

adult survival probability of 0.827), the juvenile survival rate would have to be more than double (from the estimated 0.333) to 0.790. However, given that all other parameters remain the same, Franklin (2003) estimated that if adult and subadult survival was actually 0.85, juvenile survival would have to be 0.657 to achieve a stationary population, and if adult and subadult survival were actually 0.87, juvenile survival would have to be 0.55 for a stationary population. A juvenile survival probability of 0.55 is within the realm of possibility based on juvenile survival estimates for northern spotted owls on two study areas (Franklin *et al.* 1999).

The meta-analysis for this study area included nine years of sampling (1992 to 2000) and encompassed 490 mi². The mean λ estimate for the period using Pradel's method was less than 1.0 (0.985), but was not statistically different from that of a stationary population ($\lambda = 1.0$). Examination of the annual λ estimates (per year, as opposed to the above mean λ) showed no evidence of a trend for the Lassen study, and adult apparent survival showed no substantive variation or trends through time. Fecundity was so variable through time that a linear trend (as opposed to sporadic high-low trends) could not be identified.

Although there is information that suggests that this population may be declining, uncertainties exist when interpreting the projection matrix approach, actual counts, and Pradel's methodology. Without further refinement of the projection matrix approach (*i.e.*, adjusting juvenile survival estimates using radio telemetry), it is difficult to reconcile the declining projection matrix λ of 0.910 with the statistically stationary estimate of 0.985 derived using Pradel's methodology. Thus, we cannot conclude with certainty that the population is declining, increasing, or stationary.

Eldorado Study Area—The Eldorado study area consisted of two segments: a 137-mi² density study area, and a 220-mi² regional study area. The most recent publication for this study area (Seamans *et al.* 2001a) covered 10 years of field sampling (1990 to 1999). Although surveys took place from 1986 to 1999 in the density study area, surveys in the regional study area were initiated in 1997. Only data from 1990 to 1999 were used because survey effort and sample sizes increased dramatically after 1989 due to increased funding (Seamans *et al.* 2001a). The study area was located primarily within the Eldorado National Forest, but portions were also located within the Tahoe National Forest and the Tahoe Basin Management Area.

Researchers lacked sufficient data to calculate the juvenile survival rate on the Eldorado study area, so they used the survival rate from the nearby Lassen study area (0.333) as a surrogate. This estimate was thought to be optimistic, as estimates of northern spotted owl juvenile survival from 11 study areas averaged 0.258 (Forsman 1996), and in the Eldorado study area, 11 of 147 individuals banded as juveniles were recaptured as territory holders, which would translate to a survival probability of 0.074 (Gutiérrez *et al.* 2001). However, there is a likelihood that the estimated juvenile survival of 0.258 for northern spotted owls was underestimated, as it was not corrected for juvenile emigration. A later report (Franklin *et al.* 1999) adjusted juvenile survival estimates in three northern spotted owl study areas to reflect juvenile emigration rates calculated from radiotelemetry data. The adjusted juvenile survival rates were 0.598, 0.632, and 0.366. These estimates represented increases of 137.2%, 41.8%, and 87.9% in juvenile survival estimates for each respective study area.

Using the projection matrix approach, the annual rate of population change was estimated to be 0.948, which was significantly less than that of a stationary population. This λ value suggested that the territorial female owl population declined 5.2 percent annually from 1990 to 1999. In contrast, female abundance at the start (1990) and finish (1999) of the study was 26 and 28 individuals, respectively. This difference between the estimated λ and the rate calculated from actual numbers could be attributed to immigration of individuals into the study area. If true, this would indicate that individuals were not replacing themselves, but were being replaced by recruits from outside the study population. Earlier estimates of λ from this study area calculated similar trends ($\lambda = 0.947$) using only 6 years of data (Noon *et al.* 1992). This six year estimate was not statistically less than 1.0, but the power (ability to detect differences) of this test was low, so the trend of the population was uncertain at the time (Verner *et al.* 1992). Results from the 2001 study (Seamans *et al.* 2001a) expanded the sample size and study period, and increased the statistical power of their test so that their estimate of λ (0.948) was then found to be statistically less than 1.0.

The use of a surrogate juvenile survival rate in this study may introduce bias into the estimate of λ for two reasons: the Lassen estimate of juvenile survival probably carries certain biases given the inability to

consider juvenile emigration in the estimate of juvenile survival, and the Lassen study area may not accurately represent the Eldorado study area. Further, Gutiérrez *et al.* (2001) reports that survey effort for this study area changed over time, and that survey effort can influence density and survival estimates. For this reason, data from the first four years of study were not included in the estimate of survival or reproduction (Seamans *et al.* 2001a analyzed data starting in 1990, not 1986). In a subsequent report (Seamans *et al.* 2001b), the projection matrix estimate of λ was compared to a growth rate calculated from actual numbers of adult females present during the study. The growth estimate from actual numbers was 0.951, and was significantly less than zero. This estimate was calculated using data from 1993 (37 adult females) to 2000 (24 adult females), while the value derived from the projection matrix approach (0.948), which was calculated using data from 1990 to 1999.

The meta-analysis for this study area included 11 years of sampling (1990 to 2000) and encompassed 137 mi². The mean λ estimate for this study area was greater than 1.0 (1.042), and was not statistically different from that of a stationary population ($\lambda = 1.0$). Examination of annual λ estimates showed a significant decline, and similar to the Lassen study area, adult apparent survival showed no substantive variation or trends through time. No linear trend in fecundity could be identified.

While the projection matrix estimate of λ showed a decline, (and trend in Pradel's annual λ showed a decline), actual counts increased a small amount from 1990 (26 adult females) to 1999 (28 adult females) but decreased from 1993 (37 adult females) to 2000 (24 adult females), and the mean λ estimate using Pradel's method appeared to show a stationary population. Furthermore, there were substantive uncertainties regarding the accuracy of vital rate estimates used in the projection matrix estimate of λ . These results do not allow us to reach a definitive decision with respect to population trend on the Eldorado study area, and we cannot conclude the population is declining.

Sierra Study Area—The Sierra study area was located primarily (92 percent) within the Sierra National Forest, and encompassed the watersheds of the San Joaquin River and the North Fork of the Kings River (Franklin *et al.* 2002). The study area included approximately 263 mi², and the boundaries were delineated based on National Forest boundaries and major topographic features such as