ORIG

State of California
THE RESOURCES AGENCY
Department of Fish and Game

# STATUS AND DISTRIBUTION OF THE GREAT GRAY OWL IN CALIFORNIA[1/]

by Jon Winter

## ABSTRACT

The status and distribution of the Great Gray Owl (Strix nebulosa) in California was investigated between June 1 and October 31, 1979. A total of 70 days were spent in the field during the survey period and 12,300 miles were traveled throughout the owl's possible range in California. Seven Great Gray Owls were found during field studies, but the state population is estimated at between 30 and 40 birds. Data used to assess the current status of the bird came from specimen material, screened sight records, and observations by the author. Although data on the historical status of the owl in California are poor, there are good indications that a population decline has taken place. Current distribution is in the Sierra Nevada with recent sightings from the Yosemite area to Huntington Lake. Great Gray Owls in California prefer old-growth mixed conifer and red fir forests for breeding. Preferred hunting areas appear to be montane meadows. Only five confirmed nests have ever been found, all of which were located in the tops of large broken snags greater that 24 inches (61 cm) DBH. Loss of large snags and old growth forest surrounding montane meadows is viewed as a possible reason for a decline in numbers of Great Gray Owls in California. Data on food of the Great Gray Owl in California is limited to 12 prey items (six species). Energy requirements are discussed and recommendations for future research and further field investigations are proposed.

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## RECOMMENDATIONS

As a result of this study, and based on information available at this time, the following recommendations are made to perpetuate the Great Gray Owl as a viable, wild, endemic species:

1. Place the Great Gray Owl on the Endangered Species list for the State of California, and recommend that the federal government also list this species as endangered.

2. Perform intensive population surveys on all federal and state lands within the range of the Great Gray Owl in California.

3. Determine the specific habitat requirements, including assessment of home range, feeding and nesting areas, prey, the effects of grazing, and the use of disturbed habitats.

4. Encourage land management agencies to actively manage for this species in areas where it is known to presently exist and to manage areas of similar habitat through the development and retention of large snags and forest-meadow systems. This would allow preservation of the present population and the possible increase of the population.

5. Investigate the suitability of creating artificial nest sites in logged areas surrounding Yosemite National Park or in areas where the species formally occurred. On state and federal lands within the range of this species, consideration should be given to the habitat requirements of Greay Gray Owls in forest and timber management plans, including the reassessment of plans already in force.

6. Initiate a public education program on the rarity of this species, emphasizing the fact that it is fully protected and cannot be taken.

7. Consideration should be given by land management agencies to the closure of nesting sites of Great Gray Owls where disturbance due to human visitation or activity may cause a nesting failure.

## INTRODUCTION

Although the Great Gray Owl (Strix nebulosa) is a widespread boreal species inhabitating the Holarctic, it is a rare breeding bird in the United States south of Alaska. Existing literature indicates that the owl is uncommon to rare throughout its range in Canada as well (Godfrey 1966, Jones 1954). Oeming (1955) traveled some 36,000 miles in Alberta between 1952 and 1955 and was able to locate only 2 nests, 14 dead birds, and 4 live birds. Houston (1957) indicated that the bird is rare in Saskatchewan and has probably declined in the last 125 years. Great Gray Owls apparently are more abundant in Manitoba (Nero 1969, 1970a, 1977) but the bird could hardly be considered more than uncommon in that province. Along the Pacific Coast this species is regarded as rare in Washington (Mattocks, Hun and Wahl 1976), Oregon (Gabrielson and Jewett 1940, Alderson 1960) and in California Grinnell and Miller (1944:205) state, ". . . numbers small, justifying the term rare." More recent authors (Small 1974, McCaskie and DeBenedictis, et al. 1979) have not felt justified in changing Grinnell and Miller's assessment of the bird's status.

The status and distribution of the Great Gray Owl in California are poorly known and although its historical status is sketchy, there are indications that a decline in population size may have occurred (Winter 1979). Concern for the existing populations of Great Gray Owls prompted this investigation conducted during the summer and fall of 1979. The objectives of the study were to determine the distribution and abundance, document breeding habitat, identify possible detrimental impacts, and make recommendations to maintain or increase existing populations of Great Gray Owls in California.

## METHODS

To document the historical distribution of Great Gray Owls, an extensive search of the literature was made and at least 75 active field observers were queried for additional records. Several ornithological journals carried announcements with requests for information on this species. Some 2,275 flyers were mailed out to state and federal wildlife and land management agencies, state colleges and universities, local Audubon groups and bird clubs requesting observations of Great Gray Owls. A search of the wildlife observations files of the National Park Service in Yosemite, Lassen, and Sequoia-Kings Canyon National Parks added a considerable number of records. A search also was made of the records on file of the American Birds regional editors for the Middle Pacific Coast Region.

An effort was made to locate all extant specimens of Great Gray Owls from California. At least 30 major collections were surveyed including the American Museum of Natural History, U. S. National Museum, Museum of Comparative Zoology, Chicago Field Museum, Philadelphia Academy of Natural Sciences, Carnegie Museum, and the University of Michigan. All major collections in California were searched in addition to a number of smaller state college and university collections.

Thirteen specimen records (Appendix A) and 161 sight records (Appendix B) were utilized in the study. Validity of acceptable sight records was determined by written descriptions, interviews with cooperators, or by the reputation of the observer. There were seven records (Appendix C) that did not supply sufficient data to make a justifiable decision as to their validity, or for which adequate documentation could not be found (e.g., specimen), or were reported from an area that I was unable to visit during the course of the field work. In all cases, I was unable to rule out the possibility that a Great Gray Owl had not been seen. Because of the rarity of this species, the inclusion of unconfirmed records was felt justified.

Field investigations to document current distribution were conducted from June 1 to October 31, 1979. Field surveys involved visits to areas of historical records to determine if owls were still present, and investigation of possible Great Gray Owl observations reported by cooperators. Limitations on funding and manpower precluded thorough coverage of the owl's known range in California. Therefore, the number of birds found during these field investigations should be considered preliminary data that may need further refinements before an accurate population estimate can be made. The information is useful for a gross population estimate, however.

Seventy days were spent in the field during the survey period and 12,300 miles (19,794 km) were traveled throughout the owl's known range in California. Areas were surveyed by walking the edges of meadows from about three hours before dark until about one hour after sunset. A 7 watt Superscope C-204 portable cassette tape recorder was used to play a variety of Great Gray Owl calls. Calls from this recorder could be heard at a distance of 200 yards (91.4 m) on a still night. Great Gray Owls will respond to recordings of their primary calls throughout the survey period. Late afternoon and early evening was considered, from past experience with the species, to be the best time to conduct the surveys although no attempt was made to quantify any difference in response to the taped calls or success in finding the owls at other times of the day. From one to seven days were spent in each survey area.

In an effort to measure habitat suitability, four transects were established in areas which had known breeding populations or historical records of Great Gray Owls. These transects were used to determine snag density and abundance. Two transects were run in Yosemite National Park, one at Crane Flat, and the other at Peregoy Meadow. In both locations, breeding populations of Great Gray Owls have been present for many years. The Yosemite transects are considered undisturbed habitats. The Yosemite transects were compared to two ecologically similar transects outside Yosemite, one at Yuba Pass, Sierra County and one at Blakeless Creek, Plumas County, both of which had historical records of Great Gray Owls and had been subjected to a considerable amount of disturbance from logging.

Twenty points on each transect were sampled for snag numbers and size (dbh= diameter at breast height). Distance between each sampling point was paced off from a double digit random numbers table. Transects were laid out so that meadows, roads, and barren or rocky areas were avoided and only the timber matrix was sampled. Snags greater that 6 inches (15.2 cm) dbh were measured and tallied in a 75 foot (22.86 m) radius circle at each sampling point. Sampling was done without replacement where sampling points overlapped.

The mean linear distance of the four transects was 3,268 ft (996 m) and the total area sampled by each transect was 8.11 ac (3.28 ha). Data on the estimated quantity of suitable Great Gray Owl habitat were gathered from existing U. S. Forest Service inventory statistics and in some cases these data were updated with respect to the total commercial land base.

## RESULTS

### Historical Distribution

The historical distribution of the Great Gray Owl in California as outlined by Grinnell and Miller (1944), is sketchy. New data (Figure 1) found during this study warrants revision of their work.

Newberry (1857), a naturalist on one of the early railroad surveys, claims to have found Great Gray Owls in the Sacramento Valley. This record is cited by Grinnell and Miller (1944) and by McCaskie and DeBenedictus et al. (1979), however upon reviewing Newberry's evidence for making this claim, one finds it lacking in credibility. No dates, locations, or evidence that specimens were taken are mentioned by Newberry. Spencer Baird (1858), who was responsible for summarizing the data collected on the railroad surveys, makes no mention of any specimen taken from the Sacramento Valley. Baird, Brewer and Ridgeway (1874) cite no Great Gray Owl specimens from California, nor does there seem to be any basis for their statement that the Great Gray Owl is found "in winter in Northern California." There is no basis in fact that this species has ever occurred in the Sacramento Valley and since I was unable to find modern records substantiating Dr. Newberry's claim, these old records are best considered hypothetical.

Belding (1890) mentions a specimen, which he apparently never examined, that was taken "in the hills near Chico." No date for the specimen is given, the location data is poor at best and I was unable to locate the specimen mentioned by Belding. Until the specimen is located (if it still exists), Belding's record is best considered hypothetical.

### Current Distribution

Recent authors have both perpetuated erroneous reports in some areas while continuing to overlook the species elsewhere. McCaskie and DeBenedictus et al. (1979) mention that Great Gray Owls are occasionally reported from the Lower Klamath Basin, Siskiyou County, in winter. I was unable to find any records for this area at any season. The original information apparently came from a checklist of birds for the Klamath Basin National Wildlife Refuges and was probably in error (McCaskie pers. comm. 1979) because no mention is made of it in later revisions of the checklist. A small population of Great Gray Owls is known from the area around Fort Klamath, Oregon (Alderson 1960, Griffee 1959).

Of the 174 records used in this study, only five were found outside of the Sierra Nevada. Whatever numbers of Great Gray Owls still occur in California, the center of abundance is surely the Sierra Nevada. The center of the Sierran range of this species appears to be the Yosemite area where 144 of the reports have originated.

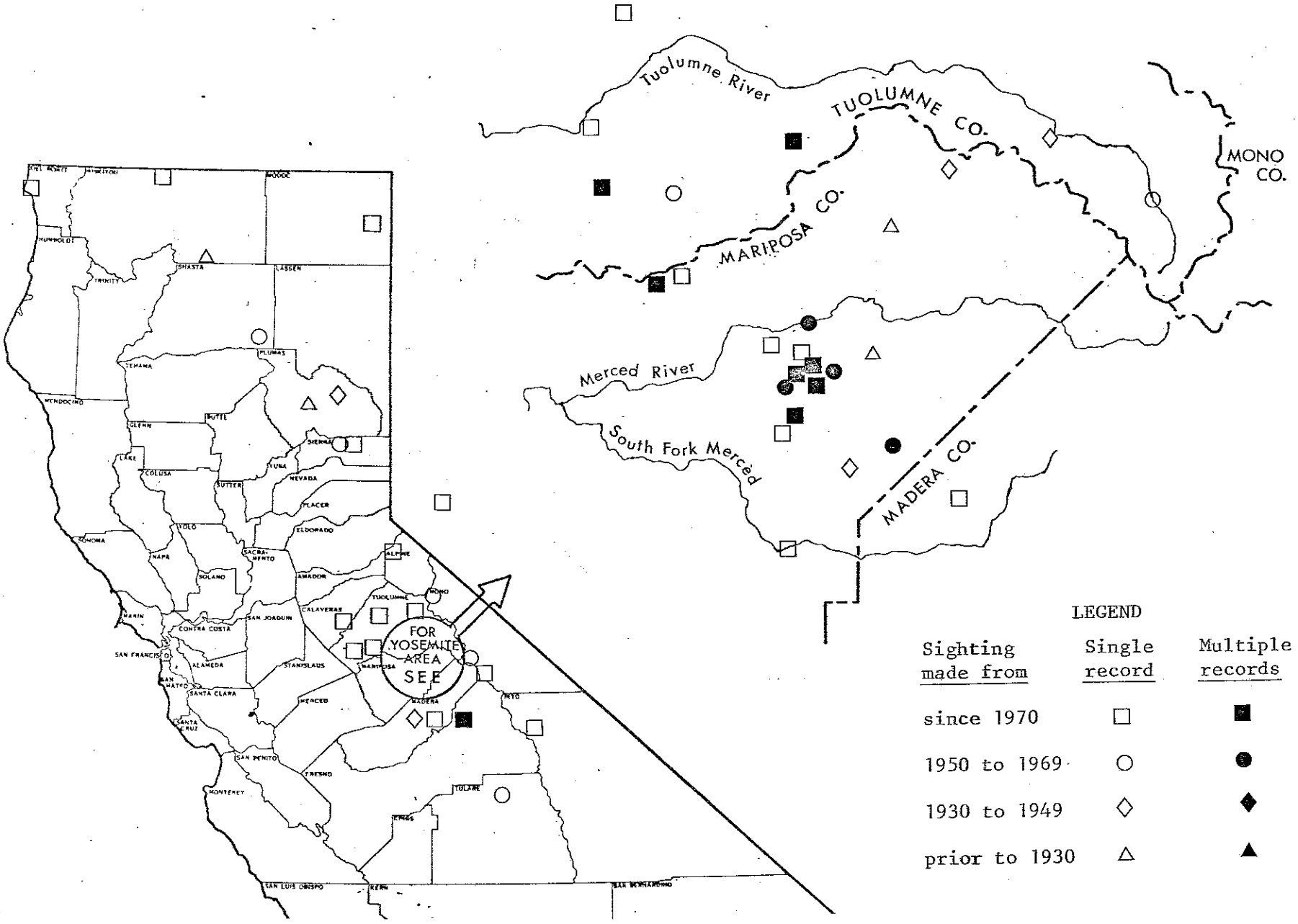


Figure 1. The distribution of the Great Gray Owl in California. None occur south of Tulare County.

Prior to this study the southern most record for a Great Gray Owl was from Madera County (Abbott 1943). A reliable observation of a single bird near Wolverton Meadow in Sequoia National Park on July 23, 1965 extends the range into Tulare County. Although there is habitat for the bird in the southern Sierra, the meadows systems are not as numerous or as large as one would find from Yosemite north. After visiting Sequoia National Park on August 10-12, I found that a number of the meadows surveyed had grasses a meter or more in height. Such meadows might not be ecologically desirable for Great Gray Owls because of the difficulty in catching prey. The bird found near Wolverton Meadow may have been an individual that had dispersed from a more northerly population (perhaps Yosemite) and the southern Sierra Nevada may have limited habitat for the bird. Harold Basey, an excellent ornithologist and U. S. Park Service seasonal naturalist at Sequoia National Park, has been observing birds there for over 27 years. He conducts morning bird walks at Wolverton Meadow during the summer months and has never seen a Great Gray Owl there or in any other area of the park. It seems likely that if Great Gray Owls were breeding in the park he probably would have encountered one at sometime during his long tenure there. My surveys of Sequoia National Park were negative as well.

Billeb (1962) reported Great Gray Owls from the east slope of the Sierra Nevada. The area is just east of Sonora Pass at Sardine Meadow. Billeb found two calling birds here in August of 1960. Although no nest was found or any other evidence of breeding, the meadow seems large enough to support a pair of Great Gray Owls. I was unable to find Great Gray Owls when I surveyed Sardine Meadow on September 8, 1979, but there were two juvenile Great Horned Owls present. When food abundance is low, or hunting areas are at a premium, Great Gray Owls and Great Horned Owls probably are competitors. Oeming (1955) and Nero (pers. comm. 1979) both have reported cases in which Great Horned Owls have killed Great Gray Owls.

In addition to the Billeb record, four other occurrences of Great Gray Owls from the east slope of the Sierra Nevada were found. In July-August of 1975, a single bird was seen hunting in Little Valley 13 miles south-southwest of Sparks, Nevada. I was unable to visit this area, but I am told that there is a good deal of suitable habitat present (Risser pers. comm. 1979). Single birds were seen on the Inyo National Forest near Valentine Camp, Mammoth Lakes on August 25, 1975, at Agnew Pass on September 5, 1950, and 2 miles north of Mt. Alice on October 12, 1974. There is also an unconfirmed record for Lee Vining in the winter of 1975. The extent to which east slope habitats support Great Gray Owls can only be determined by more intensive local surveys.

The northern limit of the historical range as described by Grinnell and Miller (1944) also must be revised. They did not indicate any records of Great Gray Owls from the Warner Mountains. On June 26, 1977, a biologist picked up a Great Gray Owl contour feather near North Deep Creek in the Warner Mountains. I have examined the feather and compared it with material in the Museum of Vertebrate Zoology and it matched feathers found on the lower flanks of Great Gray Owl specimens in that collection. In addition, the feather seemed to be in good condition suggesting that it may have been molted around the time it was found. There remains the possibility that the feather could have been molted from a wintering bird that had drifted into the Warner Mountains from a more northerly population of Great Gray Owls in Oregon.

There are only two records for the Cascades. A single bird was collected on September 26, 1913, six miles (9.7 km) south of McCloud, Siskiyou County on private property. I was not able to gain access to the property, but I did look at aerial photographs and there are several large meadows in the area where the bird was collected. I was told that these meadows had been subjected to very little disturbance so the possibility remains that Great Gray Owls could still exist there. Another bird was seen on the Bumpass Hell trail in Lassen National Park September 29, 1956.

I found only one acceptable record from the Siskiyou Mountains, Siskiyou County. A single bird was flushed from a roost on September 25, 1977 about one mile (1.6 km) southeast of Buckhorn Lookout. The area is not typical Great Gray Owl habitat, however, there are extensive meadows about nine miles (14.4 km) north-northeast of where the bird was found. I visited the area on October 30, but because of poor weather and road conditions, I was unable to conduct any field surveys.

The following summarizes the present distribution of Great Gray Owls in California. This summary is arranged by National Forests and National Parks (Figure 2), considered the most convenient unit for analysis of the birds distribution. The few records outside National Forests and National Parks are discussed later in the text.

El Dorado National Forest

There is one sight record from Carson Pass. There is suitable habitat 0.3 mile (0.5 km) west of the pass itself. I also noted good habitat in the vicinity of Luther Pass. There is an unconfirmed record for Matulich Meadow; I surveyed this area with negative results. The habitat is limited but plausible for Great Gray Owls and it should be checked more thoroughly. There is also suitable habitat in the center of Section 23 of T10N, R13E that is privately owned and was not surveyed.

Inyo National Forest

There are three records from the Inyo National Forest. Single birds were seen at Mammoth Lakes and at Agnew Pass. Another bird was seen 2 miles (3.2 km) north of Mt. Alice. Only the Mammoth Lakes bird could be considered as a possible breeding bird, the other two birds had undoubtedly drifted upslope.

Klamath National Forest

There is one record for the Klamath National Forest, a single bird seen near Buckhorn Lookout in 1977. There is suitable habitat that should be checked in the vicinity of Cow Creek (actually in Oregon) nine miles (14.5 km) to the north-northwest of where this bird was found. There is an unconfirmed record of two birds seen 1.5 miles (2.4 km) east of Indian Creek Baldy in 1979.

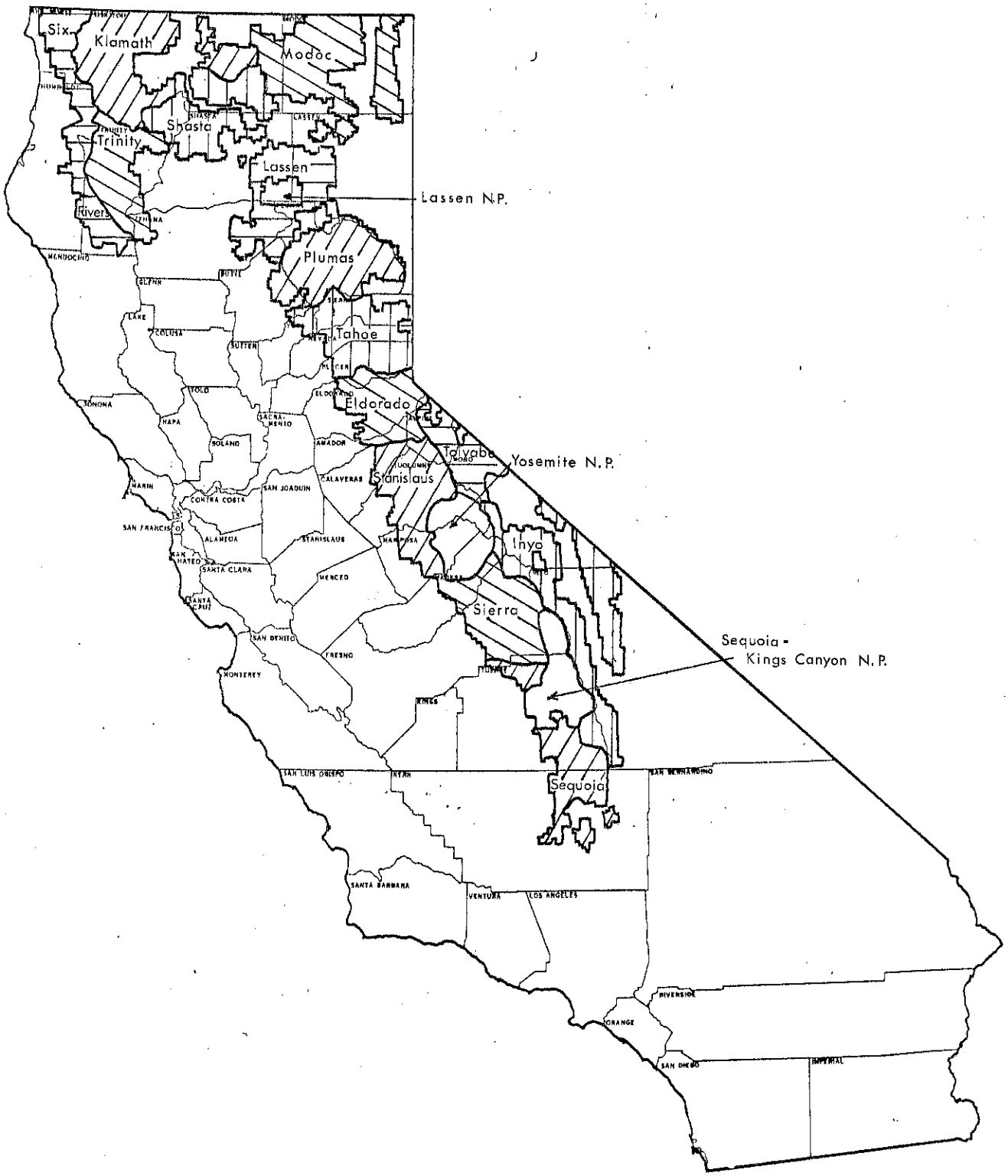


Figure 2. Locations of national forests and parks in California where suitable habitat for Great Gray Owls possibly exists.

Lassen National Forest

I was able to find only one record for the Lassen National Forest. I was told that there was a specimen confirming the record, but I was unable to locate it. The bird was supposedly taken in December, 1977 in Coon Hollow. I surveyed this area and found both Great Horned and Spotted Owls, but no Great Gray Owls. The habitat seemed good, but it is heavily grazed. I categorized this record as unconfirmed (Appendix C) although it is quite likely to be a valid record.

Lassen National Park

There is a sight record from the Bumpass Hell Trail in 1956. The habitat is atypical for Great Gray Owls; it is close to timberline and consists mostly of mountain hemlock (Tsuga mertensiana), whitebark pine (Pinus albicaulis), and marginal lodgepole pine (Pinus contorta). In veiw of the late fall date, it is possible that the bird may have come from Morgan Summit, 6½ miles (10.5 km) to the southwest, where there are some very large meadows that seem to be excellent Great Gray Owl habitat. I surveyed Upper and Lower Dersch Meadow and Summit Lake Meadow with negative results in spite of some excellent habitat. A great Gray Owl was reported from the vicinity of Manzanita Lake, but the bird was most likely a Great Horned Owl, as the habitat is atypical for Great Gray Owls and I found two very vocal juvenile Great Horned Owls there when I surveyed the area.

Modoc National Forest

A contour feather of a Great Gray Owl was found near North Deep Creek in the Warner Mountains in 1977. This area and the closest meadow, Smalls Meadow, were surveyed with negative results during this study. Also, Patterson Meadows, Long Valley and Corporation Meadow appear to be good habitat which raises the possibility that Great Gray Owls may breed in the Warner Mountains.

Plumas National Forest

There are two records for the Plumas National Forest, and both are specimens. One was taken in 1937 along Blakeless Creek, 3 miles (4.8 km) south of Mt. Ingalls. I surveyed this area with negative results. The area has been heavily logged and was being logged during my visit there. Meadows in this portion of Plumas County provide exceptionally good habitat, eventhough many meadows have been extensively developed. Some excellent habitat is now under water since Lake Davis was completed in 1966. There is so much habitat in this area that intensive local surveys will have to be undertaken to determine if Great Gray Owls still occupy the area; the bird could easily be overlooked.

The other record, first reported by Bryant (1920), was taken by Edward Garner in 1898 "near Quincy." Apparently, three birds were collected, and apparently, all have been lost over the years.

I was able to locate an old photograph of one specimen when it was on display at the Plumas County Fairgrounds one can clearly see a mount of a Great Gray Owl in the photograph. In veiw of my earlier comments, the Great Gray Owls collected by Garner should properly be considered the first record of this species for California. Quincy is surrounded by some excellent Great Gray Owl habitat, but it has been heavily logged. Because I was unable to determine the precise location where Garner collected his owls, no attempt was made to survey the Quincy area.

Sequoia National Forest

There are no records for this forest, which may lie south of the bird's range in the Sierra Nevada. However, surveys should be made before logging is allowed in areas where suitable habitat exists.

Sequoia National Park

A single bird seen near Wolverton Meadow in 1965 is the only record for the park; I consider it an extralimital bird from a more northern population. In view of the marked absence of records in this park, ecological conditions may be sub-optimum for Great Gray Owls.

Sierra National Forest

There are two acceptable records for this forest. A single bird was seen near the Pine Grove Mine in 1977. There are apparently no meadows in the area; this bird may have drifted down slope over the winter.

Near Black Point there are a series of small meadows totaling about 32 acres (13 ha) that appear to be providing habitat for three Great Gray Owls. Mike Kunde, a naturalist for the U. S. Forest Service, discovered these birds on June 18, 1979. Although he never saw the owls, they were heard again on July 7, 12, 16 and 23. The habitat seems good for the owl and is surrounded by red fir (Abies magnifica) and lodgepole pine. The area has been heavily logged (clear cut) and is being grazed as well. I visited the area in August, and on the night of August 14, I heard a male Great Gray Owl answer my tapes. The area is on the boundary of the Kaiser Wilderness which might provide some old-growth nesting habitat. I also noted three sizable meadows just inside the wilderness boundary that might also be used for foraging. There are two unconfirmed records for the Sierra National Forest (Appendix C) and a specimen record (Abbott 1943) may have come from this forest.

Six Rivers National Forest

There are no records for this forest, although, there is one record of a bird found at Crescent City in 1974 that could have come from this forest. Meadows are not as large or as numerous on this forest as one would find in the Sierra Nevada. Ecological parameters of the habitat may be less than optimum for Great Gray Owls.

Stanislaus National Forest

Ten records were located from the Stanislaus National Forest; five specimens and five sight records. There are more records for this forest than any forest in California. It is possible that Great Gray Owls have been in continuous residence for the last 24 years at Ackerson Meadow, 2½ miles (4 km) northeast of the Big Oak Flat entrance to Yosemite National Park. Two birds were shot and hung on a fence in 1955, another specimen was collected here in 1965. A single bird was heard here in 1978 and single birds were seen on June 10, and July 11, 12, 1979. This population occurs at an elevation of 4,600 feet (1,402 m), the lowest elevation where it seems reasonable that breeding occurs. To my knowledge, no nest has ever been found. There are three large meadows in the Ackerson complex totaling approximately 270 acres (109 ha) of owl foraging habitat. West Ackerson Meadow is approximately 100 acres (40 ha) and is the most heavily grazed of the three meadows. Middle Ackerson is approximately 114 acres (46 ha) and South Ackerson Meadow is approximately 30 acres (12 ha) in size, with another 26 acres (11 ha) in small connecting meadows. The southside of South Ackerson Meadow is bordered by Yosemite National Park and harbors a good deal of old-growth habitat with a number of large snags present that could provide suitable nesting sites. The habitat surrounding the meadows is mixed conifer habitat, a good deal of which has been logged. The U. S. Forest Service is planning to remove some 47 million board feet of timber from the area by 1985.

There is an additional sight record from Camp Mather, located 3½ miles (5.6 km) north of Ackerson Meadows, in 1973. This bird probably drifted down slope over the winter as the meadows at Camp Mather are quite small and probably would not support a breeding pair of Great Gray Owls.

There is a specimen taken near Long Barn in 1976 that was hit by a car. I surveyed some of the meadows in the vicinity of Long Barn with negative results. A single bird was observed in the Emigrant Wilderness near Salt Lick Meadow in 1978. There are a number of large meadows in the Emigrant Wilderness that could provide suitable habitat for Great Gray Owls.

Shasta-Trinity National Forest

A specimen was taken in 1913, 6 miles (9.7 km) south of McCloud.

Tahoe National Forest

There are two records from the Tahoe National Forest. Single birds were seen at Yuba Pass in 1971 and 2½ miles (4 km) west of Yuba Pass at the Clark Station Homesites in 1966. I surveyed Yuba Pass on June 14 and July 22 with negative results. I also surveyed Lincoln Valley and Webber Lake with negative results.

Toiyabe National Forest

There are two records for the Toiyabe National Forest. A single bird was seen in Little Valley 13 miles (21 km) south-southwest of Sparks, Nevada, in 1975. Billeb (1962) reported two birds at Sardine Meadow in 1960. I was unable to survey Little Valley, but a survey of Sardine Meadow on September 8 produced negative results.

Yosemite National Park

Some 83% of the records utilized in this study come from Yosemite National Park. A stable breeding population of Great Gray Owls has been known to occur in the park for many years. Most of the records are from Peregoy Meadow (50 records) and Crane Flat (57 records). There are an additional 37 records from other areas of the park. Birds at Peregoy Meadow have been seen most years since 1931 and birds have been known from Crane Flat since 1949. Most of the records are concentrated in an area contained within an area delineated by Old Inspiration Point at the northwest corner, Wawona at the southwest corner, Buena Vista at the southeast corner, and Taft Point at the northeast corner.

During the course of this study, single birds were seen June 2 and September 22 at Crane Flat, September 23 at Peregoy Meadow and on June 27 and September 24 at Westfall Meadow. The first records for the park were two birds collected by Grinnell and Storer (1924) at Mono Meadow in 1915. I surveyed this area on June 28 with negative results.

Population Status

Historical data on the populations of Great Gray Owls in California are poor (Grinnell and Miller 1944). It is difficult to determine if a decline has taken place. The problem is compounded by the fact that these owls can be very difficult to find. I have spoken to a number of active observers who have looked for these owls in well known locations in Yosemite and have repeatedly missed the bird. Great Gray Owl behavior is somewhat paradoxical. While they can be very tame, they can also be easily overlooked in spite of their large size.

During the course of this study, only seven birds were found. Single birds were seen at Crane Flat, Peregoy Meadow and Westfall Meadow in Yosemite National Park and at Ackerson Meadow on the Stanislaus National Forest (Appendix B). An additional three birds are believed to be present near Black Point on the Sierra National Forest. Only at Ackerson Meadow was I able to find a Great Gray Owl in an area outside a National Park where there were known historical records for the bird. This fact leads me to believe that a population decline has taken place, but it remains difficult to quantify. It is a plausible assumption that the bird has never enjoyed any abundance in numbers in California at any time past. The fact that only seven birds were found during this study should not be construed as a reliable estimate of the state population. Limitations in manpower, time,

thoroughness of coverage of a very vast amount of habitat, coupled with the fact that this owl can be very difficult to find, are all important factors influencing the number of birds found during this study. A more realistic estimate would be thirty to forty birds for the state.

An alternative method of estimating the population of Great Gray Owls in California would be to extrapolate an estimated density of birds based on the undisturbed habitat such as Yosemite. Since there are a large number of records for this park, a reasonably reliable estimate is possible. Allowing for unseasonal individuals drifting up or down slope, I estimate the Yosemite population at 14 birds. National Park Service data indicate that there are 173,581 acres (70,247 ha) of red fir habitat and 142,367 acres (57,615 ha) of mixed conifer habitat not including the valley floor in Yosemite. This provides an estimated density of $4.43 \times 10^{-5}$ birds/acre ($1.09 \times 10^{-4}$ birds/ha).

Using the data for the remaining old-growth habitat on each National Forest (Table 1), one can estimate 53 Great Gray Owls to exist in California (Table 2). I included Lassen National Park in this estimate, but I excluded Sequoia-Kings Canyon National Park for reasons mentioned earlier. Timber inventory data is currently unavailable for the Sequoia National Forest. It is probably on the southern fringe of the bird's distribution in the Sierra Nevada, as there are no Great Gray Owl records for this forest. The estimate of 53 owls does not consider a number of ecological parameters such as the size and number of meadows in preferred habitats, the structure and abundance of the prey base, and the availability of suitable nesting areas. The extrapolated estimate agrees fairly well with my more subjective estimate of thirty to forty birds. I feel, however, that the extrapolated estimate is too high. Note that the estimate for the Six Rivers National Forest is thirteen birds. This estimate yielded a density of $4.09 \times 10^{-5}$ birds/acre which is similar to the density found in Yosemite. With a density comparable to Yosemite, one would think that a Great Gray Owl would have been encountered at some time past and yet the species has never been recorded on the Six Rivers National Forest. I think that a more reasonable estimate would be two birds. No birds are projected for the Stanislaus National Forest, and yet there are more records for this Forest than any other Forest in California. A more realistic estimate for the Stanislaus National Forest would be six birds. An adjusted extrapolation would result in an estimate of 48 birds for the state, and indeed, this estimate may be high as well. I have not included wilderness areas in these estimates. There are about 178,625 acres (72,289 ha) of habitat in wilderness areas that could conceivably be utilized by Great Gray Owls and could add about eight birds to the estimate (Table 2). However, the vast majority of wilderness habitat is at too high an elevation and the forest too poorly stocked to be acceptable to breeding Great Gray Owls. The lower estimates are a more realistic indication of the state population.

## Habitat

The preferred Great Gray Owl habitat during the breeding season is, on the lower margins, mixed conifer consisting of ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), white fir (*Abies concolor*), Douglas-fir (*Pseudotsuga menziesii*), incense cedar (*Calocedrus decurrens*), and smaller amounts of black oak (*Quercus kelloggii*). On the upper margins, red fir

Table 1. Estimated old-growth mixed conifer and red fir habitat remaining on National Forests in California within the range of the Great Gray Owl.

| Inventory Year | Forest | Total Commercial Land Base | Red Fir | Mixed Conifer | Percent of Commercial Land Base |
|---|---|---|---|---|---|
| 1978 | El Dorado | 311,794 | 3,907 | 14,513 | 5.9 |
| 1979 | Inyo | 144,658 | 20,233 | 50,182[a] | 48.7 |
| 1967 | Klamath | 1,033,600 | 26,837[b] | 78,219 | 10.2 |
| 1971 | Lassen | 758,900 | 16,133[c] | 33,542 | 6.5 |
| 1971 | Modoc | 557,600 | 5,868[c] | 15,730 | 3.9 |
| 1971 | Plumas | 769,400 | 12,244 | 12,012 | 3.2 |
| - | Sequoia | 382,000 | N/A | N/A | - |
| 1970 | Shasta-Trinity | 1,085,200 | 12,099[c] | 101,367 | 10.5 |
| 1972 | Sierra | 520,937 | 26,014 | 27,738 | 10.3 |
| 1977-78 | Six Rivers | 714,333 | - [d] | 285,440[e] | 40.0 |
| 1979 | Stanislaus | 474,800 | 230 | 500 | .15 |
| 1973 | Tahoe | 519,700 | 6,931 | 9,175 | 3.1 |
| 1966 | Toiyabe | 154,000[f] | 22,706[g] | 13,481[h] | 23.5 |
| Total | | 7,426,922 | 153,202[i] | 641,899[i] | 11.3[j] |

[a]Mixed conifer timber type does not occur on this forest, i.e., includes data for lodgepole pine and Jeffery pine.

[b]Called "True Fir" includes red fir, white fir, grand fir and Shasta red fir.

[c]Shasta red fir, lodgepole pine and Jeffery pine.

[d]Inventory data not kept for this timber type. Red fir included under mixed conifer.

[e]Old-growth defined as trees > 21" DBH.

[f]Commercial land base for Sierra Nevada only.

[g]Red fir, lodgepole pine and white pine.

[h]Includes only Jeffery pine and white fir.

[i]Data excludes wilderness and primitive areas.

[j]Percent excludes Sequoia National Forest commercial land base.

N/A Not available at time of study.

Table 2. An extrapolated estimate of the number of Great Gray Owls in California by National Forest and National Park based on a density of $4.43 \times 10^{-5}$ birds/acre ($1.09 \times 10^{-4}$ birds/ha).

| National Forest (NF) National Park (NP) | Number of Birds |
|---|---|
| El Dorado NF | 1 |
| Inyo NF | 3 |
| Klamath NF | 5 |
| Lassen NF | 2 |
| Lassen NP | 3 |
| Modoc NF | 1 |
| Plumas NF | 1 |
| Sequoia NF | n/a |
| Shasta-Trinity NF | 5 |
| Sierra NF | 2 |
| Six Rivers NF | 13(2)* |
| Stanislaus NF | 0(6)* |
| Tahoe NF | 1 |
| Toiyabe NF | 2 |
| Yosemite NP | 14 |
| Total | 53 |
| *Adjusted Total (See Text) | (48)* |

n/a = Data for extrapolation not available

forest is preferred consisting of red fir (Abies magnifica), lodgepole pine (Pinus contorta), Jeffery pine (Pinus jeffreyi), and white pine (Pinus monticola). Mixed conifer ranges vertically in the Sierra Nevada from 2000-6500 feet (610-1981 m) and red fir forest from 6000-9000 feet (1829-2743 m) (Munz and Keck 1959). However, the bulk of the Great Gray Owl breeding populations probably occur between 4000-8000 feet (1219-2438 m).

Except for birds dispersing up or down slope, nearly all Great Gray Owl observations reported here are of birds found in or near meadows (Figures 3 and 4). Meadows appear to be their preferred hunting areas in California. It is not known what ecological parameters are necessary for Great Gray Owls to accept a particular meadow as a foraging area. The smallest meadows in which I found breeding Great Gray Owls in continuous residence for many years were located at Crane Flat in Yosemite National Park. There are four meadows at Crane Flat totaling 30 acres (12 ha). Great Gray Owls have been reported hunting montane meadows in Oregon (Hewkin 1961), Montana (Tryon 1943) and in Yellowstone National Park (Long 1941). In all three of these reports the birds were found in forest habitats similar to those used by Great Gray Owls in California.

Figure 3. Great Gray Owl habitat at Crane Flat, Yosemite National Park. Surrounding forest is high Mixed Conifer. Photo: J. Winter.

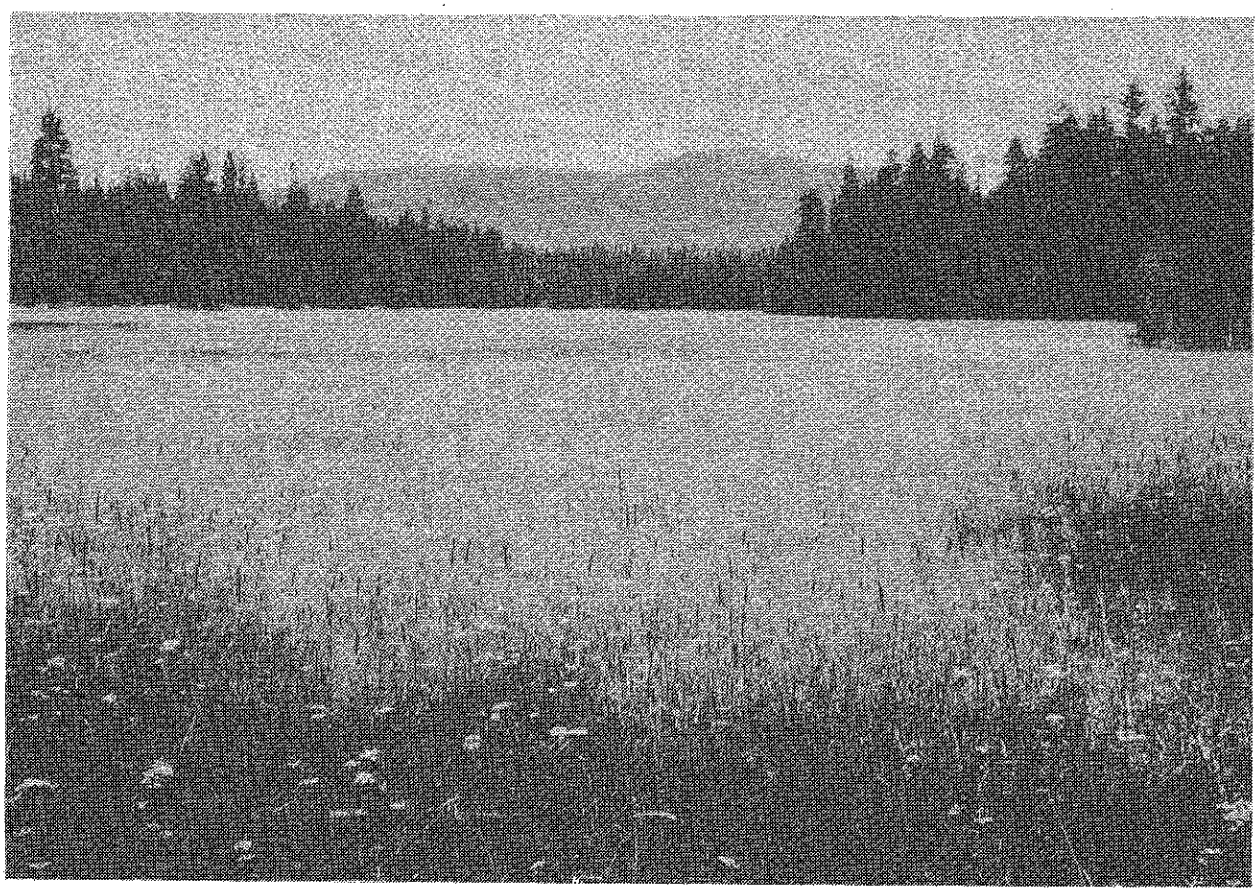

Figure 4. Great Gray Owl habitat at Ackerson Meadow, Tuolumne County. Surrounding forest is Mixed Conifer. Photo: J. Winter.

Great Gray Owls of the western United States show a marked difference in habitat selection from those found in southcentral Canada. Oeming (1955) described breeding habitat of Great Gray Owls in Alberta as black and white poplar forests with lesser amounts of black spruce and jack pine near "sizable muskegs." Nero (Pers. comm. 1979) stated that tamarack bogs were the preferred habitat in Manitoba with use of heavy spruce forests and open fields in winter (Nero 1969). Law (1960) found birds breeding in spruce and poplar forests near meadows in Saskatchewan.

The majority of records used in this study come from Yosemite National Park. This is due in part to more field observers frequenting Yosemite than elsewhere in the Sierra Nevada. However, it seems to be more than an ecological coincidence that a substantial portion of the population of Great Gray Owls in California are thriving in Yosemite; an area in which nearly completely virgin stands of timber surround their hunting and nesting grounds (Fig. 3).

All nests of Great Gray Owls reported by Bent (1938) for North America were found in abandoned hawk nests. Of 130 Great Gray Owls' nests surveyed by Mikkola (in Burton 1973), 120 (92.3%) were in abandoned hawk nests and 10 (7.7%) were found in the tops of old stumps. In California, only five nests, all in Yosemite National Park, have been found (Table 3). All the nests were found in the tops of large, broken-off snags (Fig. 5). In undisturbed, old-growth habitats utilized by Great Gray Owls in California, large snags are rather common and may provide the birds with a choice of nest sites they find more desirable (or more abundant) than those provided by hawks. The proximity of the nest site to their hunting territory may be a possible explanation for the owls' preference of nests in snags. Nero (1970b) noted that the male of a pair nesting near Roseau, Minnesota, hunted within a half mile (804 m) of the nest. Since the young and the female are fed almost entirely by the male, (Pulliainen and Loisa 1977, Höglund and Lansgren 1968) distance of the nest from the owl's hunting grounds may be an important ecological parameter in successful nesting. All nests reported in Table 1 were found within 200 yards (183 m) of meadow. I have spent a considerable amount of time walking through the forests surrounding Crane Flat and Peregoy Meadow in Yosemite and I have

Table 3. Physical characteristics of snags used as nest sites by Great Gray Owls in Yosemite National Park.

| Location | Date | DBH (inches) | DBH (cm) | Height (feet) | Height (meters) |
|---|---|---|---|---|---|
| Peregoy Meadow | 3/31/50 | -- | -- | 35 | 10.7 |
| " | 6/19-27/63 | -- | -- | 40 | 12.2 |
| " | 5/28/72 | 24 | 61 | 25 | 7.6 |
| Crane Flat | 1970-71 | 24-30 | 61-76 | 30-35 | 9-10.7 |
| " | 6/7/75 | 66* | 167.6 | 72* | 21.9 |

*Measured with DBH tape and clinometer. All other measurements were estimated.

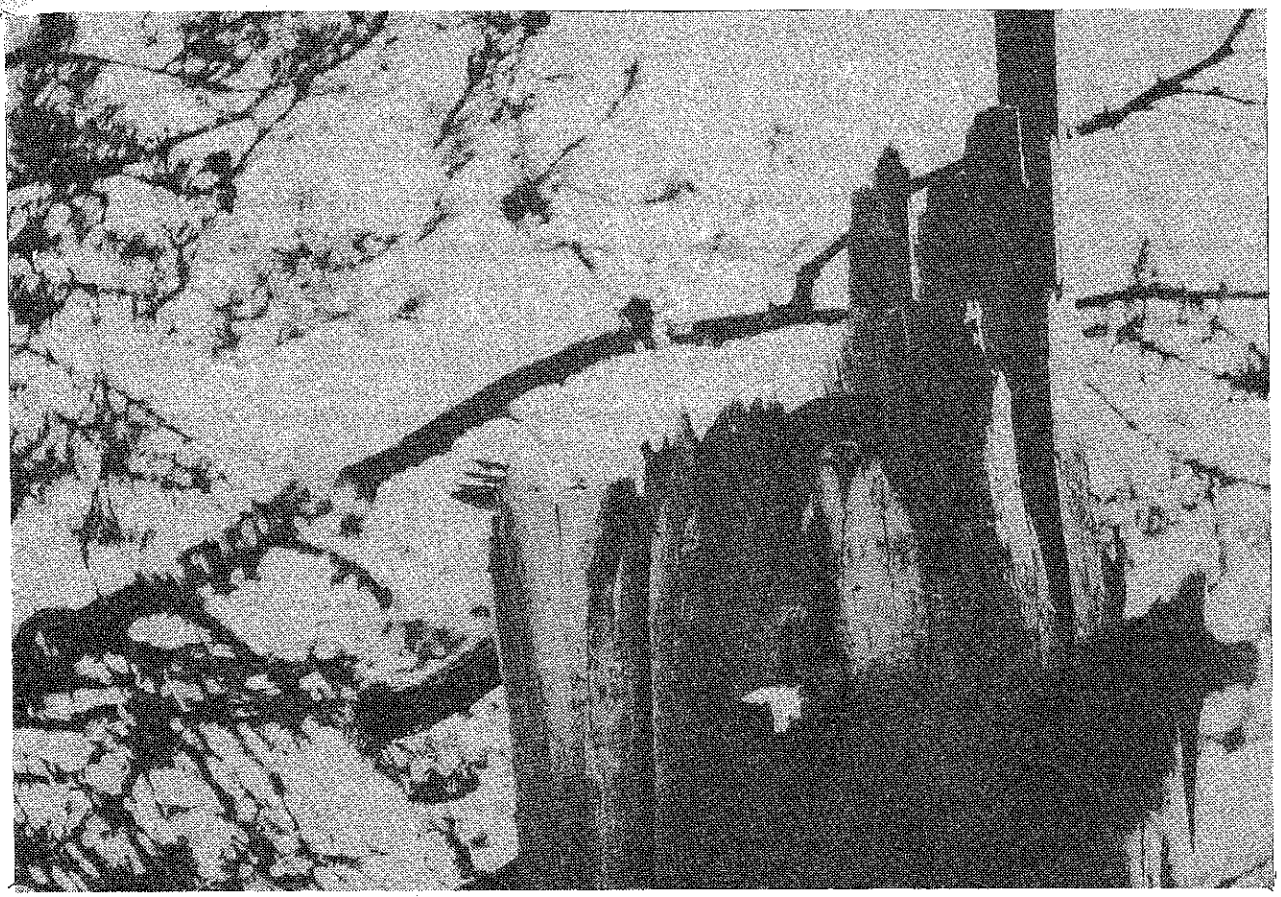

Figure 5. Great Gray Owl nest at Peregoy Meadow, Yosemite National Park, in June 1972. Note the young and female peering over the edge of the nest and the tail of the female on the left. Photo: John Luther.

never seen a hawk nest in either area. Snags apparently provide the birds with an acceptable alternative for nesting in the absence of a suitable hawk nest.

Nearly all Great Gray Owl habitat outside the National Parks is administered by the U. S. Forest Service (Table 1). It was not until 1977 that the U. S. Forest Service had a standard policy regarding snag retention on timber sales. Prior to 1977, the standard practice was to cut all snags on timber sales so that large numbers of snags were eliminated throughout much of the range of the Great Gray Owl in California. The loss of snags may have restricted successful breeding in many areas where otherwise adequate habitat exists.

In order to determine if there was a significant difference in logged and unlogged Great Gray Owl habitats, four transects, two in Yosemite National Park and two outside Yosemite, were run and analyzed for snag numbers and sizes (DBH). The transects sampled both the mixed conifer and red fir habitats. Transects run at Peregoy Meadow and at Yuba Pass sampled the red fir habitat and those run at Crane Flat and Blakeless Creek (Plumas Co.) sampled the mixed conifer habitat. With the exception of a small number of snags removed that posed a hazard to buildings, campgrounds and roads, and the occasional removal of snags thought to harbor forest damaging insects, both Crane Flat and Peregoy Meadow are undisturbed. Both areas have supported successfully breeding populations of Great Gray Owls for many years. Yuba Pass and Blakeless Creek,

on the other hand, have been subjected to logging but have historical records of Great Gray Owls (Appendices A and B). Surveys for Great Gray Owls at Yuba Pass and Blakeless Creek during this study yielded negative results. Statistical data for all four transects are summarized (Table 4) and the frequency distributions for size (DBH) are shown (Figures 6 and 7).

Crane Flat Transect
Location: T2S, R20E SE¼ Sec. 17
Elevation: 6231 feet (1899 m)

The Crane Flat transect is in a high mixed conifer habitat with heavy, well developed overstory. There are some extremely large trees along this transect. One snag measured more than 79 inches (201 cm) DBH. A live sugar pine measured near the transect was 86 inches (218 cm) DBH. Great Gray Owls have been known to occur here and have bred successfully since 1949.

Blakeless Creek Transect
Location: T24N, R12E SE¼ Sec. 16
Elevation: 5930 feet (1807 m)

The Blakeless Creek transect, as well as the Crane Flat Transect, is located in a rather high mixed conifer zone as indicated by the presence of lodgepole pine and red fir on both transects. The transect was run through private land. William Beaty Associates of Redding, California, indicate that a major overstory removal was cut in 1939-40 and was re-cut for cedar in 1960 with a smaller salvage sale cut in 1955. No volume data were available. A Great Gray Owl was last seen and collected here September 17, 1937 (Appendix A).

Peregoy Meadow Transect
Location: T3S, R21E SW¼ Sec. 16
Elevation: 7040 feet (2146 m)

Peregoy Meadow Transect is a typical example of a red fir forest (Munz and Keck 1959). The meadow is surrounded by fairly homogeneous stands of lodgepole pine, with red fir and jeffery pine in the drainages. Great Gray Owls have been nesting successfully here since 1931. The difference in the mean diameters of the Peregoy Meadow and Yuba Pass snags is primarily due to the presence of a few large snags and the smaller sample size (N=36) on the Yuba Pass transect.

Yuba Pass Transect
Location: T20N, R13E NW¼ Sec. 11
Elevation: 6748 feet (2057 m)

Yuba Pass is a typical red fir forest, but with a small amount of white fir. The transect was run about 100 yards (91.4 m) north of the meadow at Yuba Pass and where a Great Gray Owl was last seen June 11, 1971. The area is on the Tahoe National Forest and has been heavily logged. It is scheduled to be logged again in 1981 and was being salvaged logged when I visited there on June 14. U. S. Forest Service records indicate that there have been at least five entries into the area for the purposes of overstory removal and salvage logging since the 1940's. I was not able to obtain adequate estimates of the volume of timber removed.

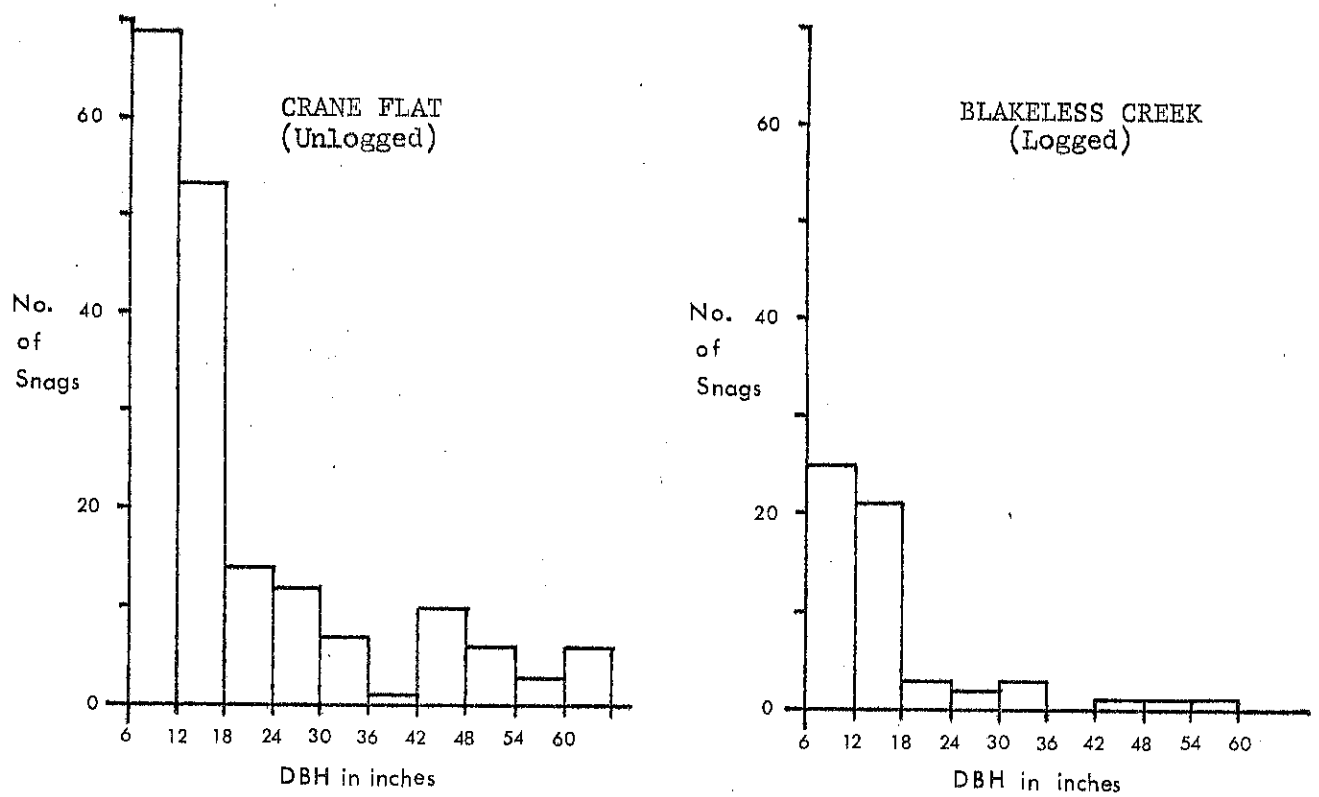


Figure 6. Snag numbers and DBH (diameter at breast height) on the Crane Flat and Blakeless Creek transects.

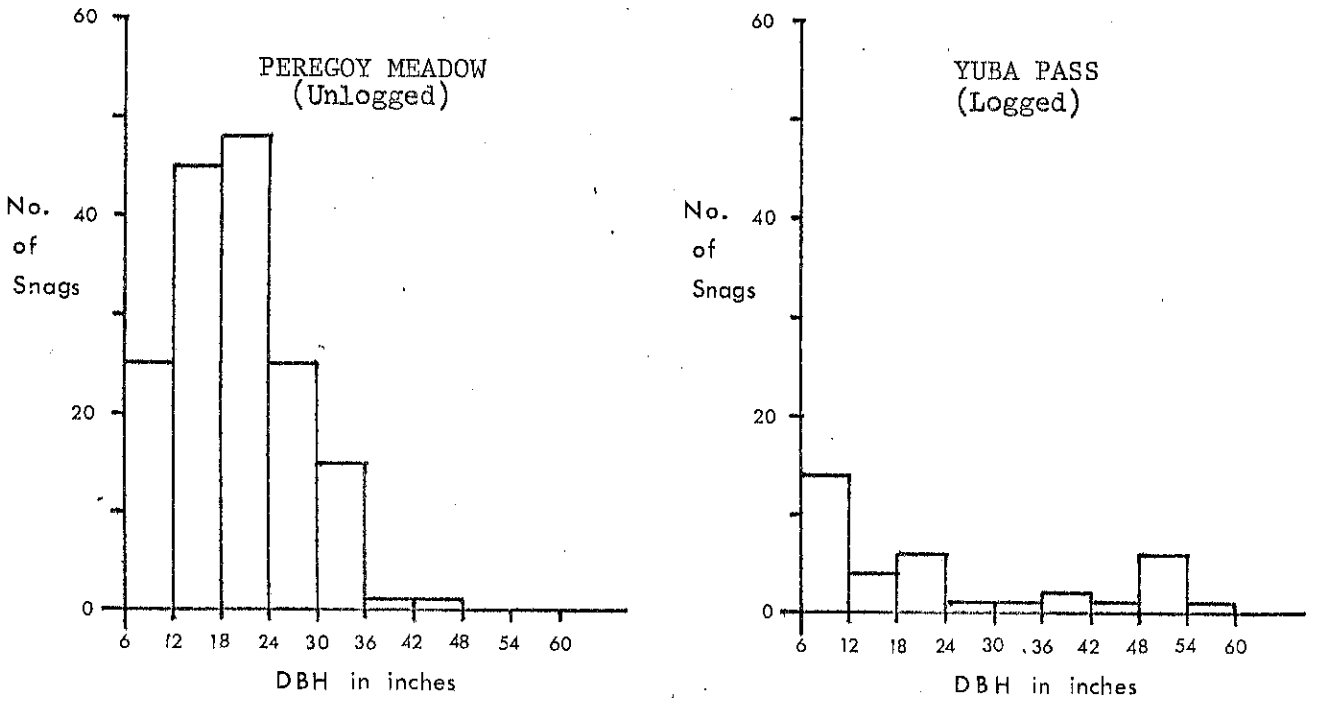


Figure 7. Snag numbers and DBH (diameter at breast height) on the Peregoy Meadow and Yuba Pass transects.

Table 4. Parameters of the snag component of unlogged and logged habitats for Great Gray Owls.

| | Crane Flat | Blakeless Creek | Peregoy Meadow | Yuba Pass |
|---|---|---|---|---|
| Number of snags | 181 | 57 | 160 | 36 |
| Range DBH (inches) | 6.6-79.8 | 6.5-58.1 | 6.1-43.1 | 6.0-57.8 |
| $\bar{X}$ DBH | 19.9 | 15.6 | 19.7 | 23.3 |
| Median DBH | 13.6 | 12.4 | 19.5 | 16.6 |
| Variance DBH | 282.8 | 113.7 | 50.6 | 287.7 |
| S. D. DBH | 15.6 | 10.7 | 7.1 | 16.7 |
| Density snags≥ 6" DBH/acre | 22.32 | 7.03 | 19.73 | 4.44 |
| Snags≥ 24" DBH | 45 | 8 | 42 | 12 |
| Density snags≥ 24" DBH/acre | 5.55 | .986 | 5.18 | 1.48 |

The frequency data (Figures 6 and 7) for (DBH), are not normally distributed so the Mann-Whitney U-Test (Sokal and Rohlf 1969) was used to test the difference in the number of snags greater than 6 inches (15.2 cm) DBH on the paired transects. The Crane Flat-Blakeless Creek (U=345) and the Yuba Pass-Peregoy Meadow (U=382) comparisons showed a significant difference ($P < 0.001$) in the paired transects. However, small snags would be of little ecological value to a Great Gray Owl searching for a nest site. Since the smallest snags used for nesting, for which there is data, are at least 24 inches (61 cm) DBH, it is more appropriate to test for a possible difference in the paired transects of the larger snags. Both the Crane Flat-Blakeless Creek (U-318) and the Peregoy Meadow-Yuba Pass (U=290.5) comparisons showed a significant difference ($P < 0.01$) in the number of snags greater than or equal to 24 inches (61 cm) DBH. The number of larger snags is viewed as ecologically important because it affords a bird searching for a nest site a greater number of sites from which to choose and because only a few of the acceptably large snags will break in a manner that will allow placement of a clutch (Figure 5).

Although not ecologically similar, it is interesting to note that there was no significant difference between the numbers of snags greater than or equal to 6 inches (U=231; $P > 0.05$) on the Crane Flat and Peregoy Meadow transects.

Most areas visited during this survey outside of national parks, had been subjected to logging. It seemed that little old-growth forest remained in the mixed conifer and red fir habitats that had not been cut at sometime in the past. U. S. Forest Service inventory statistics were consulted to determine the amount of old-growth mixed conifer and red fir remaining on national forests within the range of the Great Gray Owl. The data are summarized in Table 1. When the data on the remaining acreages of mixed conifer and red fir habitats are compared to the total area on a national forest that can be utilized for harvesting timber (total commercial land base) only 11.3% remains uncut (Table 1). On many forests current inventory data is not available, so current percentage of remaining habitat is probably less than 11%. Loss of old-growth, and particularly loss of large snags that might be used for nesting, could have affected a decline in populations of Great Gray Owl. It is interesting to note however, that a bird observed at Ackerson Meadow July 11-12, 1979, was hunting an area that was being heavily grazed and salvage logged. Great Gray Owls may be adaptable enough to utilize disturbed habitats for hunting, but their nesting requirements may be more restricted.

Movement Away from Breeding Areas

Like many raptors dependent on small rodents for food, starvation induced incursions of Great Gray Owl south of their normal range in North America are occasionally reported (Vickery and Yunick 1979, Eckert 1978, Green 1966 and 1969, Nero 1969, Bell, Phelan and Wypkema 1979). During the winter of 1978-79 large numbers of Great Gray Owls were reported in northeastern United States and scattered individuals were found as far west as British Columbia producing an estimated 413+ birds observed south of their normal range (Schuford and DeSante 1979). Only one Great Gray Owl was reported from California during the winter of 1978-79 and it was well within the expected range; northern incursions are unknown in California.

It is well known that a number of montane species drift downslope in winter or upslope in late summer and early fall (Gaines 1977, Storer and Usinger 1966). A number of records were found indicating that Great Gray Owls move up and downslope. For a starving Great Gray Owl to find food in winter in California, the bird would most likely drift downslope to an area at or near snow line. Because these birds would remain associated with the forest matrix, they could easily be overlooked. I found three records that support the contention that downslope movement occurs during winter. A single bird, photographed on February 18, 1979, at an elevation of about 2200 feet (670 m), was found in ponderosa pine-black oak habitat well below its normal vertical range in the Sierra Nevada. In addition, two birds were heard calling January 21, 1957, in Yosemite Valley (elevation circa 3968 feet, 1209 m) where they are not known to breed, and one bird was photographed on Endert's Beach near Crescent City, Del Norte County in March or April, 1974. This record remains unique; it is the only actual coastal occurrence of a Great Gray Owl in California. The bird may have drifted down from the mountains on the Six Rivers National Forest 20 miles east of Crescent City.

Quite surprising was the occurrence of a Great Gray Owl photographed in blue oak (Quercus douglasii) and digger pine (Pinus sabiniana) habitat on May 14, 1978, near Chinese Camp, Tuolumne County at an elevation of 1260 feet (384 m). The habitat is atypical for Great Gray Owls and in spite of the spring date, breeding in the area is quite unlikely. A possible explanation for such an occurrence is that juvenile Great Gray Owls are chased off the breeding grounds by the adults as winter approaches, and the young birds disperse to higher or lower elevations in search of foraging areas. Although it is not known for certain, Great Gray Owls probably don't breed in their first year of life. The Chinese Camp sighting could have been a bird hatched the previous spring that had drifted downslope during the winter and remained there through its first breeding season. Another bird collected (Abbott 1943) in May or June 1930 at an elevation of 3200 feet (975 m) between Coarsegold and Finegold, Madera County, may have been exhibiting the same behavior.

Four late summer and fall records indicate that upslope movement occurs as well. Single birds were observed at 9000 feet (2743 m) July 27, 1969, in Lyell Canyon and at 9300 feet (2834 m) near May Lake in September of 1934, both in Yosemite National Park, and at 10,000 feet (3048 m) at Agnew Pass, Inyo National Forest, September 5, 1950 (Fitzpatrick and Fitzpatrick 1951). Another bird was found at an elevation of 11,000 feet (3353 m) 2 miles north of Mt. Alice on the Inyo National Forest on October 12, 1974. There is no evidence that Great Gray Owls breed at elevations greater than 8700 feet (2652 m) and actual nesting has only been recorded at 7040 feet (2146 m). In all four cases just mentioned, the habitat was primarily lodgepole pine, and at these elevations the DBH of the trees are probably not large enough to accommodate nesting.

## Nesting Chronology

Data on the chronology of nesting in California are meager. Males probably begin calling in April to establish a territory (Berggren and Wahlstedt 1977) and by mid-May the first eggs are laid. Clutch sizes have never been recorded in California, but of 122 clutches recorded from northern Europe, the mean was 4.2 eggs (Mikkola in Burton 1973). Nero (pers. comm. 1979) noted that Great Gray Owls are most likely to desert the nest just before the eggs are laid. Mid-May would be a critical period when disturbance could result in a nesting failure. The incubation period is about 30 to 36 days (Mikkola in Burton 1973, Pulliainen and Loisa 1977). Hatching would then occur about the second week in June. The nestling period lasts about 21 days (Pulliainen and Loisa 1977) and young should begin leaving the nest during the first or second week in July. There are several records from Crane Flat and Peregoy Meadow indicating that fledging occurs at this time and a backward extrapolation allows an estimation of the time of the breeding chronology. Ecological factors such as snow depth, prey abundance, and weather, could retard or advance the chronology in any given year.

## Food Habits

Great Gray Owls feed primarily on small mammals (Table 5). The vast majority of the prey (97.5%) come from two families, Soricidae (shrews) and Microtinae (voles). Although observers have reported to me that on occasion Great Gray

Table 5. A summary of prey taken by the Great Gray Owl in the Holarctic.

| Authority | Sample Size | Soricidae | Talpidae | Leporidae | Sciuridae | Geomyidae | Cricetinae | Microtinae | Muridae | Mustelidae | Aves | Other | Location |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Craighead & Craighead (1956) | 83 | 3.6 | | | | 27.7 | 1.2 | 66.3 | | | 1.2 | | Wyoming |
| Fisher (1893) | 31 | 6.5 | 3.2 | | | | 3.2 | 83.9 | | | 3.2 | | North America |
| *Höglund & Lansgren (1968) | 1977 | 5.1 | | | | | | 93.7 | | | | 1.2 | Sweden |
| **Höglund & Lansgren (1968) | 28 | 21.4 | | | | | | 78.6 | | | | | Sweden |
| Mikkola (1972) | 130 | .8 | | | | | | 96.1 | | .8 | | 2.3 | USSR |
| *Mikkola (1973) | 2464 | 3.4 | | | | | | 94.5 | | .21 | 1.28 | .61 | Finland |
| **Mikkola (1973) | 81 | 44.6 | | 1.2 | | | | 53.0 | | | | 1.20 | Finland |
| Mikkola (1976) | 271 | 10.3 | | | | | .4 | 86.3 | .4 | | 1.1 | 1.3 | Finland |
| Nero (1969) | 46 | 30.4 | | | | | | 67.4 | 2.2 | | | | Manitoba |
| *Oeming (1955) | 78 | | | | | | | 100.0 | | | | | Alberta |
| **Oeming (1955) | 25 | 8.0 | | | | | | 92.0 | | | | | Alberta |
| Pulliainen & Loisa (1977) | 121 | 2.5 | | | | | | 97.5 | | | | | Finland |
| Smith (1968) | 139 | 6.5 | 2.2 | 3.6 | .7 | .7 | 4.3 | 79.1 | | | .7 | 2.2 | North America |
| Total % | 5474 | 5.3 | .07 | .11 | .02 | .44 | .16 | 92.2 | .04 | .11 | .69 | .91 | |

*Pellets
**Stomachs (total number of prey)

Owls pellets have been found in Yosemite, only six have ever been collected for analysis. All the pellets were found at Crane Flat; five during the summer of 1977 and one was picked up during this study on September 2. Pellet analysis revealed 12 animals of 6 species (Table 6).

Table 6. Prey found at Crane Flat, Yosemite National Park in Great Gray Owl Pellets.

| Prey Item | Number |
|---|---|
| Eutamias sp. | 4 |
| Glaucomys sabrinus | 1 |
| Thomomys sp. | 3 |
| Scapanus sp. | 1 |
| Microtus longicaudus | 2 |
| Microtus montanus | 1 |
| Total | 12 |

This prey sample from California is too small to make any generalizations about food habits, however in the Sierra Nevada, pocket gophers (Thomomys sp.) may be a more important prey item than Table 5 would suggest. I watched a Great Gray Owl eating a pocket gopher in June of 1974 at Crane Flat and Fitzpatrick (Cofer 1958) reported that he observed an owl catch and devour two pocket gophers in a matter of a few minutes in Yosemite. Warren Larson, who made an excellent film on a nesting pair of Great Gray Owls at Peregoy Meadow, noted that several of the prey items brought to the nest were pocket gophers. Dave DeSante (pers. comm. 1979) observed a male Great Gray Owl bring two Peromyscus mice to a nest at Peregoy Meadow on June 25, 1972.

The daily intake of food for a Great Gray Owl is probably between 70 and 160 grams per day (Craighead and Craighead 1956). Taking a 40 gram rodent as a standard (Mikkola 1970) it would be necessary for a bird to catch two to four mice per day. Food stress would be intense during breeding. Pulliainen and Loisa (1977) noted that females consumed three to four animals per day during incubation (120 to 160 grams/day), but when the young hatched, the male, who does all the hunting, brought an average of 9.7 (range 7 to 14) animals per day to a nest containing four young. Assuming that the male's daily food intake is similar to that of the female, then a given prey base capable of supporting a pair of Great Gray Owls would have to yield about 6 to 17 animals per day during breeding.

## DISCUSSION AND CONCLUSIONS

It is readily apparent from the results of this study that there is a very small, old-growth adapted population of Great Gray Owls in California. With an estimated 30 to 40 birds in the state, the population is comparable to those of the Peregrine Falcon and the California Condor, two species that have been recognized as endangered for many years. Although it is difficult to quantify

a decline in population has probably occurred. Data on the historic status of this species is almost nonexistent, however if the estimated density of the Yosemite birds is any indication of optimum abundance, there could have been as many as 300 birds in the state under pristine conditions. The Great Gray Owl should be placed on both the state and federal lists of endangered species so that the bird can be afforded full legal protection and the benefits of endangered species management programs.

The population estimates reported here must be considered preliminary due to limited manpower, time and available funds for this study. For a clear estimate of the true status of this species in California, intensive local surveys will have to be undertaken by state and federal land management agencies. Effective management of Great Gray Owl habitat will require more data on the home range, prey, nesting requirements, tolerance for grazing and loss of old-growth habitat.

Yosemite populations seem to thrive in spite of the supression of natural fires and heavy visitor use in the park creating a potential for disturbance. Birds fledging from nests in Yosemite must disperse in search of breeding habitat. Assuming that nest site availability is a limiting factor affecting breeding success, the Yosemite birds could be used as a reservoir population to promote the re-colonization of habitats outside the park. Oeming (1964) reported that a juvenile bird be banded in Alberta had dispersed 70 miles (113 km) north of the banding site nine years later. Robert Nero banded a nestling near Winnipeg, Manitoba, in April 1976 that was recovered 11 months later 468 miles (755 km) southeast of the banding site (Butler 1979). Wahlstedt (1969) reported two nestlings banded in northern Sweden dispersed 12 miles (20 km) and 137 miles (220 km) from the nest site over a year after banding. If these birds are any indication of the dispersal potential of this species, then colonization of areas outside Yosemite is not only possible, but probable. If loss of large snags has limited nest site availability, artificial nest sites may provide an acceptable alternative (Snyder 1978), Nero, Sealy and Copeland (1974) in Manitoba and Höglund and Lansgren (1968) in Sweden have both reported the successful use of artificial nests by Great Gray Owls. A pilot artificial nest project could be initiated on the forests surrounding Yosemite to promote the re-colonization of disturbed habitat by Great Gray Owls.

Although it is not known for certain, there has been speculation by the National Park Service in Yosemite that the abandonment of a well known and heavily visited nest at Peregoy Meadow in 1974 may have been caused by human disturbance. In the event that nests are found in the future, an effort should be made by state and federal land management agencies to prevent such disturbances. This can be accomplished by closing off nesting areas to visitor use and by not publishing the locations of known nests.

Land management agencies should make an effort to promote retention of large snags and preserve old-growth red fir and mixed conifer habitats surrounding montane meadows. Forsman et al. (1977) reported that Spotted Owls, a close relative of the Great Gray Owl, were 12 times more abundant in Oregon in old-growth forests than in second growth forests. Great Gray Owls may be similarly adapted. The preservation of these old-growth habitats cannot be too strongly stressed.

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## APPENDIX A

### SPECIMEN RECORDS OF GREAT GRAY OWLS IN CALIFORNIA

| National Forest (NF) National Park (NP) County (Co.) | Location | Date | Sex, Specimen Number |
|---|---|---|---|
| Madera Co. | Between Finegold and Coarsegold (see Abbott 1943) | May or June 1930 | ♀ SDNHM#18526* |
| Plumas NF | 3 mi. south of Mt. Ingalls (Plumas Co.) | Sept 17, 1937 | ? MVZ#73353 |
| " | "near Quincy" (see Bryant 1920) (Plumas Co.) | May 12, 1898 | ♀ PCM (photo) |
| Stanislaus NF | Ackerson Meadow (Tuolumne Co.) | Oct 19, 1955 | ♀ YM#23031 |
| " | " | " | ♂ YM#23026 |
| " | " | July 3, 1963 | ♀ LACM#41029 |
| " | 2 mi. east Long Barn (Tuolumne Co.) | Dec 5, 1976 | ? MJC |
| Shasta-Trinity NF | 6 mi. south of McCloud (Shasta Co.) | Sept 26, 1913 | ? MVZ#24484 |
| Tuolumne Co. | 3 mi. NE of Groveland | Sept, 1975 | ? private collection |
| Yosemite NP | Mono Meadow (Mariposa Co.) | June 18, 1915 | ♂ MVZ#25534 |
| " | " | June 18, 1915 | ♀ MVZ#25535 |
| " | Crane Flat (Mariposa Co.) | summer 1966 | ♀ YM#23023 |
| " | Peregoy Meadow (Mariposa Co.) | July 21, 1970 | ? YM |

*LACM - Los Angeles Co. Museum
MJC - Modesto Junior College
MVZ - Museum of Vertebrate Zool., Berkeley
PCM - Plumas Co., Museum
SDNHM - San Diego Nat. Hist. Museum
YM - Yosemite Museum

## APPENDIX B

### ACCEPTED SIGHT RECORDS OF GREAT GRAY OWLS IN CALIFORNIA

| National Forest (NF) National Park (NP) County (Co.) | Location | Date | Number Birds | Observer |
|---|---|---|---|---|
| Calaveras Co. | Between Sheep Ranch and Murphys (photo) | Feb 18, 1979 | 1 | B. & H. Lewis |
| Del Norte Co. | Enderts Beach, Crescent City (photo) | March-April 1974 | 1 | S. Davis, et al. |
| El Dorado NF | 0.3 mi. W. of Carson Pass (Alpine Co.) | summer 1968-1971 | 1 | S. Speich |
| Inyo NF | Agnew Pass (Mono Co.) | Sept 5, 1950 | 2 | (see Fitzpatrick 1951) |
| " | 2 mi. N. Mt. Alice (Inyo Co.) | Oct 12, 1974 | 1 | D. Garber |
| " | "Valentine Camp" Mammoth Lakes (Mono Co.) | Aug 25, 1975 | 1 | J. Dimmick |
| Klamath NF | 1 mi. SE Buckhorn LO (Siskiyou Co.) | Sept 25, 1977 | 1 | B. Balfrey |
| Lassen NP | Bumpass Hell Trail (Shasta Co.) | Sept 29, 1956 | 1 | B. Nielsen |
| Modoc NF | N. Deep Creek, T4S, R14E Sec 25 (feather) (Modoc Co.) | June 26, 1977 | ? | P. Bloom |
| Sequoia NP | Wolverton Meadow (Tulare Co.) | July 23, 1965 | 1 | R. Grater |
| Sierra NF | Black Point (Fresno Co.) | June 18 - Aug 14, 1979 | 3 | M. Kunde, J. Winter |
| " | Pine Grove Mine T8S, R23E SE$\frac{1}{4}$ Sec 23 (Madera Co.) | May 25, 1977 | 1 | L. Ritter |
| Stanislaus NF | Camp Mather (Tuolumne Co.) | April 29, 1973 | 1 | D. Gaines, M. Mans |
| " | Ackerson Meadow (Tuolumne Co.) | July 26, 1978 | 1 | J. Winter |

## APPENDIX B

### ACCEPTED SIGHT RECORDS OF GREAT GRAY OWLS IN CALIFORNIA

| National Forest (NF) National Park (NP) County (Co.) | Location | Date | Number Birds | Observer |
|---|---|---|---|---|
| Stanislaus NF | Salt Lick Meadow T4N, R20E NE SE Sec 16 (Tuolumne Co.) | Aug 16, 1978 | 1 | J. Frazier |
| " | Ackerson Meadow (Tuolumne Co.) | June 10, 1979 | 1 | R. R. Deloreuelle |
| " | " | July 11-12, 1979 | 1 | J. Winter, J. Peterson |
| Tahoe NF | 2½ mi. W. Yuba Pass (Sierra Co.) | Sept 9, 1966 | 1 | B. Snyder |
| " | Yuba Pass (Sierra Co.) | June 11, 1971 | 1 | V. De Costa, Golden Gate Audubon Soc. |
| Tuolumne Co. | 1 mi. E. Chinese Camp (photo) | May 14, 1978 | 1 | B. Nichelin |
| Toiyabe NF | Sardine Meadow (see Billeb 1962) (Mono Co.) | Aug 26, 1960 | 2 | S. Billeb |
| " | Little Valley, 13 mi. SSW Sparks, Nev. | July-Aug, 1975 | 1 | A. Risser |
| Yosemite NP | Crane Flat (Mariposa Co.) | 57 records 1949-1979 | 4* | many observers |
| " | Peregoy Meadow (Mariposa Co.) | 50 records 1931-1979 | 4* | many observers |
| " | 1 mi. N. Indian Rock (Mariposa Co.) | July 1, 1915 | 1 | J. Grinnell |
| " | near Ostrander Lake (see McLean 1928) (Mariposa Co.) | summer 1927 | 1 | D. McLean |
| " | near May Lake (see Gaines 1977) (Mariposa Co.) | Sept 1934 | 1 | -- |

*maximum number recorded

## APPENDIX B

## ACCEPTED SIGHT RECORDS OF GREAT GRAY OWLS IN CALIFORNIA

| National Forest (NF) National Park (NP) County (Co.) | Location | Date | Number Birds | Observer |
|---|---|---|---|---|
| Yosemite NP | Turner Meadow (Mariposa Co.) | July 22, 1941 | 1 | J. D. Webster |
| " | Badger Pass (Mariposa Co.) | Sept. 17, 1941 | 1 | H. L. Cogswell |
| " | Lower end of Tuolumne Meadow (Tuolumne Co.) | July 31, 1943 | 1 | C. Harwell |
| " | Badger Pass (Mariposa Co.) | Oct. 15, 1950 | 1 | W. J. Fitzpatrick |
| " | Glacier Point road (Mariposa Co.) | Nov 4, 1955 | 1 | WBM |
| " | " | Oct 20, 1956 | 1 | W. J. Fitzpatrick |
| " | Aspen Valley (Tuolumne Co.) | Nov 28, 1956 | 1 | G. Colison, D. Hubbard |
| " | Yosemite Valley (Mariposa Co.) | Jan 21, 1957 | 2 | W. C. Bullard |
| " | Ostrander Lake (Mariposa Co.) | Aug 1, 1958 | 1 | Brauger |
| " | Badger Pass (Mariposa Co.) | Dec 26, 1959 | 1 | W. J. Fitzpatrick |
| " | junction Ireland Cr., Lyell Fork (Tuolumne Co.) | July 27, 1969 | 1 | D. Larson |
| " | Yosemite Valley (Mariposa Co.) | Nov, 1969 | 1 | L. Hadley |
| " | McGurk Meadow (Mariposa Co.) | Aug 17, 1970 | 1 | G. S. Suffel |
| " | Yosemite Christmas Count (Count Period) | 1971 | 1 | G. Gidding |
| " | Summit Meadow | April 4, 1972 | 1 | G. Gidding |
| " | " | April 27, 1972 | 1 | C. Holly |

## APPENDIX B

### ACCEPTED SIGHT RECORDS OF GREAT GRAY OWLS IN CALIFORNIA

| National Forest (NF) National Park (NP) County (Co.) | Location | Date | Number Birds | Observer |
|---|---|---|---|---|
| Yosemite NP | Wawona (photo) (Mariposa Co.) | Nov 16-29, 1972 | 1 | D. Stone |
| " | 1½ mi. below Buena Vista Crest (Madera Co.) | June 25, 1973 | 2 | L. Hart |
| " | Gin Flat (Mariposa Co.) | Nov 18, 1973 | 1 | B. Rice, J. Edelbrock |
| " | ½ mi. SW Westfall Meadow (Mariposa Co.) | April 20, 1974 | 1 | B. Rice |
| " | McGurk Meadow (Mariposa Co.) | Oct 10, 1974 | 3 | J. Good |
| " | Pohono Trail east of Meadow Brook (Mariposa Co.) | Sept 9, 1975 | 1 | J. Benedict, K. Blackwell |
| " | White Wolf Campground (Tuolumne Co.) | Aug 29-Sept 25, 1976 | 1 | T. Beedy |
| " | Westfall Meadow (Mariposa Co.) | Sept 18, 1976 | 2 | K. Hansen |
| " | Beehive Meadow (Tuolumne Co.) | Sept 18, 1976 | 1 | D. Gaines |
| " | ½ mi. N McGurk Meadow (Mariposa Co.) | May 23, 1976 | 1 | J. Benedict |
| " | White Wolf Campground (Tuolumne Co.) | Aug 29-Sept 19, 1977 | 1 | T. Beedy |
| " | " | Sept 6-12, 1978 | 1 | T. Beedy |
| " | Westfall Meadow (Mariposa Co.) | June 27, 1979 | 1 | J. Winter |
| " | " | July 2, 1979 | 1 | J. McGee |
| " | " | Sept 24, 1979 | 1 | J. Winter |

## APPENDIX C

### UNCONFIRMED RECORDS OF GREAT GRAY OWLS IN CALIFORNIA

| National Forest (NF) | Location | Date | Number Birds | Observer |
|---|---|---|---|---|
| El Dorado NF | near Matulich Meadow | July, 1978 | 1 | B. Balon, K. Surface |
| Inyo NF | Lee Vining (Mono Co.) | winter 1975 | 1 | fide P. Bloom |
| Klamath NF | Forest Rd. 45N49 and Deadwood Creek (Siskiyou Co.) | July 3, 1979 | 2 | C. Lillard, B. McKinney |
| Lassen NF | Coon Hollow (specimen*) (Butte Co.) | Dec, 1977 | 1 | G. Stuart |
| | Russell Dairy Spring T34N, R8E, Sec 12 | July 7, 1978 | 1 | T. Akesson |
| Sierra NF | Nelder Grove T6S, R22E, $SE\frac{1}{4}$ $SE\frac{1}{4}$ Sec 6 (Madera Co.) | May 29, 1979 | 1 | K. Perke |
| " | near Hites Cove T4S, R19E, $SE\frac{1}{4}$ $NW\frac{1}{4}$ Sec 2 (Mariposa Co.) | May 31, 1979 | 1 | G. Rutledge |

*Unable to locate specimen.