

## The Biology and Current Status of the Long-eared Owl in Coastal Southern California

Peter H. Bloom

*Western Foundation of Vertebrate Zoology, Calle San Pablo,  
Camarillo, California 93010*

*Abstract.* — The Long-eared Owl (*Asio otus*) is poorly known in southern California. This paper reviews its historic nesting distribution in Orange and western San Diego counties as determined from 79 egg set records from 5 museum collections, and contrasts this with the distribution of 50 nesting attempts as recorded in Orange and northern San Diego counties between 1968–1992. Comparisons reveal a substantial area of extirpation in the coastal region with a small, remnant population in interior areas. The number of historic breeding territories has decreased by at least 55%. Reproduction appears good with 85% of 40 nests fledging young. Diet was typical of other regions with small rodents (*Microtus californicus*, *Reithrodontomys megalotis*, and *Thomomys bottae*) comprising 90% of the prey by number.

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Except for anecdotal accounts from early in this century, little is known about the biology of the Long-eared Owl (*Asio otus*) in coastal southern California (Dawson 1923; Willett 1933; Bent 1938). In this paper I present information obtained over a 24-year period (1968–1992) on nesting Long-eared Owls in coastal Orange and San Diego counties, California (Fig. 1) and contrast this with the historic (1889–1961) nesting distribution (Table 1). Also included are data on the breeding biology, nesting habitat, predators, diet, and the results of 1991 and 1992 surveys of historic and recent nest territories. These data were collected largely on an opportunistic basis while monitoring the breeding biology of the more common raptor species.

The impetus for this paper stems in part from reports of declines of Long-eared Owls in Pennsylvania, New Jersey, and California (Clark and Klem 1986; Bosakowski et al. 1989; Marti and Marks 1989), and recent distribution maps (Burton 1984; Johnsgard 1988; Marti and Marks 1989) which incorrectly indicate that the species does not breed in southwestern California. It also updates previous Long-eared Owl status reports provided in Garrett and Dunn (1981) and Unitt (1984).

### Study Area

The historic breeding distribution of the Long-eared Owl included all of southern California (Grinnell and Miller 1944) with the likely exception of some interior eastern desert areas. For the purposes of this paper the historic study area included all of Orange County, the coastal slope of San Diego County west of Mount Palomar, and the Cuyamaca and Laguna mountains (Fig. 1). My study area included southern and western Orange County, and northern San Diego County,



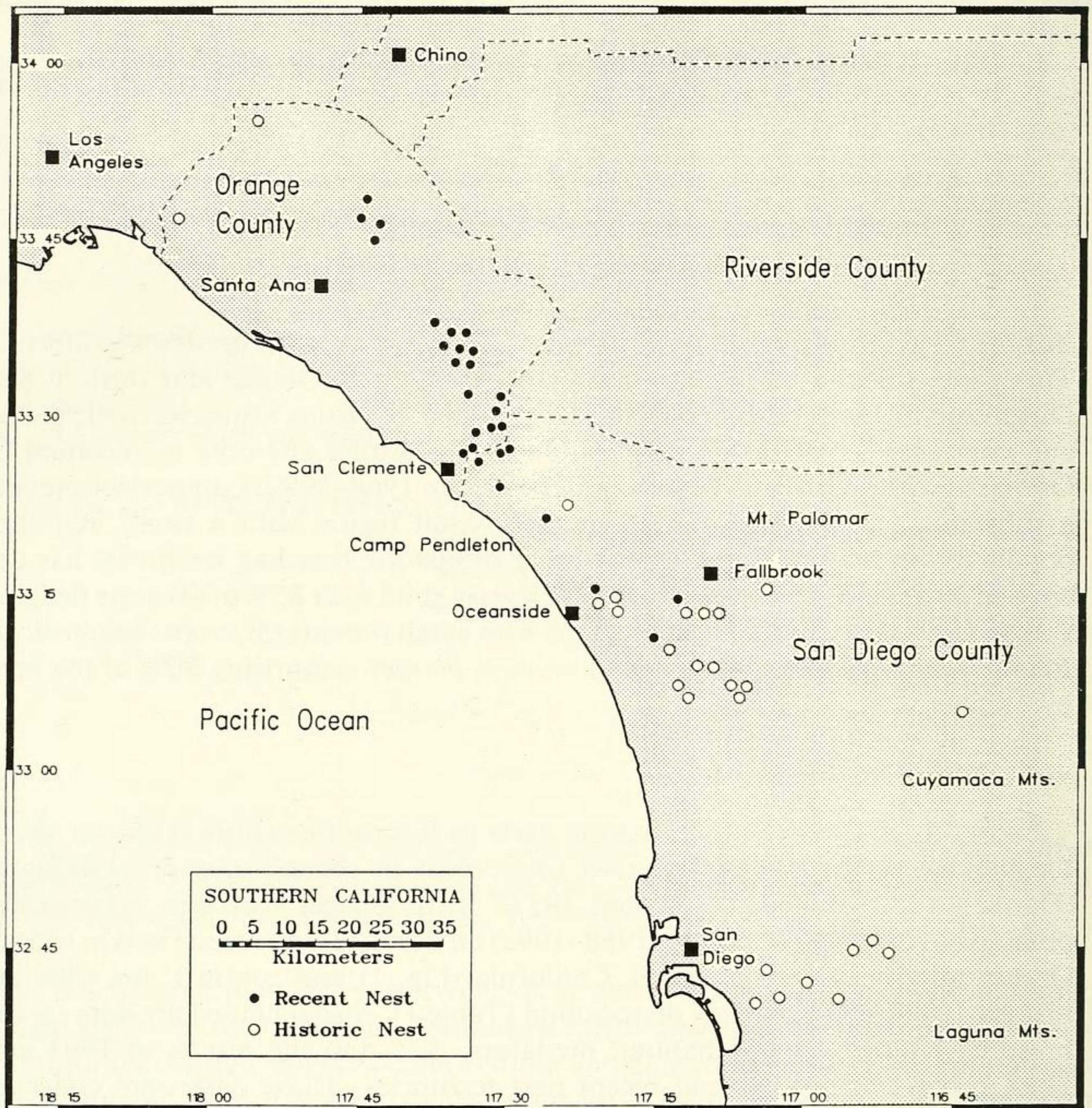


Fig. 1. Historic (1889–1961) and recent (1967–1992) locations of nesting Long-eared Owls in Orange and western San Diego counties.

California. Within Orange County, specific study sites included Rancho Mission Viejo, Irvine Ranch, Starr Ranch Audubon Sanctuary, Casper's Wilderness Park, Irvine Park, Wagon Wheel Park, Whiting Ranch Park, and Aliso-Wood Canyon Park. Within San Diego County, specific study sites were restricted to Camp Pendleton Marine Corps Base.

Oak woodland, riparian woodland, coastal sage scrub, native grassland, and non-native grassland are the predominant habitats in this region and elevation varies from sea level to 460 m. Precipitation averages 36 cm/yr and is seasonal, peaking in February (Bloom 1989).

#### Methods

All Orange and San Diego county egg set records were examined at the Western Foundation of Vertebrate Zoology (WFVZ), Museum of Vertebrate Zoology (MVZ),



San Bernardino County Museum (SBCM), and the Santa Barbara Museum of Natural History (SBMNH) (Table 1). These collections contained the majority of Orange and San Diego county sets (L. Kiff pers. comm.). Owing to the vagueness of locality data on nesting records, no attempt was made to recheck exact nest locations. However, I examined street maps and conducted 15 aerial surveys, 1–2 hr in duration, to determine the extent of urbanization and the likelihood of a former territory being occupied. I have never found an active Long-eared Owl nest within 1 km of a residential area in California. Therefore, if a residential street now exists within 1 km of a historic Long-eared Owl nest site I considered it abandoned.

Many Long-eared Owl nesting territories were encountered while searching for nests of other raptorial species. Specific surveys for nesting Long-eared Owls in 1991 and 1992 lasting 0.5–4 hr in duration, were conducted between 15 January and 1 June each year, and consisted of examining known and potential nest groves and listening for calling adults or begging young. Bal-chatri traps and mist nets were also used to ascertain the presence or absence of Long-eared Owls (Smith et al. 1983; Bloom 1987). Additional recent nest records were provided by other observers (Table 2).

Calculations of habitat loss figures in Orange County between 1972 and 1990 were derived from reports detailing land use changes (County of Orange 1972, 1993). For the purposes of this paper I used only land-use classifications that might support breeding Long-eared Owls. These included only the designations “open space” and “vacant,” which (in the 1974 edition) were defined as parks, cemeteries, beaches, and unused urban land. Unused urban land contained large ranches and the Trabuco District of the Cleveland National Forest. From the 1993 edition I used the designations that most closely approximated the 1974 edition, including “open space/recreation,” “vacant <31% slope,” and “vacant >30% slope.” These include beaches, local and regional parks, national forests, golf courses, cemeteries, wildlife preserves, recreational marinas, and public and private campgrounds (County of Orange 1993). The latter 2 categories contain mostly ranchlands. While habitats such as cemeteries, beaches, golf courses, and marinas are not typically Long-eared Owl breeding habitat, excluding their acreages would make this part of my methodology difficult to repeat; therefore, my breeding habitat acreage estimates as they relate to changes between 1972–1990 for Orange County are undoubtedly inflated and the actual acreage of suitable owl habitat is substantially less.

Foods habits were ascertained from pellets found in and directly below all active nests. Skulls and mandibles were used in the identification of rodents. A nest was considered successful if it fledged at least one young.

## Results

*Historic record.*—Seventy-nine egg sets collected between March 1889 and March 1961 from Orange (2) and coastal San Diego counties (77), respectively, were found in museum collections. Mean clutch size for these sets was 5.1 (S.D. = 1.0; range 2–7). Nests were located throughout the coastal region in 10 species of trees and shrubs. Of 69 nest substrates recorded, 21 were oak (*Quercus* sp.), 18 each in willow (*Salix* sp.) and cottonwood (*Populus fremonti*), 4 in *Eucalyptus* sp., 3 in sycamore (*Platanus racemosa*), and 1 each in orange, alder (*Alnus rhombifolia*),



Table 1. Historic nesting records of Long-eared Owls in Orange and San Diego counties from collections at the WFVZ, MVZ, SBCMNH, and SBMNH.

Museum no.	Date	Locality	No. eggs	Collector
San Diego County				
WFVZ 4,463	7 Feb. 1931	9 mi. W of Pala	2	Harrison
WFVZ 48,109	25 Feb. 1926	McCoy Grove	4	Gallup
WFVZ 73,766	17 Mar. 1898	Lakeside	4	Ingersoll
WFVZ 52,699	14 Mar. 1920	San Diego River	4	Ingersoll
WFVZ 73,763	19 Mar. 1893	Lakeside	6	Ingersoll
WFVZ 46,973	11 Mar. 1923	Near San Marcos	5	Gallup
WFVZ 48,256	11 Mar. 1923	Near San Marcos	5	Gallup
WFVZ 73,759	14 Mar. 1925	Lakeside	5	Burnham
WFVZ 4,466	9 Mar. 1933	5 mi. E of Escondido	7	Roberts
WFVZ 96,063	10 Mar. 1901	Grijito	4	Dixon
WFVZ 73,784	10 Mar. 1907	Crescent Valley	6	Sharp
WFVZ 72,133	13 Mar. 1936	Sweetwater Lake	5	Harvey
WFVZ 4,468	14 Mar. 1936	Santa Margarita Ranch	6	Harrison
WFVZ 52,701	14 Mar. 1923	Lakeside	5	Burnham
WFVZ 73,782	11 Mar. 1923	San Marcos	5	Sharp
WFVZ 52,702	13 Mar. 1921	Sweetwater River	5	Burnham
WFVZ 73,772	10 Mar. 1921	Near Lakeside	5	Ingersoll
WFVZ 52,698	14 Mar. 1920	San Diego River	3	Ingersoll
WFVZ 9,986	15 Mar. 1916	Jamacha	5	Ingersoll
WFVZ 72,021	15 Mar. 1916	Near Lakeside	4	Huey
WFVZ 9,886	15 Mar. 1913	Near Lakeside	5	Huey
WFVZ 73,768	22 Mar. 1897	Near Lakeside	5	Ingersoll
WFVZ 73,769	22 Mar. 1897	Lakeside	7	Ingersoll
WFVZ 73,764	18 Mar. 1894	Lakeside	6	Ingersoll
WFVZ 4,467	20 Mar. 1934	¼ mi. N of Bonsall	5	Harrison
WFVZ 73,792	16 Mar. 1933	Flinn Springs	7	Potter
WFVZ 73,774	16 Mar. 1933	Dihissa	5	Ingersoll
WFVZ 4,470	26 Mar. 1940	10 mi. E of Encinitas	5	Harrison
WFVZ 4,469	26 Mar. 1940	10 mi. E of Encinitas	5	Harrison
WFVZ 32,412	28 Mar. 1949	Bonsall	5	Dixon
WFVZ 52,099	27 Mar. 1919	San Diego	7	Piltifield
WFVZ 73,785	30 Mar. 1919	Escondido	6	Sharp
WFVZ 73,700	27 Mar. 1920	Lakeside	5	Ingersoll
WFVZ 71,995	27 Mar. 1927	Dihissa	5	Huey
WFVZ 73,783	30 Mar. 1913	Crescent Valley	5	Sharp
WFVZ 89,900	25 Mar. 1895	Lakeside	3	Ingersoll
WFVZ 73,765	25 Mar. 1895	San Diego River	4	Ingersoll
WFVZ 73,761	30 Mar. 1889	Lakeside	6	Ingersoll
WFVZ 83,462	18 Mar. 1961	San Luis Rey Mission	4	Quigley
WFVZ 4,471	22 Mar. 1942	Rancho Santa Fe	7	Harrison
WFVZ 75,642	20 Mar. 1949	San Luis Rey River	5	Hall
WFVZ 73,762	21 Mar. 1892	Lakeside	5	Ingersoll
WFVZ139,573	17 Mar. 1923	Old Maids Canyon	6	Heaton
WFVZ 4,464	26 Feb. 1933	2 mi. E of Bonsall	6	Harrison
WFVZ 4,465	27 Feb. 1933	½ mi. E of Bonsall	6	Harrison
WFVZ147,086	12 Mar. 1949	San Luis Rey River	6	Hall
WFVZ161,078	5 Mar. 1919	Bandy Can., San Pasqual	6	Carpenter
WFVZ 48,108	21 Feb. 1926	Bandy Canyon	5	Gallup
WFVZ127,962	6 Apr. 1917	Bonsall	5	Carpenter
WFVZ 73,786	4 May 1919	Marikle Canyon	4	Sharp



Table 1. Continued.

Museum no.	Date	Locality	No. eggs	Collector
WFVZ124,571	5 May 1903	San Pasqual	4	Wood
WFVZ 89,899	28 Mar. 1917	San Diego County	5	Potter
WFVZ 72,134	6 Apr. 1934	Sweetwater Lake	5	Harvey
WFVZ 73,781	13 Apr. 1902	San Pasqual	4	Sharp
WFVZ126,245	13 Apr. 1902	San Pasqual	7	Carpenter
WFVZ 55,120	7 Apr. 1901	San Pasqual	6	Carpenter
WFVZ 89,898	30 Apr. 1917	Lakeside	3	DeGroot
WFVZ 48,009	19 Apr. 1908	San Pasqual	5	Carpenter
WFVZ 73,760	8 Apr. 1923	Santa Isabel	5	Burnham
WFVZ 48,107	8 Apr. 1923	San Pasqual Valley	5	Gallup
WFVZ 4,476	3 Mar. 1920	Near Lakeview	7	Ingersoll
WFVZ 73,767	1 Mar. 1897	Lakeside	5	Ingersoll
WFVZ 52,700	6 Mar. 1920	San Diego River	4	Burnham
WFVZ 4,477	4 Mar. 1921	Fanita Ranch, Santee	5	Meanley
WFVZ107,394	15 Mar. 1903	San Pasqual	7	Dixon
WFVZ 52,703	6 Mar. 1921	Mission Valley	6	Burnham
WFVZ128,897	16 Mar. 1904	San Pasqual	5	Sharp
WFVZ 73,790	2 Mar. 1923	Fanita Ranch, Santee	5	Bancroft
WFVZ 73,771	10 Mar. 1901	Lakeside	7	Ingersoll
WFVZ 73,773	12 Mar. 1893	Escondido	3	Ingersoll
MVZ 13,305	29 Mar. 1925	Bonsall	3	Dixon
MVZ 5,973	17 Mar. 1896	Lakeside	5	Ingersoll
MVZ 5,974	25 Mar. 1900	Lakeside	5	Ingersoll
MVZ 5,972	27 Mar. 1920	Lakeside	5	Brown
SBCM 8,788	12 Mar. 1932	Bonsall	5	Hanna
SBCM 19,303	18 Feb. 1928	Lakeview	7	Sechrist
SBMNH 368-3*	20 Mar. 1897	Lakeside	6	Arnold
Orange County				
WFVZ115,182	12 Apr. 1891	Alamitos	6	Shields
WFVZ147,087	12 Mar. 1939	Near La Habra	4	Hall

\* County location not given on original data slip; I presumed it was San Diego County.

sumac (*Rhus* sp.), walnut (*Juglans regia*), and grape (*Vitis girdiana*). Of 47 nests for which the original nest builder was noted, 38.3% were American Crows (*Corvus brachyrhynchos*), 25.5% "rat" (*Neotoma* sp.), 12.8% Cooper's Hawks (*Accipiter cooperii*), 12.8% Red-shouldered Hawks (*Buteo lineatus*), 6.4% Swainson's Hawks (*B. swainsoni*), and 4.3% Red-tailed Hawks (*B. jamaicensis*).

Since egg collectors frequently returned to nesting territories each year, I determined that the minimum number of localities included in the 79 historic nest records represented at least 33 different localities. Eighteen (54.5%) of these 33 localities are now densely settled urban areas, or agricultural areas, and are no longer capable of supporting nesting Long-eared Owls. Nine localities given on data slips were too general to evaluate their current potential for nesting by Long-eared Owls or could not be found on maps. Only 6 (18%) (Jamacha, Sweetwater Lake, Bandy Canyon, San Pasqual Valley, Santa Ysabel, Santa Margarita Ranch) still showed any potential (> 1 km from residential area) of being used by Long-eared Owls for nesting.

*Recent studies.*—Fifty observations of Long-eared Owl nesting attempts were



Table 2. Recent Long-eared Owl nest records in Orange and San Diego counties.

Date	Location/observation
	Orange County
April 1968	Weir Can., 3 km N of confluence with Santiago Can., Orange Co., CA. Five young, 2 fledged.
April 1973	Arroyo Trabuco, 0.5 km S of O'Neill Park, Orange Co., CA. Active nest (E. Lindquist pers. comm.).
1 April 1971	Weir Can., 4 km N of confluence with Santiago Can., Orange Co., CA. Five small young. 18 April 1971, 3 young.
April 1973	Fox Can., 0.5 km E of confluence with Bell Can., Starr Ranch Audubon Sanctuary, Orange Co., CA. Fledged young present.
8 April 1974	Weir Can., 4 km N of confluence with Santiago Can., Orange Co., CA. Five eggs. 10 May 1974, failed.
May 1982	0.5 km N of Blind Can., Orange Co., CA. One recently predated fledged young (J. Bryan pers. comm.).
22 May 1977	Bell Can., 0.75 km N of confluence with Crow Can., Starr Ranch Audubon Sanctuary, Orange Co., CA. Fledged young present (D. Bontrager pers. comm.).
28 April 1984	Bell Can., 0.75 km N of confluence with Crow Can., Starr Ranch Audubon Sanctuary, Orange Co., CA. Six eggs, 2 young, 4 weeks old.
24 April 1984	Canada Gobernadora, Wagon Wheel Park, Orange Co., CA. One young (G. Chester pers. comm.).
11 May 1986	Gabino Can., 2.6 km N of confluence with La Paz Can., Orange Co., CA. Five young. 27 May 1986, 1 young predated.
22 May 1988	La Paz Can., 0.5 km N of confluence with Gabino Can., Orange Co., CA. Fledged young, 2 predated by Cooper's Hawk.
April 1988	Bell Can., 1 km S of Starr Ranch Audubon Sanctuary, Casper's Wilderness Park, Orange Co., CA. Fledged young present.
11 May 1988	Canada Gobernadora, Wagon Wheel Park, Orange Co., CA. Fledged young, 1 predated by Cooper's Hawk.
18 May 1989	La Paz Can., 0.5 km N of confluence with Gabino Can., Orange Co., CA. Three fledged young, 1 predated by Cooper's Hawk.
19 April 1991	Canada Gobernadora, Wagon Wheel Park, Orange Co., CA. Three young.
18 April 1991	Cristianitos Can., 0.1 km N of confluence with Talega Can., Orange Co., CA. Four young, one of which was predated by a Red-shouldered Hawk.
29 March 1992	Cristianitos Can., 0.1 km N of confluence with Talega Can., Orange Co., CA. Two young.
29 March 1992	Cristianitos Can., 0.1 km N of confluence with Talega Can., Orange Co., CA. Three young, one of which was predated by a Red-shouldered Hawk.
12 April 1992	Gabino Can., 2.3 km N of confluence with La Paz Can., Orange Co., CA. Five young.
13 April 1992	Canada Gobernadora, Wagon Wheel Park, Orange Co., CA. Four young.
15 April 1992	Cristianitos Can., Talega Reserve, Orange Co., CA. Fledged young.
15 May 1992	Gabino Can., 2.6 km N of confluence of La Paz Can., Orange Co., CA. Three fledged young.
19 May 1992	Santiago Can., 0.25 km S of Irvine Lake, Orange Co., CA. Fledged young present.
22 May 1992	Canada Gobernadora, 0.25 km S Wagon Wheel Park, Orange Co., CA. Fledged young present.
25 May 1992	Bell Can., 0.1 km N of Fox Can., Starr Ranch Audubon Sanctuary, Orange Co., CA. Two fledged young.



Table 2. Continued.

Date	Location/observation
8 April 1992	La Paz Can., 0.5 km N of confluence with Gabino Can., Orange Co., CA. Two young.
15 April 1992	La Paz Can., 0.6 km N of confluence with Gabino Can., Orange Co., CA. Three fledged young.
1 May 1992	La Paz Can., 1.2 km N of confluence with Gabino Can., Orange Co., CA. Fledged young.
San Diego County	
21 April 1974	Horno Can., Camp Pendleton, San Diego Co., CA. Three fledged young.
10 April 1983	Lower San Onofre Can., Camp Pendleton, San Diego Co., CA. Five young. 16 April, failed due to mammal predation.
6 May 1983	Santa Margarita River, 8 km upstream from ocean, Camp Pendleton, San Diego Co., CA. Fledged 1 young.
1 April 1983	Talega Can., at confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. One addled egg, failed.
Spring, 1988, 1989, 1990	South of Fallbrook, Hwy 76 and Gird St., San Diego Co., CA. Active nest (J. Oakley pers. comm.).
Spring 1973, 1974, 1975, 1983, 1988	Near Vista at Calveva Lake. San Diego Co., CA. Active nest (J. Oakley pers. comm.).
22 April 1983	Talega Can., 4.5 km N of confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. Three fledged young.
4 March 1984	Talega Can., 4.5 km N of confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. One addled egg, 4 young.
20 April 1984	Talega Can., 4.6 km N of confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. Fledged young present.
18 May 1985	Talega Can., 4.5 km N of confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. Failed with small young and eggs.
May 1989	Talega Can., Camp Pendleton, San Diego Co., CA. Failed with 3 small young (J. R. Bryan pers. comm.)
May 1989	Three km NE of Poway, San Diego Co., CA. Two fledged young (J. R. Bryan pers. comm.).
27 April 1991	Talega Can., 4.5 km N of confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. Fledged young present.
16 May 1991	Talega Can., 2.6 km N of confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. Three fledged young.
29 March 1992	Talega Can., 4.5 km N of confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. Two Long-eared Owl eggs and 3 Cooper's Hawk eggs in the same nest being incubated by a Cooper's Hawk. Long-eared owl nesting attempt failed.
29 March 1992	Talega Can., 4.6 km N of confluence with Cristianitos Can., Camp Pendleton, San Diego Co., CA. Five young.



made in 30 different nesting territories in Orange and San Diego counties between 1968 and 1992 (Table 2). Specific surveys of known Long-eared Owl nest territories were conducted in 1991–1992. Of 20 nest territories surveyed in 1991, 6 were active and 4 of these produced young. Fourteen territories were inactive. Of 18 nest territories surveyed in 1992, 12 were active and 11 produced young. Six territories were inactive.

Of 29 nests where the identity of the original nest builders was known, 68.9, 17.2, and 13.7 percent, respectively, were in abandoned nests of Cooper's Hawks, American Crows, and Common Ravens (*Corvus corax*). Thirty nest trees were coast live oaks (*Q. agrifolia*), and 1 was a willow. The most frequently used nesting habitat was closed canopy, young, coast live oak woodland where Cooper's Hawks and American Crows nested simultaneously, or, in alternating years, with the owls. In 4 instances in 1992, 2 pairs of Long-eared Owls nested within 25–100 m of each other.

Clutch sizes ranged from 2–8 eggs; mean clutch size was not determined. Thirty-four (85%) of 40 nests were successful. Nest failures from predation of individual Long-eared Owl chicks by Cooper's Hawks and Red-shouldered Hawks was frequent, especially if they nested in the same grove (Table 2). Competition for nests was occasionally intense. On 29 March 1992, I observed an old Cooper's Hawk nest with an adult Cooper's Hawk incubating 2 Long-eared Owl eggs and 3 of its own. The presence of an agitated adult Long-eared Owl in adjacent trees suggested that the Cooper's Hawk had recently usurped the Long-eared Owl nest and eggs. The nest fledged only Cooper's Hawks. Predation by Cooper's Hawks on Long-eared Owl chicks occurred during 3 nesting attempts at 2 territories, and in at least one instance all young were taken. D. R. Bontrager (pers. comm.) also observed an instance of attempted predation by an adult Red-shouldered Hawk on a Long-eared Owl fledgling in Orange County (Table 2). Red-shouldered Hawks preyed on at least 1 young from each of four nesting attempts and on one adult. One dead young Long-eared Owl was also found in the nest of a Red-tailed Hawk (*B. jamaicensis*). Elsewhere the Red-tailed Hawk has been recorded as a predator of adult Long-eared Owls (Collins 1960).

One hundred thirty-four pellets collected from 11 Long-eared Owl territories between 1985–1992 contained 102 vertebrates including California vole (*Microtus californicus*) (39), western harvest mouse (*Reithrodontomys megalotis*) (30), Botta pocket gopher (*Thomomys bottae*) (23), white-footed mouse (*Peromyscus*) sp. (4), pocket mouse (*Perognathus*) sp. (3), ornate shrew (*Sorex ornatus*) (1), and 2 unknown passerines.

### Discussion

Long-eared Owls were formerly common in San Diego and Orange counties but are now becoming increasingly rare in southern California. New and early investigators (Cooper 1870; Sharp 1907; Dawson 1923; Willett 1933) all reported the species as common in oak woodland and willow thicket habitats of southwestern California. Sharp (1907) regarded it as a "common resident" and further stated that "Up to a few years ago almost every crow's, hawk's, or rat's nest along the river in San Pasqual had its pair of owls." Grinnell and Miller (1944) described the status of Long-eared Owls in California as "numbers are so large as to warrant term "common," even "abundant" locally. Reduction of late years



is apparent, in the main probably mainly as result of clearing bottomlands for farming." Marti and Marks (1989) noted that the species is declining in California, and Garrett and Dunn (1981) stated that the Long-eared Owl has "virtually been eliminated there [in southern California] as a breeder." Unitt (1984) provided further documentation of the scarcity of recent San Diego County breeding records for this species and its substantial decline, stating that the species now nests only in the Anza Borrego Desert. He placed the last known coastal San Diego County breeding record at that time (1984) as 13 May 1973 near Oceanside.

The known present breeding population and historic distribution as determined from recent surveys and egg collections from two southern California counties suggest the Long-eared Owl has declined by at least 55% and possibly as much as 82%. Based upon recent habitat use trends in Orange County, the species will probably continue to decline. Of 112,195 ha (277,234 ac) of potential Long-eared Owl breeding habitat available under the categories of "open space" and "vacant" (County of Orange 1974) in 1972, only 94,982 ha (234,701 ac), representing a 15.3% decline, were still available in 1990 (County of Orange 1993). The reduction of active nesting territories is directly attributable to habitat change; however, a limited quantity of unsurveyed potential nesting habitat exists within the Cleveland National Forest which, when coupled with county, state park, National Audubon Society, and private conservancy acreages, may afford some continuing protection for owls within Orange and San Diego Counties. Presently, no Long-eared Owl breeding activity is known in any Orange County ranch or parklands west of the I-5 freeway. However, potential habitat remains there, and much of it may be designated as wilderness park additions. If so, these areas may yet be able to support a few breeding pairs of Long-eared Owls. The species was extirpated in most of western San Diego County west of I-15 with the exception of Camp Pendleton, and possibly portions of the San Luis Rey River, Santa Margarita River, and Fallbrook vicinity (Fig. 1). Most notable is the lack of any recent nesting records from the San Diego vicinity that was referred to by Grinnell and Miller (1944) as one of three "centers of abundance" in California and an area from which a minimum of 36 historic nesting records are known within 25 km of San Diego (Table 1, Fig. 1). The only hints of continued nesting activity in this area is from Cedar Canyon, east of San Diego, where a recently killed Long-eared Owl was found in summer, and 4 roosting owls were found in winter in the Proctor Valley, Otay Ranch area (Preston et al. 1992). Unitt (1984) also referred to records of roosting Long-eared Owls on the coastal slope with a maximum of 12 at Rancho Otay in 1979.

Based upon observations of 7 adults at different spring locations (1972–1992), I suspect that Camp Pendleton may still support several breeding pairs of Long-eared Owls along the Santa Margarita River between the coastal estuary and the confluence of De Luz Creek, and in the Santa Margarita Mountains near Case Springs. However, after 20 years of nesting raptor surveys which resulted in only 7 confirmed Long-eared Owl breeding territories I suspect the population is small (Table 2). One of the above territories has been inactive since 1974, and 2 have been inactive since 1983.

Long-eared Owls use a variety of vacant raptor and corvid nests and do not build their own. Hence, as numbers of other raptors decline so do opportunities for surplus nest structures that the owls depend upon. For example, 3 historic



nest sites in San Diego County were built by Swainson's Hawks, a species Sharp (1902) called formerly "abundant" near Escondido. Swainson's Hawks are now completely extirpated from coastal southern California (Bloom 1980; Risebrough et al. 1990). As competition between raptors for increasingly smaller areas of nesting habitat and nest sites grows, so will the potential for predation on Long-eared Owls, as exemplified by the observed interactions with adjacent nesting Cooper's Hawks and Red-shouldered Hawks.

Crow and raven breeding populations are large and probably increasing on the study area (pers. observ.). Although nest site availability may be proportionately greater now than historically due to increased numbers of nesting ravens, the degree of predation exerted by ravens on breeding Long-eared Owls may be an additional important factor in the decline of the owl. It is interesting that none of 69 historic Long-eared Owl nests were built by ravens, yet 13.7% of 29 recent nests were built by this species.

Compared with nest success studies in Idaho (34–51%) (Marks 1986) and Oregon (70%) (Bull et al. 1989) the 85% nest success reported in this study is high and may in part be attributable to the inclusion of nests discovered late in the season which could have inflated nesting success. It may also be due to nesting habitat quality. As suggested by Bull et al. (1989) on their coniferous Oregon study area, dense canopy cover probably reduces predation. The majority of territories in my study were composed of dense, closed canopy oak woodland which probably afforded greater protection from predation than shrubsteppe habitats in Idaho (Marks 1986). Higher quality foraging habitat would also be expected to increase nesting success.

The high proportion of small rodents found in Long-eared Owl diets in this study was similar to that found elsewhere in the United States, with voles and gophers predominating (Marti 1976; Craig and Trost 1979; Marks and Yensen 1980; Bull et al. 1989). However, as would be expected due to different habitats, they were distinct from Long-eared Owl diets in the Colorado Desert of California where pocket mice and kangaroo rats (*Dipodomys* sp.) were dominant (Barrows 1989).

Although I did not perform a rigorous analysis of Long-eared Owl nesting and foraging habitat, all territories contained substantial quantities of grasslands within 1 km of oak woodland and riparian nesting habitat where voles and gophers could be caught, suggesting that adjacent grasslands were important in the selection by Long-eared Owls of nest sites.

The destruction of grassland foraging habitat in spite of the preservation of small riparian and oak woodland nesting habitats has probably contributed to the Long-eared Owl's decline in southern California. Preservation of substantial open space reserves that contain both nest groves and adequate foraging habitats may yet prevent the local extirpation of this wide ranging owl species.

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