

# HABITAT REQUIREMENTS OF THE SPOTTED OWL IN CALIFORNIA

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Abstract. A minimum of 274 spotted owls, representing 199 pairs, were located most frequently in dense conifer forests at elevations from less than 100 to 7,600 feet. Dominant tree species varied from one geographic area to another. Redwood and Douglas-fir were dominant at sites along the north coast, canyon live oak and ponderosa pine along the south coast, and a mixed conifer forest in the Sierra Nevada Mountains. Trees at spotted owl sites usually were greater than 21 inches d.b.h., displayed a moderate degree of decadence, and formed a canopy where the closure was greater than 40 percent at 90 percent of the sites. Spotted owls commonly were found in canyon situations, frequently on a north-facing slope. Water was found within 0.2 miles of the spotted owls located at 90 percent of the sites.

Spotted owls were found in park or suburban areas where human activity was great at 14 percent of the sites. Logging was known to have occurred at or near 71 sites. Owls occurred in some logged areas and in areas of human activity where there was still ample and dense forest and "escape" areas for the owls. Where logging was more extensive, spotted owls may have been extirpated. In other areas logging may reduce the number of pairs of spotted owls in an area. The degree of reduction may depend on the timber type.

Management recommendations were suggested to gain further detailed information on habitat use by spotted owls, and to maintain present populations if land management agencies wish to do so.

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The United States Fish and Wildlife Service has identified the spotted owl (*Strix occidentalis*) as threatened in the "Red Book." The status of this secretive woodland raptor was unknown throughout its range but was believed to have been quite rare. To determine the status of the two subspecies in California--the northern spotted owl (*S. o. caurina*) and the California spotted owl (*S. o. occidentalis*)--the California Department of Fish and Game and the United States Forest Service cooperatively initiated and financed this study in July 1973. Later additional financing was provided by the

TABLE 1

## MAJOR POPULATION CONCENTRATIONS OF SPOTTED OWLS IN CALIFORNIA, 1973-1974

| Location      | No. of Pairs of Owls | Dimensions of Area (Mi.) | Approximate Area (Mi. <sup>2</sup> ) | Avg. Min. Distance Between Adjacent Pairs (Mi.) | Range of Min. Distance Between Adjacent Pairs (Mi.) |
|---------------|----------------------|--------------------------|--------------------------------------|---|---|
| South Trinity | 16                   | 2-6 x 30                 | 125                                  | 2.41  | 1.2 - 6.0   |
| West Marin    | 13                   | 2-5 x 25                 | 75                                   | 1.84  | 1.2 - 4.6   |
| Mariposa      | 18                   | 6-18 x 28                | 200                                  | 2.27  | 0.1 - 7.5   |
| North Tulare  | 11                   | 1-5 x 18                 | 40                                   | 1.64  | 0.8 - 4.0   |
| South Tulare  | 12                   | 2-8 x 28                 | 115                                  | 2.78  | 1.1 - 7.2   |

National Park Service.

Similar to many raptors, spotted owls were believed to be extremely vulnerable to human disturbance and habitat modifications. The disturbance of dense old growth timber by logging and increased recreational use of the forest was thought to have been reducing the numbers of spotted owls by the alteration of preferred habitat.

Four major objectives were accomplished during this study. First, the present distribution of this owl in California was determined. Second, some idea of the population size and the location of concentrations of spotted owls were determined. Habitat characteristics were also noted for the possible determination of habitat requirements. Finally, the training of state and federal agency biologists in location techniques and in habits requirements of spotted owls was accomplished.

This study was divided into two phases; from July 9 to September 28, 1973 work was conducted in the northwest corner of California, and remaining areas of montane forest were surveyed from March 4 to July 12, 1974. The study was cooperatively supported by: California Department of Fish and Game, Federal Aid in Wildlife Restoration Project W-54-R-6, Nongame Wildlife Investigations, Wildlife Management Branch; United States Forest Service Contract No. 39-4870, Spotted Owl Habitat Evaluation Administrative Study; and National Park Service Purchase Order PX-8000-40-504.

#### METHODS

Since spotted owls had been found in Oregon in dense, old growth timber, similar areas in California were checked. Some survey areas included managed forests where a variety of forest habitats could be sampled. Also historical sites reported in literature or museum records, or sites where cooperators had reported spotted owls, were surveyed to substantiate distribution and habitat preference. Of 124 different, previously reported, spotted owl sightings, spotted owls were relocated at 60 percent of the 86 sites checked.

Spotted owls were located by playing pre-recorded calls or vocally imitating calls of spotted owls. Owls responded to these calls by calling back. The basic call used was the four-note series of hoots occasionally broken by the barked-hoot series, whistled contact call and raven-like call.

Usually calling was done in one of two ways. With the stop method, stops were made every 0.3 to 0.5 of a mile. At each stop calls were given for about 8 to 10 minutes with 20 to 30 second intervals between individual calls. The continuous method involved walking roads and trails through survey areas calling every 50 to 100 yards. This provided continuous coverage of an area. Combined, the stop and continuous method were successful about 65 percent of the time.

To date, trained United States Forest Service and private personnel have provided an additional 17 locations. Most of these people called during daylight hours while checking timber sale sites. Also I performed daylight surveys and was successful. Daylight surveys only can be performed where habitat is limited and the caller is assured of getting close to the owls.

At each site where spotted owls were found, vocal characteristics of the owls and physical characteristics of the site were noted. Owls were sexed by their calls which facilitated the demarcation of pair territories when adjacent pairs of spotted owls were encountered. Legal descriptions of each site were noted to the nearest quarter section where possible. United States Forest Service timber type maps were reviewed to ascertain size, density and composition of tree types. For areas where timber type maps were unavailable, the author typed the areas. Slope, elevation, local

TABLE 2

## ELEVATION AT SPOTTED OWL LOCATIONS, 1973-1974

| Elevation<br>(Feet) | Percent Occurrence |              |                |              |                |                | Total |
|---------------------|--------------------|--------------|----------------|--------------|----------------|----------------|-------|
|                     | North Coast        |              | South Coast    |              | Sierras        |                |       |
|                     | Red-<br>woods      | Doug.<br>fir | Hard-<br>woods | Coni-<br>fer | South<br>Mixed | North<br>Mixed |       |
| 0 - 399             | 81                 | 4            | —              | —            | —              | —              | 10    |
| 400 - 799           | 10                 | 12           | 8              | —            | —              | —              | 5     |
| 800 - 1199          | 5                  | —            | 17             | —            | —              | —              | 2     |
| 1200 - 1599         | 5                  | 4            | —              | —            | —              | —              | 2     |
| 1600 - 1999         | —                  | —            | 17             | —            | —              | —              | 1     |
| 2000 - 2399         | —                  | 4            | —              | —            | —              | —              | 1     |
| 2400 - 2799         | —                  | —            | 17             | —            | 2              | 4              | 3     |
| 2800 - 3199         | —                  | 15           | 17             | —            | 2              | 4              | 7     |
| 3200 - 3599         | —                  | 8            | 25             | —            | 1              | 12             | 6     |
| 3600 - 3999         | —                  | 19           | —              | 8            | 10             | 8              | 10    |
| 4000 - 4399         | —                  | 23           | —              | 15           | 1              | 12             | 9     |
| 4400 - 4799         | —                  | 6            | —              | 8            | 7              | 16             | 7     |
| 4800 - 5199         | —                  | 4            | —              | 15           | 10             | 20             | 8     |
| 5200 - 5599         | —                  | —            | —              | 15           | 10             | 12             | 6     |
| 5600 - 5999         | —                  | 2            | —              | 15           | 10             | 8              | 6     |
| 6000 - 6399         | —                  | —            | —              | 23           | 13             | 4              | 7     |
| 6400 - 6799         | —                  | —            | —              | —            | 13             | —              | 5     |
| 6800 - 7199         | —                  | —            | —              | —            | 12             | —              | 4     |
| 7200 - 7599         | —                  | —            | —              | —            | —              | —              | —     |
| 7600 +              | —                  | —            | —              | —            | 1              | —              | 1     |

topography, the presence of roads, timbered areas, and water courses were also noted.

#### POPULATION STATUS

##### Size:

Two hundred and seventy-four spotted owls, representing 199 pairs, were located in 33 counties during this study (Figure 1). This is the minimum population size for California. An accurate estimation of statewide population can not be derived from these figures since the amount of habitat surveyed and the total available for spotted owls has not been calculated.

However, enough data were collected to determine the locations of large concentrations of spotted owls and to determine the relative abundance of spotted owls in different areas.

Five major population concentrations, representing 35 percent of the pairs located in the study, were found in California (Table 1). These concentrations vary in size from 10 to 18 pairs in areas approximately 40 to 200 square miles. Two of the concentrations occurred in the north coast area and 3 in the southern Sierra Nevada Mountains (Figure 1). Probably these areas are the present population centers for the northern spotted owl and the California spotted owl respectively. Only minor concentrations were found in the south coast and northern Sierra Nevada Mountains.

Since spotted owls occur in three major geographic areas in California--north coast, south coast, and Sierra Nevada Mountains--the results will be treated by geographic area. In addition, each area is further divided into two zones to conform with major habitat types. Along the north coast spotted owls occurred in the coast redwood (*Sequoia sempervirens*) belt or in the more interior Douglas-fir (*Pseudotsuga menziesii*) belt. Along the south coast spotted owls were found in either a lowland hardwood zone or a higher elevation conifer dominant zone. In the Sierra Nevada Mountains spotted owls were found in the mixed conifer belt. For comparative purposes, the Sierra Nevada Mountains were divided into northern and southern sections at the Amador-Calaveras county boundary.

Using two methods to measure the relative abundance of spotted owls, the abundance of these owls in the north coast redwood area was close to the overall statewide average. But abundance varied greatly, even over a short distance. The abundance of spotted owls in Marin County was considerably above average, but in adjacent Sonoma County abundance was low. In the north coast Douglas-fir zone spotted owls were least abundant in the marginal parts of the Douglas-fir belt--Lake, Shasta and Glenn counties. They were most abundant in Trinity and Tehama counties.

Small, very localized populations of spotted owls were found in the south coast area. Spotted owls were more abundant in the conifer habitat than in the hardwood habitat and became abundant in the conifer habitat in Riverside and San Diego counties.

Spotted owls were less abundant in the Sierra Nevada Mountains north of Amador County than south. However, abundances in Nevada and Sierra counties were comparable to the abundances in most of the counties in the southern Sierra Nevada Mountains. Here spotted owls were most abundant. The relative abundance of owls was higher than average for most counties in this area. It is interesting to note that spotted owls in Fresno County, between 2 major population concentrations, were not very abundant.

Comparisons between the relative abundance of one management area and another, in the same geographic area, can be made. In the southern Sierra

TABLE 3

## TIMBER TYPE AT SPOTTED OWL LOCATIONS

| Timber Type         | Points for Timber Type |           |             |          |             |             | Total |
|---------------------|------------------------|-----------|-------------|----------|-------------|-------------|-------|
|                     | North Coast            |           | South Coast |          | Sierras     |             |       |
|                     | Red-woods              | Doug. fir | Hard-woods  | Coni-fer | South Mixed | North Mixed |       |
| Douglas-fir         | --                     | 83        | --          | --       | 2           | 4           | 89    |
| " dominant          | --                     | 36        | --          | --       | 4           | 19          | 59    |
| yellow pine         | --                     | 21        | --          | 13       | 39          | 2           | 75    |
| " dominant          | --                     | 1         | --          | 4        | 44          | 21          | 70    |
| sugar pine          | --                     | 1         | --          | 2        | 2           | --          | 5     |
| " dominant          | --                     | 2         | --          | 2        | 41          | 7           | 52    |
| Bishop pine         | 9                      | 1         | --          | --       | --          | --          | 10    |
| " dominant          | --                     | --        | --          | --       | --          | --          | --    |
| Coulter pine        | --                     | --        | --          | --       | --          | --          | --    |
| " dominant          | --                     | --        | --          | 2        | --          | --          | 2     |
| white fir           | --                     | --        | --          | --       | 6           | 2           | 8     |
| " dominant          | 3                      | 1         | --          | --       | 39          | 20          | 63    |
| redwood             | 47                     | --        | 3           | --       | --          | --          | 50    |
| " dominant          | 3                      | --        | --          | --       | --          | --          | 3     |
| giant sequoia       | --                     | --        | --          | --       | --          | --          | --    |
| " dominant          | --                     | --        | --          | --       | 17          | --          | 17    |
| incense cedar       | --                     | --        | --          | --       | --          | --          | --    |
| " dominant          | --                     | --        | --          | 6        | 3           | --          | 9     |
| hardwoods           | 1                      | 5         | --          | --       | --          | --          | 6     |
| Calif. laurel       | --                     | --        | 5           | --       | --          | --          | 5     |
| Calif. black oak    | --                     | --        | --          | 3        | --          | --          | 3     |
| canyon live oak     | --                     | --        | 19          | --       | --          | --          | 19    |
| " dominant          | --                     | --        | 6           | 1        | --          | --          | 7     |
| noncommercial lands | --                     | 2         | --          | --       | 1           | --          | 3     |

<sup>1/</sup> Comparative points were distributed on the frequency of occurrence of a timber type in the quarter quarter section where owls were located. Two points were given to the most common or major timber type in the quarter quarter section. One point was given to the second most common or minor timber type, provided it covered more than approx. 20 percent of the quarter quarter section, and three points were given to a timber type if it covered more than 80 percent of the quarter quarter section. This system considers minor timber types as well as major timber types at each site.

Nevada Mountains spotted owls were equally abundant on United States Forest Service and National Park Service areas. However, there were relatively fewer spotted owls in Yosemite National Park than elsewhere and more in Place Big Trees and Calaveras Big Trees State Park. Both of these small parks may be remnants of undisturbed sites while both United States Forest Service and National Park Service lands have a history of logging activity. Also available habitat for spotted owls is limited around the 2 parks, probably restricting spotted owls to the parks.

The average minimum distance between adjacent pairs was about 2.2 miles in the areas of major concentrations (Table 1). The minimum distance varied from 0.1 to over 7 miles. However, 63 percent of 70 minimum distances between pairs were from 0.8 to 1.8 miles. The minimum distance of 0.1 miles was noted only once when a territorial conflict was induced by calling an area and attracting adjacent pairs of owls. It seems that the spacing between pairs separates pairs so that "hooting matches" over territorial boundaries are uncommon.

It must be noted that the minimum distance between adjacent pairs noted above is not the minimum internest distance nor the minimum distance between day-time perch sites.

Territories are not always contiguous even in areas of high relative abundance. In southwestern Tehama County 4 pairs were found along the north side of one ridge. The territories of the 2 westernmost pairs were contiguous but the minimum distance between the central 2 pairs and the eastern 2 pairs were 1.4 and 1.6 miles respectively.

Multiple locations were made on 4 pairs and a minimum area of defended territory could be measured. These areas were about 340, 320, 160 and 100 acres. The long dimension across these territories were 1.7, 1.3, 1.1 and 0.7 miles. Though these are not accurate measurements of the territory size of a pair of spotted owls, they can be indicative of the territory size and the pair's propensity to move within their territory.

#### HABITAT REQUIREMENTS

Five major characteristics of the habitat where each pair of spotted owls were found were noted--elevation, timber type, topographic type, water availability and slope exposure. Characteristics for each site pertain to that part of the site where the owl(s) was first located. Therefore, these characteristics are not necessarily representative of key spotted owl use areas such as nest or perch sites but are representative of habitat that spotted owls defended.

#### Elevation:

Spotted owls were found from less than 100 to 7,600 feet (Table 2). The elevational distribution in each of the three major geographic areas of the study closely follows the distribution of suitable forested areas and the effort involved in trying to locate owls at these elevations.

In the north coast area spotted owls were found frequently in the coastal redwood belt from 60 to about 800 feet elevation, and above 2,800 feet in the Douglas-fir zone. Spotted owls infrequently were found in the predominantly privately owned redwood zone from 800 to 2,800 feet. Likewise, they were not found at higher elevations, above 4,200 feet in Siskiyou County and above 6,000 feet in Glenn County.

Spotted owls were found along the south coast from 700 to 6,300 feet. At elevations below 3,600 feet hardwoods were dominant. Above 3,600 feet conifers became dominant, especially above 4,400 feet. No coastal sites were

TABLE 4  
SLOPE EXPOSURE AT SPOTTED OWL LOCATIONS

| Slope Exposure | Percent Occurrence  |             |             |         |                                  |                                  | Total  |
|----------------|---------------------|-------------|-------------|---------|----------------------------------|----------------------------------|--------|
|                | North Coast         |             | South Coast |         | Southern Sierra Nevada Mountains | Northern Sierra Nevada Mountains |        |
|                | Redwoods            | Douglas fir | Hardwoods   | Conifer | Mixed                            | Mixed                            |        |
| N              | 14(3) <sup>1/</sup> | 13(7)       | 27(3)       |         | 12(8)                            | 24(6)                            | 14(27) |
| NE             | 10(2)               | 25(13)      | 18(2)       | 25(3)   | 7(5)                             | 4(1)                             | 14(26) |
| E              | 10(2)               | 10(5)       | 18(2)       |         | 6(4)                             | 8(2)                             | 8(15)  |
| SE             |                     | 10(5)       | 9(1)        |         | 14(10)                           | 12(3)                            | 10(19) |
| S              | 10(2)               | 4(2)        |             |         | 9(6)                             | 4(1)                             | 6(11)  |
| SW             | 5(1)                | 12(6)       |             | 17(2)   | 12(8)                            | 4(1)                             | 9(18)  |
| W              | 10(2)               | 10(5)       | 9(1)        | 8(1)    | 10(7)                            | 8(2)                             | 9(18)  |
| NW             | 5(1)                | 15(8)       | 18(2)       | 25(3)   | 10(7)                            | 8(2)                             | 12(23) |
| -              | 38(8)               | 2(1)        |             | 25(3)   | 20(14)                           | 28(7)                            | 17(33) |

<sup>1/</sup> Parenthetical values indicate number of occurrences.

(190)



checked so the lower limit of 700 feet doesn't represent the possible lower limit of the range.

In the Sierra Nevada Mountains spotted owls were found from 2,700 to 7,600 feet. Preference was shown for the 3,600 to 7,200 foot zone in the south and the 3,200 to 5,600 foot zone in the north. Other sites with elevations less than 2,700 feet were not checked. It is quite likely that spotted owls can be found at lower elevations since this species should be able to live in hardwood sites in the foothills which are similar to those sites found along the south coast. Two cooperator sightings of spotted owls, at about 8,000 feet in Sequoia-Kings Canyon National Park, could not be checked since the snow had not melted at that elevation when the park was checked.

#### Timber Type:

Grinnell and Miller (Grinnell, J. and A. Miller, 1944. The Distribution of the Birds of California, Pac. Coast Avifauna 27:203-205) defined the habitat of the northern spotted owl as "heavy woodland and coniferous forest) and of the California spotted owl as "dense woodland or forest." The conclusions of this study are much the same though species composition, forest canopy density and structure, and tree size and degree of decadence are considered. Timber type characteristics are represented by symbols used in the United States Forest Service Manual, Section 2441.1.

Along the north coast spotted owls mainly were found in redwood and Douglas-fir situations (Table 3). Grand fir (Abies grandis), Douglas-fir, California laurel (Umbellularia californica), red alder (Alnus rubra) and Pacific madrone (Arbutus menziesii) also occurred but in small quantities where spotted owls were found in the redwood zone. Spotted owls were not found in hardwood stands in the redwood belt. In a few coastal areas Bishop pine (Pinus muricata) was dominant with an understory of California laurel.

In the Douglas-fir zone spotted owls were usually found in nearly pure Douglas-fir or Douglas-fir dominant timber types. In the more xeric, inland sites the spotted owl location were vegetated with a mixed Douglas-fir-ponderosa pine (Pinus ponderosa) or pure ponderosa pine timber type. Also there was a shift in understory hardwoods from California laurel and Pacific madrone to tanoak (Lithocarpus densiflorus) to oak (Quercus sp.) from the hydric to more xeric sites. At high elevation sites, where spotted owls were located, there were some sugar pine (Pinus lambertiana) dominant stands.

At south coast, lowland, hardwood sites, spotted owls most frequently were found in canyon live oak (Quercus chrysolepis) situations. Frequently, they were in association with California laurel, even to the extent that California laurel was dominant. Other deciduous oaks are present in the south coast hardwood area but the evergreen nature of the live oak and laurel provides year-round cover for the owls. Spotted owls were found in one area where redwood was dominant. This was in one of the southernmost, coastal redwood groves.

A ponderosa pine dominant timber type occurred most commonly at the higher elevation conifer zone sites along the south coast. Incense cedar (Libocedrus decurrens), sugar pine, and Coulter pine (Pinus coulteri) were dominant at some sites. California black oak (Quercus kelloggii) was the dominant understory species at higher elevations. However, as the only timber type in an area, it was incapable of providing adequate habitat for spotted owls.

In the Sierra Nevada Mountains spotted owls were found almost exclusively in the mixed conifer zone. This zone, though dominated in places by ponderosa pine, is characterized by a variety of species in addition to ponderosa pine and Jeffrey pine (Pinus ponderosa and P. jeffreyi). Sugar pine, white fir (Abies concolor), giant sequoia (Sequoia gigantea), Douglas-fir,

TABLE 5  
 OCCURRENCE OF SPOTTED OWLS AT LOGGED SITES,  
 SEQUOIA N.F., 1974

| Site               | Sequoia<br>present | Existing<br>timber of<br>adequate<br>density | Approx.<br>percent<br>of area<br>cut <sup>1/</sup> | Spotted<br>owls<br>present |
|--------------------|--------------------|--|--|----------------------------|
| Nobe Young Creek   | No                 | Yes  | 35-40  | No                         |
| Bone Creek         | No                 | Yes  | 10   | Yes                        |
| Long Meadow Grove  | Yes                | Yes  | 10   | Yes                        |
| Parker Meadow      | No                 | Yes  | 30   | No                         |
| Cold Springs Creek | No                 | Yes  | 10   | Yes                        |
| Starvation Grove   | Yes                | Yes  | 15   | Yes                        |
| Double Bunk Creek  | No                 | No   | 15   | No                         |
| Packsaddle Grove   | Yes                | Yes  | 20   | Yes                        |

<sup>1/</sup> Area measured for percent cut was 1½ by 1½ miles, centered around the site where spotted owls were located, or in the center of the logging sale where no spotted owls were found.

incense cedar, and California black oak are prevalent.

Monotypic timber types occurred at only 6 percent of the sites in the southern Sierra Nevada Mountains. Spotted owls rarely were found in pure white fir, white fir--Jeffrey pine and white fir--red fir (Abies magnifica) associations. Additionally spotted owls were not found in red fir--lodgepole pine (Pinus contorta)--whitebark pine (Pinus albicaulis) associations. Perhaps at higher elevations winters are too severe for this resident species of owl or tree form may not provide adequate nest sites.

In the southern Sierra Nevada Mountains, California black oaks and giant sequoias were noted at 28 and 24 percent of the sites respectively. These tree species may be an important constituent of the habitat. Cavities formed in old individuals of these species may provide nest sites.

Generally trees at spotted owl sites, regardless of forest species composition, form a dense canopy cover. At only 10 percent of the sites was canopy closure known to be less than 40 percent. And at only an additional 10 percent of the sites, could the combined canopy closure of all canopy layers have been less than 40 percent. Canopy closure may be greater than stated because hardwood canopy closure was not noted in some areas.

In areas of low canopy cover in the dominant story, the canopy cover of trees in a smaller size category often becomes more important in providing shade and cover. For this reason a multi-canopied (multi-storied) forest structure is important to spotted owls.

Multi-storied forests occurred at 55 percent of the sites. The number of stories seems dependent on the species composition of the forest. The areas with the greatest species diversity also had the highest degree of layering. Also these areas maintained the highest relative abundance of spotted owls. In the south coast hardwoods, where the trees were not only short, but where only one or 2 species occurred there was little layering. Here the relative abundance of spotted owls was quite low.

At 83 percent of the sites the size of tree in the major timber type was greater than 21 inches d.b.h. Trees 180 to 200 years or older and exhibiting medium to high decadence characteristics occurred at 45 percent of the sites with the large trees. At less than one percent of the sites were the trees in the major timber type less than 12 inches d.b.h. Larger trees allow for a multi-storied forest and show a higher degree of decadence with more broken, burned and candelabra top trees where nesting cavities can occur.

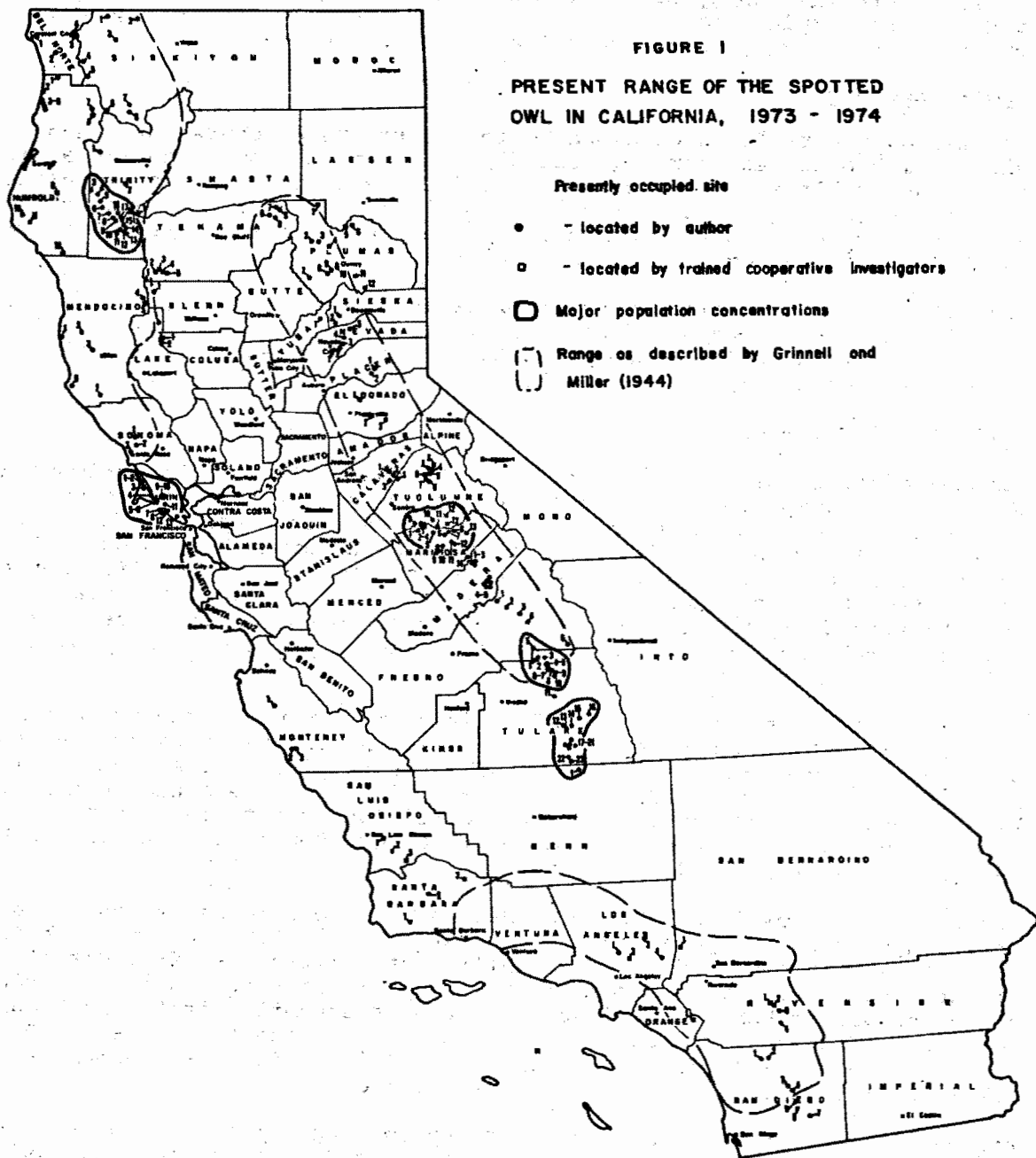
Canopy height, in multi-storied conifer forest situations, varied with tree size. In hardwood dominant areas where spotted owls were located, the bottom of canopy foliage averaged 20 to 30 feet from the ground, and ranged from 10 to 50 feet. Generally little brush grew beneath the hardwood canopy and flight space for the owls was present as it was in conifer situations.

#### Topographic Type:

Spotted owls preferred moderately deep and rather steep-walled drainages (Figure 2). Fifty-eight percent of the sites were found in steep-sided canyon types. Thirty-one percent were in shallower-sided, drainage areas.

#### Water Availability:

Spotted owls show a great affinity for water influence zones. Water courses were present in the topography type at 93 percent of the sites. Spotted owls were first located 0.2 miles, or less, from the nearest water at 90 percent of the sites. At only 3 percent of the sites were spotted owls



believed found at a distance greater than 0.5 miles from the nearest water. The size and type of water source varied but it usually was a perennial creek or river.

Spotted owls' preference for water influence zones likely is associated with the milder microhabitat in the denser vegetation along water courses. This situation may be developed further with the inclusion of an incised water course where the canopy of the trees growing up the slope overlap and provide a more complete shade cover. Also spotted owls may need to drink water, or their prey may be more abundant along water courses.

#### Slope Exposure:

Spotted owls were found on slopes with a northern exposure more than on slopes with other exposures (Table 4). Also spotted owls usually avoided south facing slopes. This was most noticeable in the south coast hardwood and conifer areas. It was least noticeable in the Sierra Nevada Mountains and does not apply to the southern Sierran area. In this area there was a slight preference for southern and western exposures.

Variations in forest structure follow variations in slope exposure. Generally larger, denser expanses of conifers grow on cooler, damper, north slopes. An even cooler, more moist habitat is created in the north slope forest because of the foliage density and shade that the foliage provides.

#### HABITAT DISTURBANCES

Natural disturbances were not noted nor studied. Fire is the only natural disturbance commonly present throughout the range of the spotted owl. It is generally not a problem to the owls in low-elevation, hardwood areas in southern California, where fires burn ridges and upper slopes but not the bottom of deep, steep-sided, wooded canyons. But fire in conifer forests can destroy habitat. However, the lack of fire in redwood and giant sequoia forests eventually may be detrimental to spotted owls. In these areas fire maintains the redwood and giant sequoia stands where old trees provide nesting sites.

Human occupation and usurpation of habitat are the major factors adversely affecting spotted owls today. Fourteen percent of 192 sites are in areas of great human activity. At each of 4 sites--Richardson Grove State Park, Muir Woods National Monument, Giant Forest and Wilsonia--the annual human visitation exceeds 100,000 and is well over a million at a fifth--Yosemite Valley. At 4 sites--Inverness Ridge, Strawberry Valley, South Fork Stanislaus River and Banner Peak--spotted owls maintain territories in towns.

The keys to the owl's survival in these areas seems to be its quiet, apparently unperturbed disposition, the cessation of disturbance to the still dense forest canopy, and the availability of habitat away from direct human disturbance. Such areas, provided by vertical distance, as in the redwoods and sequoias, or horizontal distances are infrequently visited by humans. Here spotted owls may perch during the day and locate their nests. Usually at night, when the owls are active, human activity is at a minimum and probably exerts little influence on the behavior of the owls.

The major usurpation of habitat occurs by cutting the forest for timber harvest or road construction. These activities often occur simultaneously, and many of the surveys performed during this study were from roads. Therefore spotted owls frequently were found near roads.

Logging activity was noted at 71 sites. Some owls were located adjacent to clear-cut units and others were found in both recent and past, selective-cut areas. In areas where there has been logging and where sizeable acreages of good habitat remain, spotted owls still may be found.

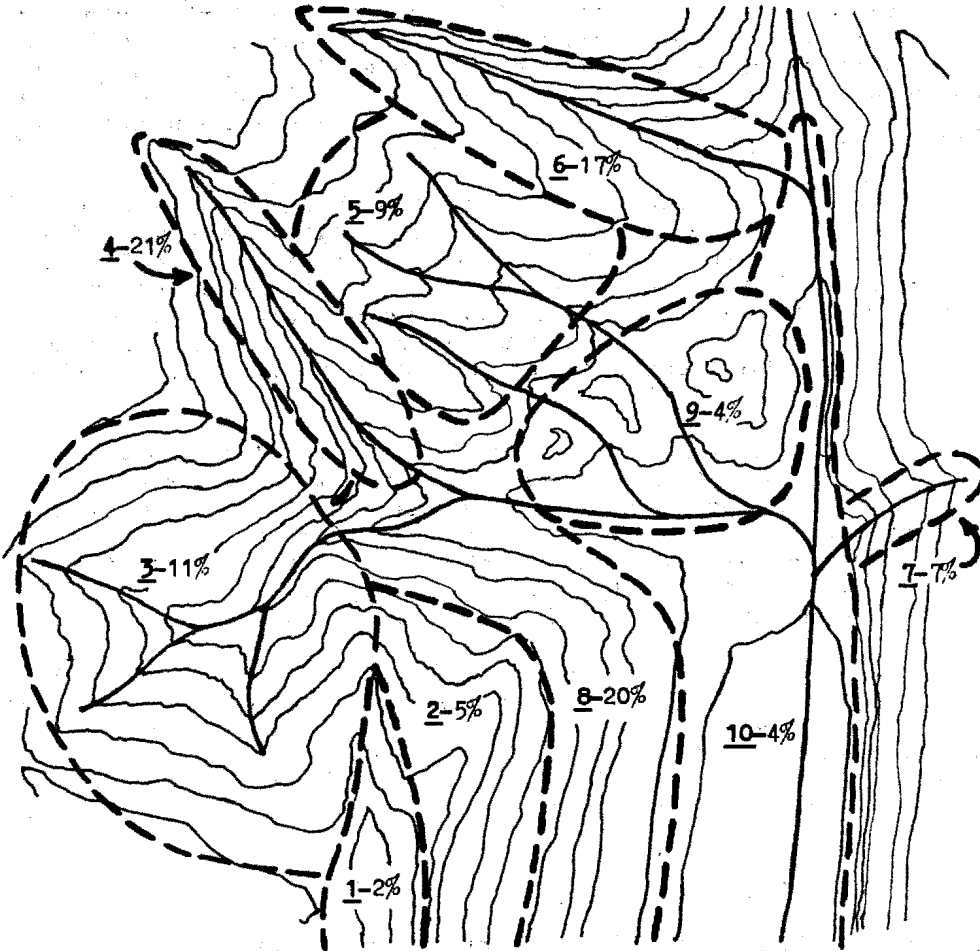


FIGURE 2

TOPOGRAPHICAL TYPES AT SPOTTED OWL LOCATIONS IN CALIFORNIA, 1973-1974

- |                           |                                  |
|---------------------------|----------------------------------|
| 1 - Ridge top             | 6 - Steep canyon                 |
| 2 - Upper slope           | 7 - Shallow canyon               |
| 3 - Upper drainage basin  | 8 - Lower slope                  |
| 4 - Upper drainage canyon | 9 - Small stream-riverside hills |
| 5 - Small upper drainages | 10 - River flat, valley floor    |

Underlined figures represent percent occurrence.

It must be noted that even though spotted owls were found in close proximity to roads and logged areas, there is no indication the owls commonly use these areas or that the owl populations are maintaining themselves there. Owls may have moved toward roads and logged areas since calling was done from these easily accessible areas. In many locations near cut areas, logging had occurred recently. Due to the sedentary nature of spotted owls they may still occur where logging has occurred, but this study did not investigate the major measurement of the stability of the owl population, their reproductive success. If the owls have lost their nesting sites to logging, or have been so disturbed that they no longer breed, the spotted owl population will not be maintaining itself and a reduction in population size will or is occurring.

Two previously known spotted owl sites, for which the exact locations were known, were checked for any indication that logging activity displaced spotted owls. Both sites had been logged, removing about 80 percent of the canopy over approximately 80 percent of the area around the sites where owls were seen 11 years ago. No spotted owls were found at these sites and no other reasons for site abandonment were noticed. It is believed that only logging could have been responsible for the unsuitability of these 2 sites only 1.4 miles apart.

The possible implications of this can be seen further along the western divide, on the Sequoia National Forest. An effort was made to check thoroughly a large area including logged sites. Eight drainages in this area were checked (Table 5). In 2 drainages, 30 to 40 percent of the area had been clear-cut; in the other drainages 10 to 20 percent of the area had been clear-cut. Vegetation type and topographical situation were similar throughout though three areas had giant sequoias.

In the 2 drainages where logging operations had cut more than approximately 30 percent of the area, spotted owls were not found. One site, where tree density was low, and no sequoias were present, spotted owls also were absent. An area of similar cutting pressure, but where sequoias were present and apparently provided adequate habitat, spotted owls were found. But 2 sites with mixed conifer habitat maintained spotted owls with a maximum 10 percent cut.

#### MANAGEMENT IMPLICATIONS

Indications are that the minimum territory size for a pair of spotted owls can be no less than 100 acres and is probably greater than 320 acres. The actual territory used by the owls may be considerably larger than the defended territory, and certain parts of the defended territory may be used more than other parts. Therefore, a study of the spotted owl's utilizations of habitat components and total area occupied should be undertaken.

The area defended by spotted owls is not the nest site, but is likely to be centered on the nest site. It is believed that the nest site grove cannot be disturbed or displacement of the owls will occur. The maximum disturbance in the defended territory, without displacing or adversely affecting the breeding success of the spotted owl, isn't known, but should be.

Considering habitat requirements, territory size, and that logging activity can displace spotted owls, management coordination guidelines are herein suggested if spotted owls are to be maintained:

1. To protect existing sites, timber sale areas be checked for spotted owls. If spotted owls are located, then the nest site or nest grove and daytime perch sites should be located.
2. Timber marking crews be trained in spotted owl identification, habitat requirements, and methods in locating owls. Trained Forest

Service biologists should conduct training programs and coordinate field surveys.

3. The following habitat management measures be employed at occupied sites:
  - a. A no cut area of at least 10 chains radius, centered on the nest site, be established.
  - b. Within a 30-chain radius of the nest no clear-cutting or succession of partial cuts should occur which does not leave:
    - some large groves of old-growth trees. These would be trees that, because of their age, have rounded, spike or multiple tops,
    - dense groves of 10 to 16 inch d.b.h. trees for daytime perch sites. Preferably this would include old sites previously used by owls,
    - the multi-species composition of the forest intact.
    - the multi-storied structure of the forest so that no one forest level is eliminated.
  - c. A water course, which flows or maintains standing water all year, in or immediately adjacent to the "no cut" area, be included.
  - d. Both sides and bottom of the main drainage in the area be included in the larger, 30 chain, area.
  - e. Cutting not be allowed within 30 chains of the nest from May 15 to August 1,
4. A follow-up program to check compliance with management coordination guidelines be established.

These guidelines are minimal and serve as interim measures until exact habitat use and the breeding success of spotted owls in natural and disturbed situations is known. Future study may disclose that other protective measures are needed. If spotted owls are to be maintained, then these guidelines should be implemented; any reduction of these measures might jeopardize the ability of the spotted owl to survive.

#### RECOMMENDATIONS

As a result of this study, and based on information available at this time, the following recommendations are made to ensure the maintenance and preservation of the spotted owl in California:

1. Consideration be given to the habitat requirements of spotted owls and adoption of the management guidelines be included in forest and timber management plans.
2. A breeding study be conducted to determine if spotted owls located in or near logged areas are breeding at a rate similar to owls located in areas not affected by logging or other disturbances.
3. A study of the exact territorial requirements be conducted if spotted owls can't maintain stable population numbers in areas where logging is occurring and if individual pairs are to be maintained on commercial timberlands where continuing harvest will occur.
4. Existence of known pairs be monitored every 4 years to observe population trends.
5. Areas which fit the habitat requirements be checked for the presence of spotted owls.