

for foraging. Although canopy covers down to 40 percent are suitable for foraging, they appear to be so only marginally. Radio tracking data from the Sierra National Forest showed that owls tended to forage more in sites with greater than 50 percent canopy cover than predicted from their availability; while stands with 40 to 50 percent canopy cover were used about in proportion to their availability (USFS 2001a). The subspecies avoids open (0–30 percent canopy cover; Gutiérrez *et al.* 1992) or logged (Call 1990, Zabel *et al.* 1992b, Gutiérrez and Pritchard 1990) areas.

Winter Habitat. Winter habitats of owls that undertake altitudinal migrations have similar canopy closures, but lower basal areas of both green trees and snags, and higher shrub densities than higher-elevation summer habitats (Gutiérrez *et al.* 1995).

General Description of Suitable Habitat. Based on the above studies, nesting habitat for California spotted owls is generally described as stands with an average dominant and co-dominant tree diameter of greater than 24 in and canopy cover of greater than 70 percent. Foraging habitat is generally described as stands of trees of 30 cm (12 in) in diameter or greater, with canopy cover of 40 percent or greater. Exceptions to both descriptions are known to occur. Suitable habitat includes California Wildlife Habitat Relationship (WHR) habitat types 4M, 4D, 5M, 5D, and 6 (Mayer and Laudenslayer 1988).

Home Range

Spotted owl pairs have large home ranges that may overlap those of conspecifics (Verner *et al.* 1992b). A portion of the home range is defended as a territory, especially against unknown intruders (Gutiérrez *et al.* 1995). However, territorial disputes between neighbors are rare. Members of the same sex are more likely to display aggression toward each other than members of the opposite sex (Verner *et al.* 1992b). Spotted owls may roost near conspecifics other than their mates (Gutiérrez *et al.* 1995). Verner *et al.* 1992b suggested that the spotted owl territorial system functions such that an individual or pair are dominant within a territory and prevent conspecifics from breeding there, but that feeding or roosting by those birds may be tolerated.

Carey *et al.* (1992) studied the relationship between the amount of habitat used by northern spotted owls and prey abundance within those habitats. They found that owls used more area in habitats where the estimated biomass of medium sized

prey, primarily flying squirrels and woodrats, was lower. The largest home ranges of California spotted owls occur where flying squirrels comprise the majority of the owl's diet and the smallest occur where woodrats dominate (Verner *et al.* 1992b, Zabel *et al.* 1992a). Woodrat populations are denser than flying squirrel populations, often by at least 10 fold, and woodrats weigh nearly twice as much as flying squirrels. Variation in prey availability likely affects the percentage of California spotted owl pairs that nest and successfully fledge young. Weather may also affect these parameters, either by directly affecting the owls or by affecting their prey base (Verner *et al.* 1992b).

Estimates of California spotted owl home range size are extremely variable. All available data indicate that they are smallest in habitats at relatively low elevations that are dominated by hardwoods, intermediate in size in conifer forests in the central Sierra Nevada, and largest in the true fir forests in the northern Sierra Nevada (Zabel *et al.* 1992a, USFS 2001a). Based on an analysis of data from telemetry studies of California spotted owls, mean breeding season pair home range sizes have been estimated as 3,642 ha (9,000 ac) in true fir forests on the Lassen National Forest; 1,902 ha (4,700 ac) in mixed conifer forests on the Tahoe and Eldorado National Forests; and 1,012 ha (2,500 ac) in mixed conifer forests on the Sierra National Forest. Zimmerman *et al.* (2000) used radiotelemetry data to estimate the breeding season home range of two pairs of California spotted owls in the San Bernardino Mountains of southern California. The average home range (571 ha (1,410 ac)) was smaller than those reported for the Sierra Nevada and varied widely between the two pairs (325 to 816 ha (803 to 2,016 ac)).

Gutiérrez *et al.* (1992) analyzed the sizes of stands containing nest trees (*i.e.*, nest stands) and the cumulative sizes of each nest stand plus all adjoining stands that were in vegetation strata preferentially used by owls for nesting. The mean size of nest stands was about 40 ha (100 ac); the mean size of the nest stand plus adjacent suitable stands was about 120 ha (300 ac). In radio tracking studies, the central area including half of the foraging locations of owls was found to vary from an average of 128 ha (317 ac) on the Sierra National Forest to an average of 319 ha (788 ac) on the Lassen National Forest (Gutiérrez *et al.* 1992). Bingham and Noon (1997) used radiotelemetry data to calculate core areas within the home ranges of four California spotted owls. Owls used the

core areas more than would be expected if the entire home range were used at random. Core areas contained an average of 66 percent of points at which owls were located within an average of 21 percent of the home range.

Habitat in Home Range. California spotted owls were found to select more consistently for habitat patches with high canopy cover than for large tree size-class (Zabel *et al.* 1992a). Call (1990) estimated 42 percent of the home range to be medium timber 28 to 53 cm (11 to 21 in) dbh, and 55 percent large timber greater than 53 cm (21 in). The proportion of habitat in home ranges of owls in conifer forests of the Sierra Nevada with canopy cover greater than 40 percent was 68 percent and 81 percent for the two conifer sites studied. (Zabel *et al.* 1992a).

California spotted owls have been known to use stands that were recently selectively harvested (Zabel *et al.* 1992b). However, where forests in the Sierra National Forest were heavily thinned, owls consistently nested in patches with large, old, high crown-volume trees (North *et al.* 2000), relying on the remaining components of the original forest.

Numerous studies have described habitat used by spotted owls and habitat that occurs around owl nest sites and activity centers, but the relationships between these forest habitat characteristics and the distribution and demographic performance of California spotted owls are not completely understood. Several studies that have related habitat characteristics with California spotted owl demographic performance and occupancy rates found that productivity was positively correlated with amounts of forest with high canopy cover. Blakesley (2002a) characterized habitat within 1,830 ha (4,532 ac) circles surrounding 67 California spotted owl nest sites in northeastern California and used those data to explain observed variation in site occupancy, apparent survival probability, reproductive output, and nest success. Site occupancy was positively associated with the amount of habitat dominated by large trees and high canopy cover. North *et al.* (2000) found higher reproduction in conifer forest associated with high foliage volumes and concluded: "The possible interaction of weather and nest-site structure on owl reproduction suggests forest managers should be cautious about reducing canopy volume in potential owl nesting areas. Retaining groups of large, old, high crown-volume trees may be needed to maintain the number of potential nesting sites in a forest." Apparent survival and