Nest Reuse by Northern Spotted Owls on the East Slope of the Cascade Range, Washington

Author(s) :Stan G. Sovern, Margaret Taylor, and Eric D. Forsman
Source: Northwestern Naturalist, 92(2):101-106. 2011.
Published By: Society for Northwestern Vertebrate Biology

DOI:
URL: http://www.bioone.org/doi/full/10.1898/10-01.1

NORTHWESTERN NATURALIST 92:101–106 AUTUMN 2011

NEST REUSE BY NORTHERN SPOTTED OWLS ON THE EAST SLOPE OF THE CASCADE RANGE, WASHINGTON

STAN G SOVERN AND MARGARET TAYLOR
Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331

ERIC D FORSMAN
USDA Forest Service, Pacific Northwest Forestry Sciences Laboratory, Corvallis, OR 97331

ABSTRACT—During a long-term demography study of Northern Spotted Owls (*Strix occidentalis caurina*) in the eastern Cascade Range of Washington State in 1989 to 2008, we documented 276 nests of Northern Spotted Owls at 73 different territories. Of these nests, 90.2% were on platforms, mostly in clumps of deformed limbs caused by dwarf mistletoe (primarily *Arceuthobium douglasii*), and 9.8% were in cavities in trees. Of the nests associated with dwarf mistletoe, 8.4% were nests built by other raptors and 91.6% were either natural accumulations of debris or debris accumulated by other birds or mammals. Owls switched nests between nesting attempts 81.2% of the time. The presence of a new male or female at a territory did not affect the odds of switching nests between nesting attempts. The odds an owl would reuse a nest were 6 times greater for owls that were successful in the previous nesting attempt compared to owls that were unsuccessful, given the same type of nest structure. The odds an owl would reuse a cavity nest were 4.7 times greater than the odds an owl would reuse a platform nest, given the same level of nest success the previous year. The estimated mean annual survival rate (φ) of nest structures was 0.98 (SE = 0.006), suggesting that mean life expectancy of nests was 42 y. However, nests on dwarf mistletoe platforms may be more ephemeral than cavity nests or the nest trees themselves, and management for viable nest areas for Spotted Owls should include multiple trees with mistletoe brooms suitable for alternate nests. Our results, and results from other studies, indicate that Douglas-fir (*Pseudotsuga menziesii*) trees infected with dwarf mistletoe are an important habitat component for Spotted Owls and many other species of birds and arboreal mammals on the east slope of the Cascade Range in Washington.

Key words: *Arceuthobium douglasii*, dwarf mistletoe, eastern Cascade Range, nesting, Northern Spotted Owl, *Strix occidentalis caurina*, Washington

Forest management in the range of the Northern Spotted Owl (*Strix occidentalis caurina*) has been influenced for decades by mandates to provide adequate habitat for the Spotted Owl and other species associated with older forests. One component of viable Spotted Owl habitat is the presence of suitable nesting structures. Thus, we think it is important to document both the types of nests used by Spotted Owls as well as the spatial and temporal patterns of reuse of nests within individual owl territories. Northern Spotted Owls nest primarily in trees (Forsman and others 1984; LaHaye 1988; Buchanan and others 1993; Forsman and Giese 1997; Hershey and others 1998). In Washington State, Forsman and Giese (1997) described nest characteristics and frequency of nest reuse on the Olympic Peninsula, and Buchanan and others (1993, 1995) described nest and nest stand characteristics of Northern Spotted Owls on the east slope of the Cascade Range.

As part of a long-term demographic study in 1989 to 2008, we documented nests of Northern Spotted Owls on the east slope of the Cascade Range, Washington. We examined data from these nests to explore the effects of nest structure, previous nest success, and replacement of territorial owls on the likelihood that an owl would reuse a nest in sequential nesting attempts. We predicted that owls would switch nests more frequently if they nested unsuccessfully in the previous nesting attempt or if there was a turnover in one of the resident owls. We also predicted that nests in cavities would have higher odds of reuse compared to other nest types because they would provide better protection from predators and inclement weather.

METHODS

The study area included the Cle Elum Ranger District on the Wenatchee National Forest, Washington, and private inholdings within the Ranger District boundaries (center of study area UTM Zone 10, 655520E, 5228810N, NAD27). Most of the study area was mountainous, with elevation ranging from 670 to 2084 m (Forsman and others 1996). The area was dominated by forests of Douglas-fir (*Pseudotsuga menziesii*), Ponderosa Pine (*Pinus ponderosa*), and Grand Fir (*Abies grandis*).

We monitored owl territories each year and used standardized protocols to document survival and numbers of young produced (Franklin and others 1996). If owls were nesting, we were usually able to identify the nest tree and document the structure used for the nest. We divided nests into 5 categories: side cavities; stovepipe cavities; platforms on clusters of deformed limbs (''brooms'') caused by dwarf mistletoe (*Arceuthobium* sp.); platforms not on dwarf mistletoe brooms; and abandoned raptor nests. Nests in side cavities and stovepipe cavities were in hollow tree trunks accessed through the side of the bole or top of the broken bole, respectively. Because we could not determine if the 1st nest used in each territory had been used previously, we excluded those nests from the analysis of nest reuse. Thus, our sampling period for examining nest reuse was 1990 to 2008, including 308 sequential nesting attempts at 62 different owl territories. Because Spotted Owls typically do not nest every year, sequential nesting attempts were often separated by >1 y. In rare cases ($n = 4$) in which pairs renested in the same year after an initial failure (Forsman and others 1995), we used only the 2nd nest in our analysis of nest reuse. For analysis of the distance between nests, we recorded Universal Transverse Mercator coordinates for each nest using a handheld Global Positioning System unit (Garmin Corporation) with an accuracy of approximately 15 m. We did not include movements of individual owls in our distance analysis, rather we calculated the distance between nests at each owl territory for each year.

All territorial owls were marked with color bands, enabling us to identify them without physical recapture (Forsman and others 1996; Franklin and others 1996). We classified territories as having a new male or female if the owl marked from the previous nesting attempt was replaced by a different owl. We used a standardized survey protocol to determine the number of young fledged each year (Franklin and others 1996). We defined a successful nest as one where ≥1 young fledged from the nest. In cases where we were unable to locate owls in a year between nesting attempts, we assumed the owls did not nest and classified the nesting attempts before and after the gap as sequential attempts.

We used logistic regression (PROC GENMOD, SAS 2008) to test effects of 4 variables on the relative odds of switching nests between sequential nesting events. The 4 variables were: (1) nest type (cavity or platform); (2) success in previous nest attempt (Y or N); (3) presence of a new female (Y or N); and (4) presence of a new male (Y or N). Our data were too sparse to model interactions between effects.

To estimate the yearly survival rate (φ) of nests, we returned to 121 (47%) of the owl nests used prior to 2000 and attempted to determine if the nest was still viable by visually inspecting the nest tree and platform. In most cases, we were unable to determine the viability of cavity nests without climbing nest trees, so we estimated nest survival for only the 105 platform nests we examined. If the tree or platform had fallen or the platform was obviously damaged to the point where we assumed the nest was no longer viable, we attempted to determine the year the nest became unviable by reviewing historical timber sale records or data from field crews who visited the nests since the nest was last used. In 7 cases in which nest trees or platform nests fell down, we estimated the year in which nests fell based on the degree of decomposition of the nest debris. We used program MARK (White and Burnham 1999) to estimate φ. We used the formula $-1/\ln \varphi$ (Brownie and others 1978:204; Forsman and Giese 1997) to calculate an estimate of the mean life expectancy of nests from the time they were first located. We climbed to 13 (24%) of the nests that produced no young to determine if some aspect of the nest contributed to the nest failure.

RESULTS

We located 276 nests: 14 (5.1%) in side cavities; 13 (4.7%) in stovepipe cavities; and 249 (90.2%) on platforms. Of the 249 nests on platforms, 226 (90.8%) were in mistletoe brooms (primarily *A. douglasii*), 2 (0.8%) were on platforms formed by debris accumulations on top of large limbs, and 21 (8.4%) were on platform nests built by other species. The mean number of nests at 62 owl territories with ≥2 nesting attempts was 4.3 (95% CI = 3.6–4.9, range = 1–12).

In 250 cases where we recorded the species of nest tree, 224 (89.6%) were in Douglas-fir, 10 (4.0%) were in Western Hemlock (*Tsuga heterophylla*), 7 (2.8%) were in Grand Fir , 4 (1.6%) were in Western Redcedar (*Thuja plicata*), 3 (1.2%) were in Ponderosa Pine, 1 (0.4%) was in a Western Larch (*Larix occidentalis*), and 1 (0.4%) was in a Black Cottonwood (*Populus trichocarpa*). Of the 25 cavity nests where we recorded nest tree species, 14 (56%) were in Douglas-fir and the remaining 44% were in Western Hemlock (24%), Western Redceder (12%), Black Cottonwood (0.4%), and Ponderosa Pine (0.4%). Noncavity nests were predominantly (93%) in Douglas-fir.

In 308 cases where we had data on sequential nests, owls reused the same nest on 58 occasions (18.8%), and switched to a different nest on 250 occasions (81.2%). In 48 (19.2%) occasions where owls switched nests between nesting attempts, they reused nests that were known to have been used at least once in previous years. The mean and median distance between sequential nests of owls that switched nests was 0.46 km (95% CI = 0.40–0.52 km) and 0.31 km, respectively (interquartile range = 0.37 km). At 57 territories with ≥2 nests, the mean and median radius of a circle containing all known nests was 0.46 km (95% CI = 0.37–0.55) and 0.34 km, respectively (interquartile range 0.38 km), corresponding to a mean and median area of 66 ha and 36 ha, respectively. The logistic regression results indicated that the relative odds an owl would switch nests between nesting attempts were independent of replacement of the female ($\chi^2_1 = 0.32$, $P = 0.57$), or the male ($\chi^2_1 = 0.01$, $P = 0.92$), but the nest success and nest structure coefficients were both significant ($P < 0.05$). After we removed the male and female effects to derive odds ratios for the effects of nest success and nest type, the model indicated that the odds of reusing a cavity nest were 4.7 times greater than the odds of reusing other nest types (95% CI = 2–11 times), given the same fledging success. The odds of reusing a nest that had successfully fledged young in the previous nesting attempt were 6 times greater than the odds of reusing a failed nest (95% CI = 1–28 times), given the same type of nest structure.

The estimated mean annual survival rate (φ) of platform nests from program MARK was 0.98 (SE = 0.006). Mean life expectancy for platform nests after they were located was 42 y. Of 17 cases where nests of any type became unusable during 1989 to 2001, 10 were cases where either some or all of a platform nest fell out of the tree but the tree was still standing. The other 7 cases included 2 cavity nests, 1 platform nest and 2 raptor nests in trees that either died or fell over, and 2 nest trees (1 raptor nest and 1 cavity nest) that were cut down during logging operations.

We climbed to 13 failed nests, including the first nests of 3 pairs that renested in the same nesting season after an initial failure. In 1 platform nest where we collected addled eggs, it appeared that the eggs rolled into a crevice in the platform where the female was unable to incubate them. Another platform nest contained a dead owlet that had become wedged between sticks in the nest and evidently was unable to extricate itself. One failed nest in a stovepipe cavity contained moss that was very wet, suggesting the nest was exposed to the weather during incubation in a particularly wet spring. In the other 10 failed nests we found no conclusive evidence of the cause of nest failure. We climbed 1 additional nest that fledged 1 juvenile. This platform nest also contained an addled egg that had evidently rolled into a part of the platform where the female could not incubate it. None of the above-mentioned nests were reused during the study.

DISCUSSION

The high proportion of platform nests used by Spotted Owls on the east slope of the Cascade Range in Washington and Oregon (Forsman and others 1984; Buchanan and others 1993; our study) is in sharp contrast to the proportion of platform nests observed in studies in western Oregon and Washington, where most nests are in cavities (Forsman and others

1984; Forsman and Giese 1997; Hershey and others 1998). It is unclear whether these differences are due to differences in the availability of platforms versus cavities, or selection of a particular nest type in areas with dramatically different climates. Hershey and others (1998) speculated that the high proportion of platform nests in the Klamath region of southwest Oregon was in part due to the scarcity of large broken-top trees, and the prevalence of dwarf mistletoe. In eastern Washington, Martin and others (1992) found that dwarf mistletoe brooms were more prevalent in forest stands where Spotted Owls used platform nests compared to stands where they used cavity nests. Forsman and Geise (1997) speculated that cavity nests might be selected in areas with high rainfall, such as western Oregon and Washington, because cavities provide better protection from the elements. In at least some portions of the east slope of the Cascade Range, high levels of dwarf mistletoe infestation in Douglas-fir, a long history of selective logging of large trees, and a relatively dry climate have produced an abundant supply of platform nests but few large trees with suitable cavities. In contrast, the Douglas-fir forests that dominate western Washington and northwest Oregon are less affected by dwarf mistletoe (Hawksworth and Wiens 1996) and probably have fewer suitable platforms as a result. Thus, it is likely that selection for a particular nest type by Spotted Owls is influenced by both climate and availability of different nest types.

In our study the vast majority of owls nested in Douglas-fir, a pattern also noted by Buchanan and others (1995) in eastern Washington, and Hershey and others (1998) in Oregon. In contrast, Spotted Owl nests on the Olympic Peninsula were distributed relatively evenly among the different coniferous tree species that dominated the area (Forsman and Giese 1997; Hershey and others 1998). Most (87%) of the nests in Douglas-fir in our study were associated with dwarf mistletoe.

Owls in our study switched between alternate nests with about the same frequency (81%) as owls on the Olympic Peninsula in western Washington (75%: Forsman and Giese 1997:36). Owls on the Olympic Peninsula, however, tended to reuse historical nest trees more often than in our study (40% vs. 19%, respectively; Forsman and Giese 1997:37) when they did switch nests between sequential nesting events. Buchanan and others (1995) found no difference in the occurrence or severity of dwarf mistletoe infestations between owl nest sites and random sites within nest stands, but they did not evaluate the availability of suitable nest platforms within the nest stand or between nest stands and stands with no history of nesting. Presumably, if dwarf mistletoe infestation is relatively uniform throughout the nest stand, there will be enough suitable platform nests to permit owls to find new nests, rather than using historic nests. In areas where owls nest most often in cavities, such as the Olympic Peninsula, owls would be expected to reuse historic nests when switching nests between nesting attempts if suitable cavities were fairly rare. Owls in our study were more likely to reuse a cavity nest than a non-cavity nest, consistent with the pattern seen on the Olympic Peninsula. This suggests that at territories where owls nested in cavities other nest types were either less available or less preferable.

Prey depletion near nests could account for the tendency to switch nests among years (Carey and others 1992). However, we question whether the comparatively short distances between most sequential nests that we observed would dramatically change the availability of prey near the nest. Another hypothesis is that overwintering parasites in nests (Young and others 1993) could lead to selection for nest switching among years. Unfortunately, there are no data on the abundance or species composition of overwintering parasites in Spotted Owl nests, so this hypothesis is untested.

Our estimate of the mean lifespan (42 y) of nests after they entered the sample was much lower than the mean estimate of 124 y for nests on the Olympic Peninsula (Forsman and Giese 1997:36). Forsman and others (1984) found that 17% of the nests located in 1970 to 1978 were no longer useable by 1978. We noted that dwarf mistletoe platforms (not necessarily nest platforms) often broke out of trees, presumably because of weak limb structure and heavy snow accumulations.

Our estimate of annual survival and mean lifespan of nests is likely biased high, because often it was not possible to determine the viability of a nest from the ground, as our experience with climbing failed nest trees indicated. It is likely, however, that nests were viable for a number of years before they were first used by the Spotted Owls in our study. It may be that movements of adult and juvenile Spotted Owls in the nest during the incubation and nestling periods tend to destabilize platform nests to the point where they are often not attractive to the owls the following year. Folliard (1993) noted that platform nests were sometimes destroyed by the end of the nesting season. The tendency to reuse nests that were successful in the previous nesting attempt could be due to those nests having better structure or microclimate, in addition to the possibility that those nests may be better positioned relative to the activity centers of potential predators.

Our estimate of the mean number of nests used is a minimum estimate, because not all territories were monitored for the same number of years. One could expect the mean number of nests to increase with more nesting attempts, given owls continue to switch nests 81% of the time between sequential attempts.

Our study underscores the importance of dwarf mistletoe (Martin and others 1992; Watson 2001) and Douglas-fir as components of wildlife habitat in eastern Washington forests. Dwarf mistletoe brooms provided the base structure for most of the nests we documented, as well as providing important food and habitat for a variety of other species (Hawksworth and Wiens 1996), including prey consumed by Spotted Owls (Lehmkuhl and others 2006a, 2006b). If the objective is to maintain Spotted Owls on the east slope of the Cascade Range, forest managers should provide numerous potential alternate nest structures for the owls to use. This is especially important in regions such as the east slope of the Cascade Range where comparatively ephemeral platforms on limbs are the primary source of nests.

ACKNOWLEDGMENTS

Many researchers from 6 cooperating agencies and organizations located owl nests included in our study, including: C Abbruzzese; M Abshire; J Bottelli; C Foster; R Gaines; P Garvey-Darda; H Graham; S Grayson; D Herter; C Holloway; L Hunt; V Illg; R Klatt; D Leversee; M MacDonald; D Manson; D Maulkin; K Maurice; L Melampy; L Neimi; M Rabanal; P Radley; S Reffler; A Renkert; J Richards; D Rolph; S Sagor; E Sanders; M Schnarre; K Siegal; H Smith; M Smith; S Smith; W Smith; H Stabins; S Stanger; and M Teske. K Dugger at Oregon State University helped with the statistical analysis. Three anonymous reviewers provided helpful comments on an earlier draft. This study was funded by the USDA Forest Service Pacific Northwest Regional Office and Pacific Northwest Research Station. In kind support was also provided by the Department of Fisheries and Wildlife and the Oregon Cooperative Wildlife Research Unit at Oregon State University.

LITERATURE CITED

BROWNIE C, ANDERSON DR, BURNHAM KP, ROBSON DS. 1978. Statistical inference from band recovery data: A handbook. USDI Fish and Wildlife Service, Resource Publication 131. 212 p.

BUCHANAN JB, IRWIN LL, MCCUTCHEN EL. 1993. Characteristics of Spotted Owl nest trees in the Wenatchee National Forest. Journal of Raptor Research 27:1–7.

BUCHANAN JB, IRWIN LL, MCCUTCHEN EL. 1995. Within-stand nest site selection by Spotted Owls in the eastern Washington Cascades. Journal of Wildlife Management 59:301–310.

CAREY AB, HORTON SP, BISWELL BL. 1992. Northern Spotted Owls: Influence of prey base and landscape character. Ecological Monographs 62:223–250.

FOLLIARD L. 1993. Nest site characteristics of Northern Spotted Owls in managed forests of northwest California [thesis]. Moscow, ID: University of Idaho. 106 p.

FORSMAN ED, GIESE AR. 1997. Nests of Northern Spotted Owls on the Olympic Peninsula, Washington. Wilson Bulletin 109:28–41.

FORSMAN ED, MESLOW EC, WIGHT HM. 1984. Distribution and biology of the Spotted Owl in Oregon. Wildlife Monographs 87. 64 p.

FORSMAN ED, GIESE AR, MANSON DJ, SOVERN SG. 1995. Renesting by Spotted Owls. Condor 97:1078–1080.

FORSMAN ED, DESTEFANO S, RAPHAEL MG, GUTIÉRREZ RJ. 1996. Demography of the Northern Spotted Owl. Studies in Avian Biology 17. 122 p.

FRANKLIN AB, ANDERSON DR, FORSMAN ED, BURNHAM KP, WAGNER FW. 1996. Methods for collecting and analyzing demographic data on the Northern Spotted Owl. Studies in Avian Biology 17:12–20.

HAWKSWORTH FG, WIENS D. 1996. Dwarf mistletoes: Biology, pathology, and systematics. USDA Forest Service Agricultural Handbook 709. 410 p.

HERSHEY KT, MESLOW EC, RAMSEY FL. 1998. Characteristics of forests at Spotted Owl nest sites in the Pacific Northwest. Journal of Wildlife Management 62:1398–1410.

LAHAYE WS. 1988. Nest site selection and nesting habitat of the Northern Spotted Owl (*Strix occi-*

dentalis caurina) in northwestern California [thesis]. Arcata CA: Humboldt State University. 125 p.

LEHMKUHL JF, KISTLER KD, BEGLEY JS. 2006a. Bushy-tailed woodrat abundance in dry forests of eastern Washington. Journal of Mammalogy 87: 371–379.

LEHMKUHL J F, KISTLER KD, BEGLEY JS, BOULANGER J. 2006b. Demography of Northern Flying Squirrels informs ecosystem management of western interior forests. Ecological Applications 16:584–600.

MARTIN SK, BEATTY J, HAWKSWORTH F. 1992. Douglas-fir dwarf mistletoe brooms and Spotted Owl nesting habitat, eastern Cascade Range, Washington. In: FRANKEL S (compiler). Proceedings of the 40th annual western international forest disease work conference, Durango, CO. p 77–79.

SAS INSTITUTE INC. 2008. SAS version 9.2. Cary, NC: SAS Institute, Inc.

WATSON DM. 2001. Mistletoe: A keystone resource in forests and woodlands worldwide. Annual Review of Ecology and Systematics 32:219–249.

WHITE GC, BURNHAM KP. 1999. Program MARK: Survival estimation from populations of marked animals. Bird Study 46 (Supplement):120–138.

YOUNG KE, FRANKLIN AB, WARD JP. 1993. Infestation of Northern Spotted Owls by hippoboscid (Diptera) flies in Northwestern California. Journal of Wildlife Diseases 29:278–283.

Submitted 11 January 2010, accepted 24 November 2010. Corresponding Editor: Joan Hagar.