State of California
THE RESOURCES AGENCY
Department of Fish and Game

HISTORIC AND CURRENT STATUS OF THE BANK SWALLOW IN CALIFORNIA, 1987

by

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Wildlife Management Division
Administrative Report 88-2

Cover: Bank Swallow (*Riparia riparia*)
Artwork by Narca Moore-Craig

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ABSTRACT

A total of 111 Bank Swallow colonies consisting of 45,045 nesting burrows were located in California during the 1987 breeding season. The Sacramento Valley region of the state was the site of 75% of these burrows, while 21% were located in Great Basin regions and 4% were located in the coastal regions. No Bank Swallow colonies were found in southern California despite numerous historical records prior to 1933. Bank Swallow nesting habitats in all regions are threatened by riprapping, various water development projects and by human harassment. These factors have played a major role in the extirpation of the species from southern California.

Recommendations include placing the Bank Swallow on the list of Threatened bird species in California, protecting nesting colonies from human harassment, and developing a habitat management plan for the Sacramento and Feather river populations.

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RECOMMENDATIONS

The contractors make the following recommendations: [1/]

1. Add the Bank Swallow to the list of Threatened bird species in California.

2. Protect Bank Swallow nesting habitat from human disturbance.

3. Develop a comprehensive management plan for Bank Swallows on the Sacramento and Feather rivers. Participation in the planning effort should include the California Department of Fish and Game, State Reclamation Board, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers and various conservation organizations.

4. Monitor Bank Swallow populations annually on the Sacramento River and every five years throughout the remainder of the species' range in California.

[1/] The Department of Fish and Game endorses these recommendations.

INTRODUCTION

The Bank Swallow (Riparia riparia) has been recorded in the lowlands of California since ornithologists began to explore these areas in the mid-nineteenth century (Grinnell and Miller 1944). Newberry (1857) considered the species to be common throughout California during his era. Bank Swallows are now considered by field ornithologists to be locally common only in certain restricted portions of the state where sandy, vertical bluffs or riverbanks are available for the birds to construct their nest burrows in colonies. In 1978 the Bank Swallow was listed as a second priority species of special concern (Remsen 1978). This status was given based on a decline in range and population levels. Remsen (1978) reported that "Channelization of rivers is the most insidious, long-term threat to the species; almost all colonies in the Sacramento Valley will be destroyed by planned bank `protection' projects by the Army Corps of Engineers." In 1985, Corps riprap projects destroyed at least three large nesting colonies during the breeding season causing the loss of all reproduction of these sites (Calif. Dept. of Fish & Game, unpublished data). During the study contracted in 1986 (Humphrey and Garrison 1987) it was found that nesting habitat for over 55% of the Sacramento River's Bank Swallow population could be destroyed within 5-10 years if currently proposed riprapping projects are completed. They also showed that 90% of the nesting habitat could be lost because of the location of these colonies on the eroding river banks that the Corps often targets for riprapping. Concern about the species' welfare caused by this loss and by threats of proposed U.S. Army Corps and California Reclamation Board riprap projects led to the initiation of this study to determine the population and distribution throughout California. The objective of this study was to determine the proportion of Bank Swallows nesting in various geographic regions in California and to determine the threats to these populations.

METHODS

Timing and data collection

We began this study in 1986 with a search for historic and recent locations of Bank Swallow colonies by reviewing literature, requesting colony location information from field ornithologists and birders and examining oological data and specimen records from museum collections. Based on the information received we defined colonies as "current" (occupied by nesting birds during 1986 and/or 1987), "recent" (occupied by nesting birds during the period from 1975 to 1985) or "historic" (occupied by nesting birds prior to 1975).

Our field surveys were conducted from 6 April to 17 July 1987. Areas with known Bank Swallow colonies and potential habitat were surveyed by automobile, motorboat, canoe, foot and fixed-wing aircraft. Emphasis was placed on the search for currently active colonies that were previously unknown. Most colony locations were photographed to document the habitat. Relative abundance of Bank Swallows at each colony was derived by counting burrows. At each colony, data collected included: 1) number of burrows; 2) general habitat type of the nesting colony; 3) surrounding land use; 4) estimated number of Bank Swallows observed (to establish activity only); 5) geographic and legal location; and 6) river mile (R.M.), if available (see Appendix 1).

Estimating the size of Bank Swallow colonies

There are at least three methods that can be used to estimate the size of a Bank Swallow colony. These methods are: 1) counting the number of birds visible at the colony; 2) counting the number of burrows; and 3) determining the percent of burrows occupied by nesting pairs and multiplying that percentage by the number of burrows to estimate the number of breeding pairs. The number of breeding pairs is the most desirable measure of colony size.

The first method is the most inaccurate and imprecise of the three methods. The number of birds flying around a colony varies with time of day, period of the nesting cycle, and disturbance to the colony. For those reasons, bird counts were used only to establish that a colony was "active".

Counting the total number of burrows visible at a colony is the method used in our study. The method has both advantages and disadvantages. Not all burrows in a colony are used for nesting. Some burrows remain from previous years and others are from abandoned nesting attempts. Therefore, the total burrow count usually overestimates the number of breeding pairs. Burrow numbers can also change through time as new burrows are dug throughout the nesting season. However, most burrows are dug by late May and early June and counts can then proceed with increased accuracy. Erosion can occur at any time destroying from several to all the burrows in a colony. Yet, making total counts of burrows is a rapid and relatively precise field method that is easily repeatable by different observers and is indicative of colony size if the count is made during the peak of the nesting season.

The rate of occupancy by nesting pairs multiplied by the number of burrows in the colony is the most accurate and time-consuming of the three measures of estimating population size. In 1986, we found the occupancy rate varied greatly among colonies on the Sacramento River (average = 55.9%, standard error = 2.7%, coefficient of variation = 25.0%, minimum = 11.4%, maximum = 76.9%) (Humphrey and Garrison 1987). The occupancy rate also was not correlated with the number of burrows in the colony ($r = 0.21$, $P = 0.31$, $N = 25$). Therefore, occupancy rate varies as does colony size, but there is no discernible relationship. Also it is not possible to extrapolate the rate of occupancy from year to year or site to site because the amount of erosion differs, and it is difficult to correct for the number of unused burrows or to estimate how many of the burrows remain from previous years. A lack of erosion which does not remove burrows from the previous year will deflate the occupancy rate and therefore reduce the population size at a colony. To obtain the most accurate estimate of breeding pairs in a population the occupancy rate should be sampled at each colony. This could be an expensive and time-consuming process.

We used aerial photographs and topographic maps to assess the potential of an area as Bank Swallow habitat. We rated an area's nesting potential based on habitat parameters that were measured at colonies along the Sacramento River in 1986 (Humphrey and Garrison 1987). Suitable Bank Swallow nesting habitat often consists of tall, freshly eroded vertical bluffs or banks, adjacent to fresh water. Nesting colonies often occur at sites that have even textured sandy loam soils and open habitats above the site. Some areas of potential habitat appeared to have suitable soil characteristics, however, no detailed soil analyses were performed. Soil samples from 1986 are currently being analyzed, however (Garrison, in prep.).

Coastal bluffs and lowland river systems were selected as the primary areas to be surveyed. We divided California into nine geographic regions: North Coast, Great Basin, Sacramento Valley, Sierran, Central Coast, San Joaquin Valley, Mono-Inyo, South Coast, and Mojave-Colorado Desert (Figure 1). The Sierran Region was surveyed only in Alpine County. The Mojave-Colorado Desert Region was surveyed thoroughly during the course of other field studies. No recent or historic breeding records exist in this region.

RESULTS AND DISCUSSION

North Coast Region

History

In 1946, Talmadge (1947) found 5 isolated nesting pairs in sandy bluffs in Humboldt County. In 1904, an egg set was collected in Eureka. This nest was constructed of straw, grass, and leaves. A suspected Bank Swallow egg set was collected on the Sonoma River, near Sonoma and is now reposited at San Bernardino County Museum. The nesting chamber contained no feathers and was probably the egg set of a Rough-winged Swallow (Stelgidopteryx serripennis) (E. Cardiff, pers. comm.). These nesting data are rather aberrant. Additional Bank Swallow records nesting in this region include an active colony at Nicasio, Marin County, in 1876; a colony at Sebastopol, Sonoma County, prior to 1890; a colony at Prairie Creek State Park, Humboldt County, in 1956; a small colony near Jenner, Sonoma County, in 1960; and a colony near Gualala, Mendocino County, in 1969. In 1983, a colony was discovered on the Smith River near its mouth at the Pacific Ocean. This colony has been active each year since its discovery (Table 1).

Results

The colony on the Smith River was active in 1987 with 702 burrows (Table 2). Surveys of the major rivers, a few smaller creeks and parts of the coastline found no other Bank Swallows and small amounts of potential habitat (Table 2).

Discussion

Several of the records for the North Coast region are of single nests and few colonies have been recorded. Bank Swallows are generally colonial nesters and include feathers in their nests while Rough-winged Swallows are solitary nesters and do not use feathers in their nests (Harrison 1978). Because of the unusual nature of the records from Sonoma (1893), Eureka (1904), and Humboldt County (1946), these records may not pertain to Bank Swallows and are possibly those of Rough-winged Swallows. However, single pair colonies have been documented in southern California (P. Lehman pers. comm.).

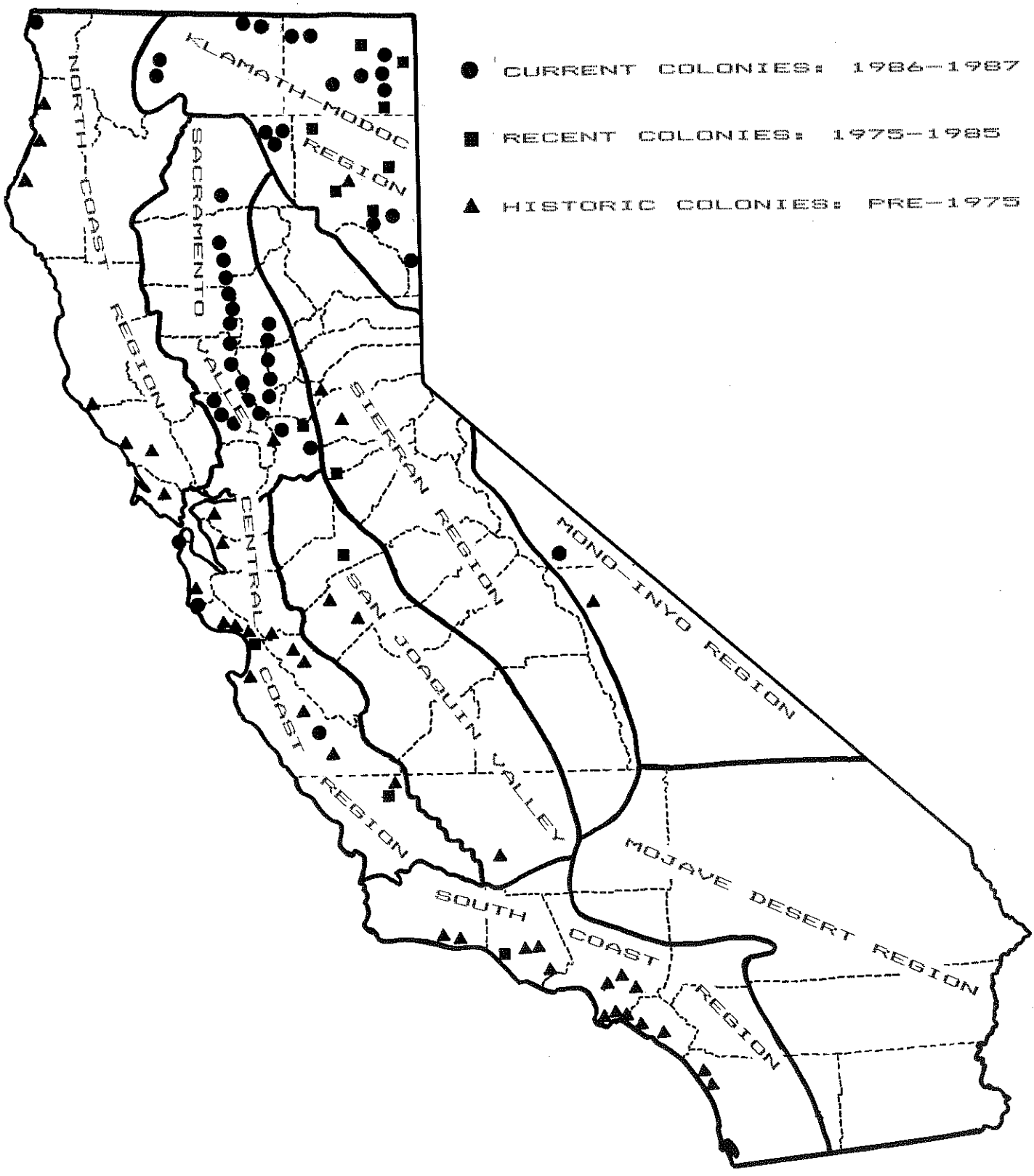

Figure 1. Historic and current breeding location of Bank Swallows in California.

Table 1. Breeding records of the Bank Swallow in California, 1864-1985

Locality	Date	Source 1/
NORTH COAST REGION		
Del Norte County		
Smith River estuary	1983-1985	ABF
Humboldt County		
Eureka	16 June 1904	egg set WFVZ
Orick Lookout	20 June 1946	Talmadge 1947
Luffenholtz Ck near Trinidad	14 June 1946	Talmadge 1947
Mad River, Essex Rock	20 June 1946	Talmadge 1947
Table Bluff	20 June 1946	Talmadge 1947
Van Duzen River	21 June 1946	Talmadge 1947
Prairie Ck	1956	AFN 11:408 1956
Mendocino County		
Gualala area	1969	BBS
Sonoma County		
Sebastopol	pre-1890	Belding 1890
Sonoma River, Sonoma	23 May 1893	egg set SBCM
Ocean bluff near Jenner	23 July 1960	AFN 15:475 1960
Marin County		
Nicasio	19 March 1876	Belding 1890
KLAMATH-MODOC REGION		
Siskiyou County		
5 mi S. of Tule Lake	26 May 1940	egg sets(15) WFVZ
Sheepylake, E of Dorris	5 July 1963	specimen MVZ
Lower Klamath NWR to Tule Lake	1972-1985	BBS & ABF (14 rcds)
Klamath River	1985	ABF
Modoc County		
Likely	1972-73, 1976, 1978, 1984	BBS
Ingalls	1973, 1978	BBS
5 mi N of Alturas	12 May 1981	ABF
Cedarville	1977	BBS
Dorris Reservoir	23 June 1973	AB 27:916 1973
Clear Lake	1985	BBS
Newell	31 July 1986	Airola (pers. comm.)

Table 1 (continued)

Locality	Date	Source 1/
Lassen County		
Nubieber	1971, 1977, 1980	BBS
Honey Lake	1972-1985	ABF, BBS, (Laymon (pers. obs.)
S. of Susanville	3 June 1973	AFN 27:916 1973
N. side Eagle Lake	July 1974	AB 28:946 1974
Pine Ck Estuary, Eagle Lk area	1977	NRP
Cold Run Creek	15 June 1983	Laymon (pers. obs.)
Levitt Lake	15 June 1983	Laymon (pers. obs.)
Madeline Plains, near Termo	1984	ABF
Shasta County		
Fall River Mills	1978-1985	ABF
Baum Lake	1981, 1982	ABF
Hat Ck Park	1982, 1985	ABF
Fall River Reservoir	1986	Brown (pers. comm.)
SACRAMENTO VALLEY REGION		
Tehama County		
Deer Ck, near Vina	1956	AFN 10:408 1956
Sacramento River, Red Bluff to Tehama	1976	5 colonies ABF
Thomes Ck, near Henleyville	1982	ABF
Glenn/Butte County		
Sacramento River, Chico to Colusa	1972-1985	BBS (8 records) ABF (13 records)
Sutter County		
Feather River, 15 mi S. of Yuba City	1985	ABF
Sacramento County		
Sacramento area	pre-1870	Grinnell & Miller 1944
Sacramento "common"	pre-1890	Belding 1890
American River, near Sacramento	pre-1972, 1973-74	ABF
American River, San Juan Rapids	1985	ABF

Table 1 (continued)

Locality	Date	Source 1/
SIERRAN REGION		
Placer County		
Auburn area	1974	BBS
El Dorado County		
Placerville area	pre-1888	Dawson 1923
Amador County		
Mokelumne River Area	1979	BBS
CENTRAL COAST REGION		
Contra Costa County		
Locations imprecise "rare"	pre-1890	Belding 1890
Alameda County		
Locations imprecise "rare"	pre-1890	Belding 1890
Hayward	pre-1927	Grinnell & Wythe 1927
San Francisco County		
Lake Merced	1908-1938	egg sets(18) WFVZ fide H. Cogswell
Ocean Beach	pre-1927	Grinnell & Wythe 1927
Ocean Beach, Fort Funston	1956-1985	ABF, AFN 10:361 1956 AFN 14:475 1960
San Mateo County		
Near Pescadero	31 May 1896	egg sets (2) WFVZ
Ano Nuevo Point	1904-1907, 1971-1985	Grinnell & Miller 1944, NRP, ABF
Santa Cruz County		
Capitola	1889	specimen MVZ
Santa Cruz area	1889	Grinnell & Miller 1944
Westcliff Dr., Santa Cruz	1950	AFN 4:259 1950
Eastcliff Dr, Santa Cruz	1950	AFN 4:259 1950
San Andreas Road, 15 mi. E of Santa Cruz	1954	AFN 8:360 1954
Soquel	pre-1962	AFN 16:505 1962

Table 1 (continued)

Locality	Date	Source 1/
Santa Clara County		
Betebel	28 May 1931, 6 June 1931	egg sets WFVZ
Monterey County		
2 mi N of Seaside	5 June 1897	egg sets(4) MVZ
5 mi N of Monterey	8 June 1898	egg set MVZ
2 mi N of Seaside	28 May 1898	egg sets(4) MVZ
2 mi N of Seaside	8 June 1898	egg sets(4) MVZ
San Ardo	pre-1923	Dawson 1923
E of Elkhorn Slough	3 July 1949	H. Cogswell (pers. comm.)
Trafton Rd., N of Moss Landing	1950-1952, 1974	AFN 4:259 1950
Moss Landing	9 May 1951	AFN 5:309
Old Toll Road	1952	AFN 6:298 1952
Watsonville	1954-1962	AFN 8:360 1954 AFN 16:505 1962
Greenfield	1972	ABF
Bluffs Rd, mouth of Pajaro River	1972-74, 1977-79, 1981-1983	AFN 26:805 1972 ABF
Salinas River-King City area	1973-1985	BBS, ABF
San Benito County		
Paicines	12 June 1898	n. specimen CAS
San Benito River, Hollister	3-20 June 1922	egg sets(10) CAS
N San Benito County	21 May 1932	egg sets(2) WFVZ
San Luis Obispo County		
near Shandon	13 May 1933	egg set MVZ
Cholame area	1970's	D. Roberson (pers. comm.)
W of Shandon	1971-73, 1977	BBS
near Paso Robles	1973	BBS
SAN JOAQUIN VALLEY REGION		
Stanislaus County		
Waterford, Tuolumne River	1984	BBS
Merced County		
10 mi E of Los Banos	21 May 1925	juv. specimen MVZ
Gustine	10 July 1940	juv. specimen MVZ

Table 1 (continued)

Locality	Date	Source 1/
Kern County		
Buena Vista Lake	26 June 1921	juv. specimen UCLA
MONO-INYO REGION		
Inyo County		
Owens River, Alvord near Big Pine	1891	Fisher 1893
Crowley Lake	pre-1950-present	D. Gaines (pers. comm.)
SOUTH COAST REGION		
Santa Barbara County		
Hope Ranch Beach, Santa Barbara	18 June 1913	egg set SBMNH
near Santa Barbara	28 June 1913	egg sets(2) SBMNH
Hendries Beach, Santa Barbara	4 June 1927	egg set WFVZ
Santa Barbara County	May 1933	egg sets(3) WFVZ
Goleta	9 May 1943	H. Cogswell (pers. comm.)
Ventura County		
Lake Sherwood	2 June 1864	egg set WFVZ
Santa Clara River, E of Santa Paula	5 May 1904	egg set WFVZ
Santa Clara River, Sespe Station	8 May 1910	egg set WFVZ
Santa Clara River, E of Santa Paula	13 May 1926	egg sets(2) WFVZ
Santa Clara River Estuary	1976	Garrett & Dunn 1983
Los Angeles County		
Los Angeles River, Los Angeles	19 May 1893	egg sets(2) WFVZ
Los Angeles	1907	Shepardson 1909
San Gabriel River, near Whittier	4 July 1894	egg set WFVZ
Alhambra	21 May 1902	egg set WFVZ
Long Beach, Bixby	21 May 1904	specimens MVZ
San Pedro	1904, 1908, 1909	Shepardson 1909
	1921,	egg sets WFVZ BL 23:256 1921
Port Los Angeles	1907	Shepardson 1909
Long Beach	23 April 1913	specimens UCLA
San Pedro over harbor	2 May 1915	egg sets (2) WFVZ
Long Beach, Bixby	29 June 1919	egg set SBCM
Long Beach	16 April 1925	BL 27:271 1925
Soledad Cyn, 15 mi E of Newhall	26 April 1928	BL 30:282 1928

Table 1 (continued)

Locality	Date	Source 1/
Orange County		
Huntington Beach	1906-09, 1918, 1927, 1937	egg sets(14) WFVZ SBMNH, Shepardson 1909
Newport Beach	pre-1917	Grinnell & Miller 1944
San Diego County		
Oceanside	1912-1925	egg set SBMNH Grinnell & Miller 1944 Willett 1933
Los Flores (ocean bluff, Camp Pendleton)	13 May 1917, 2 May 1919	egg sets WFVZ

1/ Source

AB	American Birds
ABF	American Birds Editors Files
AFN	Audubon Field Notes
WFVZ	Western Foundation of Vertebrate Zoology
CAS	California Academy of Sciences
SBCM	San Bernadino County Museum
SBMNH	Santa Barbara Museum of Natural History
MVZ	Museum of Vertebrate Zoology
BBS	Breeding Bird Survey, U.S. Fish and Wildlife Service
NRP	Nest Record Program, Cornell
UCLA	University of California, Los Angeles
BL	Bird Lore

Table 2. Bank Swallow population distribution by geographic regions in California, 1987.

Geographic Region	Number of Colonies	Percent of Total	Number of Burrows	Percent of Total
NORTHERN COAST	1	0.9	702	1.6
GREAT BASIN	27	24.3	7,395	16.4
SACRAMENTO VALLEY	79	71.2	33,696	74.8
SIERRAN	--	---	---	---
CENTRAL COAST	3	2.7	942	2.1
SAN JOAQUIN VALLEY	--	---	---	---
MONO - INYO	1	0.9	2,310	5.1
SOUTH COAST	--	---	---	---
MOJAVE - COLORADO DESERT	--	---	---	---
Total	111	100.0	45,045	100.0

The Smith River colony is the only active site in this region, and the geographically isolated from the rest of the state's Bank Swallows. The nearest active colony in California was located on the Scott River 128 km (80 miles) to the east. There are, however, colonies on the coast of Oregon within 16 km (ten miles) of the California border (R. Erickson pers. comm.). The Smith River colony is on land owned by the California Department of Parks and Recreation, and the colony could be protected from habitat destruction.

The Eel and Mad rivers were the only rivers surveyed in this region with habitat that appeared able to support Bank Swallows. Each river had approximately 1% potential habitat for the surveyed area.

The coastline, from Crescent City to the Russian River, had scattered bluffs that appeared too rocky for use by Bank Swallows; however, we estimated that approximately 2% of the surveyed area was potential habitat. The extensive coniferous forests, steep river canyons, and lack of extensive alluvial flood plains appear to make the north coast generally unsuitable for nesting Bank Swallows.

Great Basin Region

History

There are several historic and recent records for this region. Eggs were collected from a colony near Tule Lake, Siskiyou County, in 1940. The U.S. Fish and Wildlife Service's Breeding Bird Survey has recorded Bank Swallows on routes near Ingalls, Cedarville, Likely, and Clear Lake Reservoir in Modoc County. A colony on the Susan River, at Honey Lake Wildlife Area, Lassen County has been active since 1972, and Bank Swallows are known to breed at Tule Lake and Lower Klamath Lake, Siskiyou County. In 1981, a colony was found north of Alturas, Modoc County, and in 1986, another colony was found near Newell, Modoc County (Table 1).

The colony at the town of Fall River Mills, Shasta County, is the renowned colony of this region (Figure 2). Information on the colony is available at least beginning in 1978. In 1986, a colony was reported from the nearby Fall River Reservoir.

Results

In 1987, we found 27 colonies with 7,395 burrows in this region (Table 2). The colonies at Honey Lake and Newell were again active in 1987. Three colonies were found at Lower Klamath Lake, 1 colony at Indian Tom Lake, Siskiyou County, a second colony in Newell, 3 colonies at Clear Lake Reservoir, 1 colony along Long Valley Creek, Lassen County, 2 colonies along Baxter Creek near Susanville, Lassen County, 1 colony near Dorris Reservoir, Modoc County and 3 colonies along the Pit River near Alturas, Modoc County (Table 3).

The colonies at Fall River Mills and Fall River Reservoir were active in 1987. We found two additional colonies on Lake Britton, Shasta County, 1 colony at Hat Creek, Shasta County and 5 colonies on the Scott River near Etna, Siskiyou County.

The colonies at Lake Britton, Fall River Reservoir, and Hat Creek are on lands owned by Pacific Gas and Electric Company. The Scott River colonies occur on eroding streambanks similar to colonies on smaller rivers in the Sacramento Valley. The colony at Fall River Mills occurs on private land on a road cut next to State Highway 299. The landowner has expressed an interest in discouraging nesting at this colony (D. Smith pers. comm.).

Some potential habitat exists in this region. Lower Klamath Lake, the Pit River, Indian Tom Lake, the Susan River, and Baxter Creek all had at least 5% of the surveyed area with potential habitat (Table 3). It is likely that more Bank Swallow colonies occur in this region, given the large number of reservoirs, natural lakes, extensive creek and river systems, and alluvial and marine sedimentary deposits.

Photo by Ronald W. Schlorff

Figure 2. Bank Swallow colony in road cut at Fall River Mills, Shasta County.

Table 3. Bank Swallow survey coverage by region in California, 1987.

Locality	Miles Covered	% Coverage	% Potential Habitat	No. Burrows (No. Colonies)
NORTH COAST REGION (6/13-15, 6/23, 7/10/87)				
Dry Creek (Paralleling Hwy 36 Bowman Road to Ball Road)	17	25	0	0
Van Duzen River (Alton to Mad River)	37	15	0	0
Eel River, Main Fork (Mouth at Pacific Ocean to Weott)	35	50	1	0
Mad River (Mouth at Pacific Ocean to Hwy 299 Bridge)	4	75	1	0
Smith River (Mouth at Pacific Ocean to Hwy 101 Bridge)	7	40	5	702(1)
Klamath River (Mouth at Pacific Ocean to Klamath Glen)	5	35	0	0
Gold Bluff Beach	6	100	0	0
Redwood Creek (Mouth at Pacific Ocean to Bald Hills Road	1	50	0	0
Crescent City (Crescent City to Point Saint George)	3	20	1	0
Pacific Ocean Coastline (Russian River to Klamath River)	250	60	2	0
Mattole River (Mouth at Pacific Ocean to Petrolia)	4	75	0	0
Russian River (Mouth at Pacific Ocean to Geyserville)	23	80	0	0
Clear Lake	38	50	0	0
GREAT BASIN REGION (5/29-31, 6/18-21/87)				
Sacramento River (Shasta Lake to Dunsmuir)	41	75	0	0
Scott River (Patterson Creek to Douglas School)	22	80	15	850(5)
Shasta River (Mouth at Klamath River to Grenada)	17	40	0	0
Pit River (Shasta Lake to Lookout)	115	25	15	0
Lake Britton	4	90	10	1,313(2)
Baum Lake	2	85	0	0
Hat Creek (Hwy 299 Bridge to Hat Creek Pump House No. 2)	2	90	5	316(1)
Fall River Mills (Pit River to Dana and Tule River)	18	70	5	1,671(2)
Indian Tom Lake	3	85	10	319(1)
Lower Klamath Lake	25	85	10	851(3)
Tule Lake Sump	20	90	10	0

Table 3 (continued)

Locality	Miles Covered	% Coverage	% Potential Habitat	No. Burrows (No. Colonies)
Newell	1	100	5	502(2)
Clear Lake Reservoir	23	90	5	480(3)
Goose Lake	25	90	0	0
Pit River (Lookout to 3 miles NE of Alturas)	53	25	5	292(3)
Modoc National Wildlife Refuge	2	50	5	0
Pine Creek (County Road 115 to Pine Creek Reservoir)	6	20	1	124(1)
Westside Canal (Hwy 395 to Centerville Road)	5	75	0	0
Madeline (Gravel Pit N to Blue Lake Road)	1	100	0	0
Secret Creek (Paralleling Hwy 395)	10	15	0	0
Susan River (Susanville to Honey Lake Wildlife Area)	10	25	5	175(1)
Levitt Lake	2	75	0	0
Baxter Creek (County Road A3 Bridge to Hwy 395 Bridge)	3	50	25	403(2)
Long Valley Creek	35	80	15	100(1)
SACRAMENTO VALLEY REGION (4/6-7/17/87)				
Sacramento River (Collinsville to Shasta Dam)	257	100	5	25,329(53)
American River (Sacramento River to Sunrise Ave. Bridge)	16	70	2	0
Consumnes River (Wilton to Michigan Bar)	13	65	5	196(1)
Cache Creek (Yolo to Clear Lake)	50	65	5	1,134(5)
Feather River (Mouth at Sacramento River to Oroville)	80	100	10	6,592(18)
Putah Creek (I-505 Bridge to Solano Lake)	3	25	0	0
Thomes Creek (Mouth at Sacramento River to 5 mi. w of Henleyville)	8	50	8	207(1)
Cow Creek (Mouth at Sacramento River to Millville)	3	80	10	238(1)
MONO-INYO REGION (5/30-6/2,7/17/87)				
East Walker River (Bridgeport to the Nevada border)	1	100	0	0
West Walker River & Hat Ck (False Hot Springs to Topaz Lake)	26	100	0	0

Table 3 (continued)

Locality	Miles Covered	% Coverage	% Potential Habitat	No. Burrows (No. Colonies)
Owen's River (Owen's Lake to Crowley Dam)	78	95	0	0
Lake Crowley	6	100	5	2,310(1)
Wilson Creek near Mono Lake	1	100	0	0
Cottonwood Ck/Wyman Ck	5	100	0	0
Chalfant,Benton,Queen, and Adobe Valleys	24	100	0	0
SAN JOAQUIN VALLEY REGION (6/8-6/12,6/17-6/21,7/11/87)				
Kern River (Lake Isabella to Hwy 119)	49	100	0	0
Poso Creek	6	95	0	0
White River	18	90	0	0
Deer Creek	18	100	0	0
Kings River (Pine Flat Dam to Fresno Slough)	42	100	0	0
San Joaquin River (Friant Dam to Delta)	279	100	10-15	0
Stanislaus River	42	100	5	0
Merced River	6	100	0	0
Tuolumne River	35	100	5	0
Mokelumne River	18	95	0	0
Walker Basin Area	4	100	0	0
Tule River	12	0	0	0
SIERRIAN REGION (5/29,6/2/87)				
West Fork Carson River (Woodsford to Nevada)	5	100	0	0
East Fork Carson River & Hot Springs Ck (Markleeville area)	13	100	0	0
CENTRAL COAST REGION (6/5,6/28-7/2,7/10-7/11,7/19-7/21/87)				
San Benito River/Tres Pinos Ck	30	95	0	0
Arroyo as Positas (Livermore)	3	50	0	0
Pacheco Creek	5	100	0	0
Salinas River	96	95	5	250(1)
Cholame Creek	24	100	0	0
San Juan Creek	8	90	0	0
Pacific Coast (San Francisco to Monterey)	125	95	5	692(2)

Table 3 (continued)

Locality	Miles Covered	% Coverage	% Potential Habitat	No. Burrows (No. Colonies)
Pacific Coast (Monterey to Pt Sal)	2	100	0	0
Buena Vista Dr, Santa Cruz	5	100	1	0
SOUTH COAST REGION (6/8,7/7-7/10,7/13/87)				
Santa Ynez River	27	100	5	0
Santa Clara River	6	50	0	0
Pacific Coast (Pt Sal to Pt Conception)	30	100	0	0
San Antonio Creek	13	100	0	0
Pacific Coast (Camp Pendleton)	15	100	0	0
Cuyama River	57	100	0	0
Cuddy Creek	6	100	0	0
San Juan Creek Valley	10	100	5	0

Discussion

Much of this region is high elevation with extensive mixed-coniferous forests. Many of the rivers and streams occur in steep rocky channels of volcanic origin. The extensive forests and lack of suitable soil make a large portion of this region unsuitable for nesting Bank Swallows. The mountainous portions are interspersed with valleys which provide high quality habitat.

Some of the Bank Swallow colonies in this region were located on National Wildlife Refuges and a State Wildlife Area and there appears to be no immediate threats to these sites. However, levee and pond maintenance activities could threaten these sites in the future. Both of the colonies at Newell occurred in borrow pits, as did the colony near Dorris Reservoir. Several colonies occurred along rivers and creeks which are small compared to the rivers of the Central Valley. There appears to be few attempts to control bank erosion through riprapping along many of these water courses. The dominant land-use in this region is livestock grazing and not intensive agriculture or urban development of the type common to the Central Valley.

Pacific Gas and Electric Company has plans to install bank protection at several points on Lake Britton to protect Native American cultural sites (M. Jenkins, pers. comm.). Bank protection could impact the two Bank Swallow colonies in this area. An earthen levee bordered much of the Scott River and several points along the river were riprapped. The colonies on Hat Creek and Fall River Mills are on road cuts which have relatively high levels of human disturbance. Excavation, road maintenance, or actions of a private landowner could possibly result in loss of these colonies. Because of the scattered distribution, and isolated nature of colonies in this region, efforts must be made to protect existing colony sites from habitat destruction. Once destroyed, these colonies may not be re-established at the same location.

Areas that were not completely surveyed but may support a few more Bank Swallow colonies include Eagle Lake, Lassen County, much of the Pit River and its tributaries, Modoc, Lassen, and Shasta counties, reservoirs in the Modoc National Forest, Modoc County, other sites in Honey Lake Valley, Lassen County and in Grizzley Valley, Plumas County.

Sacramento Valley Region

History

Ridgeway reported the Bank Swallow to be common in the vicinity of Sacramento prior to 1890 (Belding 1890). Grinnell and others (Grinnell et al. 1930) did not find the species along the Sacramento River or it's tributaries in the vicinity of Red Bluff, Tehama County. In 1973, Bank Swallows were found to be locally common on the Sacramento River between Red Bluff and Colusa, Tehama County (D. Gaines pers. comm.). Four colonies were reported to the regional editors of American Birds from the Sacramento River between 1972 and 1974, and 10 colonies were reported on the Sacramento River from 1976 to 1985. This low number of reports does not reflect a lack of the Bank Swallows since during the period from 1974 to 1980 they were observed in numbers similar to those found on surveys in 1986 and 1987 (Laymon pers. obs.). Humphrey and Garrison (1987) surveyed the Sacramento River in 1986 and found 60 colonies between the

confluence of the Feather River upstream to Redding (Figure 3). One confirmed active, and a second possible colony, were reported from the American River from 1985 and 1986, and two colonies were found on the Feather River between 1978 and 1985. Humphrey and Garrison (1987) found 7 colonies on the Feather River in 1986. In 1982, two colonies were found along Thomes Creek, Tehama County (Table 1).

Results

In 1987, we found 53 colonies with 25,329 burrows on the Sacramento River between the confluence of the Feather River upstream to Redding, Shasta County. Eighteen colonies with 6,592 burrows were found along the Feather River between Verona, Sutter County, upstream to Oroville, Butte County. Smaller tributaries of the Sacramento River supported 7 colonies and 1,579 burrows. These tributaries included Cache Creek, Yolo County (5 colonies, 1,134 burrows), Thomes Creek, Tehama County (1 colony, 207 burrows), and Cow Creek, Shasta County (1 colony, 238 burrows). One colony with 196 burrows was found on the Cosumnes River, Sacramento County (Table 3).

Discussion

The Sacramento Valley Region, consisting primarily of habitats along the Sacramento and Feather rivers, currently supports the majority of Bank Swallows in California. Information on which to assess population changes is poor prior to 1972. In the vicinity of Sacramento where historic populations existed but none are now found, population declines have currently taken place. Flood control and bank stabilization projects have resulted in an extensive system of levees and riprapped banks which undoubtedly resulted in losses of habitat (Figure 4).

Bank protection under the Sacramento River Bank Protection Project (SRBPP) has resulted in the installation of almost 213 km (133 miles) of riprap since Congress authorized the project in 1960 (Jones and Stokes Associates, 1987). To date, the percentage of Sacramento River riverbanks riprapped under SRBPP is 38% between Collinsville and Sacramento, 35% between Sacramento and Colusa, and 28% between Colusa and Chico Landing. If all riprap that is proposed under SRBPP is completed and added to that which already exists these percentages will increase to 75%, 60%, and about 50%, respectively. Translating past losses of Bank Swallow habitat to actual losses of Bank Swallow populations as a result of these projects is difficult without historical colony locations and sizes. However, in 1987, one contract of SRBPP destroyed 4 known colony sites, and another SRBPP contract destroyed 1 known colony site in 1986 (Figure 5). A large colony of over 2000 burrows 2.4 km (1.5 miles) downstream from the Red Bluff Diversion Dam was destroyed by a Corps riprap project in 1980 (Laymon pers. obs.) and three other large colonies near Chico and Butte City were destroyed during 1985 (Calif. Dept. of Fish and Game unpublished data). Given past and current circumstances relative to Corps activities on the Sacramento River, it is certain that other Bank Swallow colonies have been destroyed by bank stabilization projects.

Some apparently suitable, unoccupied Bank Swallow habitat exists along the rivers and creeks in the Sacramento Valley (Table 3). We are not certain why these areas are unoccupied. The soils may not be suitable.

Photo by Joan M. Humphrey

Figure 3. Typical Bank Swallow colony on the Sacramento River, located at River Mile 166.5, Glenn County.

Photo by Joan M. Humphrey

Figure 4. An example of a concrete lined levee used for flood control and bank stabilization, south of Sacramento, Sacramento County.

Photo by Joan M. Humphrey

Figure 5. An example of recently installed riprap.

Sierran Region

History

Only three, non-site specific, records exist in this region. A pre-1888 record near Placerville, El Dorado County could have been a response of Bank Swallows to hydraulic mining. Two sightings of Bank Swallows (1974, 1979) were probably from the low foothills and may refer more to the Central Valley region (Table 1).

Results

We surveyed the east and west forks of the Carson River near Woodfords and Markleeville, Alpine County. Typical of streams in this region, the West Fork Carson River is a rocky trout stream. The valley areas contained low banks and large numbers of livestock. No Bank Swallow colonies were found.

Discussion

Mountain streams with steep gradient are unlikely to produce the alluvial deposits that ultimately result in Bank Swallow habitat. However, in Great Britain, the species is recorded from the rushing streams of the highland moors as well as the meandering rivers of the lowland valleys.

Central Coast Region

History

Bank Swallows are well documented in this region historically (Table 1). Records from 1890 to the early 1900's are clustered around Monterey Bay, Monterey and Santa Cruz counties. Belding (1890) recorded Bank Swallows as a rare summer resident in Alameda and Contra Costa counties. There are fewer records from recent years, most are from the Salinas River system. Colonies in the areas of Ano Nuevo Point, San Mateo County and Fort Funston/Lake Merced, San Francisco County have been recorded since 1905.

Results

We found three known colonies in this region:

Año Nuevo Point (275 burrows), Fort Funston, San Francisco (417 burrows), and Metz Road, near King City, Monterey County (250 burrows) (Table 3). All of these were active in previous years. No additional colonies were located during the survey.

Most of the coast south of San Franciso Bay consists of steep rocky cliffs and shores which were not adjacent to sources of freshwater. The King City colony was situated in the 12m (40 ft) bluffs of the Salinas River system about 1.6 km (one mile) from the river, (Figure 6), whereas most other colonies found in

Photo by Joan M. Humphrey

Figure 6. Bank Swallow colony along Metz Road north of King City, Monterey County. This is one of a few colonies located away from water.

this study were adjacent to freshwater. The burrows were located in fine, loose, even textured soils that alternated with rocky soil layers. Occupancy rate was estimated at 40%, giving a colony size of 60 breeding pairs.

The coastal bluff colony at Año Nuevo was estimated to have a 55% occupancy rate, yielding a population of 150 breeding pairs. This colony apparently expanded in 1987 to occupy three separate locations, with new nesting areas just north and south of the traditional site. Burrows were dug in specific layers of the consolidated sand dunes (Figure 7). These bluffs are 4m (15 ft) or more in height but in the northern location some burrows were only 1m (3.5 ft) above the beach talus. Common Ravens (Corvus corax) have been observed preying on nestlings in Bank Swallow burrows at Año Nuevo (G. Strachan pers. obs.).

The Fort Funston colony was characterized by high levels of human disturbance. The colored compacted sandstone bluff at the site is attractive to rock carvers and the lowest burrows are only 2m (6 ft) above the sandy talus below the cliff. Occupancy rate was 60%, with an estimated colony size of 250 breeding pairs.

Discussion

The coastal bluff colonies at Año Nuevo and Fort Funston shared the characteristics of close proximity to freshwater lakes, extensive amount of dune or coastal terrace adjacent to the colony site, high levels of human activity, and traditional Bank Swallow use since 1905. The Año Nuevo State Reserve is adopting the policy of closing areas adjacent to Bank Swallow colonies during the nesting season. The recently active colony at the mouth of the Pajaro River, Monterey County, was apparently disturbed by off-road vehicle activities and was not active in 1987 (R. Warriner, D. Robertson pers. comm).

Chalome and San Juan creeks, San Luis Obispo County, in the vicinity of recent colonies, were dry in 1987, but had potential habitat that in some years might support active colonies. The soils along these creeks and the Cuyama River did not exhibit an eroding talus slope beneath the bank which is often characteristic of sites used by Bank Swallows. In addition, water was not present at the base of the bank which is typical of the sites where most colonies occur. Further study of the soil types and water practices in these valleys would be of interest to determine how often these sites are suitable for Bank Swallows.

San Joaquin Valley Region

History

Only four historic records of nesting Bank Swallows were found for the San Joaquin Valley region. This may be due more to lack of observers at the time than a lack of nesting Bank Swallows. Although he was an active field ornithologist for many years in the Stockton area, Belding (1879) did not record Bank Swallows in his listing of the birds of central California. Juvenile specimens of Bank Swallows were collected in 1921 in Kern County and 1925 and 1940 in Merced County. Sightings of Bank Swallows along the Tuolumne

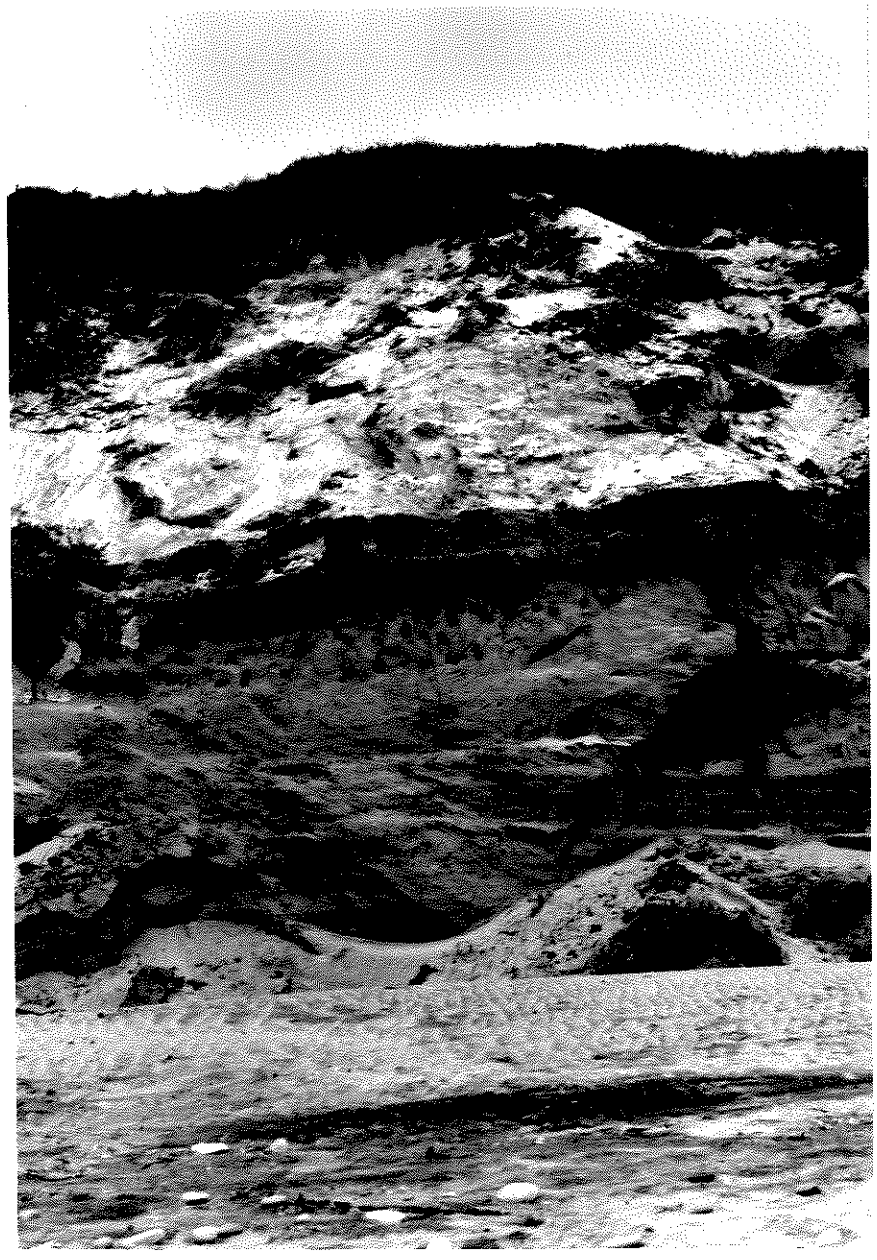

Photo by Joan M. Humphrey

Figure 7. A portion of the Bank Swallow colony at Año Nuevo Point, San Mateo County.

River in 1984 are not confirmed breeding records, although steep banks do exist along the river (Table 1).

Results

This area was thoroughly surveyed in 1987; however, not a single Bank Swallow colony was found. In addition, there were very few areas that could be considered potential habitat. Throughout the region, most small rivers and creeks were dry and flowing water existed almost exclusively in canals and irrigation ditches. We noted a remnant of marginal habitat along the Kern River just east of Bakersfield, Kern County.

The Kings River from Pine Flat Dam to Fresno Slough, Fresno County, was devoid of Bank Swallow habitat. Two Bank Swallows were observed at the Hacienda Evaporation Ponds, Kings County on 11 June but were probably late migrants. The Bank Swallows were not present on 4 or 11 July. Searches of potential habitat in the area yielded no Bank Swallows, but one pair of breeding Rough-winged Swallows was found.

We surveyed the San Joaquin River from Friant Dam to the Sacramento-San Joaquin River Delta, a distance of 267 river miles (RM). The only potential Bank Swallow habitat for the San Joaquin Valley was between RM 70 and RM 133. The river from RM 70 to the delta is one continuous stretch of riprapped bank. The best potential habitat for Bank Swallows occurred in the meandering area between the mouth of the Stanislaus River at RM 75 and RM 100. Controlled, low water flows were the norm. Large areas of the river have been converted to irrigation canals and sections of the upper river were dry. Riverbank soils did not have the layered appearance found along stretches of the middle Sacramento River, but were fine and evenly textured in appearance.

Water flow along the tributaries of the San Joaquin River was also slow, and did not appear sufficient to maintain Bank Swallow habitat. Near the mouth of the Stanislaus River there was much potential habitat with many breeding Rough-winged Swallows.

Discussion

Although soil analyses were not accomplished, there were a few areas along the San Joaquin River that appeared suitable for Bank Swallows. These areas of potential habitat were small and widely scattered, possibly precluding the establishment of sustainable populations. The scant and controlled water flow in this region almost certainly has contributed to the local extirpation of Bank Swallows. Rough-winged Swallows also appear to have declined in the southern part of the San Joaquin Valley and their populations may require close monitoring in the near future.

The controlled nature of the San Joaquin River has eliminated most of its potential as habitat for Bank Swallows. In addition, the damming of the major tributaries such as the Kings, Merced and Stanislaus Rivers has destroyed most former foothill valley habitats that may have originally supported viable populations of Bank Swallows. This region, more than any other, represents what could happen to Bank Swallows on the Sacramento River and its tributaries if current trends of habitat destruction continue unchecked.

Mono-Inyo Region

History

There is one historic record for this area. A colony occurred in the bluffs at Alvord, near Big Pine, Inyo County along the Owens River in 1891 (Table 1). A colony at Lake Crowley, Mono County has been in existence for at least 30 to 40 years, but details of population size have not been well documented.

Results

In 1987, the Lake Crowley colony had 2310 burrows divided among 15-16 subgroups at four separate locations around the shore of the lake (Table 2). Occupancy rate was estimated at 65% for a total of 1500 breeding pairs. The primary colony location at North Landing (1585 burrows) was composed of tuff deposits (layered volcanic ash) similar in appearance to some of the sediments along the middle Sacramento River. The cliff where the primary colony was found, was 12 to 15m (40 to 50 ft) in height with most nests 6 to 9 m (20 to 30 ft) above the lake level (Figure 8). Water level was lower than normal in 1987 and many of the remaining small burrow groupings were in the eroded sediments below the normal high water level. Plans by Los Angeles Department of Water and Power to increase the reservoir's capacity and raise the lake level an additional 6 m (20 feet) above the present maximum lake level threaten most if not all subgroups of this population (D. Gaines pers. comm.).

No additional colonies were located. Much of the Owens Valley had very fine ashy soils which would tend to collapse if Bank Swallows dug burrows in the banks. Near Big Pine, we located the bluff area that may have been the site of the 1891 Bank Swallow colony. With the exception of Lake Crowley, there was no potential Bank Swallow habitat in this region. Rough-winged Swallows were found breeding in the few areas of marginal habitat. Most drainages were dry or were rocky trout streams, unsuited to Bank Swallow nesting.

Discussion

Throughout the study, we noted the presence of the Belted Kingfisher (Ceryle alcyon) and the Rough-winged Swallow, the other burrow nesting species. Few Rough-winged Swallows were found along the entire Owens River. The only Belted Kingfisher sighted, was along a mountain creek rather than the river. This region apparently has very little potential habitat for Bank Swallows.

South Coast Region

History

Historic distribution and abundance of Bank Swallows is well documented in this region. The earliest record is from Lake Sherwood, Ventura County, in 1864, with several additional records before 1900 (Table 1). Bank Swallows were considered common in the lowlands in summer and nested in large numbers in the sandy coastal bluffs (Grinnell 1898).

Photo by Joan M. Humphrey

Figure 8. Bank Swallow colony at North Landing, Crowley Lake, Mono County.

The interior rivers are represented by records from the Los Angeles and San Gabriel Rivers, Los Angeles County, in 1893 and 1984 respectively, and the Santa Clara River, Ventura County from 1904-1926. Coastal bluff colonies were found from Oceanside, San Diego County, to Santa Barbara, Santa Barbara County. A single nesting record of a solitary pair of Bank Swallows was reported from Ventura County in 1976 and is the only record since 1933 for all of southern California (Table 1).

Results

No Bank Swallows were located in the South Coast region during 1987. Some apparently suitable habitat at coastal bluffs and at man-made reservoirs remains, but was unoccupied.

Discussion

Bank Swallows have been totally extirpated from a region where they were historically quite common. Reasons for the disappearance of Bank Swallows in the South Coast region are not precisely known; however, the growth of human populations and urban expansion probably contributed to the demise of the species. Virtually every river and natural waterway has been converted to concrete flood control channels and the hoards of beachgoers and other associated human activities make the area uninhabitable for the species. The bluffs on the shores of man-made reservoirs are the only sites that could now support active colonies in this region.

It appears likely that Bank Swallows, nesting in coastal bluff habitats, need a nearby source of fresh water, such as a pond, lake, lagoon, or estuary. Changes resulting from water diversion and stream channelization projects have removed foraging areas over fresh water adjacent to coastal bluffs in this metropolitan area.

SUMMARY AND MANAGEMENT IMPLICATIONS

A total of 111 colonies, consisting of 45,045 burrows were located in California during a 1987 survey conducted during spring and summer. Seventy-five percent of the burrows (burrow counts are representative of the level of nesting activity) were located in the Sacramento Valley region while 21% were found in the Great Basin and Mono-Inyo regions, and 4% were found along the North and Central Coast regions.

The information collected during surveys conducted in 1986-87 is the first comprehensive, site specific data gathered on Bank Swallows for California. Comparable data needed to show declines from historic times on a site specific basis do not exist due to lack of previous studies where population data were collected. Regional declines are easier to document. Population declines in areas with little historic data can be assumed based on the over-all range contractions.

Bank Swallows have been completely extirpated from southern California. The majority of the population that remains in California is now centered in the Sacramento Valley along the Sacramento and Feather rivers. The lack of

historic information for northern California makes it difficult to determine if a change in the population has taken place in this region. There have been documented losses of colony sites on the Sacramento River since 1975 due to riprap installation, but direct evidence that actual population declines due to lost habitat are occurring will require continued annual monitoring. However, riprap is a persistent and serious threat to colonies on the Sacramento River because of projects proposed by the U.S. Army Corps of Engineers and California State Reclamation Board (Figure 9). Humphrey and Garrison (1987) projected a potential loss of over 50% of the colonies on the Sacramento River if all presently proposed riprap projects are carried out. As more colony sites and potential habitat on the Sacramento River are removed, declines in the largest remaining population of Bank Swallows in California are certain to occur.

The overall range of Bank Swallows in California has decreased by 50% since the turn of the century. This range contraction undoubtedly corresponds to a population decline. In addition, future population declines are certain if further habitat is removed. Based on these conclusions, we propose the Bank Swallow be listed as a Threatened bird species in California because it qualifies for such protection under the California Endangered Species Act. Listing the Bank Swallow as a Threatened species will greatly facilitate the establishment of protection programs for Bank Swallows and their habitats. It may also enhance opportunities to fund future research and management activities on the Sacramento River and throughout the remainder of the range in California.

Annual monitoring of colonies on the Sacramento River should be continued since riprap projects that threaten nesting habitat are proposed and implemented annually and could conceivably cause the extirpation of the Bank Swallow from this last breeding stronghold. The rest of California should be surveyed every five years. Local Audubon Society Chapters or other volunteers should be encouraged to continue yearly monitoring at selected local colonies.

Techniques to replace Bank Swallow habitat lost to riprap projects including habitat enhancement and construction of artificial banks for nesting, must be developed and proved to be effective before they can be credited as mitigation. Habitat enhancement techniques and artificial nesting sites should be used at or near recently active and historic colony locations especially in southern California where the species is now extirpated.

As a means of ensuring the long-term viability of Bank Swallow populations, it is essential that a system of habitat preserves be established along the Sacramento and Feather rivers. These could include the creation of a National Wildlife Refuge or habitat preserve system designed to protect riparian habitat along the Sacramento River from Colusa, Colusa County, upstream to Red Bluff, Tehama County and on the Feather River from Nicolaus to Marysville, Sutter and Yuba counties. These habitat preserves should be managed with a minimum of human interaction in order to allow natural fluvial processes to maintain habitat necessary to support populations of Bank Swallows.

A comprehensive habitat management plan needs to be developed for Bank Swallow populations on the Sacramento and Feather rivers. This plan should include habitat preservation as well as detailed studies of erosion rates and trends due to natural flooding and man-caused activities such as use of the rivers for water transport and recreational boating. To be workable, this plan must

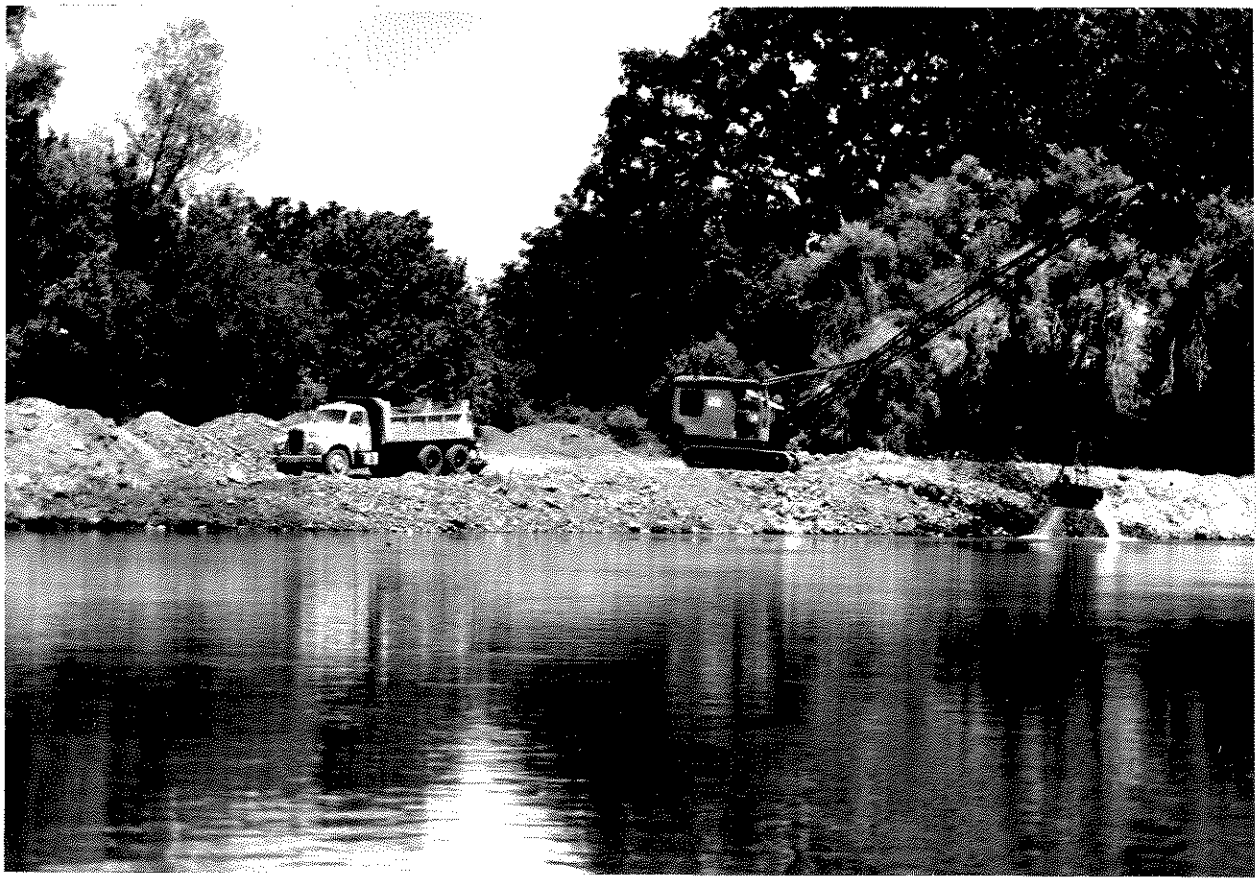

Photo by Stephen A. Laymon

Figure 9. Installation of riprap in progress on the upper Sacramento River.

have active participation in the development and implementation phases by representatives of the California Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, the California State Reclamation Board and conservation organizations such as The Nature Conservancy, Sacramento River Preservation Trust and the National Audubon Society. Only through cooperation among these various agencies and implementation of workable solutions to the problems of habitat destruction and disturbance can meaningful progress be made in the effort to preserve Bank Swallow habitat and populations in the region where the species is now concentrated.

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APPENDIX 1. Location (legal description and river mile - L = Left, R = right), date surveyed and size of Bank Swallow colonies found in California, 1987.

LOCATION	RIVER MILE	DATE	NUMBER OF BURROWS
NORTH COAST REGION			
Smith River			
T18N R13W SW33 NW1/4 NW1/4	2.4 L	06/14/87	702
GREAT BASIN REGION			
Indian Tom Lake			
T48N R1E S16 SW1/4 SW1/4		05/29/87	
T48N R1E S16 SE1/4 SW1/4		05/29/87	
T48N R1E S17 SE1/4 SE1/4		05/29/87	
T48N R1E S21 NW1/4 SE1/4		05/29/87	
T48N R1E S21 NW1/4 NE1/4		05/29/87	
T48N R1E S21 SE1/4 NE1/4		05/29/87	319 1/
Lower Klamath Lake			
T48N R2E S21 NW1/4 NE1/4 2/		05/29/87	
T48N R2E S21 NE1/4 NE1/4 2/		05/29/87	
T48N R2E S22 NW1/4 NW1/4 2/		05/29/87	
T48N R2E S22 SE1/4 SW1/4 2/		05/29/87	428 1/
T47N R3E S8 NW1/4 NW1/4 2/		06/19/87	
T47N R3E S6 SE1/4 SE1/4 2/		06/19/87	
T47N R3E S6 SE1/4 SW1/4 2/		06/19/87	397 1/
T48N R2E S14 NW1/4 SW1/4 2/		05/29/87	26
Newell			
T47N R12E S30 SW1/4 SW1/4		05/29/87	427
T47N R12E S26 SE1/4 SE1/4		05/29/87	75

APPENDIX 1 (Continued)

LOCATION	RIVER MILE	DATE	NUMBER OF BURROWS
Clear Lake Reservoir			
T46N R7E S6 SW1/4 SE1/4		06/18/87	225
T46N R7E S16 NW1/4 SW1/4		06/18/87	30
T47N R7E S27 SE1/4 SW1/4		06/18/87	225
Pit River			
No Ground Location		06/18/87	75
T42N R11E S13 NE1/4 SE1/4		06/20/87	42
No Ground Location		05/25/87	175
Modoc National Wildlife Refuge (Dorris Reservoir)			
T42N R13E S28 SW1/4 NE1/4		05/30/87	124
Long Valley Creek			
No ground location		05/28/87	100
Honey Lake/Susan River			
T29N R14E S21 NE1/4 SE1/4		05/30/87	175
Baxter Creek			
T29N R13E S33 SE1/4 SW1/4		05/30/87	163
T29N R13E S32 NE1/4 SW1/4		05/30/87	240
Scott River			
T43N R9W S26 NE1/4 SE1/4		06/19/87	
T43N R9W S35 NE1/4 NE1/4		06/19/87	85 1/
T43N R9W S35 NE1/4 SW1/4		06/19/87	
T43N R9W S35 SE1/4 NW1/4		06/19/87	32 1/
T42N R9W S2 SE1/4 NW1/4		06/19/87	64 1/

APPENDIX 1 (Continued)

LOCATION	RIVER MILE	DATE	NUMBER OF BURROWS
Scott River			
T42N R9W S2 SE1/4 SW1/4		06/19/87	517
T41N R9W S11 SW1/4 SE1/4		06/19/87	152
Lake Britton/Pit River			
T36N R3E S2 NE1/4 NW1/4		06/21/87	649
T37N R3E S21 SW1/4 SW1/4		06/21/87	663
Hat Creek			
T36N R4E S20 SE1/4 SW1/4		06/20/87	
T36N R4E S29 NE1/4 NW1/4		06/20/87	316 1/
Fall River Mills			
T37N R5E S31 NE1/4 NW1/4		05/31/87	1173
Fall River Reservoir			
T37N R4E S25 NW1/4 NE1/4		05/31/87	
T37N R4E S25 NE1/4 NE1/4		05/31/87	
T37N R4E S25 SE1/4 NE1/4		05/31/87	
T37N R4E S25 NE1/4 SE1/4		05/31/87	498 1/
SACRAMENTO VALLEY REGION			
Sacramento River			
T11N R3E S28 SE1/4 SE1/4 2/	81.9 R	06/11/87	59
T11N R3E S28 NE1/4 SE1/4 2/	81.9 L	06/11/87	198
			257 1/
T11N R3E S28 NW1/4 SW1/4 2/	82.8 L	06/11/87	24
T11N R3E S18 SW1/4 SW1/4	87.8 L	06/11/87	640
T12N R2E S21 SE1/4 SW1/4	96.5 L	06/11/87	223
T12N R2E S28 NW1/4 NW1/4	97.1 L	06/11/87	131
			354 1/

APPENDIX 1 (Continued)

LOCATION				RIVER MILE	DATE	NUMBER OF BURROWS
T12N R1E	S24	NE1/4	SE1/4	100.5 L	06/10/87	420
T13N R1E	S1	SW1/4	NE1/4	116.7 L	06/10/87	149
T14N R1E	S8	NW1/4	NW1/4	126.1 R	06/10/87	170
T15N R1E	S31	NE1/4	SW1/4	128.1 L	06/10/87	432
T15N R1E	S31	NW1/4	NW1/4	129.3 R	06/10/87	233
T15N R1W	S25	SE1/4	NE1/4 2/	130.2 R	06/10/87	1050
T16N R1W	S19	SW1/4	SE1/4 2/	144.2 L	06/10/87	641
T16N R1W	S19	NE1/4	SE1/4 2/	145.0 R	06/10/87	390
						1031 1/
T17N R1W	S19	SW1/4	NW1/4	155.5 R	04/22/87	399
T17N R1W	S19	NE1/4	NW1/4	156.1 L	04/22/87	411
T17N R2W	S13	SE1/4	SE1/4	156.5 R	04/22/87	1627
T17N R2W	S13	NE1/4	SE1/4	156.9 L	04/22/87	35
						2472 1/
T17N R2W	S1	SE1/4	SE1/4 2/	159.1 L	07/16/87	29
T17N R1W	S6	SE1/4	SW1/4 2/	159.6 L	04/22/87	113
						142 1/
T18N R1W	S31	NW1/4	NE1/4 2/	161.5 L	07/16/87	984
T18N R1W	S7	SE1/4	SE1/4 2/	165.2 L	04/22/87	562
T18N R1W	S5	SW1/4	SW1/4 2/	166.5 R	04/22/87	854
T18N R1W	S5	NW1/4	NE1/4 2/	167.9 L	07/16/87	500
T19N R1W	S32	NW1/4	SE1/4	168.6 R	04/22/87	52
T19N R1W	S29	SE1/4	NW1/4	169.9 R	07/16/87	92
T19N R1W	S17	NW1/4	SW1/4 2/	171.6 R	04/22/87	149
T19N R1W	S17	SW1/4	NE1/4 2/	172.0 L	04/22/87	210
						359 1/
T19N R1W	S7	NE1/4	SE1/4 2/	173.4 R	04/22/87	369
T19N R1W	S7	NE1/4	SE1/4 2/	173.9 R	04/22/87	124
						493 1/
T20N R1W	S29	SW1/4	NW1/4 2/	178.1 L	04/22/87	431
T20N R1W	S8	SE1/4	SW1/4 2/	181.5 R	05/15/87	303
T20N R1W	S4	SW1/4	SW1/4 2/	182.8 L	05/15/87	1082

APPENDIX 1 (Continued)

LOCATION				RIVER MILE	DATE	NUMBER OF BURROWS
T21N R1W	S33	SW1/4	SW1/4 [2/]	183.9 R	05/15/87	226
T21N R1W	S33	NW1/4	NW1/4 [2/]	184.8 L	05/15/87	81
T21N R1W	S28	SE1/4	NW1/4 [2/]	185.6 R	04/18/87	545
T21N R1W	S21	SE1/4	NW1/4 [2/]	187.9 R	04/18/87	10
T21N R1W	S16	NW1/4	SW1/4 [2/]	189.0 L	04/18/87	66
T21N R1W	S15	SE1/4	NW1/4 [2/]	190.5 L	04/18/87	1066
T21N R1W	S11	SW1/4	NE1/4 [2/]	192.3 L	04/18/87	209
T22N R1W	S35	NW1/4	NW1/4 [2/]	195.0 R	04/26/87	98
T22N R1W	S7	SE1/4	SW1/4	201.5 R	04/26/87	1173
T22N R2W	S12	NE1/4	NE1/4 [2/]	202.2 R	04/26/87	790
T22N R1W	S6	SE1/4	SW1/4 [2/]	203.4 L	04/26/87	1568
						2358 [1/]
T23N R2W	S26	SE1/4	SW1/4 [2/]	207.2 R	04/26/87	212
T23N R2W	S15	SW1/4	SE1/4 [2/]	209.8 R	04/26/87	245
T23N R2W	S11	SE1/4	SW1/4 [2/]	211.3 R	04/26/87	114
T24N R2W	S28	NW1/4	NE1/4	218.7 L	05/17/87	984
T24N R2W	S16	NW1/4	SE1/4	221.0 L	05/16/87	277
T24N R2W	S16	SE1/4	NE1/4	221.2 R	05/16/87	226
						503 [1/]
T24N R2W	S15	NW1/4	NW1/4	222.5 L	05/16/87	520
T24N R2W	S4	NW1/4	SE1/4 [2/]	223.0 R	05/16/87	12
T25N R2W	S33	SE1/4	SW1/4 [2/]	224.1 R	05/16/87	62
T25N R2W	S28	NE1/4	SW1/4 [2/]	225.2 L	05/16/87	61
T25N R2W	S28	NW1/4	SW1/4 [2/]	225.5 R	05/16/87	12
						73 [1/]
T26N R2W	S32	NE1/4	SE1/4 [2/]	231.9 L	05/08/87	573
T26N R2W	S32	NE1/4	NW1/4 [2/]	232.4 R	05/08/87	198
						771 [1/]
T26N R2W	S20	NW1/4	SW1/4 [2/]	235.1 R	05/08/87	548

APPENDIX 1 (Continued)

LOCATION				RIVER MILE		DATE	NUMBER OF BURROWS
T26N R2W	S18	NW1/4	NW1/4 [2/]	236.9	L	05/08/87	63
T27N R3W	S36	SW1/4	SE1/4	239.9	L	05/08/87	748
T27N R3W	S34	NE1/4	NE1/4	241.8	L	05/08/87	160
T29N R3W	S23	NW1/4	NW1/4 [2/]	271.6	L	05/16/87	102
T29N R3W	S9	NE1/4	SE1/4	273.4	R	05/16/87	626
T30N R3W	S34	SE1/4	NW1/4	275.7	L	05/16/87	161
T30N R3W	S17	NW1/4	NE1/4	279.9	L	05/16/87	427
T31N R4W	S18	SE1/4	SE1/4	291.8	L	05/29/87	80
Feather River							
T12N R3E	S27	SE1/4	SW1/4	5.0	R	04/06/87	57
T12N R3E	S22	SE1/4	NE1/4	6.6	R	06/17/87	40
T12N R3E	S12	NE1/4	SE1/4 [2/]	9.5	L	06/18/87	720
T12N R4E	S6	NW1/4	SW1/4 [2/]	10.7	L	06/18/87	30
T13N R3E	S36	NW1/4	SE1/4 [2/]	11.8	L	06/18/87	230
T13N R3E	S25	SE1/4	NE1/4 [2/]	12.9	R	06/18/87	30
T13N R3E	S13	NW1/4	SE1/4 [2/]	15.2	R	06/18/87	90
T13N R3E	S12	NE1/4	NW1/4 [2/]	16.6	R	06/18/87	90
T14N R3E	S23	NE1/4	SW1/4 [2/]	21.5	L	06/18/87	110
T15N R3E	S10	SE1/4	NE1/4 [2/]	30.7	R	06/17/87	195
T15N R3E	S3	SE1/4	SE1/4 [2/]	31.6	R	06/17/87	230
T16N R3E	S34	SE1/4	SE1/4 [2/]	32.7	L	06/17/87	150
T16N R3E	S34	NE1/4	NW1/4	33.9	L	06/17/87	
T16N R3E	S27	SW1/4	SW1/4	34.1	R	06/17/87	450 [1/]
T16N R3E	S3	NW1/4	NW1/4 [2/]	41.7	L	05/23/87	750
T17N R3E	S27	SW1/4	NW1/4 [2/]	44.8	L	05/23/87	2800

APPENDIX 1 (Continued)

LOCATION	RIVER MILE	DATE	NUMBER OF BURROWS
Feather River (cont.)			
T17N R3E S15 SW1/4 NW1/4 2/	47.2 L	05/22/87	250
T18N R3E S22 SW1/4 SE1/4 2/	54.2 L	05/22/87	150
T18N R3E S15 SE1/4 SE1/4 2/	55.1 L	05/22/87	220
Cache Creek			
T9N R1W S23 SE1/4 SW1/4 2/		06/05/87	301
T9N R1W S22 SW1/4 NE1/4 2/		06/05/87	431
T10N R2W S6 SW1/4 SE1/4 2/		07/03/87	126
T11N R3W S14 SW1/4 SW1/4 2/		07/03/87	168
T11N R3W S4 NE1/4 NE1/4 2/		07/24/87	108
Thomes Creek			
T25N R3W S36 NE1/4 NW1/4 2/		05/17/87	207
Cow Creek			
T30N R3W S8 NW1/4 NE1/4		05/16/87	238
Consumnes River			
T7N R8E S6 SE1/4 SE1/4	30.0 L	05/22/87	196
CENTRAL COAST REGION			
Fort Funston, San Francisco			
T2S R6W S34 NW1/4 NE1/4 2/		06/30/87	
T2S R6W S27 SW1/4 SE1/4 2/		06/30/87	417 1/
Año Nuevo Point			
T9S R4W S29 SW1/4 SE1/4 2/		06/29/87,7/19/87	
T9S R4W S29 SE1/4 SE1/4 2/		06/29/87,7/19/87	
T9S R4W S30 NE1/4 SE1/4 2/		06/29/87,7/19/87	
T9S R4W S30 SW1/4 NE1/4 2/		06/29/87,7/19/87	275 1/

APPENDIX 1 (Continued)

LOCATION	RIVER MILE	DATE	NUMBER OF BURROWS
Salinas River, King City			
T19S R8E S32 NW1/4 NE1/4 2/		01/7/87	250
MONO - INYO REGION			
Crowley Lake			
T3S R29E S35 NW1/4 SW1/4		06/1/87	
T4S R29E S13 NE1/4 SW1/4		06/1/87	
T4S R29E S12 SW1/4 NE1/4		06/1/87	
T4S R29E S12 NW1/4 NE1/4		06/1/87	
T4S R29E S1 NE1/4 SW1/4		06/1/87	
T4S R29E S1 NW1/4 SW1/4		06/1/87	
T4S R29E S2 NW1/4 NE1/4		06/1/87	
T4S R29E S2 NE1/4 NE1/4		06/1/87	
T4S R29E S2 SE1/4 NE1/4		06/1/87	2310 1/

1/ Total for multi-site colony

2/ Legal descriptions approximate and based on estimated sections because these areas were not surveyed by the U.S. Geological Society.