BREEDING DISTRIBUTION OF VAUX'S SWIFT IN CALIFORNIA

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Vaux's Swift (*Chaetura vauxi*) is a migrant that breeds from the western United States south to northern Venezuela and winters from central Mexico to Venezuela (AOU 1983). In 1994, the California Department of Fish and Game designated it a "species of special concern." Its breeding biology and habitat requirements are poorly known but are thought to be closely linked to old-growth forests (Lundquist and Mariani 1991, Bull and Hohmann 1993). One of the most controversial topics facing biologists today is the fragmentation of old-growth forests and its effects on bird distribution in the western United States (Harris 1984, Thomas et al. 1990). The bulk of the ornithological work addressing this topic focuses on the ecology of three species, the Spotted Owl (*Strix occidentalis*) (Thomas et al. 1990), Marbled Murrelet (*Brachyramphus marmoratus*) (Carter and Morrison 1992), and Pileated Woodpecker (*Dryocopus pileatus*) (Mellen 1987). Other species receive relatively little research emphasis (Carey 1989, Ralph et al. 1991, Huff and Raley 1991).

Most published studies on Vaux's Swift have concentrated on its use of man-made chimneys as nest sites (Baldwin and Hunter 1963, Baldwin and Zaczkowski 1963, Thompson 1977), although more recent work focuses on forested ecosystems in northeastern Oregon (Bull and Cooper 1991, Bull and Hohmann 1993, Bull and Beckwith 1993).

For California, Grinnell and Miller (1944) described the breeding distribution of Vaux's Swift as extending in a "narrow northwest coast belt south from the Oregon line in Del Norte County as far south as Santa Cruz, Santa Cruz County." The coastal breeding range of swifts in California generally corresponds to the historical distribution of the Coast Redwood (*Sequoia sempervirens*) (Kuchler 1977). Less than 10% of the original old-growth redwood forest remains (Fox 1989), the rest having been harvested (Green 1985) since the early ornithological surveys of California. Grinnell and Miller (1944) also cited occasional breeding-season records from the Sierra Nevada. We discuss here the current distribution of Vaux's Swift in California based on our recent survey work, U.S. Fish and Wildlife Service (FWS) breeding-bird surveys, anecdotal observations, and a review of the literature.

METHODS

Vaux's Swifts were censused from Del Norte to Sonoma County during 129 Marbled Murrelet surveys conducted in 1989 by Paton and Ralph (1990), who provided details on the study areas and survey methods.

Biologists conducted surveys along transects, with 250 to 1000 m spacing between stations and 8 to 12 stations per transect. They censused each station for 10 minutes. The survey period extended from 45 minutes before to 90 minutes after sunrise from mid-May through mid-August. They noted swifts as present or absent at each station. Defining statistical significance as alpha ≤ 0.05, we compared swift use of old-growth versus second-growth stands by means of a log-likelihood ratio-test statistic (G^2).

Fox (1989), using infrared aerial photographs, mapped and classified redwood forest as old growth (> 200 yrs. old) or second growth (< 200 yrs. old). Using these data, we designated each of our transects as old growth or second growth.

J. Hunter and G. Hazard (unpublished data) conducted 4452 ten-minute point counts in 274 randomly selected late mature (150–200 yrs. old) and old-growth (> 200 yrs. old) stands from 17 April to 23 July 1995 in the Mad River Ranger District of the Six Rivers National Forest. Their study area extended north to Last Chance Ridge, south to the Yolla Bolly Wilderness, west to approximately 30 miles from the coast, and east to 45 miles from the coast at South Fork Mountain.

Sterling searched for Vaux's Swifts during extensive bird surveys for the U.S. Forest Service in Modoc, eastern Shasta, and northwestern Lassen counties from April to September 1990 and 1991. These surveys included 30 transects each 1 km long and 200 meters wide as well as incidental observations during active searching from all localities accessible by road. The bulk of the effort was along Hat Creek, in the Warner Mountains, on the Modoc Plateau, and in the Black's Mountain region.

We searched *American Birds* files for all breeding-season records of Vaux's Swift in northern California. We also obtained data from the Breeding Bird Survey Program (BBS) of the FWS as well as from numerous birders and biologists.

We felt that swifts found from June to early August were probably not migrants and represented breeding populations. We incorporated data from mid May in the results only if swifts were also present at that site in June and July. Apart from a few nesting records from chimneys in towns, conifers provide nesting and roosting sites.

RESULTS

Swifts on Marbled Murrelet Surveys

Swifts were observed on 48 of the 129 surveys (37.2%). We plot the locations in Figure 1. There was a tendency for swifts to be detected more often on old-growth transects: 29 of 65 old-growth transects (44.6%) and 19 of 64 second-growth transects (29.7%). However, using a log-likelihood ratio test, we found the difference of $P = 0.079$ ($G^2 = 3.09$, df = 1) only marginally significant statistically.

During murrelet surveys, we saw swifts in all four northwestern California counties—Del Norte, Humboldt, Mendocino, and Sonoma (Figure 1). Areas with the most stations where swifts were present included the large state and national parks in Humboldt and Del Norte counties: Jedediah Smith Red-

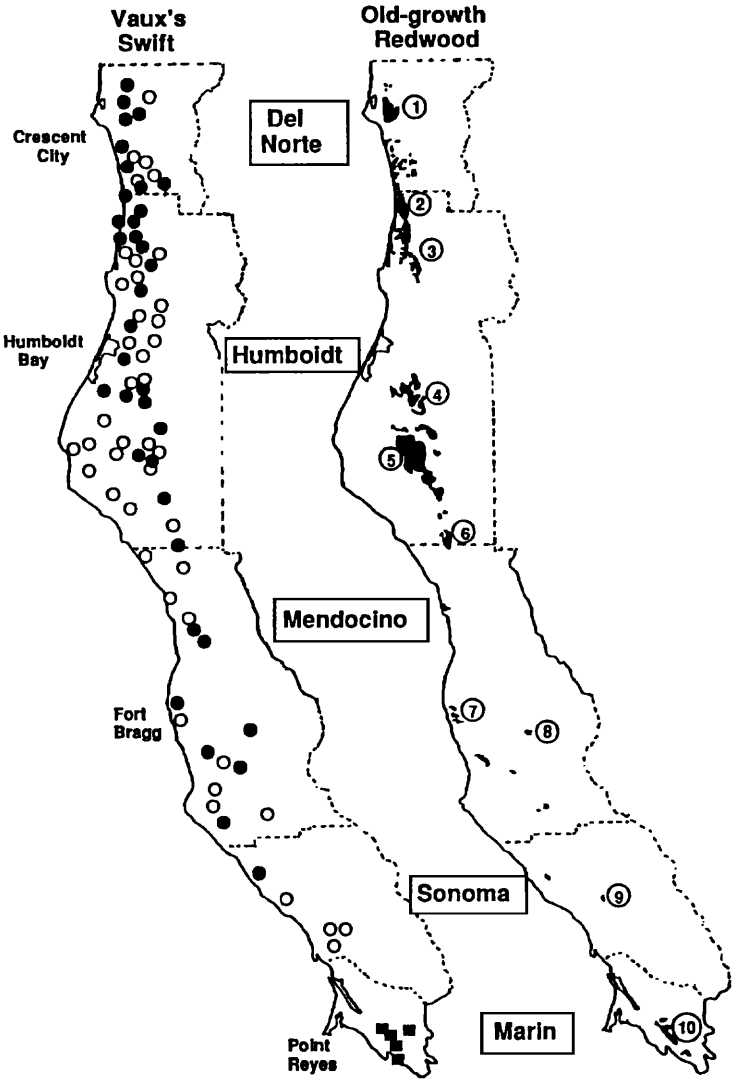

Figure 1. Current distribution of Vaux's Swift and old-growth redwood in northwestern California, based on Fox (1989). Open circles, no swifts detected on murrelet transect; filled circles, swifts detected on murrelet transect; filled squares, probable swift breeding site from Shuford (1993). Numbered polygons: (1) Jedediah Smith Redwoods State Park, (2) Prairie Creek Redwoods State Park, (3) Redwood National Park, (4) Pacific Lumber Company lands, (5) Humboldt Redwoods State Park, (6) Miranda, (7) Russian Gulch/Van Damme state parks, (8) Standish Hickey State Park, (9) Armstrong Redwoods State Park, (10) Samuel P. Taylor State Park.

woods State Park, Prairie Creek Redwoods State Park, Redwood National Park, and Humboldt Redwoods State Park. Encounters with swifts extended as far inland as 24 miles at Grizzly Creek Redwoods State Park, Humboldt County, although this was the farthest inland that we conducted murrelet surveys.

Point-Count Data from Six Rivers National Forest

Hunter and Hazard detected swifts on only three of 4452 point counts. Two records were during the breeding season: in addition, a pair and a single swift were at two locations in the study area (see Appendix A). These sites are 35 to 45 miles inland.

Distribution Throughout California

In the northeast, pairs in courtship display were located at three widely scattered areas along Hat Creek, at four localities in the Warner Mountains, and in the town of Fort Bidwell. Swifts were not detected from over a large area including the Black's Mountain region of the Lassen National Forest and the Modoc Plateau (Sterling pers. obs.).

Of the 217 BBS routes conducted throughout California from 1968 to 1994, only 32 had swifts, primarily in the northwest and northeast (Figure 2). The routes within 25 miles of the north and central coast averaged 1.64 swifts per route per year for all survey years ($n = 310$). In contrast, routes in the northeast averaged only 0.48 swifts ($n = 169$). Using a two-tailed t test, we found the difference highly significant, with $P < 0.000001$.

We determined that the coastal breeding range extends from the north coast of Del Norte County south to Santa Cruz County and, rarely, to Big Sur, Monterey County. This matches the broad-scale range described by Grinnell and Miller (1944). However, we speculate that forest fragmentation alters the species' distribution on a smaller scale, as we found the majority of murrelet transects with swifts in parks (Figure 1). Future research should focus on the effects of this fragmentation. Scattered inland records are from western Siskiyou County and central Trinity County south through central Mendocino County and eastern Sonoma County. Infrequently, a few pairs have nested in chimneys in eastern Modoc, central Sonoma, central Contra Costa, and Santa Clara counties. Further inland, a few swifts reside from southeastern Siskiyou County south along the west slope of the Sierra Nevada to Tulare County (most between 1500 and 4500 feet elevation) and in eastern California from the Warner Mountains in Modoc County south to Sierraville, Plumas County (Appendix; Figure 2) (BBS data, *Am. Birds* data, Gaines 1992, Harris 1991, Roberson and Tenney 1993, Shuford 1993, Sterling pers. obs.).

DISCUSSION

We view the results from several angles. First, Vaux's Swift's breeding distribution may be closely linked to the availability of suitable nest sites, namely, large, hollow live trees and snags and man-made chimneys (Bull and Collins 1993). Second, we lack both quantitative and qualitative data on

nest-site selection in California. Third, we lack detailed knowledge of how far Vaux's Swifts range from their nests and how that distance may vary by habitat, stage of the nesting cycle, or time of day.

A discussion of the species' breeding range should consider the availability of suitable nest sites; however, there is still relatively little known about the breeding ecology of Vaux's Swifts in California forests. In northeastern Oregon, all 21 nests found by Bull and Cooper (1991) were in Grand Firs (*Abies grandis*) decayed and hollowed out by Indian paint fungus (*Echinodontium tinctorium*) and excavated by Pileated Woodpeckers. In California, the Grand Fir is restricted to the north coast forests, where it is

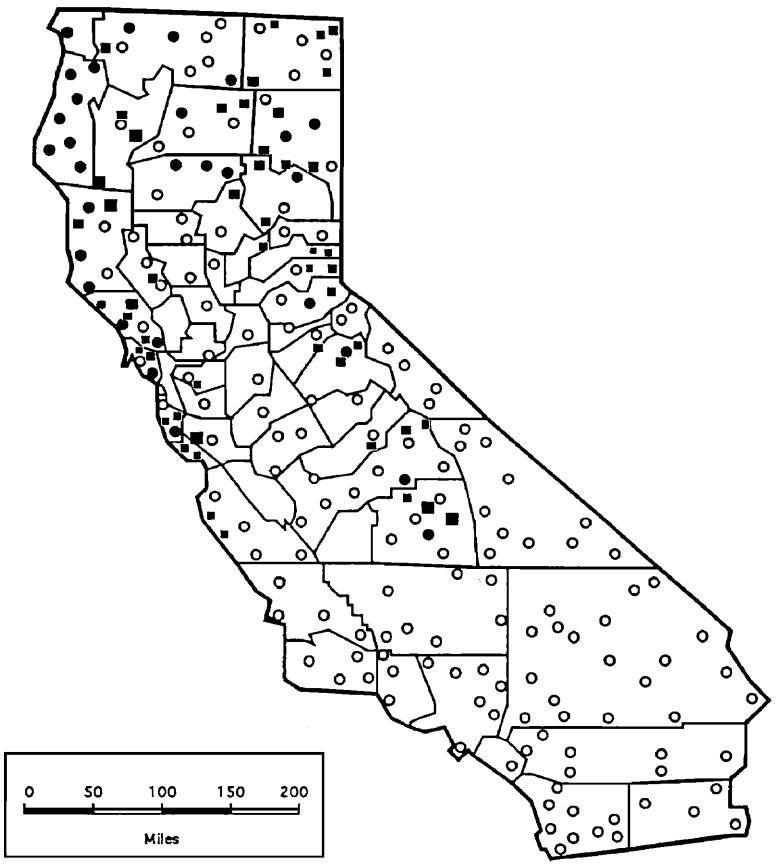

Figure 2. Current distribution of Vaux's Swift in California during the breeding season. Open circle, no detections on breeding-bird survey route; filled circle, swifts detected on breeding-bird survey route; filled square, single or multiple detections from *American Birds* files and unpublished sightings.

only minor component of the forest. However, evidence for a stronger association between Pileated Woodpeckers and Vaux's Swifts is the close correspondence of the two species' ranges (Zeiner et al. 1990). The swift's only known nesting populations outside of the woodpecker's range in California, in Modoc, Contra Costa, Santa Clara, and Monterey counties, are small. Interestingly, many of the records of swifts nesting in man-made chimneys are from these localities.

It is difficult to assess the effects of forest fragmentation on the coastal range of Vaux's Swift properly because we lack quantitative and qualitative data on potential nest trees. This makes conclusions of habitat requirements based on census results speculative. Bull and Hohmann (1993) positively associated swifts with mature and old-growth forests, which contain a higher density of suitable nest trees than logged stands. However, we are unsure if these findings from northeastern Oregon are relevant to coastal populations, especially in the redwood zone. We did not conduct detailed vegetation studies along our Marbled Murrelet survey transects. Potential nest trees may have existed in both the old-growth and second-growth stands that we surveyed, explaining why we found only slight differences in the swift's frequency in these two forest-age classes. It is possible that the lack of significant difference is due to the definition of the two classes. Bull (pers. comm.) believes that in northeastern Oregon mature stands (>150 years) offer a suitable forest structure and nest sites. Perhaps if we had defined the age classes as second-growth (<150 years) and mature to old-growth (>150 years) we would have found a significant difference in the survey results.

Bull and Hohmann (1993) reported limited use of residual snags in second-growth forest. Dawson (1923) and egg collectors such as Clay (from egg-set data cards at Humboldt State University) described nests in residual snags on old burns and clear-cuts. There is a great need for studies that determine the extent of residual snags in logged stands, the length of time these snags remain standing after the logging of adjacent forest, and the time needed for their regeneration in different areas.

The results of our censuses may reflect the early-morning foraging by swifts in second-growth stands away from their nest trees in old-growth forests. Bull and Beckwith (1993) found swifts foraging more than 40 meters from their nests 47% of the time. To our knowledge, no one has quantified the activity patterns of swifts in California. We need observations of known nest sites and their occupants' foraging to enable us to interpret census results properly. At this point in our knowledge, the best method for assessing the swift's population is censuses of nest sites.

Our study of Vaux's Swift distribution in California has supported and somewhat extended the range described by Grinnell and Miller (1944). The BBS data demonstrate the restriction of highest densities in the state to the narrow coast belt of northern and central California, the redwood zone. The study in Six Rivers National Forest indicates that swifts fall to very low density only 30 to 45 miles inland and in apparently suitable forest, namely, mature and old-growth Douglas Fir (*Pseudotsuga menziesii*). This low density is seemingly representative of the swift population throughout the bulk of its range in California. It is difficult to know whether the species' range in California has recently extended into the northeast. Early explorers possibly

overlooked it. In the Sierra Nevada, apart from one nest, suspected breeding remains undocumented. Amazingly, there are only a few reports of nests in the entire state since Grinnell and Miller (1944). Of these, all but one, to our knowledge, are from chimneys, including the first documented nest for Marin County in 1995 (Appendix).

SUMMARY

In California, Vaux's Swifts live mostly in the narrow redwood-forested coastal zone from Del Norte to Santa Cruz counties. At the time of Grinnell and Miller (1944), there were a few scattered breeding-season records from the Sierra Nevada and no nesting records outside the narrow belt along the north coast. Since then, our knowledge has changed little. There are still only a few records from scattered localities in the Sierra Nevada, and these probably reflect the species' true status rather than our lack of data. The lack of swifts over large areas illustrates how local this distribution is; for example, Jim Steele (pers. comm.) reports an absence of June and July records for the Yuba Pass and Sierra Valley area since 1976. Since the swift nests primarily in hollow snags, the presence of nest sites probably limits its distribution. In northeastern Oregon, suitable nest trees had Pileated Woodpecker cavities, and in California, Vaux's Swift and this woodpecker have nearly coinciding ranges. Their relationship merits more research. In California, ornithologists and birders contribute principally to the understanding of Vaux's Swifts by expanding the number of known summer localities through northeastern California and the Sierra Nevada. Unfortunately, the knowledge of the species in California does not extend much beyond the description of its general range.

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APPENDIX. Records of Vaux's Swift in California during the breeding season, from *American Birds* files and unpublished data. Organized by county, location, date, and observer; if the birds were noted using a chimney, this is specified. Abbreviations: cyn., canyon; ft., fort; mt., mountain; PRBO, Point Reyes Bird Observatory; r., river; res., reservoir; S. P., state park.

Butte Co.: Butte Meadows?, Jun–Jul 1973 (D. Gaines)

Contra Costa Co.: Walnut Creek, 12 Jun 1972 (W. Purcell); Alamo, 17 Jun 1981 (J. Richmond)

Del Norte Co.: Crescent City, 8 Jul 1982 (J. Hornstein); Yurok, Klamath R., 6 Jun 1990 (G. Lester), 18 Jun 1990 (A. Barron), 7 Jul 1990 (G. Lester)

El Dorado Co.: Wright's Lake, 17 Jul 1955 (W. Minturn), 14 Jul 1956 (A. Craig); China Flat, 9 Jun 1962 (F. Evenden); Union Valley Res., 6 Jun 1987 (E. Harper); Kyburz, 21 May 1993 (M. Johnson)

Fresno Co.: Kinsh Flat, 29 Jun 1975 (R. Hansen); Teakettle, 1 Jun 1990, 7 Jun 1990 (K. Purcell); Markwood, 18 Jun 1990 (K. Purcell)

Humboldt Co.: Orleans, 30 May 1988 (M. Robbins); Arcata and Eureka, each summer (many observers), in chimneys

Lassen Co.: South Eagle Lake, mid Jun 1974 (S. Laymon); 12 mi. W Susanville, 7 Jul 1979 (M. Mans); Manzanita Lake, 30 Jul 1979 (B. & C. Yutzy); Johnstonville, 4 Jun 1980 (B. Deuel); Crater Lake, 7 Jul 1984 (P. Metropulos); near Westwood, 13 Jul 1985 (J. Hornstein); Blue Lake, S. Warner Mts., 20 Jun 1990 (J. Sterling)

Marin Co.: Lake Lagunitas, 15 Jul 1970 (A. L. Carl); Alpine Lake, 22 Jun 1971 (W. Purcell); Palomarin, 16 Jun–7 Jul 1979, 3 Jun 1977, 23 Jun 1982 (PRBO); Five Brooks, 31 May 1980 (J. Evens), 17 Jun 1977 (B. Sorrie); Bolinas Lagoon, 14 Jun 1980 (J. Evens), 30 Jul 1995 (K. Hansen), in chimney; Novato, 16 Jul 1980 (D. Shuford); Kent Lake, 18 Jul 1981 (D. Shuford); Terralinda, 30 May 1982 (B. Lenarz); Carson Ridge, 5 Jun 1982 (D. Shuford); Garden Club Cyn., 4 Jul 1982 (D. Shuford);

Galloway Cyn., all Jun 1983 (D. DeSante), 1 Jun 1985 (PRBO); Bolinas Ridge, 30 Jun 1985 (D. Holway); Bolinas, 27 Jul 1985 (A. Edwards); Las Gallinas pond, 13 Jul 1988 (D. Holway)

Mariposa Co.: Yosemite, 17 Jun 1969 (A. Baldridge), 13 Jun 1971 (T. Chandik); Tamarack Flat, 25 Jul 1983 (W. Bousman); Vernal Falls, 20 Jul 1984, Chisholm; North Dome Trail, 11 Jun 1985 (R. Marlowe)

Modoc Co.: Buck Creek, 18 Jun 1975 (D. Winkler); Lassen Creek, 21 Jun 1975 (D. Winkler); Day, 8 Jun 1980 (S. Laymon); Whitehorse Flat R., 3 Jun 1985 (M. Robbins); Thoms Creek at Highway 299, 5 Jun 1985 (J. Greenhouse); Clear Lake, 15 Jul 1985 (D. Shuford); Soup Creek, S. Warner Mts., 20 Jun 1990 (J. Sterling); Ft. Bidwell, 11 Aug 1988, Jun–Jul 1990, Jun–Jul 1991 (J. Sterling), in chimney; near Eagleville, 15 Jul 1990 (J. Sterling); Cedar Pass, Jun–Jul 1991 (J. Sterling); S. Warner Mts., 6 Jul 1991 (A. Barron)

Mono Co.: Paha Campground, 20 Jul 1985 (H. Green)

Monterey Co.: Torres and Grimes Creek, 5 Aug 1984 (D. Roberson); Big Sur R. mouth, 8 Jun 1985 (D. Roberson); Partington Cyn., 29 Jun 1991 (D. Roberson)

Nevada Co.: Boca Res., 16 Jul 1959 (G. McCaskie); Sagehen Creek, 19 Jul 1966 (H. Cogswell)

Placer Co.: Tahoe City, 16 Jul 1959 (G. McCaskie), 16 Jun 1962 (P. DeBenedictis), 20 Jun 1982 (D. Yee); French Meadows, 27 Jun 1982 (T. Chandik)

Plumas Co.: Buck's Lake, 9 Aug 1973 (R. Stallcup); Butterfly, 2 Jul 1974 (P. Metropulos); Chester, 5 Jul 1984 (H. Green); L. Almanor, 22 Jul 1987 (H. Green)

San Mateo Co.: Skyline Ridge, 16 Jun 1981 (D. Houk), 11 Jun 1988 (W. Bousman); Skyline Ranch, 29 Jun 1986, 13 Jul 1986 (P. Noble); Pescadero, Jun–Jul 1987 (H. Green); Gazos Creek, 1 Jul 1987, 8 Jun 1988 (H. Green); Año Nuevo, 6 Jul 1988 (P. Metropulos)

Santa Clara Co.: Los Gatos, 16 Jul 1957 (E. Smith), in chimney, 28 Jun 1991 (J. DuBois), in chimney; Saratoga, 18 Jun 1959 (E. Smith), in chimney, 7 Jul 1987 (W. Bousman); Rancho San Antonio, 4 Jul 1986 (A. Edwards); Coyote Creek, 6 Jun 1987 (D. Roberson); Vasona Res., 6 Jun 1987 (W. Bousman); Fremont Older Open Space Preserve, 22 Jun 1987 (W. Bousman)

Santa Cruz Co.: Santa Cruz Swamp, 17 Jul 1955 (A. Craig); Aptos, 21 Jul 1985 (B. LaBar), in chimney; Ben Lomond, 6 Jun 1987 (N. Naslund), in chimney; Summit Meadows, 16 Jun 1987 (D. Suddjian); Univ. Calif., Santa Cruz, 17 Jun 1987 (D. Suddjian); Big Basin S. P., 20 Jun 1987, 30 Jun 1987 (D. Suddjian); 11 Jun 1989 (P. Paton); Soquel, 26 Jun 1987 (D. Suddjian); Brookdale, 3 Jul 1987, 12 Jul 1988 (N. Naslund), in chimney; Henry Cowell S. P., 15 Jul 1987 (D. Suddjian); San Lorenzo R., 24 Jul 1987, 25 Jun 1988 (D. Suddjian); Sycamore Grove, 5 Jun 1988 (D. Suddjian); Scott's Valley, 25 Jul 1988 (N. Naslund), in chimney; Blooms Creek Campground, 27 Jun 1989 (N. Naslund)

Shasta Co.: Ft. Cook, 2 Jun 1971 (T. Manolis); Burney Falls, 10 Jul 1979 (B. & C. Yutzy), Jun–Jul 1990, Jun–Jul 1991 (J. Sterling); Hat Creek town, Jun–Jul 1990 (J. Sterling); Hat Creek at Pit R., Jun–Jul 1990, Jun–Jul 1991 (J. Sterling)

Sierra Co.: Chapman Creek, 20 Jul 1962 (F. Evenden)

Siskiyou Co.: Bull Mt., 18 Jun 1980 (S. Laymon); Cedar Lake, 22 Jun 1980 (B. & C. Yutzy); Butler Creek, 2 Jun 1985 (M. Robbins); Crepo Creek, 1 Jun 1986 (M. Robbins); Thompson Creek, 27 May 1987 (M. Robbins); Somes Bar, 30 May 1988 (M. Robbins); Seiad, 3 Jun 1989 (M. Robbins)

Sonoma Co.: Gualala, 16 Jun 1956 (W. Pursell), 11 Jul 1982 (T. Gates), 1 Jun 1991 (M. Parmeter); Timber Hill, 17 Jul 1956 (G. Bolander); Duncan Mills, 25 May 1956(J. Kelly); Santa Rosa, 10 Jul 1962 (N. Mestechin); Sonoma, nested in 1961, 1963 (N. Mestechin), 11 Jul 1979 (L. Binford), in chimney; Austin Creek, 27 Jul 1983 (D. Beall); Two Rock, 13 Jul 1986 (R. Marlowe); Healdsburg, 22 Jul 1986 (J. Smith), 20 Jul 1990 (M. McCulley); Duncan's Landing, 17 Jun 1989 (R. Rudesill), in chimney; Monte Rio, 24 Jun 1989 (D. Willard); Stewart's Point, 25 May 1990 (B. Lenarz), in chimney; Dry Creek, 2 Jul 1990 (Bird Rescue Center), nestlings

Tehama Co.: Chico Meadows, 13 Jul 1962 (T. Rodgers); Elan Creek Campground, 15 Jul 1962 (E. Hodnette)

Trinity Co.: Waterman Ridge, 20 Jul 1982 (K. Rosenberg); Hayfork, 20 Jun 1995 (G. Hazard); Hyampom, 6 Jul–25 Aug 1995 (G. Hazard)

Tulare Co.: Colby Meadow, 7 Jul 1952 (P. Raven); Hogietown Picnic Area, 7 Jul 1973 (A. Baldridge); Log Meadow, 6 Jul 1974 (D. DeSante), nest in tree, 9 Jul 1979 (L. Norris), 11 Jul 1985 (J. Boone); near Badger, 19 Jun 1975 (R. Hansen); Park Ridge Lookout, 18 Jun 1980 (L. Norris); Big Stump, 2 Aug 1982, 3 Jun–30 Jul 1985, 4–11 Jun 1986, 19 Jul 1987 (J. Warner); Potwisha Campground, 10 Jun–1 Aug 1984, 31 Jul 1985 (J. Boone); Wolverton area, 12 Jun 1984 (J. Boone); Crescent Meadow, 26 Jun 1984 (G. San Miguel), 25 Jul 1986 (D. Graber); Moro Rock, 4 Jul 1984 (J. Boone); Ash Mountain, 17 Jun 1985 (L. Norris); Grant Grove, 28 Jun 1985, 16 Jul 1987, 14 Jul 1988 (G. San Miguel); Lodgepole, 30 Jun 1985 (J. Boone); Pine Camp, 30 Jun 1985 (G. San Miguel); Big Baldy Trail, 7 Jul 1985 (G. San Miguel); Wolverton Meadow, 18 Jun 1986 (J. Boone), 2 Aug 1988 (J. Warner), 24 Jun 1989 (G. San Miguel); Redwood Saddle, 10–11 Jun 1988 (G. San Miguel); South Fork Campground, 12 Jun–6 Aug 1988 (T. Jeffrey); Dorst Creek, 6 Jun 1990 (G. San Miguel)

Tuolumne Co.: Crane Flat, Jun–Jul 1971, 8 Jul 1973 (M. Mans), 1 Jul 1974 (no observer), 9–28 Jul 1985 (J. Lovio), 9 Jun 1986 (P. Metropulos), 20 Jun 1986, 26 Jun 1987 (D. Suddjian); Hodgdon Meadow, 27 Jun 1982 (Keeler); Harden Flat, 21 Jul 1988 (R. Erickson)

Yuba Co.: W of Yuba Pass, 16 Jun 1973 (no observer); Yuba Summit, 12 Jun 1976 (J. Richmond)

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