

BIOLOGY AND DISTRIBUTION OF THE NORTHERN SPOTTED OWL

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INTRODUCTION

The Northern Spotted Owl (*Strix occidentalis caurina*) is one of three subspecies of the Spotted Owl inhabiting western North America (Gutiérrez et al. 1995). The taxonomic separation of these subspecies is supported by genetic (Barrowclough and Gutiérrez 1990, G. Barrowclough, personal communication), morphological (Gutiérrez et al. 1995), and biogeographic information (Barrowclough and Gutiérrez 1990).

The purpose of this chapter is to provide a synopsis of relevant biology of the Northern Spotted Owl particularly with respect to its distribution, habitat use, and life history characteristics. Other literature reviews of Spotted Owl biology that are particularly comprehensive include Campbell et al. (1984), Gutiérrez (1985), Gutiérrez and Carey (1985), Thomas et al. (1990), Verner et al. (1992), and Gutiérrez et al. (1995).

PHYSICAL DESCRIPTION

The Spotted Owl is a medium-sized owl, about 46–48 cm in length and weighs approximately 490–850 g (Dawson 1923, Hamer et al. 1994, Gutiérrez et al. 1995). The Northern Spotted Owl is the largest of the three subspecies (Gutiérrez et al. 1995). It is dark brown with a barred tail and white spots on the head and breast, and has dark brown eyes that are surrounded by prominent facial disks (Bent 1938, Gutiérrez et al. 1995). Three age classes can be distinguished on the basis of plumage characteristics (Forsman 1981, Moen et al. 1991).

The Spotted Owl superficially resembles the Barred Owl (*Strix varia*), a species with which it occasionally hybridizes. Hybrids exhibit characteristics of both species (Hamer et al. 1994).

DISTRIBUTION

GEOGRAPHIC RANGE

The Northern Spotted Owl occurs in the mountains of northwestern California (from Marin Co. north), western Oregon, western Washington, and southwestern British Columbia. The eastern edge of its range generally corresponds with the eastern periphery of the Cascades Range, and with the Central Valley in California (Bent 1938, Gutiérrez et al. 1995).

REGIONAL DISTRIBUTION

The distribution of the Northern Spotted Owl within its known range is relatively contiguous, but is influenced by the natural insularity of habitat patches within geographic provinces, and by natural and man-caused fragmentation of vegetation within and among geographic provinces. For example, few Spotted Owls occur in the western Washington Lowlands where nearly all old forests have been logged and replaced with young forests (USDI 1992a, Gutiérrez 1994a). As a result of the natural and man-caused fragmentation of habitat, Spotted Owls may exhibit a metapopulation structure in some parts of their range (Gutiérrez and Harrison *in press*).

BEHAVIOR

Spotted Owls are territorial. However, the fact that home ranges of adjacent pairs overlap (Forsman et al. 1984, Solis and Gutiérrez 1990) suggests that the area defended is smaller than the areas used for foraging. Territorial defense is primarily effected by hooting calls, barking calls, and/or shrill whistles (Forsman et al. 1984, Fitton 1991). Because they respond readily to imitations of their calls, Spotted Owls are relatively easy to locate (Forsman 1983, Franklin et al. *this volume*).

Northern Spotted Owls are monogamous and usually form long-term pair bonds. "Divorces" occur but are relatively uncommon. There are no known examples of polygyny in this owl, although associations of 3 or more birds have been reported (Forsman et al. 1984, Gutiérrez et al. 1995). Males and females divide nesting duties, with the male providing food to nesting females. The female does all of the incubating and brooding of owlets (Forsman 1976).

Median home range sizes of Northern Spotted Owls range from 5.7–40.2 km² for owl pairs and 3.4–38.2 km² for individual owls (see summary in Gutiérrez et al. 1995). Home range size appears to be correlated with the amount of habitat fragmentation, suitable habitat, and/or primary prey (Carey et al. 1992, Zabel et al. 1995). Spotted Owls maintain smaller home ranges during the breeding season and often dramatically increase their home range size during fall and winter (Forsman 1980, Forsman et al. 1984, Sisco 1990).

HABITAT RELATIONSHIPS

HABITAT USE

Northern Spotted Owls have been detected in many different forest habitats. Forsman et al. (1984) reported owls from the following forest types: Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), white fir (*A. concolor*), ponderosa pine (*Pinus ponderosa*), and Shasta red fir (*A. magnifica shastensis*). Owls also have been recorded using redwood (*Sequoia sempervirens*), western red cedar (*Thuja plicata*), mixed conifer-hardwood (Klamath montane), and mixed evergreen forest (Grinnell and Miller 1944, Forsman et al. 1984, LaHaye 1988, Solis and Gutiérrez 1990, Folliard 1993). In essence, most low and mid-elevation conifer or conifer/hardwood forest types within the subspecies' range have been used by the owl if they have the appropriate structure (see below). Some owls have used pure hardwood stands in the southern part of the range if a perennial water source was present.

In California, owls are found from near sea level in coastal forests to a little over 2130 m in the Cascades. The upper elevational limits at which Spotted Owls occur decrease gradually with increasing latitude in Oregon and Washington. In northern Washington and southern British Columbia, few owls occur above 1500 m elevation. In all areas, the upper elevation limits at which owls occur correspond to the transition to subalpine forest, which is characterized by relatively simple structure and severe winter weather.

HABITAT SELECTION

Studies of habitat use indicate that Northern Spotted Owls generally select mature and old-growth forest equal to or more than expected, and early seral stage forest less than expected (Forsman 1980, Forsman et al. 1984, Solis and Gutiérrez 1990, Sisco 1990, Carey et al. 1990, 1992). Individual owls may show variation in the general pattern, with some owls using intermediate-aged stands (50–100 yrs old) in proportion to, or more than, expected. Several landscape level studies indicate that Northern Spotted Owls select habitats that have a significantly higher proportion of mature/old-growth forests around nests and roosts than is randomly available (Ripple et al. 1991, Lemkuhl and Raphael 1993, Hunter et al. 1995).

Ward (1990) found that Spotted Owls foraged in areas that had lower variance in prey densities (prey were more predictable in occurrence) within older forest and near ecotones of old forest and younger brush seral stages. Presumably owls foraging in edge areas might encounter prey that

ventured into the older forest. Carey et al. (1992) and Carey and Peeler (1995) found that owls occupying fragmented landscapes had larger home ranges. When prey communities were dominated by flying squirrels (*Glaucomys sabrinus*), Spotted Owls apparently depleted some local flying squirrel populations (Carey et al. 1992). Carey et al. (1992) suggested that Spotted Owls not only have to forage within many patches but must also "monitor" prey recovery within depleted patches to efficiently use their home ranges. Finally, Zabel et al. (1995) showed that Northern Spotted Owl home ranges are larger where flying squirrels are the predominant prey and, conversely, are smaller where woodrats (*Neotoma* spp.) are the predominant prey.

Habitat structure

Spotted Owls select roosts that have more complex vegetation structure than forests generally available to them (Forsman 1976, Barrows and Barrows 1978, Forsman 1980, Solis 1983, Forsman et al. 1984, Chavez-Léon 1989, Sisco 1990, Solis and Gutiérrez 1990). These habitats are usually multi-layered forests having high canopy closure and large diameter trees in the overstory. In northwestern California, roosts usually are found on the lower third of slopes near streams (Blakesley et al. 1992). Complex vegetation or association with streams may facilitate thermoregulation by maintaining lower ambient stand temperature and providing a variety of perch sites which may allow owls to select cooler microclimates (Forsman 1976, Barrows and Barrows 1978, Barrows 1981, Solis 1983, Forsman et al. 1984).

Northern Spotted Owls nest almost exclusively in trees. Like roosts, nest sites are found in forests having complex structure dominated by large diameter trees (Forsman et al. 1984, LaHaye 1988). Even in forests that have been previously logged, owls select forests having a structure (i.e., larger trees, greater canopy closure) different than forests generally available to them (Folliard 1993, Buchanan et al. 1995). Nests are usually platforms (e.g., old raptor nests, debris accumulations), or cavities in large trees. The proportion of nest types used apparently is related to availability; platforms comprise a higher proportion of nests in disturbed or young forests, whereas nests in tree cavities tend to predominate in old forests (Forsman et al. 1984, LaHaye 1988, Buchanan et al. 1993, Folliard 1993).

Foraging habitat is the most variable of all habitats used by territorial owls (Thomas et al. 1990). Yet foraging habitat is still characterized by the complex structure found at nest and roost sites (Solis and Gutiérrez 1990). Owls will forage in forests with lower canopy closure and smaller

trees than forests containing nests or roosts. Habitat structure at Spotted Owl nest sites found in disturbed (i.e., managed) forests is similar to habitat structure found at both foraging and nesting sites in unmanaged (i.e., unlogged forests) (Bart and Earnst 1992, Folliard 1993).

FORAGING BEHAVIOR AND FOOD HABITS

Northern Spotted Owls are perch and pounce predators (Forsman 1976). They are primarily nocturnal hunters but will opportunistically take prey during daylight hours (Laymon 1988, Sovern et al. 1994). On the basis of radio-telemetry observations and prey sampling, Carey and Peeler (1995) suggested that Northern Spotted Owls fit the description of central place foragers.

Spotted Owls eat a variety of prey, the majority of which is small and medium-sized small mammals (Marshall 1942, Forsman 1976, Barrows 1980, Solis 1983, Forsman et al. 1984, Barrows 1987, Carey et al. 1990, Thomas et al. 1990, Ward 1990). Two species dominate the diet: flying squirrels and woodrats. Flying squirrels comprise the bulk of the diet in the northern part of the subspecies' range and woodrats are the dominant prey in the southern part of the range. In addition to mammals, Spotted Owls eat birds, insects, reptiles and amphibians (Solis 1983, Forsman et al. 1984, Thomas et al. 1990).

Barrows (1985, 1987) suggested that nesting pairs of Northern Spotted Owls take more large prey (e.g., woodrats) than non-nesting pairs. However, Ward (1990) did not observe this relationship.

LIFE HISTORY CHARACTERISTICS

FECUNDITY

Although Spotted Owls occasionally breed at 1 year of age, most do not breed until they are ≥ 2 years old (Miller et al. 1985). Reproduction by Spotted Owls varies greatly among years, with most pairs breeding in good years, and few pairs breeding in poor years (Forsman et al. 1984, Gutiérrez et al. 1995). Annual variation in breeding may be related to weather conditions and fluctuations in prey abundance (e.g., see Zabel et al. *this volume*).

In years when they nest, Spotted Owls raise only one brood. They will on rare occasion renest if a first nest fails (Lewis and Wales 1993, Kroel and Zwank 1992, Forsman et al. *in press*). Most clutches are one or two eggs. In good years some owls raise three young. Although there are three records where California or Mexican Spotted Owls produced broods of four young (see Gutiérrez et al. 1995), Northern Spotted Owls have never been observed to produce more than three

young. The small clutch size, temporal variability in nesting success, and somewhat delayed maturation all contribute to the low fecundity of this species.

Spotted Owl pairs begin courtship activities in late February or March (Forsman 1976, Forsman et al. 1984). Early nesters may lay eggs in March, but the majority of egg laying occurs in April. Nesting phenology apparently is delayed slightly at higher elevations (Forsman et al. 1984), but it is relatively synchronous over the entire range of the subspecies. Most eggs hatch in late April or May, and the majority of young fledge in June. Owlets leave the nest when they are still weak fliers and remain dependent on their parents until late summer or early fall. Once the young disperse, pair members roost together less frequently and begin winter home range expansion (Forsman 1980, Forsman et al. 1984, Sisco 1990).

Some Spotted Owls are not territorial but either remain as residents within the territory of a pair or move among territories. These birds are referred to as "floaters." Floaters have special significance in Spotted Owl populations because they may buffer the territorial population from decline (Franklin 1992). Little is known about floaters other than that they exist. Since they are non-territorial they typically do not respond to hooting as vigorously as territorial birds.

DISPERSAL

Dispersal of juvenile Spotted Owls is obligatory. Dispersal begins in early September (rarely August) and continues into October (Gutiérrez et al. 1985, Miller 1989). The secondary sex ratio (fledged juveniles) estimated by examination of chromosomes is probably 50:50 (see Gutiérrez et al. 1995).

Initial dispersal appears to be in a random direction. However, individual birds once having left their natal territory may have strong, oriented movements (Gutiérrez et al. 1985). Individual dispersal movements can be rapid, and the birds will cross small areas of unsuitable habitat (e.g., grasslands). Some birds may exhibit philopatry but this is rare. Dispersing juveniles may establish a stable first year winter range only to continue dispersal the following spring (Miller 1989).

Primary causes of mortality in both juvenile and adult Spotted Owls are starvation and predation. Predation is most frequently caused by Great Horned Owls (*Bubo virginianus*) and Goshawks (*Accipiter gentilis*) (Forsman et al. 1984, Gutiérrez et al. 1985, Miller 1989). Arboreal hunting mustelids may also prey on eggs, and perhaps females (Gutiérrez et al. 1995). Accidents (e.g., collisions with automobiles or tree

limbs) also account for some mortality (Gutiérrez et al. 1985).

Carey et al. (1992) demonstrated that owls occupying areas with more fragmented habitat had larger home ranges than owls found in more contiguous habitat. They hypothesized that these owls would incur a greater energetic cost in hunting a larger home range. A higher energetic cost could negatively affect either reproduction or survival.

The Barred Owl, which is gradually invading the range of the Spotted Owl, may compete with Spotted Owls for space and food (Hamer 1988), thereby reducing survival of Spotted Owls. Although relationships between Barred Owls and Spotted Owls are poorly documented, there is evidence that Barred Owls may, in some cases, usurp the territories of Spotted Owls (Hamer 1988).

SUMMARY

The Northern Spotted Owl is widespread in the Pacific Northwest, occurring in most forested portions of physiographic provinces within its range. It is strictly a forest dwelling species rarely venturing into open habitat unless it is dispersing. Structural features of forests used for roosting, nesting, and foraging are similar. All of these habitats have diverse vegetation structure. However, a broader range of habitats are used for foraging than are used for nesting and roosting.

Key words: behavior, diet, distribution, habitat use, home range, nesting, Northern Spotted Owl, populations, *Strix occidentalis caurina*, reproduction.

In addition, both disturbed (e.g., those previously logged or burned) and undisturbed (usually mature/old-growth conifer forests) habitats used by owls show strong structural similarity. In general, Spotted Owls select habitats with large trees and more complex structure than is available to them at a particular locality.

Northern Spotted Owls are monogamous breeders with low fecundity and high survival rates. They are territorial and tend to form long-term pair bonds. Breeding occurs irregularly.

Because of their specificity for certain kinds of habitat, low fecundity, long life span, and apparent negative response to fragmentation and habitat loss (Forsman et al. 1984, Forsman et al. 1988, Carey et al. 1992, Johnson 1992), it should not be surprising that this subspecies was a candidate for population decline following extensive habitat disturbance (Thomas et al. 1990, USDI 1990, 1992). The forests that the owl inhabits also contain extremely valuable timber (Simberloff 1987). This combination of factors has led to the Northern Spotted Owl being one of the most extensively and intensively studied birds in the world.

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