

# SPOTTED OWL

## *Strix occidentalis*

Original by Ian Blackburn and  
Stephen Godwin

## Species Information

### Taxonomy

Three subspecies are recognized: Mexican Spotted Owl (*Strix occidentalis lucida*), California Spotted Owl (*S. occidentalis occidentalis*), and Northern Spotted Owl (*S. occidentalis caurina*) (Dawson et al. 1986; Wilcove 1987). Starch-gel electrophoresis was unable to detect variation between *S. occidentalis occidentalis* and *S. occidentalis caurina*; however, *S. occidentalis lucida* did show variation, suggesting the possibility of two distinct species (Barrowclough and Gutierrez 1990). In addition, two separate evolutionary histories have been demonstrated by the major allelic frequency difference between *occidentalis/caurina* and *lucida* (Barrowclough and Gutierrez 1990).

### Description

The Spotted Owl is considered a medium-sized owl with an average height of about 45 cm, and average wingspan of about 90 cm. The plumage consists largely of dark brown body feathers with a regular pattern of round to elliptical white spots, white horizontal bars on the chest and tail, large dark brown eyes surrounded by tawny facial disk, and no ear tufts. Male and female Spotted Owls have similar plumage. Females may be distinguished by their comparatively larger body size (females:  $n = 65$ , mean = 663 g, SD = 42.8 g; males:  $n = 68$ , mean = 579 g, SD = 34.9 g; Blakesley et al. 1990), and higher pitch of their vocalization (Forsman et al. 1984).

## Distribution

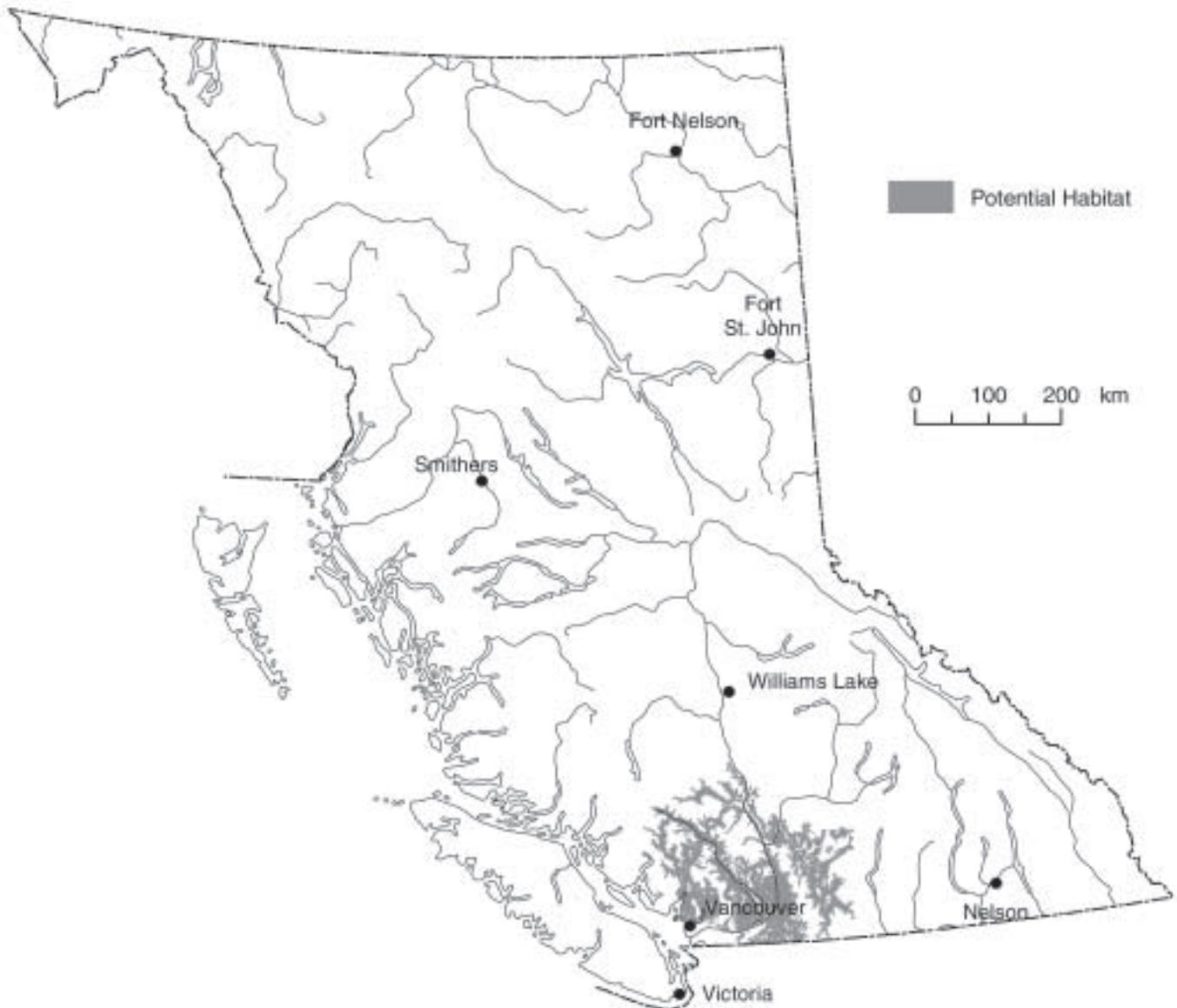
### Global

The Spotted Owl occurs from southern British Columbia south to central Mexico. The Mexican Spotted Owl ranges from southern Utah and central Colorado, south through the mountainous regions of Arizona and New Mexico; Guadalupe Mountains of western Texas; mountains of northern and Central Mexico south to Michoacan and Guanajuato. The California Spotted Owl ranges from southeastern Shasta County, south through the Sierra Nevada to Kern County, through the Coast Ranges from Monterey County to San Diego County to northern Baja California (Sierra San Pedro Martir). The Northern Spotted Owl ranges from southwestern mainland British Columbia, western Washington, western Oregon, to northwestern California.

### British Columbia

Based on historic (pre-1985,  $n=28$ ) and recent ( $n = 65$ ) records, the current known range of the Spotted Owl in British Columbia extends from the international border north about 200 km to Carpenter Lake, and from Howe Sound and Pemberton east about 160 km to the slopes of the Cascade Mountain range (MWLAP 2003). There are unconfirmed historic records occurring as far northwest as Bute Inlet in the Sunshine Coast Forest District (Laing 1942). Although the Spotted Owl occurred historically in the lowlands of the lower Fraser River Valley, the species is thought to be extirpated from this area as a result of the extensive loss of old forests due to urbanization, agriculture, and forestry. Despite relatively recent historic records, survey efforts conducted between 1992 and 1997 in the Squamish and Whistler corridor were

## Spotted Owl (*Strix occidentalis*)



Note: This map represents a broad view of the distribution of potential habitat used by this species. The map is based on several classifications (Forest Cover Data and Biogeoclimatic) as well as current knowledge of the species' habitat preferences. This species may or may not occur in all areas indicated. More detailed maps are available for this species from the Ministry of Sustainable Resource Management.

unsuccessful at detecting Spotted Owls, suggesting that the species may have become locally extirpated in this area. The full extent of the range of Spotted Owls in British Columbia is still unknown. Inventories are still required to assess the western, northern, and eastern extent of the species range.

### **Forest region and districts**

Coast: Chilliwack, Squamish

Southern Interior: Cascades

### **Ecoprovinces and ecoregions**

COM: EPR, NWC, SPR

GED: FRL

SOI: LPR, HOR

### **Biogeoclimatic units**

CWH: dm, ds1, mm1, ms1, ms2, vm1, vm2

ESSF: mw

IDF: dk2, ww

MH: mm1

### **Broad ecosystem units**

AU, AV, CD, CH, CW, DE, DL, EW, FR, IH, MF, RD

### **Elevation**

~0–1370 m

## **Life History**

### **Diet and foraging behaviour**

Spotted Owls are nocturnal and considered a sit and wait predator that moves from perch to perch waiting to detect prey. Spotted Owls primarily prey on small mammals, although they have been known to predate on a broad array of taxa including birds, amphibians and insects (Forsman et al. 1984). The composition of their diet varies among regions and forest types. In general, their diet includes flying squirrels, deer mice, tree voles, woodrats, red-backed voles, and hares. Pellet analysis of Spotted Owls in British Columbia revealed the largest contribution (41.2%) to the owl's diet is Northern Flying Squirrels (*Glaucomys sabrinus*) and bushy-tailed woodrats (*Neotoma cinerea*) (27.8%; Horoupian et al. 2000), which is consistent with other studies throughout the species range (Forsman et al. 1984;

Forsman et al. 2001). Flying squirrels are also nocturnal, and tend to be more abundant in old forests than in young forests; however, their density in old forests is low (Carey et al. 1992). In British Columbia, Ransome (2001) found the density of Flying Squirrels in old forest in the wet coastal ecosystem to be  $1.5 \pm 1.8$  squirrels/ha (range 0.3–2.9) and in second-growth stands to be  $1.0 \pm 1.4$  squirrels/ha (range 0.06–1.8). Although the densities in British Columbia were not significantly different, the results suggest densities of flying squirrels may be higher in old forests. Even a potential 0.5 squirrel/ha more in old forest than second growth could translate to significantly more squirrels within a home range and improve the owls' likelihood of survival and reproduction. Due to this low density of prey, the Spotted Owl requires large amounts of old forest for foraging (Carey et al. 1992).

### **Reproduction**

Spotted Owls are typically monogamous, although evidence suggests a low, but frequent occurrence of separation between pairs (Forsman et al. 2002). In late winter, Spotted Owls begin roosting together near the nest 4–6 weeks prior to egg laying, with copulation generally occurring 2–3 weeks before nesting (Forsman et al. 1984). The average clutch size is two owlets  $\pm$  one owlet. The incubation period is estimated to be approximately 30 days  $\pm$  2 days (Forsman et al. 1984). Females incubate and brood the juveniles while the males provide food for both females and juveniles (Forsman et al. 1984). Most juveniles leave the nest when they are 34–36 days old. Although the mean date when juveniles left the nest varied among years, Forsman et al. (2002) reported mean dates of June  $8 \pm 0.53$  days in Oregon ( $n = 320$  owls, range May 15 to July 1) and June  $18 \pm 1.67$  days in Washington ( $n = 77$ , range May 13 to July 15). Similar to Washington, juveniles at two locations in British Columbia were observed off the nest between June 15 and June 20 (Hobbs 2002); however, juveniles have been observed off the nest in British Columbia as early as on June 7 (D. Dunbar, pers. comm.). The results support Forsman et al. (1984) that nesting typically occurs earlier in southern portions of the species range in

North America. In Washington and Oregon, re-nesting after a nest failure was rare, only occurring 1.4% of the time after an initial failure (Forsman et al. 1995).

In Washington and Oregon, Forsman et al. (2002) reported that 22% of males and 44% of females were paired at 1 year of age; however, only 1.5% of 1-year-old males and 1.6% of 1-year-old females actually bred. Typically, Spotted Owls begin breeding at 3 years of age. Franklin et al. (1999) note that fecundity appears to vary over time with evidence of a bi-annual cycle where by more young fledged in even years than odd years (even/odd effect). The cause of this cyclic pattern is unknown, but may be linked to weather or prey populations (Franklin et al. 1999).

### Site fidelity

Spotted Owls typically have strong fidelity to breeding sites and tend to occupy the same geographic area for long periods of time (Forsman et al. 1984). Forsman et al. (2002) observed a minimum 6% of non-juvenile owls changed territories annually. The frequency of these non-juvenile movements was higher for female owls, younger owls, and owls without a mate or who had lost their mate through death or separation in the previous year. In the Olympic Mountain range in Washington, owl pairs changed nests in 75% of sequential nesting attempts; 40% returned to a nest used previously (Forsman and Giese 1997). The median distance between these alternate nests was 0.52 km (range 0.03–3.35 km;  $n = 92$ ).

### Home range

Home range sizes vary by geographic location, with a general increasing trend from southern to northern portions of the species range (Thomas et al. 1990). For example, home range sizes have been reported as small as 549 ha for a single owl in Oregon (Forsman et al. 1984) and as large as 11 047 ha for a pair of owls in Washington (Hanson et al. 1993). The size of an owl's home range depends on many factors including food availability; interspecific and intra-specific competition; presence of predators; and the

quantity, quality, and dispersion of suitable habitats (USDI 1992). For example, decreasing the density of suitable habitat or prey populations within the landscape may result in an increase in home range size as owls expand their foraging area to find sufficient amounts of habitat with prey.

In Washington, the median annual home range for a pair of owls for the west side and east side of the Cascade Mountain range was estimated at about 3321 ha (range 1302–7258 ha) and 2675 ha (range 1490–6305 ha), respectively, with a total suitable habitat composition of 67% and 71%, respectively (Hanson et al. 1993). In British Columbia, annual home range estimates for 3 pairs of owls in the drier ecosystem ranged from 1732 to 4644 ha, with suitable habitat compositions ranging from 60 to 66% (A. Hilton, pers. comm.). However, these home ranges for British Columbia are likely underestimated due to the small sample size and limited seasonal tracking duration. Annual home range sizes for British Columbia are likely comparable to those in Washington, if not slightly larger.

Forsman et al. (1984) observed an average 68% home range overlap between paired individuals. Despite this overlap, paired individuals used the same locations for foraging only 4–10% of the time, suggesting little competition for food between paired individuals. In contrast, adjacent, non-paired individuals overlap their home ranges by about 12% where both owls tend to spend relatively small portions of their time in the periphery of their home range (Forsman et al. 1984).

### Movements and dispersal

Juveniles are obligate dispersers and typically leave their natal area by September 19 (95% CI, September 17 to 21) in Oregon and September 30 (95% CI, September 25 to October 4) in Washington (Forsman et al. 2002). In British Columbia, the latest date that juveniles owls were observed with their parents was September 28 (2 records; MWLAP 2003), suggesting that the initial date of dispersal is likely similar to Washington. The direction of dispersal appears random; however, it may be influenced by barriers such as high elevation terrain,

large bodies of water, and large open areas of unsuitable habitat (Thomas et al. 1990; Miller et al. 1997; Forsman et al. 2002). Distances between the natal area and where the owls eventually settled ranged from 0.6 to 111.2 km apart; however, the distribution of distances were skewed towards shorter distances (Forsman et al. 2002). Female juveniles typically disperse farther than males, with 50% of female and male juveniles settling within 22.9–24.5 km and 13.5–14.6 km from their natal areas, respectively (Forsman et al. 2002).

## Habitat

### Structural stage

- 6: mature forest
- 7: old forest

### Important habitats and habitat features

#### Nesting

Spotted Owls do not create their owl nest structures, but use a variety of pre-formed structures that includes cavities in the side and top of trees, and platforms constructed by other birds or by natural accumulations of debris (Forsman et al. 1984; Dawson et al. 1986; Buchanan et al. 1993; Forsman and Giese 1997). Nest structures are about 50 cm in diameter, and typically do not differ in size by nest type or geographic region (Forsman and Giese 1997). However, tree species and size of nest trees (dbh) are geographically variable and selection is thought to be based largely on the availability of suitable cavities and platforms. Regardless of geographic region, cavity nests were in trees with greater diameters than platform nests (Table 1).

In wetter ecosystems, Spotted Owls primarily nest in cavities in large diameter trees typically found in old forest stands or younger stands with residual large diameter old trees (Thomas et al. 1990; Forsman and Giese 1997). In the Olympic Mountain range, nest trees averaged 136.6 cm dbh and were predominantly western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), and Douglas-fir (*Pseudotsuga menziesii*) ranging from 114 to 1189 m in elevation. In drier ecosystems, Spotted Owls nest in a wide range of forest stand ages ( $n = 62$ , median age = 147 yr, range 66–700 yr; Buchanan et al. 1993)

and forest structures. On the eastern slopes of the Cascade Mountain range in Washington, nest trees averaged 66.5 cm dbh and were found almost exclusively in Douglas-fir trees ranging from 381 to 1463 m in elevation (Buchanan et al. 1993, 1995). In contrast to wetter ecosystems, 84% ( $n = 85$ ) of Spotted Owl nests were on platforms in trees created by abandoned Northern Goshawk (*Accipiter gentilis*) nests ( $n = 47$ ) or mistletoe brooms ( $n = 21$ ), with only 16% of nests found in cavities or tops of trees (Buchanan et al. 1993). In British Columbia, nests have been similarly found in cavities of large diameter living western redcedar, western hemlock, and Douglas-fir trees, in tops of large diameter dead Douglas-fir snags, and in abandoned Northern Goshawk nests.

#### Foraging

Three habitat types have been defined in Washington based on their use by Spotted Owls for nesting, roosting and foraging (Hanson et al. 1993). Superior habitats are preferred by Spotted Owls as these habitats are used by the owl in greater proportion than the availability of this habitat type in the landscape. Moderate habitats are used by Spotted Owls in equal proportion to the availability of this habitat type in the landscape. Marginal habitats are used less than this habitat type's availability in the landscape, and are considered unsuitable for sustained use by Spotted Owls. Table 2 defines the stand characteristics for superior and moderate habitats for the wetter and drier ecosystems.

Spotted owls are a sit and wait predator that usually roost within or adjacent to forest stands used for foraging. The structural diversity found in superior habitat type provides for numerous roosting and foraging perches at various heights in the canopy and understorey. The openness of these stands allow for greater maneuverability within the canopy layers and greater access to prey. These open stands tend to possess higher quantities of understorey shrubs and herbs that support higher densities of prey. The characteristics of superior habitat is predominantly found within old forest (forests >140 yr); however, some younger forests, particularly in drier ecosystems, may also possess these characteristics.

**Table 1.** Comparison of nest tree diameter at breast height (dbh), tree height, and nest diameter among three geographic regions in Washington and Oregon

	Cavity nests			Platform nests		
	<i>n</i>	mean	SD/SE	<i>n</i>	mean	SD/SE
<b>Washington Olympic Mountains – (Forsman and Giese 1997)</b>						
dbh (cm)	99	141.8	6.15 SE	11	88.7	15.74 SE
Tree height (m)	95	40.7	1.36 SE	11	39.8	3.99 SE
Nest diameter (cm)	76	45.3	1.15 SE	10	48.0	4.59 SE
<b>Washington Eastern Slopes of Cascade Mountains – (Buchanan et al. 1993)</b>						
dbh (cm)	14	94.7	23.1 SD	71	59.4	21.8 SD
Tree height (m)		Not reported			Not reported	
Nest diameter (cm)		Not reported			Not reported	
<b>Oregon – (Forsman et al. 1984)</b>						
dbh (cm)	28	135.0	6.03 SE	16	106.0	11.93 SE
Tree height (m)	28	38.1	2.37 SE	16	42.0	3.42 SE
Nest diameter (cm)	20	50.0	0.93 SE	8	62.0	1.32 SE

**Table 2.** Suitable Spotted Owl habitat definitions for British Columbia (SOMIT 1997)

<b>Superior habitat</b> (nest, roost, forage and dispersal)	<b>Moderate habitat</b> (roost, forage, and dispersal)
<b>Wetter ecosystems:</b> maritime CWH and MH biogeoclimatic zones (CWHdm, CWHvm1, CWHvm2, MHmm1)	
<ul style="list-style-type: none"> <li>• ≥3 canopy layers, multi-species canopy dominated by large (&gt;75 cm dbh) overstorey trees (typically 37–185 stems/ha)</li> <li>• moderate to high (60–80%) canopy closure</li> <li>• ≥5 large (&gt;50 cm dbh) trees/ha with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections)</li> <li>• ≥5 large (&gt;75 cm dbh) snags/ha.</li> <li>• accumulations (≥268 m<sup>3</sup>/ha) of fallen trees and other CWD on ground</li> </ul>	<ul style="list-style-type: none"> <li>• ≥2 canopy layers, multi-species canopy dominated by large (&gt;50 cm dbh) overstorey trees (typically 247–457 stems/ha, although densities as low as 86 stems/ha are possible where large diameter trees are present)</li> <li>• moderate to high (60–80%) canopy closure</li> <li>• ≥5 large trees/ha (&gt;50 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections)</li> <li>• ≥5 large (&gt;50 cm dbh) snags/ha</li> <li>• accumulations (≥100 m<sup>3</sup>/ha) of fallen trees and other CWD on ground</li> </ul>
<b>Drier ecosystems:</b> sub-maritime CWH and MH, IDF, and ESSF biogeoclimatic zones (CWHds1, CWHms1, CWHms2, MHmm2, ESSFmw, IDFww)	
<ul style="list-style-type: none"> <li>• ≥3 canopy layers, multi-species canopy dominated by large (&gt;50 cm dbh) overstorey trees (typically 173–247 stems/ha, although densities as low as 86 stems/ha are possible where large diameter trees are present)</li> <li>• moderate to high (60–85%) canopy closure</li> <li>• ≥5 large trees/ha (&gt;30 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections)</li> <li>• ≥7 large (&gt;50 cm dbh) snags/ha.</li> <li>• accumulations (≥268 m<sup>3</sup>/ha) of fallen trees and other CWD on ground</li> </ul>	<ul style="list-style-type: none"> <li>• ≥2 canopy layers, multi-species canopy dominated by large (&gt;30 cm dbh) overstorey trees (typically greater than 247 stems/ha)</li> <li>• stands must contain 20% Fd and/or Hw in the overstorey</li> <li>• &gt;50% canopy closure.</li> <li>• ≥5 large trees/ha (&gt;30 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections)</li> <li>• ≥5 large (&gt;30 cm dbh) snags/ha</li> <li>• accumulations (≥100 m<sup>3</sup>/ha) of fallen trees and other CWD on ground</li> </ul>

# Conservation and Management

## Status

The Spotted Owl is on the provincial *Red List* in British Columbia. It is considered *Endangered* in Canada (COSEWIC 2002). The “Northern” Spotted Owl is federally designated as Threatened throughout its entire range in the United States under the U.S. *Endangered Species Act*.

Summary of ABI status in BC and adjacent jurisdictions (NatureServe Explorer 2002)

BC	CA	OR	WA	Canada	Global
S1	S2	S3	S3	N1	G3T3

## Trends

### Population trends

Blackburn et al. (2002) estimated the historic (pre-European settlement) Spotted Owl population size in British Columbia as about 500 pairs of owls. Between 1992 and 2001, the Spotted Owl population declined by about 49% at an average annual rate of -7.2% ( $\pm 1.7\%$  for 90% CI; Blackburn et al. 2002).

Survey results from 2002 suggest that the population declined by an additional 35% between 2001 and 2002. Combined, the Spotted Owl population has declined by about 67% since 1992 at an average rate of -10.4%/yr (Blackburn and Godwin 2003).

Applying this observed decline to the fewer than 100 pairs of owls estimated in British Columbia in the early 1990s (Dunbar et al. 1991) suggests that the current Spotted Owl population in British Columbia may be fewer than 30 pairs of owls. It is reasonable to assume that the extirpation of the Spotted Owl from British Columbia is imminent if the observed annual rate of decline continues (Blackburn et al. 2002).

The observed large decline in Spotted Owl numbers is not exclusive to British Columbia. In the United States, monitoring of Spotted Owls at 15 different demographic study areas between 1985 and 1998

suggests a range-wide annual population decline of -3.9% ( $\pm 3.6\%$  for 95% C.I.; Franklin et al. 1999).

### Habitat trends

Since European settlement, timber harvesting for urbanization, agriculture, and resource extraction has occurred, with almost the entire forested area in the lower Fraser River Valley converted to non-forest uses. It is estimated that suitable habitat represents about 50% of the current capable forested area in the two forest districts (Blackburn et al. 2002). Some of these habitats are currently unusable by Spotted Owl due to their small patch size, isolation from other habitat patches, or distribution in landscapes with suitable habitat densities too low to support the species. Over the next 25 years, the rate of habitat loss caused by timber harvest and natural disturbance is expected to exceed the recruitment of suitable habitat from young forests, resulting in further fragmentation and isolation of habitats available to the owl (Blackburn and Godwin 2003).

### Threats

Due to their small population size and low densities, Spotted Owls in British Columbia are vulnerable to extirpation. Factors that threaten the species can be divided into primary and secondary factors (Blackburn and Godwin 2003). Primary factors cause long-term sustained effects that limit the carrying capacity, or total capable population size. Primary factors include habitat loss and fragmentation, competition with Barred Owls (*Strix varia*), and global warming. Secondary factors cause short-term effects in population size, but the population recovers from these factors relatively soon after the influence of the factor changes to a more favourable condition. Secondary factors include stochastic environmental and demographic events, genetic variability, predation, disease, parasites, and viruses. Although primary factors limit population size and may cause extirpation, secondary factors are likely the leading cause of extirpation of small populations.

## Population threats

Since the 1960s, Barred Owls have invaded the range of the Spotted Owl. Although some niche segregation is evident (Hamer et al. 1989), Barred Owls likely exclude Spotted Owls from utilizing some mature and old forests found within core Barred Owl territories. As well, the presence of both species within the same geographic area may suppress prey populations. The combined competitive effect of habitat exclusion and prey suppression may cause Spotted Owls to increase their home range size to compensate for this loss, or cause the displacement of Spotted Owls as they leave their territory to find new territories with less competition (Kelly 2001). In addition to these competitive effects, the low occurrence of cross breeding between Spotted Owls and Barred Owls negatively impacts the reproductive success of the Spotted Owl population by effectively removing adult Spotted Owls from the pool of potential breeders.

Catastrophic environmental events such as fire, windstorms, and insect outbreaks may eliminate both habitat and Spotted Owls that they support (Thomas et al. 1990). As well, severe weather events may cause poor reproductive performance or high adult mortality, resulting in periodic gaps in the demographic profile. If the population cannot recover from these events, the population may continue to decline to extirpation as future stochastic events occur.

Isolated small populations are prone to decreased genetic variability caused by founder effects, increased incidence of inbreeding, and/or genetic drift. Isolated populations may have higher incidences of adult and juvenile mortality caused by pronounced deleterious recessive genes, reduced adaptability to environmental change, and/or higher susceptibility to disease. Furthermore, closely related individuals may not mate at all, thereby reducing the productivity and recruitment of the population. Decreasing population size and increasing isolation of individuals and populations places the Spotted Owl population in British Columbia at greater risk of extirpation caused by the loss of genetic variability.

Spotted Owls are incidental prey to several predators including Great Horned Owls (*Bubo virginianus*) and Northern Goshawks. Ravens are also predators, more likely preying on very young owls and eggs rather than adult owls. Some researchers also include Barred Owls as a possible predator, although evidence is limited (Kelly 2001). Most predation of individuals is thought to occur during juvenile dispersal, when young owls are inexperienced and searching for new habitats. Perhaps the increasing abundance of unsuitable habitats within the landscape has increased the exposure of dispersing Spotted Owls to predators as they move through these unsuitable habitats resulting in an increased rate of mortality. For predators to be the main cause of the population decline requires the rate of mortality to be higher than normal mortality rates caused by predation.

Spotted Owls are prone to disease, parasites, and viruses; however, these seldom result in sufficient mortality to cause population declines. Of recent concern is the range expansion of the West Nile Virus. The West Nile Virus is usually transmitted to birds through mosquitoes, where once established in a bird, mortality may follow. Those that survive may act as carriers to help spread the virus. Although the West Nile Virus does not occur within southwestern British Columbia, it likely is only a matter of time before it does. Its potential impact on the Spotted Owl is not known; however, there is a risk that it could cause further declines in Spotted Owl numbers in British Columbia.

## Habitat threats

Habitat is threatened by timber harvesting, urbanization, and natural disturbances such as fire, wind, insects, and diseases. Habitat loss and fragmentation may increase the risk of mortality caused by predation and exposure of owls that must move through unsuitable habitats to reach other suitable habitats. Within an owl's territory, habitat loss and fragmentation may cause the resident owls to increase their home range size to compensate for this habitat loss and need to find sufficient prey. As well, habitat loss and fragmentation may reduce the

reproductive success and adult survivorship as adult owls must expend more energy to find food farther away from their core area. Eventually continued habitat loss and fragmentation within a home range will surpass the minimum threshold needed to sustain owls, and the area will remain vacant from Spotted Owls until habitats are restored. As a result, the number of potential territories available in the landscape is reduced. Isolation of territories occurs as the interspatial distances between territories exceed the maximum distance needed for successful dispersal. Without successful dispersal, isolated territories and populations will eventually decline to extirpation.

## **Legal Protection and Habitat Conservation**

The Spotted Owl, its nests, and its eggs are protected under the provincial *Wildlife Act*.

A Spotted Owl Recovery Team was formed in 1990 to develop a recovery plan for the species. At the request of the provincial government, the recovery team developed a range of management options that spans the scale from minimum to maximum protection for Spotted Owl with correspondingly minimum to maximum socio-economic consequences (Dunbar and Blackburn 1994). In 1997, the provincial Cabinet approved the Spotted Owl Management Plan (SOMP) with the goal of achieving a reasonable level of probability that owl populations will stabilize, and possibly improve, over the long term without significant short-term impacts on timber supply and forest employment. The SOMP recognizes that the Spotted Owl population will continue to decline over the next 20–30 years with a 60% chance of the population stabilizing, and possibly improving its status over the long term. Timber supply impacts of SOMP are estimated at between 3 to 5% reduction in allowable annual cut. The SOMP includes a strategic and operational guidelines component, and Resource Management Plans. The strategic component describes the strategic objectives and policies for Spotted Owl management in 21 special resource management zones (SRMZs) totalling about

363 000 ha) identified for the long-term conservation of the species. The operational guidelines component provides resource managers with further guidance for developing long-term Resource Management Plans within SRMZs, and forest practices that will create or retain forest attributes critical for Spotted Owl survival. Resource Management Plans demonstrate how, over a long-term planning horizon of one or more forest rotations, the Spotted Owl and forest management objectives and policies will be achieved in each SRMZ. Resource Management Plans identify landscape and stand level management strategies that are expected to best protect suitable habitat and to provide forestry, economic and employment opportunities.

The 21 SRMZs include 159 000 ha of protected areas (includes capable/suitable habitats within the Greater Vancouver Watershed Districts: Seymour, Capilano, and Coquitlam; protected areas: Seymour, Cypress, Garibaldi, Golden Ears, Sasquatch, Manning, Skagit, Pinecone/Burke Mountain, Birkenhead Lake, Mehatl Creek, and Liumchen) and 204 000 ha of Crown forest land. The SRMZs are spaced a maximum 20 km apart to provide a reasonable chance that owls can disperse from one SRMZ to another. Each SRMZ varies in size and contains between 2 to 13 Long-term Activity Centre (LTACs), each about 3200 ha and capable of sustaining a breeding pair of Spotted Owls in the future. The long-term stabilization, and possible improvement, of the Spotted Owl population is dependent upon maintaining, or restoring, a minimum 67% of the gross forested area as suitable habitat (i.e., forests >100 years old, taller than 19.4 m, and below 1370 m) in each LTAC. Of the 101 LTACs identified within SRMZs, only 55 LTACs currently meet the minimum 67% habitat target. Recruitment of habitat up to this minimum target in the other 45 LTACs may require up to 60 years.

The SOMP provides temporary protection for an additional eight activity centres (referred to as Matrix Activity Centres) that are found entirely or partially outside of SRMZs. These Matrix Activity Centres are to be phased out by allowing, over a 50-year period, limited clearcutting of suitable habitat

at a similar rate as suitable habitat is recruited within SRMZs. However, some Matrix Activity Centres will be phased out sooner to achieve forest company timber needs to offset the impacts associated with the creation of the Mehatl Creek Protected Area (SOMIT 1997).

The SOMP does not provide protection over existing provisions of the *Forest and Range Practices Act*, to Spotted Owl activity centres found outside of SRMZs, Matrix Activity Centres, and protected areas discovered after June 1995. Since June 1995, 19 Spotted Owl activity centres have been discovered and remain unprotected. Fourteen of these occur farther north beyond the managed range of SOMP, eight of which occur in the Cascades Forest District (formerly the Lillooet Forest District).

Due to concern over the Endangered status and immediate threat of extirpation, a Spotted Owl Recovery Team was re-established in 2002 to develop a Recovery Plan including assessing the SOMP's effectiveness for stabilizing the population. Completion of the Spotted Owl Recovery Plan is expected by 2005.

## Identified Wildlife Provisions

### Sustainable resource management and planning recommendations

Due to the status of the Spotted Owl in British Columbia, all individual owls are critical to the recovery of the species and should be considered for protection. The following recommendations may be considered within strategic level planning processes. These recommendations are consistent with the Spotted Owl Management Plan, and its associated documents, and are recommended for the management of habitat to sustain a pair of Spotted Owls (see SOMP for more information). These management provisions may change pending the implementation of a Spotted Owl Recovery Plan or other direction from government.

- ❖ Maintain suitable Spotted Owl habitat (i.e., coniferous forest >100 years old, >19.4 m tall and <1370 m elevation).

- ❖ Maintain LTACs throughout the range of the Spotted Owl.
- ❖ Where possible aggregate LTACs into clusters of multiple breeding territories.
- ❖ Where possible the distance between LTACs and clusters of LTACs should be <20 km.
- ❖ Where the distance between LTACs is >20 km, consider establishing an additional LTAC to ensure habitat connectivity to facilitate dispersal.
- ❖ Maintain or restore suitable habitat within LTACs.
- ❖ Wherever possible and practicable, overlap LTACs with other constrained areas (i.e., protected areas, non-contributing areas) to minimize timber supply impacts.

### Wildlife habitat area

#### Goal

Maintain areas of suitable habitat throughout the range of the Spotted Owl.

#### Feature

Establish WHAs at resident Spotted Owl areas consistent with current government direction. WHAs may be established to legalize existing LTACs under FRPA, to modify existing LTACs, to protect new resident Spotted Owl areas or to protect other habitat for recovery.

#### Size

The size of the WHA will generally be 3200 ha of forested area.

#### Design

The WHA should include a core area(s) (80 ha), and a management zone which includes a long-term owl habitat area (light volume removal) and a forest management area (heavy volume removal). The WHA should include an 80 ha core area around all known nesting or roosting sites. The WHA should also include a minimum of 67% suitable habitat (i.e., coniferous forest >100 years old, >19.4 m tall and <1370 m). The long-term owl habitat areas (LTOHAs) define where, over the long term, the minimum 67% suitable habitat target will be maintained or restored within each WHA. The

forest management areas (FMAs) define where, over the long term, timber harvesting can occur to reduce the amount of suitable habitat as low as the 67% habitat target for the WHA.

## General wildlife measures

### Goals

1. Protect known nest and roost areas. Recruit suitable nesting and roosting habitat and habitat structures.
2. Minimize disturbance at known nesting and roosting sites.
3. Maximize forest interior habitat.
4. Create, enhance, or maintain suitable habitat (i.e., multi-layered, variable density, multi-species stand structure with canopies dominated by dominant and co-dominant trees within areas).
5. Maintain important habitat features (e.g., coarse woody debris, wildlife trees, interior forest, large diameter trees, moderate to high canopy closure; see Table 2).
6. Maintain or enhance habitat for prey species.

### Measures

#### Access

- Do not construct, modify, or deactivate roads or landings within the core area. Where approved, do not construct, modify or deactivate between 1 March and 31 July.
- Minimize road clearing widths to  $\leq 3$  m between the timbers edge and either the toe of the fill or the top of the cut, unless no other practicable option exists.

#### Harvesting and silviculture

- Do not harvest or salvage within core area(s).
- Do not salvage in the management zone.
- Do not remove non-timber forest products.
- Maintain or restore at least 67% of the gross forested area within the WHA in suitable owl habitat of which 75% should be maintained or restored as superior habitat (>140 years, >19.4 m tall and <1370 m). When there is <67%, do not harvest the next oldest age class and/or stands that best achieve Spotted Owl habitat distribution objectives. Heavy volume removal is permitted within the FMA when WHA includes >67% suitable habitat.

- Distribute the 67% suitable habitat into large unfragmented patches >500 ha that are connected by movement corridors of suitable habitat that are a minimum of 1 km wide.
- When harvesting in the management zone (LTOAC and FMA) implement the following measures:
  - Patch cuts (0.05–0.5 ha in size) can represent no more than 5% of the prescribed cut block. Patch cuts must be minimum 100 m (edge to edge) from adjacent patch cuts, clearcuts or natural openings >0.25 ha in size.
  - Remove up to one-third of the basal area from each 10 cm stand diameter class distributed evenly across the treatment area.
  - Retention of trees should be relatively evenly distributed throughout cut blocks. Timber extraction corridors will not exceed the average inter-tree spacing requirement of the treatment area as described in Table 3.
  - For cut blocks within CWHds1, CWHms1, CWHms2, MHmm2, ESSFmw, and IDFww, maintain or create on average 5 snags >30 cm dbh/ha and maintain existing coarse woody debris, and add 25 cubic m/ha of unmerchantable logs >30 cm dbh.
  - For cut blocks within CWHdm, CWHvm1, CWHvm2 and MHmm1, maintain or create on average 5 snags >50 cm dbh/ha and maintain existing coarse woody debris, and add 25 cubic m/ha of unmerchantable logs >50 cm dbh.

**Table 3.** Average corridor width spacing requirements for partial harvests

Retention of dominant trees/ha	Average corridor widths
173	7.6 m
200	7.0 m
250	6.3 m
300	5.8 m
400	5.0 m
500	4.5 m
625	4.0 m
800	3.5 m
1000	3.2 m

### Pesticides

- Do not use pesticides.

### Within the FMA

- Locate cut blocks in areas that minimize impacts to suitable habitat objectives and Spotted Owls activity.
- Maintain a minimum of 10% wildlife tree retention areas. Wildlife tree retention areas that consist of non-suitable habitat may be enhanced utilizing partial harvest.
- Maintain or create on average 5 snags >76 cm dbh/ha in CWHdm, CWHvm1, CWHvm2 and MHmm1, or maintain or create on average 5 snags >51 cm dbh/ha in the CWHds1, CWHms1, CWHms2, MHmm2, ESSFmw, and IDFww.
- For cut blocks within CWHds1, CWHms1, CWHms2, MHmm2, ESSFmw, and IDFww, there should be an average of 40 windfirm leave trees maintained from the top 80 largest diameter trees/ha.
- For cut blocks within CWHdm, CWHvm1, CWHvm2, and MHmm1, there should be an average of 15 windfirm leave trees maintained from the top 30 largest diameter trees/ha.

### Information Needs

1. Current range and distribution in the province.
2. Short-term population changes and long-term population demographics.
3. Habitat selection/preference requirements.

### Cross References

Bull Trout, Coastal Giant Salamander, Coastal Tailed Frog, Keen's Long-eared Myotis, Marbled Murrelet, Pacific Water Shrew

### References Cited

Barrowclough, G. and R. Gutierrez. 1990. Genetic variation and differentiation in the spotted owl (*Strix occidentalis*). *Auk* 107(4):737–744.

Blackburn, I., A. Harestad, J. Smith, S. Godwin, R. Hentze, and C. Lenihan. 2002. Population assessment of the northern spotted owl in British Columbia 1992–2001. B.C. Min. Water, Land and Air Prot., Surrey, B.C.

Blackburn, I. and S. Godwin. 2003. The Status of the Northern Spotted Owl (*Strix occidentalis caurina*) in British Columbia. B.C. Min. Water, Land and Air Prot., Surrey, B.C.

Blakesley, J., Franklin, A., and R. Gutierrez. 1990. Sexual dimorphism in Northern Spotted Owls from northwest California. *Journal of Field Ornithology*, 61 (3), 320–327.

B.C. Ministry of Water, Land and Air Protection (MWLAP). 2003. Regional Spotted Owl database. Surrey, B.C.

Buchanan, J.B., L.L. Irwin, and E.L. McCutchen. 1993. Characteristics of Spotted Owl nest trees in the Wenatchee National Forest. *J. Raptor Res.* 27(1):1–7.

Buchanan, J.B., L.L. Irwin, and E.L. McCutchen. 1995. Within-stand nest site selection by Spotted Owls in the eastern Washington Cascades. *J. Wildl. Manage.* 59:301–310.

Carey, A., S. Horton, and B. Biswell. 1992. Northern spotted owls: influence of prey base and landscape character. *Ecol. Monogr.* 62(2):223–250.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002. Canadian Species at Risk. [www.speciesatrisk.gc.ca](http://www.speciesatrisk.gc.ca)

Dawson, W., J. Ligon, J. Murphy, J. Myers, D. Simberloff, and J. Verner. 1986. Report of the scientific advisory panel on the spotted owl. *Condor* 89:205–229.

Dunbar, D. L., B. P. Booth, E. D. Forsman, A. E. Hetherington and D. J. Wilson. 1991. Status of the Spotted Owl (*Strix occidentalis*) and Barred Owl (*Strix varia*) in Southwestern British Columbia. *Can. Field-Nat.* 105:464–468.

Dunbar, D. and I. Blackburn. 1994. Management options for the northern spotted owl in British Columbia. B.C. Environ., Surrey, B.C.

Forsman, E., R. Anthony, J. Reid, P. Loschl, S. Sovern, M. Taylor, B. Biswell, A. Ellingson, C. Meslow, G. Miller, K. Swindle, J. Thrailkill, F. Wagner, and E. Seaman. 2002. Natal and breeding dispersal of Northern Spotted Owls. *Wildl. Monogr.* 149:1–35.

Forsman, E., A. Giese, D. Herter, D. Manson, and S. Sovern. 1995. Renesting by spotted owls. *Condor* 97:1078–1080.

Forsman, E. and A. Giese. 1997. Nests of northern spotted owls on the Olympic Peninsula, Washington. *Wilson Bull.* 109(1):28–41.

Forsman, E., C. Meslow, and H. Wight. 1984. Distribution and biology of the spotted owl in Oregon. *Wildl. Monogr.* 87:1–64.

- Forsman, E., I. Otto, S. Sovern, M. Taylor, D. Hays, H. Allen, S. Roberts, and E. Seaman. 2001. Spatial and temporal variation in diets of Spotted Owls in Washington. *J. Raptor Res.* 35(2):141-150.
- Franklin, A. B., K. P. Burnham, G. C. White, R. G. Anthony, E. D. Forsman, C. Schwarz, J. D. Nichols, and J. Hines. 1999. Range-wide status and trend in northern Spotted Owl populations. Colorado State Univ. and Oregon State Univ., Fort Collins, Colo. Unpubl. report.
- Hamer, T.E., S.G. Seim and K.R. Dixon. 1989. Northern spotted owl and northern barred owl habitat use and home range size in Washington. Preliminary report, Washington Department of Wildlife. 65 pp.
- Hanson, E., D.W. Hays, L. Hicks, L. Young, and J. Buchanan. 1993. Spotted owl habitat in Washington. Washington Forest Practices Board. Washington. 115 pp.
- Hobbs, J. 2002. Spotted Owl nest searches in the Lillooet forest district – 2002: Summary of results. B.C. Min. Water, Land and Air Prot.. Biodiversity Br., Victoria, B.C. Unpubl.
- Horoupian, N., C. Lenihan, A. Harestad, and I. Blackburn. 2000. Diet of northern spotted owls in British Columbia. Simon Fraser Univ., Dep. Biol. Sci., Burnaby, B.C. Unpubl. manuscript.
- Kelly, L.G. 2001. The range expansion of the northern barred owl: an evaluation of the impact on spotted owls. Thesis, Oregon State Univ., Corvallis, Oreg. 78 pp.
- Laing, H. 1942. Birds of the coast of central British Columbia. *Condor.* 44:175-181.
- Miller G., R. Small, and C. Meslow. 1997. Habitat selection by Spotted Owls during natal dispersal in western Oregon. *J. Wildl. Manage.* 61(1):140-150.
- NatureServe Explorer. 2002. An online encyclopedia of life [web application]. Version 1.6. Arlington, Virginia. Available: <http://www.natureserve.org/explorer>.
- Ransome, D. 2001. Population Ecology and Resource Limitation of Northern Flying Squirrels and Douglas Squirrels. Ph. D. Thesis. Faculty of Graduate Studies Dep. For. Univ. British Columbia, B.C. 106 p.
- Spotted Owl Management Inter-Agency Team (SOMIT). 1997. Spotted owl management plan: Strategic component. B.C. Min. Environ., Lands and Parks and B.C. Min. For., Victoria, B.C.
- Thomas, J., E. Forsman, J. Lint, E. Meslow, B. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl. Interagency scientific committee to address the conservation of the northern spotted owl, Portland, Oreg.
- U.S. Department of the Interior (USDI). 1992. Recovery plan for the northern spotted owl –draft. Fish Wildl. Serv., Washington, D.C.
- Wilcove, D. 1987. Public lands management and fate of the spotted owl. *Amer. Birds* 41(3):361–367.

## Personal Communications

- Dunbar, D. 2001. Min. Water, Land and Air Protection, Surrey, B.C.
- Hilton, A. 2001. Panorama Wildlife Research, Surrey, B.C.