

# SWAINSON'S HAWK NESTING POPULATION IN THE ANTELOPE VALLEY OF THE WESTERN MOJAVE DESERT, CALIFORNIA

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**ABSTRACT:** The Swainson's Hawk (*Buteo swainsoni*) has a long history of breeding in California, but a severe decline in the statewide breeding population was identified in 1979, when in all of southern California only two pairs were found, one in the Antelope Valley of the western Mojave Desert. That area was little studied until we began banding Swainson's Hawks there in 1997. Over 20 breeding seasons between 1979 and 2022, we documented in the Antelope Valley 124 attempts to nest, in which the mean clutch and brood sizes were 2.49 and 2.37, respectively. From 2004 through 2006, we observed two to four breeding pairs annually; from 2009 through 2022, three to 14 breeding pairs. The rate of success of the 91 nests revisited to determine if any young fledged was 64%. Nest trees consisted of 81.5% non-native species, 13.7% native species, including Joshua trees (*Yucca brevifolia*), and 4.8% unidentified deciduous trees. Between 1997 and 2022, in 50 nests, we recorded 170 vertebrate prey items, of which 90 were gophers (*Thomomys bottae*). Though the Antelope Valley population has grown since 1980, its nesting and foraging habitat now face multiple threats. To conserve occupied nesting territories, we recommend creation of nesting and foraging habitat reserves that include both native desert and cultivated alfalfa close to existing conserved land.

Swainson's Hawk (*Buteo swainsoni*) breeds throughout the wide-open spaces of western North America, spending six months on the breeding grounds and six months migrating or wintering, mostly in Argentina (Brown and Amadon 1968, Bechard et al. 2020), though recently it has begun wintering (short stopping) in western Mexico (Airola et al. 2019). The occurrence of Swainson's Hawk in southern California, and specifically Los Angeles County, dates back to the Pleistocene (Stock 1930). There is considerable historical evidence of a large coastal southern California breeding population that extended south into northern Baja California, potentially as far as Ensenada de Todos Santos, Baja California (Bent 1937). From museum records, between 1880 and 1933, 132 Swainson's Hawk egg sets were collected in California, 20 of them in cismontane Los Angeles County (Bloom 1980). In their overview of California birds, Grinnell and Miller (1944) were the first to report the statewide reduction in the number and breeding distribution of Swainson's Hawk. From about 1940 to 1979, California experienced an estimated 91% decline in its breeding population with nearly complete extirpation of breeding pairs below the 36<sup>th</sup> parallel, essentially all southern California (Bloom 1980).

Prior to the 1979 survey, the last known attempts of Swainson's Hawk to nest in southern California were in 1933, when Ed N. Harrison collected three sets of eggs in northwestern San Diego County (WVZ, Western Foundation of Vertebrate Zoology; <https://collections.wfvz.org/>; EN-173347, EN-173348, EN-173349), 1939, when James B. Dixon took a set of eggs near Adelanto, San Bernardino County (WVZ EN-29168), and 1946, when Sidney B. Peyton collected a set of eggs near Adelanto (WVZ EN-82220; Bloom 1980).

The Antelope Valley of northern Los Angeles and southern Kern counties has a long history of documentation of Swainson's Hawks, beginning with 28 specimens, mostly adults, collected during the breeding season between 7 July 1904 and 1 April 1931 near Neenach, Lancaster, or Palmdale (MCZ, Museum of Comparative Zoology, Harvard University, <http://digir.mcz.harvard.edu/ipt/resource?r=mczbase>; WfVZ, <https://collections.wfvz.org/>; MVZ, Museum of Vertebrate Zoology, [https://arctos.database.museum/SpecimenSearch.cfm?guid\\_prefix=MVZ%3ABird](https://arctos.database.museum/SpecimenSearch.cfm?guid_prefix=MVZ%3ABird)). Of the two nests from which eggs were collected near Palmdale, one was in a "yucca palm," presumably a Joshua tree (*Yucca brevifolia*). More evidence of nesting in the Mojave Desert just to the east in San Bernardino County includes five nests in the vicinity of Victorville between 1916 and 1946, four of which were in Joshua trees (Bloom 1980). No observations of nesting Swainson's Hawks were confirmed in the Antelope Valley between 1931 and 1978 (K. Garrett pers. comm., Bloom 1980).

Concern over Swainson's Hawk's statewide decline prompted surveys in 1978 and 1979. These revealed only two nesting territories remaining in southern California, one northeast of Lancaster in the eastern portion of the Antelope Valley (K. Garrett pers. comm.) and one near Cima in eastern San Bernardino County (E. A. Cardiff pers. comm., Bloom 1980; Figure 1). In both years, the attempts in the Antelope Valley failed during nest building or incubation, and no active nests were found in 1980 (K. Garrett pers. comm.). The territory near Cima was inactive whenever visited over multiple years from 1981 to 2022. Although there were museum specimens and observations from the Antelope Valley over the 17 years following 1979, Swainson's Hawk was not confirmed nesting there again until 1997, when we began our efforts at banding.

Since at least 1979 (Bloom 1980), the Antelope Valley Swainson's Hawk population has been relatively isolated from other breeding pairs but has become less isolated over the last 10 years (Bloom unpubl. data). The closest known active nesting territories found in the last 10 years include 11 from 40 to 70 km north of the western end of the Antelope Valley in the vicinity of Bakersfield, Bealville, and Caliente, Kern County (observed in 2016, 2018, and 2020; Bloom unpubl. data), one 5.5 km south of Owens Dry Lake near Olancho, Inyo County (observed in 2015, 2016, and 2021; Bloom unpubl. data), and one isolated nesting territory approximately 130 km south of the Antelope Valley at Naval Weapons Station Seal Beach, Orange County (observed in 2019, 2020, 2021, and 2022; R.S. Winkelman pers. comm; Figure 1).

Here we detail the history, ecology, productivity, and diet of Swainson's Hawks nesting in the Antelope Valley, on the basis of intermittent surveys and banding of nestlings and adults from 1979 to 2022 (Figure 1).

## STUDY AREA

If the surrounding native desert habitats and fragments of native habitat remaining on the valley floor are representative of what occurred historically, prior to the advent of agriculture, the Antelope Valley was dominated by Joshua tree woodland, creosote bush (*Larrea tridentata*), burrow-weed (*Ambrosia dumosa*), rabbitbrush (*Ericameria* spp.), and saltbrush (*Atriplex*

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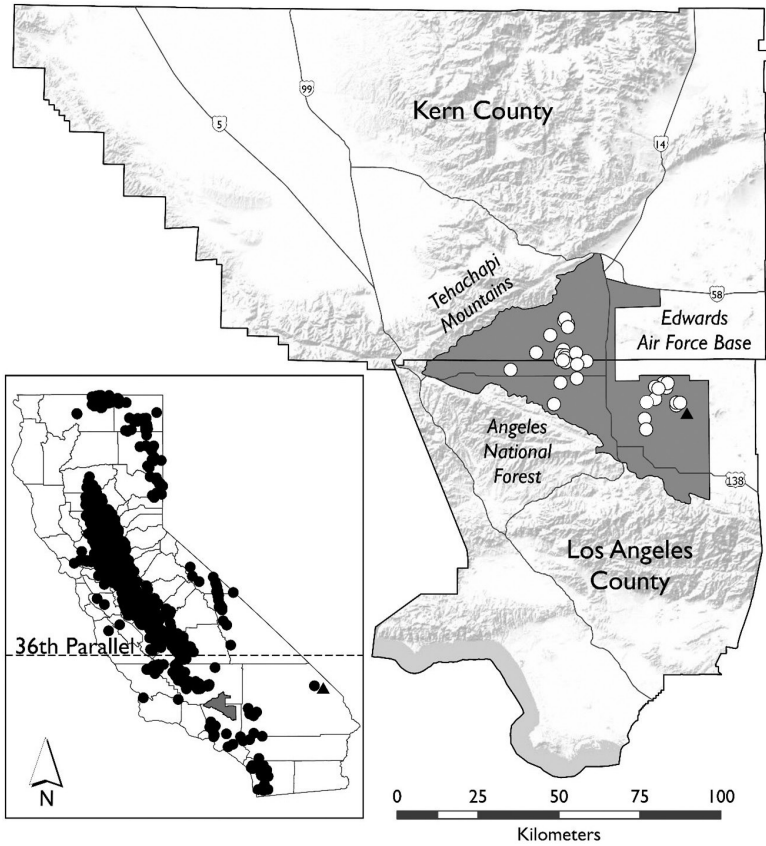


FIGURE 1. Antelope Valley Swainson's Hawk nesting locations and study area (1979–2022), Kern and Los Angeles counties, California. Gray shading, the study area; black triangles, 1978–1979 nest locations (K. Garrett pers. comm., Bloom 1980); black dots, all California nest locations outside of the study area (Calif. Dept. Fish and Wildlife data); white dots, Antelope Valley nest locations, 1997–2022.

spp.). Joshua trees were likely the principal sites of Swainson's Hawk nests in the Antelope Valley in the early 20<sup>th</sup> century before thousands of hectares of native desert habitats were removed and replaced with alfalfa, a crop that supports abundant vertebrate prey and in which Swainson's Hawk forages regularly throughout California (Bloom 1980, unpubl. data, Woodbridge 1991, Babcock 1995, Briggs et al. 2011). As the local groundwater basin has been depleted (*Los Angeles County Waterworks District No. 40 v. Diamond Farming Co.*; Antelope Valley Groundwater Cases 2020), fallow alfalfa fields have become the dominant habitat. While the maximum number of hectares under alfalfa cultivation in the early to mid-1900s is unknown, from 1948

to 1988 the number of hectares of alfalfa in the Antelope Valley fell from approximately 25,000 to 4000 (Templin et al. 1995). By 2021 we estimate active alfalfa to have decreased further, to 2000 hectares.

As of 2022, solar-energy facilities, residential development, and wind farms have expanded over much of the Antelope Valley, now occupying former native desert and agricultural land.

## METHODS

The 1979 Swainson's Hawk survey of the Antelope Valley was part of a California statewide effort focused on the species' nesting habitat. These "windshield" surveys entailed driving at 40 to 48 km/hour with periodic stops to survey potential nesting habitat (Bloom 1980). We followed the same procedures in more recent years. The objective was to locate all nesting territories to identify and locate any population decline. Binoculars and a 25- to 60-power spotting scope were used to search for hawks and confirm active nests. Five days in May 1979 were dedicated to the Antelope Valley floor from 300th Street West east to 170th Street East, and from Willow Springs in the north to Palmdale in the south, excluding Edwards Air Force Base. The same area was surveyed again in 1980, 1997, 1998, 2016, 2018, and 2020, when we attempted censuses of the population. Targeted surveys of known nesting territories, with limited searching for new territories, were conducted from 2004 through 2006, 2009 through 2015, and in 2017, 2019, 2021, and 2022.

We define an active nest as one newly built or recently added to, with adults present on the nest and or defending it, or with eggs or young present. Upon finding an active Swainson's Hawk nest, we climbed the nest tree to band young, collect unhatched eggs, and identify prey remains. Bloom identified prey from whole and partial carcasses, feathers, tails, claws, skulls, mandibles, and other skeletal remains and teeth in the nest. No prey remains were brought into the lab for identification; all were left at the nest. Trees were climbed only once to reduce disturbance and potential predation by the bobcat (*Lynx rufus*; Bloom 1974). We recorded each nest's location (Figure 1), date, number of young, success, supporting tree, and, if the nest was entered, prey species and clutch size. We considered a nest successful if at least one young fledged. We considered a chick to have fledged if it was at least three-quarters grown (5.5 weeks old) during the final observation (Steenhof 1987). Chicks older than 2.5 weeks were banded with U.S. Geological Survey aluminum bands and beginning in 2011 were also banded with alphanumeric color bands. Added eggs were deposited at the WFVZ.

## RESULTS

### Current Population Status

After 1980, the population of Swainson's Hawk in the Antelope Valley began to increase and spread, in both native desert and agricultural areas. From 1995 to 1999 breeding was probable or confirmed in the Antelope Valley in four blocks defined for the Los Angeles County breeding bird atlas (Allen et al. 2016). Five pairs may have been present in the Antelope Valley

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in 2005. Our highest count of active territories was 14 in 2021, of which three successfully fledged young, two failed with chicks in the nest, and nine failed prior to confirmation of hatching. In five other years from 2015 to 2022 we located 9 to 11 active nests (Table 1).

Nesting Ecology

From 1979 to 2022 we documented 124 nest attempts. Of these, 22 failed prior to egg laying or without egg laying being confirmed. In the remaining 102 nests, which contained at least one egg, if not also young, the average clutch size was 2.49 eggs (SE = 0.08). In the 99 nests that contained at least one young the average brood size was 2.37 chicks (SE = 0.08; Table 1). For the 91 nests revisited to determine if any young fledged, the rate of success ranged from 0% in 1979 and 2017 to 100% in 1997, 1998, 2004 through 2006, and in 2009 and 2010, averaging 64.4% across all years. A minimum of 126 young were fledged from 54 nests over the 20-year study period (Table 1). However, we did not revisit all nests to determine if young had fledged. Between 1991 and 2022, 198 young were banded, of which 124 received auxiliary bands with an alphanumeric code.

**TABLE 1** Annual Nest Success and Size of Clutch and Brood for Swainson's Hawk Nests in the Antelope Valley, California, 1979–2022

Year	Nests <sup>a</sup>	Chicks banded	Percent successful <sup>b</sup>	Mean clutch size <sup>c</sup>	Mean brood size
1979	1	0	0		
1997	2	6	100	3	3
1998	3	6	100	3.33	3.33
2004	2	3	100	1.5	1.5
2005	4	11	100	2.75	2.75
2006	4	7	100	3.25	2.75
2009	6	16	100	3	2.83
2010	5	13	100	3.2	2.6
2011	8	20	75	3.29	3
2012	6	7	50	1.75	1.75
2013	6	3	50	2	1.6
2014	5	8	50	2.2	2
2015	10	21	80	2.89	2.78
2016	6	9	40	2	1.83
2017	9	17	0	2.5	2.25
2018	11	16	50	2.25	2.25
2019	3	1	33.3	2	2
2020	9	21	88.9	2.67	2.33
2021	14	5	21.4	1.4	1.4
2022	10	8	50	1.89	1.44
Mean		198	64.4	2.49	2.37
SE				0.08	0.08

<sup>a</sup>Number of active nests observed.

<sup>b</sup>Nests which had young ≥5.5 weeks old at the time of the last observation.

<sup>c</sup>Not all nests which failed prior to young being observed were examined for the presence of eggs.

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Trees supporting Swainson's Hawk nests were largely non-native species (81.5%,  $n = 101$ ), including elm (*Ulmus* spp., 43 nesting attempts), Aleppo pine (*Pinus halepensis*, 32), black locust (*Robinia pseudoacacia*, 10), tamarisk (*Tamarix* spp., 11), and Arizona cypress (*Cupressus arizonica*, 5). Native trees constituted 13.7% ( $n = 17$ ) of the 124 observed nesting attempts, which included eight attempts in Joshua trees, six in Fremont cottonwoods (*Populus fremontii*), two in willows (*Salix* spp.), and one in a California juniper (*Juniperus californica*). An additional six nest trees (4.8%), most of which have either died or have been removed, were documented as deciduous without being identified to species. Figures 2 and 3 show examples of non-native and native trees in which Swainson's Hawks nested and the surrounding habitat.

### Diet and Feeding Ecology

Between 1979 and 2022 we recorded the remains of 170 prey observed in 50 Swainson's Hawk nests, identified to the lowest taxonomic level allowable (Table 2). Observed prey consisted entirely of vertebrates and almost entirely of rodents (82.9%,  $n = 141$ ). Birds represented 7.1% ( $n = 12$ ) of the total prey items, followed by reptiles (6.5%,  $n = 11$ ) and amphibians (3.5%,  $n = 6$ ). Of the 170 items observed, Botta's pocket gopher (*Thomomys bottae*) was the dominant prey, found in 23 nests. The California vole (*Microtus californicus*) and California ground squirrel (*Otospermophilus beecheyi*) were the next most common prey, observed in 10 and five nests, respectively.



FIGURE 2. Swainson's Hawk nest in elm tree and adjacent alfalfa fields in the Antelope Valley, Los Angeles County, California, July 2020.

*Photo by Peter H. Bloom*

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FIGURE 3. Swainson's Hawk nest in Joshua tree in native desert in the Antelope Valley, Kern County, California, November 2021.

*Photo by Kerry G. Ross*

## DISCUSSION

## Population and Distribution

Except for the isolated territory near Olancha, Inyo County, the substantial increase in the Antelope Valley population is the only change in the nesting distribution of Swainson's Hawk in the Mojave Desert since the 1979 statewide survey that led to the species being listed as threatened. While California's entire Mojave Desert has not been systematically surveyed for nesting Swainson's Hawks, much of the known nesting habitat (Joshua tree woodland) has been examined repeatedly over the decades, and hundreds of Red-tailed Hawk (*Buteo jamaicensis*), Great Horned Owl (*Bubo virginianus*), and Common Raven (*Corvus corax*) nests have been identified and their young banded (Bloom unpubl. data). In addition, no nests of Swainson's Hawk in areas of the Mojave Desert outside of the Antelope Valley have been reported to us or through <https://eBird.org>, [www.iNaturalist.org](http://www.iNaturalist.org), or the California Natural Diversity Data Base (<https://map.dfg.ca.gov/rarefind/view/RareFind.aspx>, accessed 3 Apr 2021).

Population increases documented in other portions of the species' range during this same period (Battistone et al. 2019, Furnas et al. 2022) were not taking place in the Mojave Desert outside of the Antelope Valley. As a nesting species, Swainson's Hawk may always have been less abundant in the Mojave Desert (Grinnell and Miller 1944) than west of the Tehachapi Mountains and Sierra Nevada. Given the extensive distribution of the Joshua tree (Munz 1974), nesting is plausible anywhere the tree is found in California. Dawson

**TABLE 2** Prey Observed in Swainson's Hawk Nests in the Antelope Valley, California, 1979–2022.

Common name	Scientific name	Quantity	Percent
Botta's pocket gopher	<i>Thomomys bottae</i>	90	52.9
California vole	<i>Microtus californicus</i>	14	8.2
California ground squirrel	<i>Otospermophilus beecheyi</i>	12	7.1
Merriam's kangaroo rat	<i>Dipodomys merriami</i>	9	5.3
Desert cottontail	<i>Sylvilagus audubonii</i>	8	4.7
Unidentified snake		7	4.1
Black-tailed jackrabbit	<i>Lepus californicus</i>	5	2.9
Unidentified frog or toad		5	2.9
Horned Lark	<i>Eremophila alpestris</i>	4	2.4
Unidentified rodent		3	1.8
Eurasian Collared Dove	<i>Streptopelia decaocto</i>	2	1.2
Western whiptail	<i>Aspidoscelis tigris</i>	2	1.2
Unidentified passerine		2	1.2
Western Meadowlark	<i>Sturnella neglecta</i>	1	0.6
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	1	0.6
Barn Owl	<i>Tyto alba</i>	1	0.6
Domestic poultry	<i>Gallus</i> spp.	1	0.6
Desert horned lizard	<i>Phrynosoma platyrhinos</i>	1	0.6
Western toad	<i>Anaxyrus boreas</i>	1	0.6
Unidentified lizard		1	0.6
Total		170	100

(1923) referred to Swainson's Hawk as "less common on the south-eastern deserts" (probably referring to the Colorado Desert) and included a photo of a nest in a Joshua tree in the Mojave Desert, as did Bent (1937). Grinnell and Miller (1944) referred to it as "apparently scarce in summer on Colorado and Mojave Deserts; but known to nest near Cima, San Bernardino County." While the historic distribution of nesting Swainson's Hawks in the Mojave Desert was widely dispersed around the Antelope Valley, Olancho, Adelanto, Victorville, and Cima, the core nesting population is now found in the Antelope Valley.

Four decades have elapsed since the 1979 survey of the Antelope Valley, and the population has experienced a 14-fold increase. The ultimate cause of the increase in the Antelope Valley and Central Valley (Battistone et al. 2019) is unknown since no active management was undertaken in the preceding decades. However, the Central Valley population was recognized as the core state population and reproductively healthy. Whether the increase in Antelope Valley nesting pairs was a product of local reproduction or immigration is unknown. Equally puzzling is why so little breeding has extended to southern California counties except in the Antelope Valley. Given the species' propensity for short-distance dispersal (Woodbridge et al. 1995), all or the majority of adults breeding in the Antelope Valley likely fledged from nests in the Antelope Valley. However, occasional long-distance dispersers are known and could have originated from the core population in the Central Valley or a state other than California (Bloom unpubl.). The species' typically short distance of natal dispersal may have contributed to the growing population's failure to spread widely in southern California.

### Nesting Ecology

Although our sample size was relatively small (124 nests), the combined annual reproductive performance of Swainson's Hawks in the Antelope Valley was like that reported elsewhere in California and western North America (Bloom 1980, Woodbridge et al. 1995, England et al. 1995). The species' clutches typically range from one to four eggs; average clutch sizes have been reported as 2.66 in Washington, 2.34 in Colorado, and 2.48 in New Mexico (Bechard et al. 2020). Similarly, Bloom (1980) reported an average clutch size of 2.58 and an average brood size of 2.27 for California nesting pairs. Our observed mean clutch size of 2.49 and mean brood size of 2.37 are consistent with the results of other studies. Various studies throughout the western U.S. found that pairs were successful in 54.6% (Olendorff 1978), 65% (Woodbridge et al. 1995), 64.7% to 82.1% (England et al. 1995), 81.3% (Fitzner 1978), and 89.5% (Bloom 1980) of reproductive attempts. The success rate of 64.4% in the Antelope Valley is consistent with these findings. However, this rate may be biased toward lower success, in part because of our not returning to all nest sites to confirm if young fledged and the assumption that young less than 5.5 weeks old at the time of the last observation did not successfully fledge. Thus our findings support the conclusion of Risebrough et al. (1989) that in California organochlorine pesticides were not a significant factor in the decline in the state's breeding population.

Five mostly drought-tolerant species of exotic trees currently provide the majority of nest sites for Swainson's Hawks in the Mojave Desert (81.5%),

while native Fremont cottonwoods, Joshua trees, California junipers, and willows provide nest substrates only occasionally (13.7%).

### Diet and Feeding Ecology

In California (Bloom 1980, Woodbridge 1991) and throughout the western United States (Andersen 1995, Bechard 1983, Gilmer and Stewart 1984), Swainson's Hawks have a strong preference for ground squirrels, gophers, and voles. We found the same to be true in the Antelope Valley where gophers, voles, and ground squirrels accounted for 68% ( $n = 116$ ) of the prey observed in Swainson's Hawk nests. These rodents occur in both disturbed and native desert habitats in the Antelope Valley, but active alfalfa fields support the highest abundance of gophers and voles (pers. obs.). This observation is consistent with the high densities of gophers, mice, and voles in pastureland (including alfalfa) found in Washington by Bechard (1982) as well as Woodbridge's (1991) finding of a high abundance of voles, ground squirrels, and gophers in alfalfa fields in northern California. One nest that we examined adjacent to alfalfa fields contained the remains of 59 gophers, four ground squirrels, one cottontail, and two jackrabbits. This nest successfully fledged four offspring and contained 38.8% ( $n = 66$ ) of all prey items observed ( $n = 170$ ) and 65.6% of all gophers observed. We found Swainson's Hawk nests in native desert rarely to yield more than three prey items. In the Antelope Valley, reptiles such as the desert horned lizard ( $n = 1$ ) and western whiptail ( $n = 2$ ) are found almost exclusively in pristine native desert habitats, and our finding their remains in Swainson's Hawk nests suggest that despite the species' predilection for foraging in alfalfa fields when nesting in agricultural areas (Bloom 1980, Woodbridge 1991), adults also hunt in native habitats.

### Conservation and Future Studies

While the population has grown in recent years, it is under increasing pressure from the conversion of nesting and foraging habitat to solar-energy facilities, residential housing, wind farms, and other development. These landscape-level changes in the Antelope Valley are incompatible with continued Swainson's Hawk nesting and foraging. Along with the diminishing availability of water in the Mojave basin and climate change, these factors have cumulative and compounding effects, potentially setting the stage for a significant and rapid population decline. Creation of reserves dedicated to the conservation of both foraging and nesting habitat for nesting and migrating Swainson's Hawks in the Antelope Valley should include both native desert and alfalfa components and be located as close to nesting territories and existing reserves as possible.

The Antelope Valley's population of Swainson's Hawk has been understudied in comparison to breeding populations elsewhere in California. A telemetry study involving adults equipped with GPS/GSM transmitters would provide considerable insight into how Mojave Desert Swainson's Hawks use their territories, which may include native desert, agricultural crops, solar fields, and windfarms, among other areas. Further, a telemetry study may allow for the customization of conservation areas, based upon movements of specific nesting pairs and known territory configurations. The population is small and may have been reestablished by the single pair found in 1978 and

1979. Therefore the species' strong philopatry and territory fidelity suggest that individuals may be closely related, a hypothesis to be tested with genetic studies. If conservation efforts are successful and this population continues to expand, it may serve as a source for recolonization of other regions of southern California in which Swainson's Hawks once nested.

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#### LITERATURE CITED

- Airola, D. A., Estep, J. A., Krolick, D. R., Anderson, R. L., and Peters, J. R. 2019. Wintering areas and migration characteristics of Swainson's Hawks that breed in the Central Valley of California. *J. Raptor Res.* 53:237–252.
- Allen, L. W., Garrett, K. L., and Wimer, M. C. 2016. Los Angeles County Breeding Bird Atlas. Los Angeles Audubon Soc., Los Angeles.
- Andersen, D. E. 1995. Productivity, food habits, and behavior of Swainson's Hawks breeding in southeast Colorado. *J. Raptor Res.* 29:158–165.
- Antelope Valley Groundwater Cases. 2020. Calif. Appeals Court, 5<sup>th</sup> Dist. 58:343.
- Babcock, K. W. 1995. Home-range and habitat use of breeding Swainson's Hawks in the Sacramento Valley of California. *J. Raptor Res.* 29:193–197.
- Battistone, C. L., Furnas, B. J., Anderson, R. L., Dinsdale, J. L., Cripe, K. M., Estep, J. A., Chun, C. S. Y., and Torres, S. G. 2019. Population and distribution of Swainson's Hawks (*Buteo swainsoni*) in California's Great Valley: A framework for long-term monitoring. *J. Raptor Res.* 53:253–265; doi.org/10.3356/JRR-18-34.
- Bechard, M. J. 1982. Vegetative cover on foraging site selection by Swainson's Hawk. *Condor* 84:153–159; doi.org/10.2307/1367658.
- Bechard, M. J. 1983. Food supply and the occurrence of brood reduction in Swainson's Hawk. *Wilson Bull.* 95:233–242.
- Bechard, M. J., Houston, C. S., Saransola, J. H., and England, A. S. 2020. Swainson's Hawk (*Buteo swainsoni*), in *The Birds of the World* (A. F. Poole, ed.). Cornell Lab Ornithol., Ithaca, NY; doi.org/10.2173/bow.swahaw.01.
- Bent, A. C. 1937. Life histories of North American birds of prey. U.S. Natl. Mus. Bull. 167; doi.org/10.5479/si.03629236.167.i.
- Bloom, P. H. 1974. Some precautions to be used in banding studies of nestling raptors. *W. Bird Bander* 49:3–5.
- Bloom, P. H. 1980. The status of the Swainson's Hawk in California, 1979. Final Report II-8.0, U.S. Bureau of Land Management and Federal Aid in Wildlife Restoration, Proj. W-54-R-12, Calif. Dept. Fish and Game, Sacramento, CA.
- Briggs, C., Woodbridge, B., and Collopy, M. 2011. Correlates of survival in Swainson's Hawks breeding in northern California. *J. Wildlife Mgmt.* 75:1307–1314; doi.org/10.1002/jwmg.167.

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- Brown, L. H., and Amadon, D. 1968. *Eagles, Hawks and Falcons of the World*. McGraw-Hill, New York.
- Dawson, W. L. 1923. *The Birds of California*. South Moulton Co., Los Angeles, CA.
- England, A. S., Estep, J. A., and Holt, W. R. 1995. Nest-site selection and reproductive performance of urban-nesting Swainson's Hawks in the Central Valley of California. *J. Raptor Res.* 29:179–186.
- Fitzner, R. E. 1978. Behavior ecology of Swainson's Hawk (*Buteo swainsoni*) in south-eastern Washington. Ph.D. dissertation, Wash. State Univ., Pullman.
- Furnas, B. J., Wright, D. H., Tennant, E. N., O'Leary, R. M., Kuehn, M. J., Bloom, P. H., and Battistone, C. L. 2022. Rapid growth of the Swainson's Hawk population in California since 2005. *Ornithol. Appl.* 124:1–12; doi.org/10.1093/ornithapp/duac006.
- Gilmer, D. S., and Stewart, R. E. 1984. Swainson's Hawk nesting ecology in North Dakota. *Condor* 86:12–18; doi.org/10.2307/1367335.
- Grinnell, J., and A. H. Miller. 1944. The distribution of the birds of California. *Pac. Coast Avifauna* 27.
- Munz, P. A. 1974. *A Flora of Southern California*. Univ. Calif. Press, Berkeley; doi.org/10.1525/9780520338654.
- Olendorff, R. R. 1978. Population status of large raptors in northeastern Colorado, 1970–1972. *Raptor Res. Rep.* 3:185–205.
- Risebrough, R. W., Schlorff, R. W., Bloom, P. H., and Littrell, E. E. 1989. Investigations of the decline of Swainson's Hawk populations in California. *J. Raptor Res.* 23:63–71.
- Steenhof, K. 1987. Assessing raptor reproductive success and productivity, *in* *Raptor Management Techniques Manual* (B. A. Giron Pendleton, B. A. Millsap, K. W. Cline, and D. M. Bird, eds.), pp. 157–170. *Natl. Wildlife Fed.*, Washington, D.C..
- Stock, C. 1930. Rancho La Brea: A record of Pleistocene life in California. *Los Angeles County Mus. Nat. Hist. Sci. Ser.* 1.
- Templin, W. E., Phillips, S. P., Cherry, D. E., DeBortoli, M. L., et al. 1995. Land use and water use in the Antelope Valley, California. *Water-Resources Investigations Report* 94-4208. *U.S. Geol. Surv.*; <https://pubs.usgs.gov/wri/1994/4208/report.pdf>.
- Woodbridge, B. 1991. Habitat selection by nesting Swainson's Hawks: A hierarchical approach. Master's thesis, Ore. State Univ., Corvallis.
- Woodbridge, B., Finley, K. K., and Bloom, P. H. 1995. Reproductive performance, age structure, and natal dispersal of Swainson's Hawks in the Butte Valley, California. *J. Raptor Res.* 29:187–192.

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