transect. If using broadcast vocalization tapes to determine habitat relationships, one must be aware that vocalization tapes may pull an individual owl out of its territory and preferred habitat.

Northern Saw-Whet Owl (*Aegolius acadicus*)

The northern saw-whet owl is endemic to North America (Holt et al. 1991). The northern saw-whet owl is found across southeastern and central Canada, into the United States from the northeastern states, Great Lake states to the western states and into southeastern Alaska (Johnsgard 1988). Saw-whets use low elevation riparian habitats which are dominated by deciduous forests as well as high elevation coniferous forests into the spruce-fir zone (Cannings 1987, Palmer 1986). As with other small, mostly nocturnal, cavity nesting owls there is a notable lack of information on the population status of this species. The northern saw-whet owl is not listed as a species of concern.

Local Occurrence

We expect saw-whet owls to nest in riparian deciduous forests in cottonwood and aspen along major stream corridors and in mixed spruce-fir and Douglas-fir communities around the foothills. Saw-whets have been heard in the study area within cottonwood and Douglas-fir habitat types between 5,400 and 6,000 feet in elevation. Many of our sample areas have potential nesting habitat, though we detected northern saw-whet owls in only two sample sections.

Reproductive Biology

The northern saw-whet owl nests in cavities excavated by northern flickers, hairy woodpeckers, man-made boxes and natural cavities. These owls often nest in aspen or cottonwoods. We have extrapolated data from studies performed in other regions to arrive at the following nesting phenology (Cannings 1987, Palmer 1986, Marks et al. 1989). Nesting activities, including egg laying, may start as early as March in our area. Annual climatic conditions can cause some variation in the exact dates of egg laying. Second clutches may be laid as late as mid-May (Cannings 1987). Clutch sizes range

from 4-7 eggs per nest with 5 eggs being the average. Hatching is asynchronous with incubation starting after the laying of the second egg and lasting 27-29 days (early to mid-April in our area). The nestling period lasts from 29-36 days or until late May to early June. The brood is provided food during the incubation and nestling period by the attending male (Marks et al. 1989).

Ecology and Habitat Relationships

Second to the great horned owl, the northern saw-whet is expected to be the most common owl in the study area. Its habitats include low elevation deciduous forests to higher elevation (>7200') coniferous forests. Nesting owls are expected in aspen, cottonwood, Douglas-fir and lodgepole pine stands. The saw-whet owl is a secondary cavity nesting species, utilizing natural, excavated and man-made cavities. Home ranges have been documented at 142-159 ha (Cannings 1987) (these measurements come from a study utilizing nest boxes). Based upon calling owls, a maximum density of 1 pair per 40 acres has been documented (Swengel and Swengel 1987). The northern saw-whet owl is tightly associated with small mammalian prey. Numerous studies identify deer mice as a dominant prey item in the diet of non-nesting saw-whets, followed by voles (*Microtus* sp.), shrew (*Blarina* and *Sorex* sp.) (Holt et al. 1991, Marks et al. 1989, Swengel and Swengel 1987). Marks and Dormeus (1988) found mice to be the most numerous prey item (by number) used by breeding northern saw-whets. However, meadow voles provided the greatest biomass. Small birds such as pine siskins and sparrows and invertebrates are less important saw-whet prey.

Detection Methods

Broadcast vocalizations of territorial adults and food-begging juveniles are used to survey for the presence and reproductive status of saw-whet owls. The method is as described for flammulated owls with modification to the spe-

cific habitat and nesting chronology of sawwhet owls (Appendix A, Table 3). The cavity nests are located using the same technique also described for flammulated owls. As a general rule, territorial calling ends around the end of April with some annual exceptions. Wind and precipitation can restrict calling activity (Palmer 1987).

Boreal Owl (*Aegolius funereus*)

Boreal owls range across the boreal forest zone of North America from the Pacific to the Atlantic coast through Canada and United States. In the U.S., the boreal is known to occur from Alaska across to the extreme northern tier states. Only recently has the boreal owl been documented as breeding in Washington, Idaho, Montana, Wyoming, Colorado and New Mexico (Hayward and Garton 1983, Palmer and Ryder 1984, Hayward et al. 1987, Whelton 1989, Stahlecker and Rawinski 1990). Boreal owls may be found further south in winter after going through eruptive movements in response to prey availability. They generally, however, winter within their breeding range. Due to the birds mostly nocturnal nature and use of inaccessible habitats, its population status is poorly known. The boreal owl is listed as a sensitive species by the Forest Service and BLM and a species of special concern by the Idaho Department of Fish and Game.

Local Occurrence

Boreal owls have not been detected in the study area, which may be lower than their normal elevational range of over 7500 feet. Potential boreal owl habitat is thought to occur above the river corridor in the high elevation conifer forest. The closest known occurrence of boreal owls to the study area is approximately 5 miles north of the Snake River corridor towards Teton Basin.

Reproductive Biology

Territorial singing males can be heard as early as mid-February in our area. Depending

upon the particular year, they may continue singing until pair formation has occurred or when nesting is no longer feasible (Bondrup-Nielsen 1984). Unpaired males may continue singing late into the nesting season. Courtship flights and mate-feeding may occur in the nesting territory 1-3 months prior to nesting. Nest site occupancy ranged from 13-30, April in Central Idaho (Hayward 1989). Extrapolation of data from Colorado and Central Idaho suggests egg laying could occur between early April to mid-May (Hayward 1994). Incubation lasts approximately 29 days. Dramatic variations in clutch sizes occur between geographic areas and years. These variations are attributed to fluctuating annual prey populations. In Idaho, Hayward (1983), documented a range of 2.5 to 3.5 eggs per nest. The nestling period lasts 28-36 days. Young owlets are independent of the adults after another 5-6 weeks. The mean number of young fledged in the Central Idaho study area was 2.3 young. Studies on European boreal owl populations have documented the mean number of young fledged at 3.4 to 3.9 per successful nest. Boreal owls are mostly monogamous through the duration of the nesting season. Polygamy occurs in European boreal owl populations when vole populations are high. Prey populations are thought to effect the first age of breeding, clutch size, fledging success, seasonal dispersal and nomadic movements.

Ecology and Habitat Relationships

Habitats used for nesting include aspen intermixed with conifer (Eckert and Savaloja 1979), and mature and late successional conifer subalpine-fir forest type (Hayward et al. 1993) including spruce, Douglas-fir, subalpine fir, western hemlock and lodgepole pine forests. Boreal owls are secondary cavity nesters. They utilize the cavities excavated by northern flickers and pileated woodpeckers. Nests are generally located in large diameter trees (\times dbh = 33-112 cm) or snags (Hayward 1994). Nest cavities are thought to be a limiting factor in some ranges

(Hayward 1994). Hayward found boreal owls nesting at the lower elevation of a territory in aspen/conifer areas where cavities are more likely to occur and roosting and foraging in higher elevation subalpine fir forests. Roosting sites do change between winter and summer seasons (Hayward 1994). Artificial nest boxes have been used by boreal owls. Nest boxes have been used to gather demographic and life history information on certain boreal populations.

Boreal owls mostly hunt at night using a sit and pounce strategy as opposed to a chase pursuit. Small mammals make up the majority of their diet including red-backed voles, microtines, northern bog lemmings, deer mice, shrews, flying squirrels, and northern pocket gophers. Small birds such as robins, mountain chickadees, kinglets and redpolls may also be taken (Palmer 1986, Hayward and Garton 1988). Prey taken varies with seasonal and annual availability.

Home ranges of boreal owls in Colorado have been documented at 1,395 to 1,576 ha (Palmer 1986). Considered minimums, boreal home ranges are documented at 1,451 ha in the winter and 1,182 ha in the summer (Hayward et al. 1993). There are no accurate population densities of boreal owls in North America. Territorial singing by males and other behaviors are thought to be confined to within a 100 m radius of the nest cavity and within the courtship and breeding period (January to July) (Hayward 1994).

Detection Methods

The use of broadcast territorial calls of the adult male have been successfully used to determine presence of boreal owls. The same technique described for flammulated owls applies. The courtship period is thought to end at approximately the time that nighttime temperatures remain above 0 degrees centigrade. Boreal calling starts by mid-January and can continue until the end of June (Palmer 1987) (Appendix A, Table 3). The combination of precipitation and wind can restrict calling activity (Palmer 1987). In the Island Park area of southeast Idaho, we

detected juvenile food-begging calls as late as early August.

Nest boxes have been used to collect information on the population demographics of boreal owls (Hayward et al. 1992). Hayward concluded that: 1) long term monitoring of nest boxes must be established before owl demography can be related to habitat changes; 2) the relationship between a larger owl population and those using nest boxes must be examined before trends can be inferred; and 3) the use of nest boxes is expensive and intensive but it does produce relatively precise estimates of occupancy and productivity when nest box occupancy exceeds 65%.

Northern Pygmy-Owl (*Glacidium gnoma*)

Residents of western North America, the northern pygmy owl distribution extends from southeastern Alaska west into British Columbia south to western Mexico and Guatemala. The northern pygmy owl is a resident of forested habitat from the foothills to higher elevations (Reynolds et al. 1989). These owls are not thought to be migratory though they may undergo an elevational shift in habitat between summer and winter. The European pygmy owl (*Glacidium passerinum*) has also shown irruptive movements in Fenno-Scandia (Mikkola 1983). The diminutive size of this species and its nocturnal habitats have resulted in few nests being found and thus little information on this species exists (Holt and Norton 1986). The northern pygmy is probably more commonly seen during winter months when it frequents more urbanized areas in search of prey at bird feeders. Little is known about the nesting habitat, territories or population trends of this small owl.

Local Occurrence

The northern pygmy owl occurs in the study area. We heard a singing male at a Douglas-fir/cottonwood interface within the South Fork canyon in 1992 outside of our selected sample areas. B. Alford (pers. comm.) reported a