Environmental Factors Associated with Spotted Owl Reproduction[1]

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Abstract

Although research on spotted owls (*Strix occidentalis*) has increased dramatically in the last decade, factors influencing owl reproduction still are poorly known. This ongoing study uses 9 years of demographic data to analyze associations between owl reproduction and weather, cone crop abundance, and nest-site structure. Initial results indicate no correlation between cone crop abundance and owl reproduction, but significant associations between owl reproductive success and spring weather conditions and nest-site structure.

The management of many western forests has been directly influenced by legal and biological requirements for maintaining viable populations of the spotted owl (*Strix occidentalis*). Although most of the controversy has focused on protecting the old-growth habitat associated with the owl, the long-term viability of the species will also depend on its reproductive success. It has been difficult to assess owl population trends because owls disperse over large areas, and demographic studies rarely have a closed population in which a thorough, long-term census has been done. In the absence of better demographic data, identifying factors that may influence reproduction can be an important tool for inferring population response to changing environmental conditions.

Several studies of the spotted owl have inferred that habitat quality, prey abundance, and weather are likely influences on reproduction (Franklin and others 2000, Thomas and others 1990, Zabel and others 1996). Reproduction by the northern spotted owl (*S. occidentalis caurina*) may be negatively correlated with current winter precipitation (Wagner and others 1996, Zabel et al 1996). In the San Bernardino Mountains of southern California, however, reproduction by the California spotted owl (*S. occidentalis occidentalis*) was shown to be positively correlated with rainfall during the preceding winter (LaHaye and others 1997). Spotted owls in the San Bernardino Mountains are part of a southern California subpopulation, geographically isolated from a larger subpopulation in the Sierra Nevada of California, and with a diet largely dependent on woodrats (*Neotema* sp.). This contrasts with most other populations of spotted owls, for which northern flying squirrels (*Glaucomys sabrinus*) dominate diets, especially in conifer forests.

Our objectives in this study are to assess the possible relations between weather conditions and California spotted owl reproduction, to look for nest-site attributes correlated with reproductive success, and to characterize nest-site structure for owls in the southern Sierra Nevada (North and others 2000).

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Preliminary Results and Discussion

On the basis of a 9-year demographic study in the Sierra National Forest and in Sequoia/Kings Canyon National Parks, two observed trends are being explored in this study. First, reproductive success of all surveyed owls tended to be synchronous throughout both study areas within any given year. The common reproductive response produces distinct annual fluctuations, with good years in which each owl pair averaged from 0.6 to 1.7 fledged young, and bad years with pairs averaging fewer than 0.4 fledged young. This pattern suggested the operation of a factor with an extensive regional influence on owl reproductive success.

Weather and the abundance of prey are two possible explanations for this regional effect. The possible role of weather in the reproductive performance of the owls is under investigation (North and others 2000), but region-wide data on the abundance of prey are not available. An alternative is to infer prey availability indirectly from studies of the two food sources most widely consumed by small mammals—truffles and conifer seeds. Truffle abundance did not vary significantly over a 2-year study, and the available standing crop always exceeded a hypothesized consumption rate of 0.6 kg/ha (North and others 1997). By using data from the USDA Forest Service's tree nursery at Placerville, California, the annual quantity of dried seed per bushel of cones of conifer species was compared to the annual reproductive rates of owls in the study area (*table 1*). Although some of the correlation coefficients were above 0.50, owl reproduction was not significantly correlated with any of the previous year's conifer seed abundance.

The second trend noted over the 9-year study was that some nests had consistently higher reproductive success than others. Even during several "bad" years, some nests with repeated use continued to produce young. To rank nests in terms of their reproductive performance, I weighted reproductive success of each nest in the study area by dividing the number of fledglings produced in each nest in a given year by the mean, annual reproductive rate for all surveyed owl pairs in the study (*table 2*). This increased the ranking scores of nests that produced young in bad years and gave less weight to nests that were productive in years when most pairs nested. On this weighted scale, the 117 nests found during the study ranked from 0 to 34 in weighted reproductive success. Most of the nests with higher reproduction have been used year after year, but commonly the nests with low ranking scores were used only once. This pattern suggested that, in addition to regional influences that affect all owl pairs, local nest-site factors must also influence reproduction

Table 1—*Correlation coefficients (P-values) for seed crop abundance and spotted owl reproduction, 1989-1998*

Species	Correlation coefficient
White fir (*Abies concolor*)	0.61 (0.15)
Red fir (*Abies magnifica*)	0.57 (0.32)
Jeffrey pine (*Pinus jeffreyi*)	0.01 (0.97)
Sugar pine (*Pinus lambertiana*)	-0.25 (0.51)
Ponderosa pine (*Pinus ponderosa*)	0.42 (0.27)
Mean seed abundance	0.57 (0.11)

Table 2—*Mean weighted number of young per owl pair and number of nests, classed by years of nest use*

Number of years a nest was used	Number of nests	Mean weighted number of young per owl pair[1]
1	76	1.61[a]
2	30	2.54a[b]
≥ 3	11	3.29[b]

[1] Values with different superscripts are significantly different ($P < 0.05$, posthoc ANOVA).

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