

## Swainson's Hawk (*Buteo swainsoni*)

### Legal Status

*Federal:* Bird of Conservation Concern (USFWS 2002)

*State:* Threatened.



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*Global and State Conservation Status:* G5S2: Global Rank, G5 = Secure: Common; widespread and abundant; State Rank, S2 = Imperiled: Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

*Recovery Plan:* None.

### Species Description and Life History

Swainson's hawk (*Buteo swainsoni*) is a long-winged, medium-sized (48-56 cm [19-22 in] and 693-1367 g [24.46-48.26 ounces]) soaring raptor that nests and roosts in large trees in flat, open grassland or agricultural landscapes. Females average larger than males, but there are no distinguishing plumage characteristics for separating the sexes. Swainson's hawk is characterized by its long, narrow, and tapered wings held in flight in a slight dihedral shape. The body size is somewhat smaller, thinner, and less robust than other buteos, although the wings are at least as long as other buteos. This body and wing shape allows for efficient soaring flight and aerial maneuverability, important for foraging, which Swainson's hawks do primarily from the wing, and during courtship and inter-specific territorial interactions.

There are three definitive plumage morphs: light, rufous, and dark. However, there are numerous intermediate variations between these plumage morphs. The two most distinguishing plumage characteristics are a dark breast band and the contrasting darker flight feathers and lighter wing lings on the underwings giving most individuals a distinctive bicolored underwing pattern. These characteristics are most pronounced in lighter morph birds and become less so as the plumage darkens, and are indistinguishable in the definitive dark morph, which is completely melanistic. All three definitive plumage morphs are present in the Central Valley with a relatively large proportion of the population categorized as intermediate morph, with varying amounts of streaking or coloration in the belly and wing linings.

### *Seasonal Patterns*

Swainson's hawks arrive on their breeding grounds in the Central Valley from early March to early April. The breeding season extends through mid-to-late August, when most young have fledged and breeding territories are no longer defended. By late August pre-migratory groups begin to form. The fall migration begins early- to mid-September. By early October, most Swainson's hawks have migrated out of the Central Valley. Central Valley Swainson's hawks winter primarily in Central Mexico and, to a lesser extent, throughout portions of Central and South America (Bradbury *et al.* in preparation). This differs from what is known about the migratory pattern and wintering grounds of Swainson's hawk populations outside of the Central Valley, most of which take a different migratory route and winter entirely in southern South America, with the largest wintering populations known to occur in northern Argentina (England *et al.* 1997).

### *Reproduction*

Swainson's hawks exhibit a high degree of nest site fidelity, using the same nests, nest trees, or nesting stands for many years (England *et al.* 1997). Pairs are monogamous and may maintain bonds for many years (England *et al.* 1997). Immediately upon arrival onto breeding territories, breeding pairs begin constructing new nests or repairing old ones. One to four eggs are laid in mid- to late April followed by a 30 to 34 day incubation period. Nestlings begin to hatch by mid-May followed by an approximately 20-day brooding period. The young remain in the nest until they fledge in 38 to 42 days after hatching (England *et al.* 1997). Studies conducted in the Sacramento Valley indicate that one or two—and occasionally three—young typically fledge from successful nests (Estep in preparation). The rate of young fledged per nest in the Central Valley is among the lowest recorded in the entire species range. This geographic difference in reproductive success may be related to the reliance on small voles that may not meet the high energetic demands of breeding adults and developing young compared to the diets that include a higher proportion of gophers, rabbits, ground squirrels and other larger mammals consumed in other locations (S. England pers. comm.). In Yolo County, fledging rates ranged from 1.15 to 1.96 young per successful nest from 1988 to 2000 (Table 1) (Estep in prep.).

After fledging, young remain near the nest and are dependent on the adults for about 4 weeks, after which they permanently leave the breeding territory (Anderson *et al.* in progress).

### *Home Range/Territory Size*

Home ranges are highly variable depending on cover type, and fluctuate seasonally and annually with changes in vegetation structure (e.g., growth, harvest) (Estep 1989, Woodbridge 1991, Babcock 1995). Smaller home ranges consist of high percentages of alfalfa, fallow fields, and dry pastures (Estep 1989, Woodbridge 1991, Babcock 1995). Larger home ranges were associated with higher proportions of cover types with reduced

prey accessibility, such as orchards and vineyards, or reduced prey abundance, such as flooded rice fields. Swainson's hawks regularly forage across a very large landscape compared with most raptor species. Data from Estep (1989) and England *et al.* (1995) indicate that it remains energetically feasible for Swainson's hawks to successfully reproduce when food resources are limited around the nest and large foraging ranges are required. Radio-telemetry studies indicate that breeding adults in the Central Valley routinely forage as far as 30 km (18.7 mi) from the nest (Estep 1989, Babcock 1995).

Home ranges (calculated as minimum convex polygons) for 12 Swainson's hawks in the Central Valley, including six in Yolo County, averaged 27.6 km<sup>2</sup> (10.7 mi<sup>2</sup>) (range: 3.36 to 87.18 km<sup>2</sup> [1.3 to 33.7 mi<sup>2</sup>]) (Estep 1989). Using similar methods, four Swainson's hawks in West Sacramento averaged 40.5 km<sup>2</sup> (15.6 mi<sup>2</sup>) (range: 7.2 to 76.6 km<sup>2</sup> [2.8 to 29.6 mi<sup>2</sup>]), and included fields planted in grain, alfalfa, tomatoes, and safflower, as well as fallow fields (Babcock 1995).

Swainson's hawks in the central region of the Central Valley (including Yolo County) had the shortest distances between nests of those reported in England *et al.* (1997); on average, nests were 1.14 km (0.7 mi) apart (Estep 1989). Nesting density in the Central Valley was calculated at 30.2 pairs/100 km<sup>2</sup> (11.7 pairs/100 mi<sup>2</sup>) (range: 21.4 to 39.1 km<sup>2</sup>; [8.3 to 15.1 mi<sup>2</sup>]) (England *et al.* 1995). This high nest density was attributed to widely available, uniformly distributed optimal foraging habitat and relatively abundant nesting sites along narrow riparian corridors, farm shelterbelts, roadside trees, remnant groves, and isolated trees. Results from a 2007 baseline survey of nesting Swainson's hawks in Yolo County indicate a nesting density within the survey area (excluding the higher elevation portions of the county of 98 pairs/100 km<sup>2</sup> (37.8/100 mi<sup>2</sup>), the highest nesting density reported for this species (Estep Environmental Consulting 2008).

#### *Foraging Behavior and Diet*

Swainson's hawks hunt primarily from the wing, searching for prey from a low altitude soaring flight, 30 to 90 m (98.4 to 295.2 feet) above the ground and attack prey by stooping toward the ground (Estep 1989). This species is also highly responsive to farming activities that expose and concentrate prey, such as cultivating, harvesting, and disking. During these activities, particularly late in the season, Swainson's hawks will hunt behind tractors searching for exposed prey. Other activities, such as flood irrigation and burning, also expose prey and attract foraging Swainson's hawks.

In the Central Valley, Swainson's hawks feed primarily on small rodents, usually in large fields that support low vegetative cover (to provide access to the ground) and high densities of prey (Bechard 1982; Estep 1989). These habitats include hay fields, grain crops, certain row crops, and lightly grazed pasturelands. Fields lacking adequate prey populations (e.g., flooded rice fields) or those that are inaccessible to foraging birds (e.g., vineyards and orchards) are rarely used (Estep 1989; Babcock 1995, Swolsgard 2003).

Meadow vole (*Microtus californicus*) is the principal prey item taken by Swainson's Hawks in the Central Valley (Estep 1989). Pocket gopher (*Thomomys bottae*) is also an

important prey item. Other small rodents, including deer mouse (*Peromyscus californicus*) and house mouse (*Mus musculus*) are also taken along with a variety of small birds, reptiles, and insects.

During late summer, the diet of post-breeding adults and juveniles includes an increasing amount of insects, including grasshoppers and dragonflies. Dragonflies may constitute a major proportion of the diet of post-breeding and migrant birds. In the Central Valley during summer, dragonfly species that swarm in large numbers and that are a potentially important, abundant food source are common green darner (*Anax junius*), spot-winged glider (*Pantala hymenaea*), and wandering glider (*Pantala flavescens*). In alfalfa and corn crops in Idaho, post-breeding flocks also forage primarily on grasshoppers (Johnson *et al.* 1987). Dragonflies are also the primary prey for wintering birds in Argentina (Jaramillo 1993).

Following their arrival back on the breeding grounds, Swainson's hawks again shift their diet to include larger prey such as small rodents, rabbits, birds, and reptiles (England *et al.* 1997). This shift to a higher quality diet is prompted by the nestlings' nutritional demands during rapid growth and the adults' high energetic costs of breeding.

### **Habitat Requirements and Ecology**

#### *Nesting*

Throughout much of its range, both in North and South America, the Swainson's hawk inhabits grasslands, prairies, shrub-steppes, and agricultural landscapes—including dry and irrigated row crops, alfalfa and hay fields, pastures, and rangelands. They nest in trees most often in riparian woodlands and farm shelterbelts (England *et al.* 1997), as well as in urban/suburban areas with large trees adjacent to suitable foraging habitat (England *et al.* 1995, James 1992). Suitable nest trees are usually deciduous and tall (up to 30.48 m [100 feet]); but in suburban/urban areas, most nest trees are conifers (England *et al.* 1997, England *et al.* 1995). Nests are built of sticks sometimes several feet in diameter. They are generally placed in the uppermost and outermost branches that will support the nest, often in mistletoe clumps (England *et al.* 1997).

In the Central Valley, Swainson's hawks usually nest in large native trees such as valley oak (*Quercus lobata*), cottonwood (*Populus fremontii*), walnut (*Juglans hindsii*), and willow (*Salix* spp.), and occasionally in nonnative trees, such as eucalyptus (*Eucalyptus* spp.). Nests occur in riparian woodlands, roadside trees, trees along field borders, isolated trees, small groves, and on the edges of remnant oak woodlands. Stringers of remnant riparian forest along drainages contain the majority of known nests in the Central Valley (Estep 1984; Schlorff and Bloom 1984; England *et al.* 1997). However, this appears to be a function of nest tree availability rather than dependence on riparian forest. Nests are usually constructed as high as possible in the tree, providing protection to the nest as well as visibility from it.

Tables 1 and 2 indicate the nesting habitat results from the 2007 baseline survey (Estep Environmental Consulting 2008). Riparian habitat was the most frequently used nesting habitat type, followed by roadside tree rows, isolated trees, and rural residential trees. Valley oak (*Quercus lobata*) was the most frequently used nest tree species, followed by Fremont cottonwood (*Populus fremontii*), walnut (*Juglans hindsii*), willow (*Salix* spp.), and eucalyptus trees (*Eucalyptus* spp.).

**Table 1. Nesting Habitat Associations of Swainson's Hawk Territories in the Yolo County Study Area, 2007.**

Nesting Habitat Type	Number of Territories	Percent of Total
Riparian (natural)	106	36.6
Roadside Tree Row	39	13.4
Riparian (channelized)	36	12.4
Isolated Tree	32	11.0
Rural Residential	26	9.0
Tree Row	19	6.6
Isolated Roadside Tree	15	5.2
Eucalyptus Grove	6	2.1
Oak Grove	4	1.4
Urban	3	1.0
Cottonwood Grove	1	0.3
Savanna	1	0.3
Farmyard	1	0.3
Mixed Grove	1	0.3
Total	290	100

**Table 2. Nest Tree Species used by Nesting Swainson's Hawks in the Yolo County Study Area, 2007.**

Tree Species	Number of Active Nest Sites	Percent of Total
Valley Oak	101	35.7
Cottonwood	76	26.9
Walnut	33	11.7
Willow	32	11.3
Eucalyptus	26	9.2
Pine	7	2.5
Locust	4	1.4
Redwood	2	0.7
Sycamore	2	0.7
Total	283	100

*Foraging*

Swainson's hawks are essentially plains or open-country hunters, requiring large areas of open landscape for foraging. Historically, the species used the grasslands of the Central Valley and other inland valleys. With substantial conversion of these grasslands to farming operations, Swainson's hawks have shifted their nesting and foraging into those agricultural lands that provide low, open vegetation for hunting and high rodent prey populations.

Foraging habitat value is a function of patch size (i.e., Swainson's hawks are sensitive to fragmented landscapes; use will decline as suitable patch size decreases), prey accessibility (i.e., the ability of hawks to access prey depending on the vegetative structure), and prey availability (i.e., the abundance of prey populations in a field). In the Central Valley, agricultural land use or specific crop type determine the foraging value of a field at any given time. Cover types were evaluated by Estep (1989) and ranked based on these factors. However, suitability ranking is based on a variety of site-specific issues and at a landscape level should be characterized only on a general basis. On a site-specific level – important for land management purposes to maximize foraging value – individual cover types can be assessed based on site-specific and management conditions.

Important land cover or agricultural crops for foraging are alfalfa and other hay, grain and row crops, bare fallow fields, dryland pasture, and annual grasslands. The matrix of these cover types across a large area creates a dynamic foraging landscape as temporal changes in vegetation results in changing foraging patterns and foraging ranges.

Hay crops, particularly alfalfa, provide the highest value because of the low vegetation structure (high prey accessibility), relatively large prey populations (high prey availability), and because farming operations (e.g., weekly irrigation and monthly mowing during the growing season) enhances prey accessibility. Most row and grain crops are planted in winter or spring and have foraging value while the vegetation remains low, but become less suitable as vegetative cover and density increases. During harvest, vegetation cover is eliminated while prey populations are highest, significantly enhancing their suitability during this period. Some crop types, such as rice, orchards, and vineyards, provide little to no value because of reduced accessibility and relatively low prey populations.

**Species Distribution and Population Trends***Distribution*

In North America, Swainson's hawks nest in the grassland plains and agricultural regions from southern Canada (and possibly in the northern provinces and territories, and Alaska) to northern Mexico. Other than a few documented small wintering populations in the United States (Herzog 1996, England *et al.* 1997), the species winters primarily in the Pampas region of Argentina. The Central Valley population winters between Mexico and central South America (Bradbury *et al.* in preparation).

Early accounts described Swainson's hawk as one of the most common raptors in California, occurring throughout much of lowland the portions of the state (Sharp 1902). Since the mid-1800s, the native habitats that supported the species have undergone a gradual conversion to agricultural or urban uses. Today, native grassland habitats are virtually nonexistent in the state, and only remnants of the once vast riparian forests and oak woodlands still exist (Katibah 1983). While the species has successfully adapted to certain agricultural landscapes, this habitat loss has caused a substantial reduction in the breeding range and in the size of the breeding population in California (Bloom 1980; England et al. 1997) (Figure 4). Current breeding populations occur primarily in the Central Valley, but also in the Klamath Basin, the northeastern plateau, Owen's Valley, and rarely in the Antelope Valley (Grinnell and Miller 1944, Bloom 1980, Garrett and Dunn 1981). The bulk of the Central Valley population resides in Yolo, Sacramento, Solano, and San Joaquin Counties.

### *Population Trends*

Swainson's hawk populations have declined in California, Utah, Nevada, and Oregon (England *et al.* 1997). Populations in other western states are considered stable. Bloom (1980) reported a statewide estimate of 375 breeding pairs. This was followed by estimates of 550 (CDFG 1988) in the late 1980s and 800 to 1,000 breeding pairs in the late 1990s (Swainson's Hawk Technical Advisory Committee). However, none of these estimates was generated using a statistically-based statewide survey effort and would be considered less credible than the results of a more statistically valid approach. The most recent statewide population estimate for California is 2,081 breeding pairs (Anderson *et al. in preparation*) and is based on a statistically valid statewide survey effort conducted in 2005 and 2006. While this estimate is higher than the original statewide estimate that led to the state listing of the species (Bloom 1980) and subsequent estimates through the 1980s and 1990s, it cannot be reliably used to measure trends. It does, however, represent a substantial decline (50-90%) of the historic statewide breeding population in California (Bloom 1980).

### *Distribution and Population Trends in the Plan Area*

In Yolo County, the species is distributed throughout the low elevation agricultural region east of the Interior Coast Range. Closely associated with agricultural cover type, the distribution of the species generally follows the pattern of hay, grain, and row crops. The majority of nesting pairs occur from several miles north of Woodland south to Putah Creek, and east to the Sacramento River. Fewer pairs occur in the predominantly rice growing region in the northeastern portion of the county, in the orchard region in the northwest and southwest portions of the county, and the wetland-dominated areas of the southern panhandle. They generally avoid scrub, chaparral, savannah, or oak-dominated habitats in the western portion of the county. The highest nesting concentrations are north of Woodland to County Road 12, along oak and cottonwood-dominated riparian corridors such as Willow Slough, Putah Creek, and the Sacramento River, and between

Davis and Woodland, and west to approximately Interstate 505 and east to the Sacramento River (Estep Environmental Consulting 2008).

Baseline surveys conducted in 2007 located a total of 290 active breeding territories in Yolo County (Estep Environmental Consulting 2008). This was the first comprehensive baseline of this species in the county, and thus cannot be used to assess a trend in the number of breeding pairs in the county. However, based on the results of a long-term population study conducted in Yolo County since the mid-1980s (Estep in prep.), there appears to have been an upward trend in the number of breeding pairs (Table 3). While this may be at least partially attributed to increasing observer detection skill in the early years of the study, this local population appears to be at least stable with respect to the number of breeding pairs. Whether or not this population is stable based on productivity and recruitment is undetermined.

**Table 3. Swainson's Hawk Activity Data: Yolo County Study Area 1988-2000<sup>1</sup>.**

Year	Active Territories	Nesting Pairs	Successful Nests	Number of Young	Fledging Rate per Successful Nest
1988	55	48	46	62	1.34
1989	71	61	60	90	1.50
1990	85	72	70	118	1.69
1991	108	95	83	122	1.45
1992	122	110	94	136	1.45
1993	101	80	68	105	1.54
1994	137	128	110	188	1.70
1995	140	110	83	110	1.33
1996	139	101	75	107	1.43
1997	125	78	66	92	1.39
1998	158	103	27	31	1.15
1999	131	127	71	139	1.96
2000	136	126	69	102	1.48

<sup>1</sup>From Estep, J.A. In preparation. Ecology of the Swainson's Hawk in the Central Valley of California.

### Threats to the Species and Other Conservation Issues

Swainson's hawks face different threats in different portions of their range. In California, causes of population decline are thought to be loss of nesting habitat (Schlorff and Bloom 1984) and loss of foraging habitat to urban development and to conversion to unsuitable agriculture, such as orchards and vineyards (England *et al.* 1997, England *et al.* 1995). Nestlings are vulnerable to starvation and fratricide (i.e., the larger nestling killing the smaller nestling in times of food-stress); predation from crows, ravens, and other raptors cause significant nestling losses. Natural population cycles of voles in central California may be a major factor in reproductive success where vole population crashes suppresses reproduction or leads to increased starvation rates of nestlings (J. Estep pers. comm.). In addition, insecticides and rodenticides may contribute to these rates by reducing prey abundance. There is little evidence that adult Swainson's hawks are killed by natural

predators, but collisions with moving vehicles and illegal shooting and trapping have been identified as sources of mortality (England et al. 1997).

Well documented mass poisoning of hundreds or thousands of Swainson's hawks wintering in Argentina (Woodbridge *et al.* 1995, Goldstein *et al.* 1996) have led to that country's ban of an insecticide (organophosphate monocrotophos) used on alfalfa and sunflower fields to control grasshopper populations. Levels of DDE in Swainson's Hawks from the Central Valley may have been high enough to negatively affect reproductive success during the decades when it was used extensively in the United States. However, levels of DDE measured in eggs collected in 1982–1983 were not considered high enough to indicate a health threat (Risebrough *et al.* 1989).

Where populations are limited by inadequate nesting and foraging habitat, the most effective approach for Swainson's hawk conservation may be in management of agricultural landscapes (Smallwood 1995). Nesting density is greatest in cultivated areas where tree density (Schmutz 1984) and prey availability (Bechard 1982) are highest. Alfalfa fields are among the more valuable foraging habitats in California, even when compared with non-agricultural areas. However, valuable prey species such as pocket gophers (*Thomomys* spp.) and other small mammals may be exterminated in such fields (Smallwood 1995). While agricultural areas may benefit these hawks, fully realizing the conservation potential of cultivated areas to Swainson's hawks will be impaired when prey populations are controlled by means of poisons. Maintenance of critical prey populations is necessary to attain the full benefits of alfalfa fields and other agricultural crops to Swainson's hawks (Smallwood 1995).

In contrast to some agricultural landscapes, Swainson's hawks are absent from or are in very low densities in large expanses of annual grasslands in the Central Valley (Detrich 1996 cited in Woodbridge 1998). These grasslands have high densities of nocturnal, burrowing rodents that are rarely available as prey to Swainson's hawks and have low densities of voles (*Microtus* spp.) and pocket gophers that the hawks prefer (Woodbridge 1998). Because voles are active during the day and live among vegetation, they are especially accessible and important prey for hawks. Restoring perennial grasslands and promoting agriculture that supports high densities of voles and pocket gophers would create or enhance foraging habitat and could potentially expand Swainson's hawk distribution in Yolo County.

Many populations of prey species, especially voles, mice and insects, fluctuate due to annual, seasonal, and local geographic variations in rainfall, predation pressures, natural population cycles, and agricultural practices—including changing crop types, harvesting, applying rodenticides and insecticides, flood irrigating, and discing. The timing of harvesting and discing also strongly affects prey abundance (Woodbridge 1998). The importance of crop types for foraging habitat rest on two variables: abundance of voles and other important prey, and amount of vegetative cover that affects access to prey. Alfalfa is an important habitat because although it supports lower populations of voles, the amount of vegetative cover is not sufficient to provide much protection to voles from foraging hawks (Woodbridge 1998). Tomato and beets fields, in contrast, support high

populations of voles, but their higher vegetative cover provides better protection for voles, thereby decreasing those habitats' value (Woodbridge 1998). Furthermore, as crops mature, their protective cover for rodents increases, making prey less available to hawks (Bechard 1982). In agricultural landscapes, prey abundance and accessibility to hawks continuously change through the breeding season. All of these factors play major roles in reproductive success (J. Estep pers. comm.). To reduce negative effects on regional populations, large areas of optimal foraging habitats should be preserved or managed for populations of Swainson's hawks and their prey (CDFG 1994). Better understanding of the dynamics and processes of how agricultural practices affect these populations on a landscape level would help to guide conservation planning.

In areas with suitable foraging habitat that lack Swainson's hawks, surveys of potential nest trees should be conducted to assess whether the hawk population is limited by lack of suitable nest trees. Also, the relationship between Swainson's hawks and locally breeding red-shouldered hawks, red-tailed hawks, and great horned owls should be studied to determine whether competition for nest trees and prey are negatively affecting the Swainson's hawk population or distribution in Yolo County.

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