State of California
Department of Fish and Game

Memorandum

Date: April 11, 2016

To: Michael Yaun, Acting Executive Director
Fish and Game Commission

From: Charlton H. Bonham
Director

Subject: Five Year Status Review for Swainson's Hawk (*Buteo swainsoni*)

Attached is the Five Year Status Review for Swainson's Hawk (*Buteo swainsoni*). This Status Review updates descriptions, habitat requirements, threats, research needs, etc., for this species. The Status Review recommends retaining this species as Threatened.

The Swainson's hawk was listed as a threatened species by the California Fish and Game Commission in 1983, pursuant to the CESA (Title 14, California Code of Regulations, §670.5(b)(5)(A)). According to FGC Section 2077, the Department is required to reevaluate Threatened and Endangered species every 5 years by developing a Status Review. The last status review for the Swainson's Hawk was completed in 1993. This status review was prepared to satisfy several management and reporting objectives including Section 2077.

If you have any questions regarding this item, please contact Dr. Eric Loft, Chief, Wildlife Branch, at (916) 445-3555.

Attachment

ec: Eric Loft, Ph.D., Chief
Wildlife Branch
eric.loft@wildlife.ca.gov

Stafford Lehr, Acting Deputy Director
Wildlife and Fisheries Division
stafford.lehr@wildlife.ca.gov

CALIFORNIA DEPARTMENT OF
FISH AND WILDLIFE
WILDLIFE AND FISHERIES DIVISION
NONGAME WILDLIFE PROGRAM
1812 Ninth Street
Sacramento, California 95814

Status Review:
SWAINSON'S HAWK (*Buteo swainsoni*)

IN CALIFORNIA

Reported to:

California Fish and Game Commission

2016

FIVE-YEAR STATUS REPORT

Table of Contents

I. COMMON NAME, SCEINTIFIC NAME AND CLASSIFICATION

Common Name: Swainson's Hawk

Scientific Name: *Buteo swainsoni*

Current Classification: State Threatened

II. RECOMMENDED ACTION

The California Department of Fish and Wildlife (Department) recommends that Swainson's Hawk retain threatened status under the California Endangered Species Act.

III. SUMMARY OF REASONS FOR RECOMMENDED ACTION

The Swainson's Hawk was listed as a threatened species by the California Fish and Game Commission in 1983, pursuant to the California Endangered Species Act (CESA; Title 14, California Code of Regulations, §670.5(b)(5)(A)). The last status review was completed in 1993 (California Department of Fish and Game 1993). Timely 5-year status reviews have not been possible due to budget, staff, and workload priorities.

The primary threat to the Swainson's Hawk population in California continues to be habitat loss, especially the loss of suitable foraging habitat, but also nesting habitat in some portions of the species' breeding range due to urban development and incompatible agriculture. This impact may have been the greatest factor in reducing Swainson's Hawk range and abundance in California over the last century (California Department of Fish and Game 1993, California Department of Conservation 2011).

Urban development continues to reduce Swainson's Hawk foraging habitat in the Central Valley, particularly in the southern Sacramento Valley (California Department of Conservation 2011). Swainson's Hawk densities are the greatest in this portion of their range, particularly in Sacramento, Yolo, and San Joaquin Counties (see Figure 2). While the Swainson's Hawk is a focus of planning efforts, current General Plans within Sacramento and San Joaquin counties contain goals of converting large areas of natural and agricultural lands that contain suitable Swainson's Hawk foraging habitat to urban features that do not provide foraging habitat (Sacramento County 2011, San Joaquin County 1992). San Joaquin County, however, does have in place an approved Habitat Conservation Plan under which Swainson's Hawk preservation is a major emphasis. In Yolo County, one of the densest areas of hawk territories in the State, current policies focus on preserving both agriculture and Swainson's Hawk foraging habitat. Current efforts under the developing Yolo County Natural Heritage Program (http://www.yolohabitatconservancy.org/) are aimed at maintaining this focus into the

future, thereby potentially lessening the long-term impacts to the species once the plan is approved and implemented.

Agricultural cropping patterns directly influence the distribution and abundance of the Swainson's Hawk in the Central Valley (Estep 1989). Swainson's Hawks can forage in natural grasslands, pasture, hay crops, and some irrigated crops but do not preferentially forage in other agricultural crops such as orchards and vineyards once these crops develop their typical canopy (Estep 2009, Swolgaard et al. 2008). This dependence on land use patterns poses a continuing vulnerability for a large percentage of the remaining population based on current trends toward cultivation of largely incompatible crop-types such as orchards and vineyards (California Department of Conservation Agricultural Land Mapping 2010). Compatible crop types do, however, provide a very important benefit to the species (Estep 2008). The lack of suitable nesting habitat throughout much of the San Joaquin Valley, due to conversion of riparian systems and woodland communities to agriculture, also limits the distribution and abundance of Swainson's Hawks (California Department of Fish and Game 1993). The loss of historic sage-steppe/grassland foraging habitat may also be a significant factor in a continuing decline of Swainson's Hawks in portions of the Great Basin and Mojave Desert regions of the state (California Department of Fish and Game 1993). Disturbances on the hawk's Mexican and South American wintering grounds, or during migration, may also contribute to population declines (Goldstein et al. 1996, Sarasola et al. 2005).

At this time, the Department recommends retaining the Threatened classification for this species based on the following:

- On-going cumulative loss of foraging habitats throughout California
- Significantly reduced abundance throughout much of the breeding range compared to historic estimates
- An overall reduction in the hawk's breeding range in California

IV. SPECIES DESCRIPTION AND BIOLOGY

The Swainson's Hawk is a medium-sized raptor with relatively long, pointed wings that curve up while in flight (California Department of Fish and Game 1993). There are three main plumage morphological types: light, rufous, and dark, with several intermediates (Woodbridge 1985). Light morph adults have dark heads, a light chin, and a dark breast band, set off distinctively from the lighter colored belly. In dark morph adults, however, the entire body of the bird may be a drake brown to sooty black. The cere (the fleshy region at the base of the upper bill) is bright yellow and set off distinctively from the dark head. The throat is white or partially white in dark morph adults and the wings are bicolored underneath, with the wing linings generally lighter than the dark, and with gray flight feathers. The light colored leading edge of the wing is a diagnostic feature. Juveniles have the same characteristic underwing markings; however there is more spotting and streaks on the breast and sides than adults (Bechard et al. 2010). Adults generally weigh from 550 to 1100 grams (19 to 39 oz); females, which range between 650 and 1100 grams (23 to 39 oz), are heavier than males, which range from 550 to 850

grams (19 to 30 oz) (Anderson pers. comm. 2012, Bradbury pers. comm. 2012, Estep pers. comm. 2012). Butte Valley hawks in northeastern California seem to be slightly larger than in other areas of the state, with females from 880 to 1300 grams, and males from 620 to 970 grams (Briggs pers. comm. 2012).

The Swainson's Hawk was historically a species adapted to open grasslands and prairies, but it has become increasingly dependent on agriculture as native plant communities have been converted to agricultural lands (California Department of Fish and Game 1993). This bird also forages in large numbers in managed wetlands during the dry summer months when the vegetation in these wetlands is being mowed or disced (Feliz pers. comm. 2012). The diet of the Central Valley population is varied. The California vole (*Microtus californicus*) is the staple of the diet; however, a variety of other small mammals, birds, and insects are also taken (Estep 1989).

The Swainson's Hawk breeds in the western United States, and Canada (California Department of Fish and Game 1993). Its winter range occurs in isolated areas of California, Mexico and Central America, through South America and as far south as Argentina (Bechard et al. 2010, Kochert et al. 2011). Generally the Swainson's Hawk is found in wintering areas from early November through mid-March (England et al. 1997, Kochert et al. 2011, Bradbury pers. comm. 2012). In 1997, six Swainson's Hawks from the Central Valley were fitted with satellite transmitters and tracked to determine routes of migration and the locations of wintering areas (Bechard et al. 2010). Central Valley birds were located wintering in a region north of Mexico City, Mexico, and near Bogota, Colombia (England et al. 1997), although a hawk from northeastern California was tracked to Argentina during the winter of 1996 (Feliz pers. comm. 2012). One unpublished telemetry study found that Central Valley hawks mostly winter in Central Mexico, but some also end up in central and northern South America (Anderson pers. comm. 2014). A current telemetry study on hawk in the Natomas area of California, has tracked several birds (N= 2 to 4) to Argentina, while the remaining birds went to northern South America, Central America, and Mexico (Anderson pers. comm. 2014). After their long migration north, Swainson's Hawks arrive at their breeding sites in the Central Valley between March and April (Bechard et al. 2010).

Swainson's Hawks are generally monogamous, with some undocumented cases of polyandry (Briggs pers. comm. 2012), and show a high degree of site fidelity by returning to the same territory year after year (England et al. 1997, Bechard et al. 2010). Breeding pairs begin to build nests soon after they arrive at their territory, and lay eggs between late-March to early-April (England et al. 1997, Bradbury pers. comm. 2012). Clutch size is between 1 and 4 eggs, but most often 2 or 3 eggs are laid (Bechard et al. 2010). The incubation period lasts 34-35 days (Bechard et al. 2010). The young typically fledge from the nest about 6 weeks after hatching, but may leave the nest as early as 5 weeks old and remain on nearby branches (Bradbury pers. comm. 2012). Craighead and Craighead (1956) reported fledging success of 0.6 young per pair. Studies conducted in the Sacramento Valley reported an average of 1.4 to 1.8 young per successful nest (Estep 2008). In the Butte Valley, Briggs (2007) found productivity to be at 2.01 fledged young per successful breeding attempt. Throughout California, most young have fledged by

mid- to late-August, at which point pre-migratory groups begin to form (Bechard et al. 2010). In the Central Valley most young fledge during the first part of July (Bradbury pers. comm. 2012). Migration back to the wintering grounds begins mid-August, and by October most hawks have left California (Kochert et al. 2011).

Several studies on breeding home range have been conducted on California's Swainson's Hawk population. In the Central Valley, home range size varies from 2760 to 4038 ha, with a relatively smaller home range size of 405 ha found in the Butte Valley (Table 1). Home range size is thought to be related to quality of, and distance to foraging habitat (Estep 1989, Babcock 1995, Bechard et al. 2010).

Home Range Size (ha)	Area	Reference
2760.4	Central Valley	Estep 1989
405	Butte Valley	Woodbridge 1991
4038.4	Central Valley	Babcock 1995
3265.4	Central Valley	Sernke 1999

Table 1. Home range for the Swainson's Hawk in California.

Swainson's Hawks in the Central Valley often nest at the periphery of riparian forests or in riparian corridors where they have greater access to foraging areas, but virtually any suitable tree may be used (Estep 1989, England et al. 1995, Bechard et al. 2010). Hawks will also use lone trees in agricultural fields or pastures, and roadside trees when they are adjacent to suitable foraging habitat (Estep 1989, Anderson et al. 2007). Estep (1989) found Valley oak (*Quercus lobata*), Fremont cottonwood (*Populus fremontii*), walnut (*Juglans sp.*), and willow (*Salix* sp.) are the most commonly used nest-tree species, with an average height ranging from 12.6 to 25 m (41.3 to 82.0 ft), Similarly, Anderson et al. (2007) found Valley oak, cottonwood, willow and *Eucalyptus* spp. were more frequently used, with an average height between 14.8 to 16.2 m (48.6 to 53.1 ft).

In the Great Basin, Swainson's Hawks occupy the juniper/sagebrush community typical of the area; however, much of the lowlands have been converted to agriculture (Bloom 1980, Woodbridge et al. 1995). Junipers (*Juniperus occidentalis*), with an average height of 4.6 m (15.0 ft), are most commonly used as nest trees in the Great Basin (California Department of Fish and Game 1993). The diet of the Great Basin population consists largely of montane meadow voles (*Microtus montanus*) and Belding's ground squirrels (*Spermophilus beldingi*) (California Department of Fish and Game 1993).

Other areas in California inhabited by small populations of Swainson's Hawk include the isolated desert areas in the Mojave National Preserve regions of the western Mojave Desert, the greater Antelope Valley near Lancaster, and in the Owen's Valley along the eastern edge of the Sierra Nevada (see Figure 2). Joshua tree (*Yucca brevifolia*), ornamental trees, and lone trees along roadsides or on private property are commonly used as nest trees in these regions (Bloom 1980).

V. HABITAT REQUIREMENTS

Large open areas of suitable foraging habitat with abundant and available prey base in association with suitable nesting habitat are basic requirements for the successful reproduction of Swainson's Hawk (Estep 1989). Historically, the natural foraging habitat of the Swainson's Hawk was primarily open stands of grass-dominated vegetation and relatively sparse shrublands (Bloom 1980, Bechard et al. 2010). However, much of the original foraging habitat in California has been converted to either urban landscapes or agricultural production. Consequently, the Swainson's Hawk has shifted its foraging strategy to rely more heavily on agricultural crops (Bloom 1980, Estep 2009).

Today, suitable foraging habitat includes a variety of agriculture crops, grassland, and pasture. In the Central Valley, Swainson's Hawks forage more often in mixed agricultural lands that support irrigated hay crops (e.g. alfalfa), as well as dryland pasture, grassy ruderal lots, and some irrigated crops, due to a higher accessibility and relative abundance of prey (Bloom 1980, Estep 1989, Babcock 1995, Smallwood 1995, Swolgaard et al. 2008, Anderson et al. 2011). Alfalfa fields are more routinely used by foraging Swainson's Hawks than any other crop type (Bloom 1980, Woodbridge 1985, Estep 1989, Babcock 1995, Sernka 1999, Swolgaard et al. 2008, Anderson et al. 2011). Anderson et al. (2011) reported that 63% of observed foraging occurred in alfalfa.

The ability of the hawk to use agricultural crops for foraging is dependent on a complex interaction of crop structure and the timing of agricultural practices (Bechard 1982, Schmutz 1987, Estep1989, Woodbridge 1991, Smallwood 1995, Sernka 1999, Estep 2009). Prey species may be displaced during irrigation, burning, and harvesting activities, which often allows for ample foraging opportunities for Swainson's Hawks and other predators (Sernka 1999). The availability of prey is also largely dependent on the crop structure. Certain crops provide improved foraging opportunities for Swainson's Hawks due to high prey numbers, low vegetation structure, and favorable farming practices (e.g. mowing, irrigating; Estep 1989, Babcock 1995, Sernka 1999, Swolgaard et al. 2008, Estep 2008, Estep 2009). Some crops and managed wetlands are useful in foraging for a period after harvest, but may remain relatively unavailable in other periods of crop growth; likewise, other crops are available early in the season when a less dense vegetative structure and shorter height allows for access to prey (England pers. comm. 2012, Feliz pers. comm. 2012).

In a report to the Yolo Natural Heritage Program, Estep (2009) described the relative value (low to high) of vegetative structure and accessibility of different agricultural crop types in Yolo County to foraging Swainson's Hawk. Based on two main components, prey accessibility and prey availability, Estep (pers. comm. 2012) places high value on alfalfa, and on wheat, tomatoes, and beets during harvest; moderate value on irrigated and non-irrigated pasture, grasslands, and some other annually rotated crops; low value safflower, sunflower, corn and rice; and little to no value on orchards and vineyards. The variety of habitats used for foraging by this hawk suggests that maintenance of large heterogeneous areas of agricultural habitats and grasslands, which include a high

percentage of alfalfa, should be a priority for conservation of the species (Swolgaard et al. 2008, Estep 2009, Anderson et al. 2011).

Unsuitable or low value foraging habitat includes any habitat which does not support adequate prey abundance, as well as any habitat in which prey are inaccessible to foraging hawks due to vegetation characteristics (e.g. vineyards, mature orchards, cotton fields, dense or tall vegetation). For example, orchards and vineyards in general are not suitable foraging habitat for Swainson's Hawk due to the dense woody cover making prey unavailable (Estep 1989, Babcock 1995). In a study to ascertain the extent of vineyard use by Swainson's Hawk in the Central Valley, Swolgaard et al. (2008) observed relatively low foraging levels in vineyards and stated that "large contiguous areas of vineyards are likely unsuitable for foraging by Swainson's Hawk at a population level."

Suitable nesting habitat includes trees within mature riparian forest or corridors, lone oak trees and oak groves, and mature roadside trees. It is thought that trees on the periphery of riparian habitat are preferred by Swainson's Hawk (Estep 1989, England et al. 1995, Bechard et al. 2010). The majority of documented Swainson's Hawk nest trees in the Central Valley have been found in riparian systems in Sacramento, Sutter, Yolo, and San Joaquin counties, making this habitat type critically important (Schlorff and Bloom 1983). This is likely the case for nesting hawks in the San Joaquin Valley as well; however the hawks that regularly nest here have not been extensively studied. A portion of the Swainson's Hawk population also resides in the Great Basin of Northeastern California where hawks typically nest in juniper trees (Bloom 1980). Swainson's Hawks have been observed in several studies to select nest sites in greater densities when near large tracts of agricultural lands than when adjacent to non-agricultural lands (e.g. urban, annual grassland, or even vernal pool landscapes; Bloom 1980; Estep 1989; Babcock 1995; Smallwood 1995; Swolgaard et al. 2008). Data collected during Department Swainson's Hawk nest surveys in 2002 through 2009 indicated that nests were clumped at higher densities in mixed agricultural landscapes (Gifford et al. 2012). Nest sites are generally adjacent to, or within easy flying distance to suitable foraging habitat that provides available prey resources (England et al. 1995). The Swainson's Hawk is also known to nest within urban environments, such as Davis, Stockton and Sacramento, California; however, what is known about these nesting pairs is largely anecdotal as there have been no focused studies on these hawks.

Wintering habitat in California is less critical for Swainson's Hawk because only a small number of hawks have been documented to over winter in California (Herzog 1996; Anderson pers. comm. 2012; eBird 2012). In the Central Valley Delta region, overwintering hawks have been documented to roost in numbers of 10 to 30 individuals, mostly comprised of adults and some juveniles, in large cottonwoods or eucalyptus trees (Anderson pers. comm. 2012). During the day these hawks disperse on the nearby landscape to forage either individually or in groups with red-tailed hawks, Ferruginous hawks, rough-legged hawks, corvid species, and other raptors. It is unknown where these wintering birds originated (Anderson pers. comm. 2012).

During the breeding season and just prior to their annual fall migration period, Swainson's Hawk in California often congregate in groups from 5 up to 100+ individuals (Anderson pers. comm. 2012). Foraging often occurs during congregation, but communal roosting may also take place. Congregations during the breeding season happen nearer nesting sites and groups will sometimes form during any portion of the nesting cycle (nest building to fledgling care). Late summer-fall congregations may occur during delayed migration periods lasting up to three months starting in early August through late October. These congregation areas can occur anywhere there is food available, but are typically associated with alfalfa, other hay crops, and various row crops (excluding orchards and vineyards) that have been recently mowed, disced, harvested or irrigated (Anderson pers. comm. 2012). Support for practices that provide for these critical breeding and pre-migration congregation areas is an important conservation need.

VI. NATURE AND DEGREE OF THREAT

Foraging Habitat Conversion to Urban and Non-Suitable Habitat

Fragmentation of habitat has been observed to adversely affect long-term viability of animal populations, and can be defined as dissection of habitat into smaller portions that does not allow free movement of individuals (Fahrig 2003). Habitat fragmentation has two components, both of which contribute significantly to, and may even cause, extinctions for some species: (1) reduction in total habitat area, and (2) redistribution of the remaining area into disjunct fragments (Wilcove et al. 1986).

Significant loss of agricultural lands and foraging habitat has occurred in counties within the Sacramento and San Joaquin valleys due to urban development. According to the State of California's 2008-2010 California Farmland Conversion Report (California Department of Conservation 2014), Southern California and San Joaquin Valley counties were included in the "top ten list" of California counties with the most acres converted from farmland to urban land. Irrigated farmland was the source of 25 percent of all new urban land statewide, with another 30 percent of new urban land derived from dryland farming and grazing uses, and 45 percent from natural vegetation or vacant lands. Direct conversion of irrigated farmland to urban land was 25 percent of total new urban growth for both the Sacramento and San Joaquin valleys. Land idling was the most prevalent in the southern San Joaquin Valley and counties in the Sacramento-San Joaquin Delta. If current trends in habitat conversion of compatible agriculture to urban development continue, the Swainson's Hawk population will likely experience reduced foraging opportunities, which may result in a further reduction in the species' range, distribution, and abundance.

Native foraging habitat in the lowland areas of the Great Basin also has been converted to agricultural land (Bloom 1980). The smaller Great Basin Swainson's Hawk population, while not subject to the same urban development pressures as the Central Valley population, is becoming more dependent on the agricultural system of the region to provide suitable foraging habitat (California Department of Fish and Game 1993). As

agricultural conversion continues to replace native habitat, the suitability of crop-types could determine the level of Swainson's Hawk foraging use. Ultimately the distribution of crops dictates the distribution and abundance of Swainson's Hawks in the Great Basin as it does in the Central Valley (California Department of Fish and Game 1993).

There has been a steady decline in active Swainson's Hawk territories occupying rangeland habitat in the Great Basin region of the state. Overgrazing and fire suppression have caused an increase in juniper forest and sagebrush communities (Miller and Rose 1999, Miller et al. 2001). The Swainson's Hawk decline in this area may have been a result of the increase in juniper/sage habitat at the expense of sage-steppe/grassland communities. Replacement of sage-steppe/grassland with juniper/sage habitats results in a reduction of microtine rodents and ground squirrels, the principal prey of the Swainson's Hawk in the Great Basin (California Department of Fish and Game 1993). While Swainson's Hawks have steadily declined in rangeland habitats of the Great Basin, there has been an apparent increase in breeding pairs utilizing agricultural foraging habitats such as alfalfa fields, largely due to greater prey densities and availability of prey in these areas (California Department of Fish and Game 1993).

Habitat Conversion to Vineyards and Orchards

Vineyards and orchards are considered low value foraging habitat for Swainson's Hawk because of low prey density and vegetation structure which prevents hawks from stooping on prey (Estep 1989, Smallwood 1995). Statewide, wine grape acreage has approximately doubled since 1990 (California Department of Conservation Agricultural Land Mapping 2010). Conversion of undeveloped land to vineyards involves the clearing of native upland and riparian vegetation. This type of conversion has the potential to affect Swainson's Hawk breeding and foraging habitat.

The 2008-2010 California Farmland Conversion Report (California Department of Conservation 2014) states that while urbanization is a leading component of agricultural land conversion throughout the state, economic and resource availability factors (i.e. water) also lead to conversion to more intensive agricultural uses, including orchards and vineyards. Conversion from grasslands to orchards, mainly almonds, was the most widespread form of conversion in 2010, with the Sacramento Valley having more conversions to high density olive orchards. Again, if conversion of compatible foraging habitat to non-habit continues, the Swainson's Hawk population in California will likely be impacted.

Breeding Habitat Conversion

Swainson's Hawks are not exclusively or predominately associated with nests in riparian areas, although a significant portion of the known nesting population in the Sacramento and San Joaquin Valleys occur in riparian areas (Bloom 1980, Estep 1989). Loss of suitable breeding habitat through conversion of riparian and woodland habitat to agriculture and unsuitable urban environments is a concern for breeding Swainson's Hawks across California, particularly in the San Joaquin Valley where suitable nest trees

are in lower abundance. Loss of lone trees along roadsides to road maintenance and construction may also impact breeding Swainson's Hawks as many of these trees are in proximity to suitable foraging habitat and are often used by Swainson's Hawks.

Implementation of levee vegetation removal policies could result in significant impacts to Central Valley Swainson's Hawk populations as a large portion of suitable nesting habitat may be removed. In April 2010, the Department's Director and the Department of Water Resources wrote a letter to the U.S. Army Corps of Engineers (Corps; DWR and CDFW 2010) expressing concern over the Corps' issuance and use of a new levee vegetation removal policy (USACE ETL 1110-2-571), and stating that "the proposed vegetation policy will likely have devastating environmental impacts, as the remnants of the once vast riparian forests and adjacent riverine ecosystems of the Central Valley are now concentrated on the banks and levees of its flood channels".

Climate Change

Climate change adds unpredictability to the existing suitable breeding and foraging habitats and could cause additional stress on Swainson's Hawk populations. These impacts, both to suitable habitats and to populations, can be generally anticipated based on current climate research. However, the level of these impacts is impossible to predict with accuracy or precision. Most climate projection studies agree that California will retain its typical Mediterranean climate (i.e. cool, wet winters and hot, dry summers), yet the degree of wetness/dryness will likely be amplified and vary by location across California (Pierce et al. 2011, Cayan et al. 2012,). Impacts may include increased winter runoff and flooding (with possible impacts to riparian nesting habitat) and sea level rise (with possible inundation of low-lying nesting or foraging habitat), more frequent extreme temperature events, and less snowpack (Pierce et al. 2011, Cayan et al. 2012).

Limited water availability in the summertime may significantly reduce the supply of water and therefore reduce prevalence of alfalfa and other high-quality foraging habitat. In addition, drought conditions associated with long-term changes in precipitation may negatively impact prey abundance (CDFW 2016), and consequently impact breeding success and survival of Swainson's Hawks.

The 2006 Executive Order S-06-06 calls for the increased production and use of bioenergy, including ethanol and biodiesel fuels made from renewable resources, largely comprised of corn. The market price for energy crops could result in farmers shifting to those crops that do not provide high value habitat to the Swainson's Hawk. For example, one study looking at agriculture impacts of climate change in Yolo County predicts that crops with high water utilization, such as alfalfa, are likely to become more scarce on the landscape in the future if water availability declines, and crops with a higher cash value per unit of water, such as vegetables, fruits and nuts will become more common (Jackson et al. 2009). Other potential indirect impacts may come from practices aimed at mitigating climate change. The future agricultural landscape could change from the existing mosaic of crops to grasses that can be used for carbon sequestration. Changing crop types to those less frequently irrigated and harvested, or those that would store

carbon for a longer time period could still provide habitat, but research is needed to understand the potential scale of the changes and how that could affect the range and reproductive success of the Swainson's Hawk (Bradbury 2009).

Renewable Energy Facilities

Wind energy project areas contribute to direct mortality of Swainson's Hawk through turbine strikes, particularly where wind resource areas overlap with hawk foraging areas. Swainson's Hawk mortality from wind turbines has been documented by Kingsley and Whittam (2001). The Solano County Wind Resource Area, which overlaps with the range of Central Valley Swainson's Hawks, has one of the highest raptor abundances of California's wind resource areas and initial studies show substantial numbers of bird and bat mortalities related to wind development. Birds most susceptible to this source of mortality are those that fly at or below the maximum blade height of wind turbines, particularly while hunting (Orloff and Flannery 1992), as is the case with Swainson's Hawks.

Disease

There have been some documented cases of Swainson's Hawk having experienced West Nile Virus (WNV) mortality. One Swainson's Hawk has been reported to test positive for WNV in California (reported in South Lake Tahoe area, but thought to have been brought from Mono County; Center for Disease Control and Prevention database), and another was confirmed positive by the Department's Wildlife Investigation Laboratory in 2015 from Contra Costa County (Rogers pers. comm. 2015). Eleven Swainson's Hawks were found dead with WNV infection in the USA from 1999 to 2004 (Nemeth et al. 2006). However, the extent of vulnerability WNV presents to the Swainson's Hawk is unknown at this time. Increased levels of WNV in California populations could exacerbate the effects of other threats on this species.

Contaminants

Insecticides are responsible for high mortality rates in hawks that migrate to Argentina. Prior to northerly migration, when flocks feed on insects in nearby harvested agriculture fields, several large-scale mortality events of Swainson's Hawks (>1000's found dead) were reported in Argentina due to applications of organophosphate and carbamate insecticides in agricultural fields (Goldstein et al. 1996). However, many of the birds that breed in California winter in Mexico, where the timing of pesticide applications poses less of a threat. Therefore, the importance of this factor for California's breeding hawks is unclear.

Application of anticoagulant rodenticide (AR) is a known threat to raptors due to ingestion of poisoned prey. Numerous field monitoring studies on raptor species indicate lethal and sublethal impacts of AR exposure (Stone et al. 2003, Murray 2011, Thomas et al. 2011, Christensen et al. 2012). Pesticide use throughout the Swainson's Hawk's range, specifically targeting ground squirrels, may also impact Swainson's Hawks and cause

secondary poisoning. In 2015, the Department's Wildlife Investigation Laboratory confirmed two AR exposures for Swainson's Hawks, both from Contra Costa County, with the cause of death in one due to AR toxicosis (Rogers pers. comm. 2015). Although the evidence indicates raptors are negatively affected by pesticide use, further research is needed to determine what extent Swainson's Hawks also incur these same impacts.

Other Direct Mortality Agents

Swainson's Hawk mortality is reported occasionally in California. Direct mortality of birds can be due to several actions as also described elsewhere in this document, including trimming of nest trees (typically due to construction or utility maintenance activities), shooting, vehicle collisions, electrocution, or pesticides. Biologists have only occasionally found shot or electrocuted Swainson's Hawks.

Stochastic Events

A mass mortality event of wintering Swainson's Hawk was observed in Argentina during November of 2003 when 113 Swainson's Hawks were found dead as a result of a single hailstorm (Sarasola et al. 2005). In addition, 14 hawks with severe injuries were recovered alive, but only 10 of these survived. Another 45 dead birds of 11 species were collected in the area. Interviews with local landowners conducted in other areas of these wintering grounds provided further evidence of past hailstorm-related mortality involving the hawk, suggesting that such events commonly occur in the Argentine Pampas. This potential cause of mass mortality of Swainson's Hawk wintering in agricultural areas of Argentina may be significant when added to the increased mortality associated with poisoning events during the last decade. Even though California's Central Valley Swainson's Hawk population is known to largely over-winter in Mexico, the Central Valley population may experience similar events.

VII. HISTORICAL AND CURRENT DISTRIBUTION

Historical Distribution (pre-1980)

Information gathered through an extensive search of the literature and museum records allowed Bloom (1980) to estimate the historic range of the Swainson's Hawk in California (Figure 1). From this analysis, Swainson's Hawks were found throughout the state except in the Sierra Nevada, North Coast Ranges and Klamath Mountains (Bloom 1980). Historically, the species was found in large, open grassland valleys with scattered trees or groups of trees. Swainson's Hawks also established breeding territories in foothill and canyon habitat. The valleys and deserts of southern California and the coastal valleys from the Santa Rosa Valley south to the Mexican border supported significant populations of Swainson's Hawks.

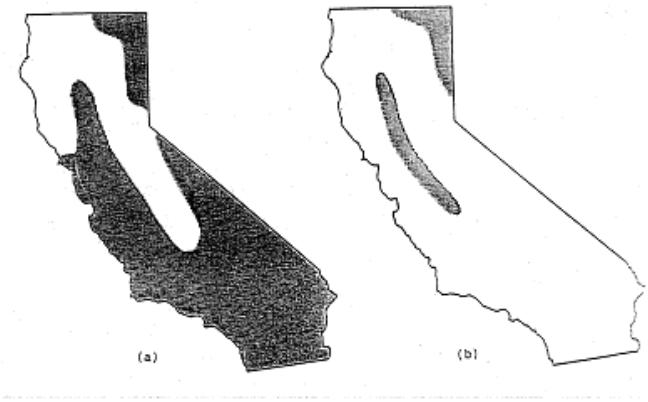

Figure 1. This figure was taken from Bloom 1980 and shows the historic (a) and current (b) range of Swainson's Hawk in California, as understood at that time.

In 1979, Bloom surveyed much of the state to determine the current distribution of Swainson's Hawks (Bloom 1980). In his report he depicted eight major geographic regions in California where Swainson's Hawk were found. The greatest number of nesting Swainson's Hawks were located in the Central Valley and also in the Great Basin of northeastern California from Butte Valley east to Nevada, south-central Modoc County and eastern Lassen County (Bloom 1980). In addition, Swainson's Hawks were also located in the Shasta and Owens valleys, and the Mojave Desert (Bloom 1980). Bloom's description of Swainson's Hawk distribution remains consistent with current knowledge and more recent data do not contradict Bloom's estimate of distribution as explained below.

Current Distribution (post-1980)

In 1988, the Department surveyed the entire Central Valley, coastal valleys, and parts of Southern California, and was provided with information from cooperators in the Great Basin region of the state. In addition, information on Swainson's Hawk activity was gathered by the Department from 1979 to 1993 throughout the state (California Department of Fish and Game 1993). These data revealed no change in the distribution of the Swainson's Hawk in California since Bloom's 1980 report (California Department of Fish and Game 1993).

In 2005 and 2006 another statewide survey of Swainson's Hawk breeding pairs was conducted using a stratified random sample design (Anderson et al. in prep). The results of these survey findings roughly duplicate Bloom's (1980) earlier findings, with the majority of Swainson's Hawk records located in the Central Valley, and with the next large population center in the Great Basin. However, this survey was only focused within the current known distribution and did not cover areas of the state where Swainson's Hawk had historically nested and the species was presumed extirpated (Anderson et al. in prep). For example, additional areas not included in the 2005 and 2006 survey include some areas in Sonoma and Napa counties. Recently, 3 to 4 Swainson's Hawk nests have

been detected in upland habitat at the north end of San Francisco baylands near Highway 37 (Fish pers. comm. 2012). These nests have been monitored as part of the Golden Gate Raptor Observatory's Bay Area Raptor Nesting Survey over the last few years.

The Department's California Natural Diversity Database (CNDDB) records contain 2,394 Swainson's Hawk occurrence records, ranging from 1894 to present (California Natural Diversity Database; December 1, 2015). Eighty-five percent (2029/2394) of the CNDDB records occur within the Central Valley, and 59% (1407/2394) occur within Sacramento, Yolo, Solano, and San Joaquin counties. CNDDB records largely corroborate Bloom (1980) and Anderson et al. (in prep) results in that the majority of the records occur within the Central Valley (Figure 2). A majority of records (n=2140) are from 1990 on. Of equal importance, in areas of the state where Bloom reported that the Swainson's Hawk had been extirpated, CNDDB similarly contained no Swainson's Hawk records. There are no CNDDB records in the Sierra Nevada, North Coast Ranges, and Klamath Mountains, and with the exception of a handful of new records in Napa County, Sonoma County, and two records in San Luis Obispo County. CNDDB provides no indication that the species has reoccupied historical range in coastal valleys from Santa Rosa south.

EBird (http://ebird.org) is a citizen science database that houses bird observation data. To supplement CNDDB data, we extracted likely breeding records (e.g. observations with noted breeding activity, nest location, eggs or young) for Swainson's Hawks in California from 1995 during the breeding season (April through August). We found 716 breeding records in eBird, some of which may duplicate CNDDB occurrences (see Figure 2). Some caution should be used when interpreting eBird data for breeding activity. EBird is an observational database not meant to track breeding status of any one species, and designation of breeding status from extracted data in this case was largely gleaned from the notes a submitter entered. Therefore, some breeding observations may have been missed, while others misclassified. Although the incoming data to eBird receives some level of scrutiny via automated filters and volunteer reviewers, there is still some margin of error. Alternately, incoming records for CNDDB receive a much higher level of verification before it is added and viewable.

The data for Swainson's Hawk recorded in the CNDDB and eBird is not collected in a systematic fashion and for this reason its use as the principle measure for describing the species' distribution and range is open to criticism. Nevertheless, the accumulation of over 2,300 Swainson's Hawk observational records in CNDDB and over 700 in eBird can be used, in conjunction with other records, to form a better understanding of the species' current distribution and range.

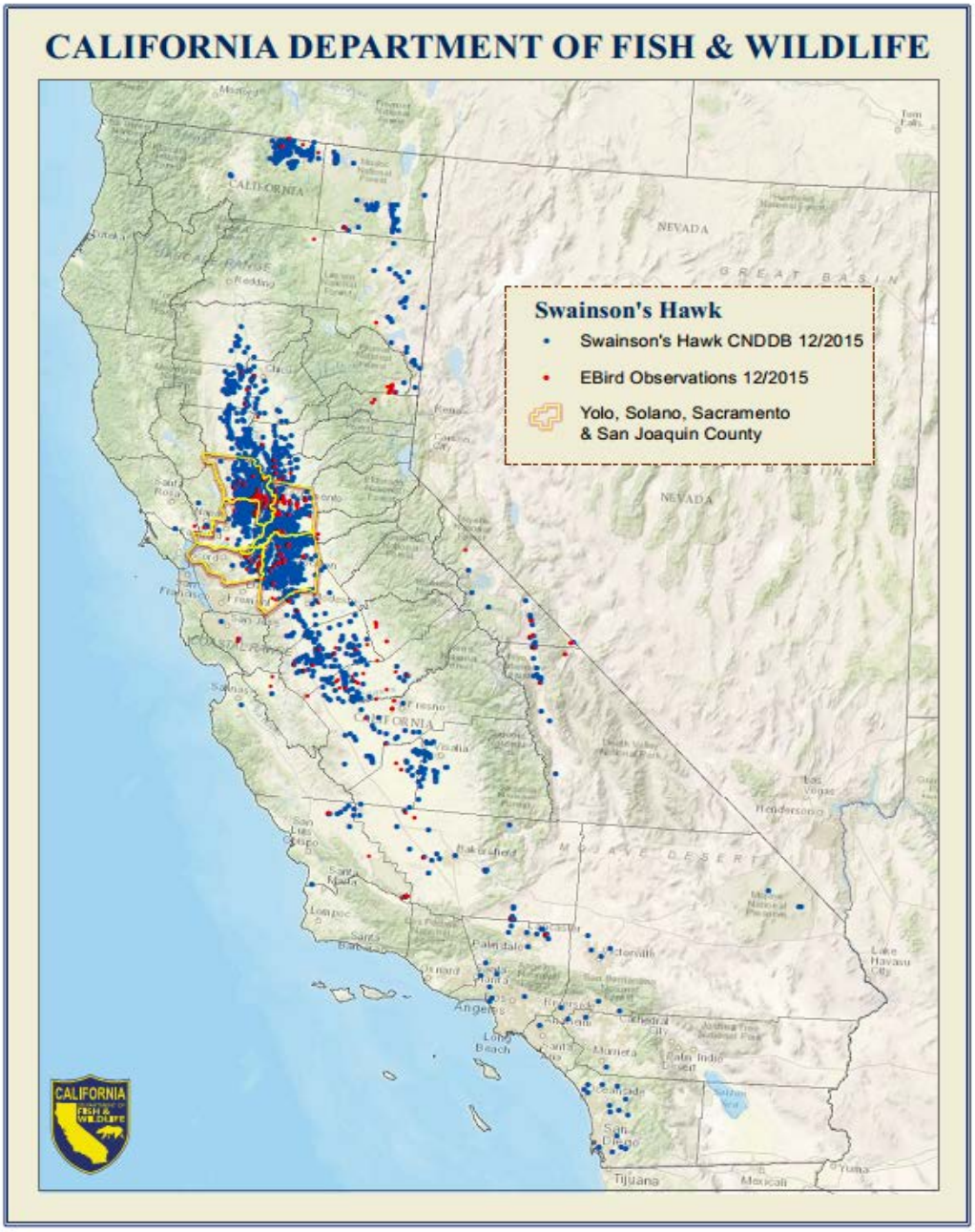

Figure 2. CNDDB and eBird data for Swainson's Hawk in California (extracted from CNDDB 12/1/2015 and eBird in 12/15/2016). The majority of the Central Valley's Swainson's Hawk population lies within an area that includes Sacramento, Yolo, Solano, and San Joaquin counties.

As previously mentioned, Bloom (1980), Gifford et al. (2012), Anderson et.al. (in prep.), CNDDB occurrence records, and eBird breeding records all indicate that the majority of Swainson's Hawk nests are located in the Central Valley and that the nesting density in the Central Valley is unevenly distributed. Approximately 70 to 80% of the Central Valley population is located in the southern Sacramento-northern San Joaquin Valley, a

region composed of four counties: Yolo, Solano, Sacramento, and San Joaquin (Bloom 1980, Anderson et.al. in prep., Gifford et al. 2012). These four counties are located in the Central Valley, where suitable irrigated farmland is the primary land-use (Estep 1989). Numbers of breeding pairs decreased both to the north and south of this four county region, and no significant foothill breeding populations have been documented. Another important Swainson's Hawk population center is in the Great Basin.

The distribution of the Swainson's Hawk has changed little since Bloom (1980) originally described the species distribution. With few exceptions, areas within the historical range, particularly along the Central Coast and southern regions, have not been reoccupied, and the Central Valley and Great Basin continue to provide the species its core habitat in California. However, the Antelope Valley is considered reoccupied by some, probably as a result of irrigated agriculture, as well as some inner coastal valleys, portions of the Sierra foothills, and some portions of the San Joaquin Valley (Estep pers. comm. 2012).

VIII. HISTORICAL AND CURRENT ABUNDANCE

Historical Abundance

Historically, the Swainson's Hawk was considered one of California's most common nesting buteos (Sharp 1902), but the population declined dramatically around 1900, concurrent with a contraction of the species' range, particularly along the central and southern coastal areas of California. Bloom (1980) estimated as many as 17,136 pairs of Swainson's Hawks historically nested in California (includes data from 1880-1969). This estimated 90% decline in the population and the loss of a significant portion of its range prompted the hawk's listing by the State of California as a Threatened species in 1983 by the California Fish and Game Commission pursuant to CESA. (See Cal. Code Regs., tit. 14, §670.5(b)(5)(A).

Current Abundance

In a 1979 survey, Bloom (1980) estimated that there were only 375 ($\pm$50) breeding pairs of Swainson's Hawks remaining in California. Since this estimate was made and the hawk was listed in 1983, interest in the Swainson's Hawk has grown considerably. Thus there has been an increased survey effort throughout the state. This increase in data collection efforts may be one reason we see higher breeding densities reported from certain areas within the state. A 1988 estimate of the Central Valley population was obtained using nest density information contained in the study by Estep (1989), where an area estimate of the habitat was multiplied by a breeding density of 0.16 pairs/sq km (0.42/sq mi) (the lowest breeding density of Estep's four study areas in the Central Valley, totaling an area of 374.4 sq km). The results indicated an estimate of 430 pairs in the Central Valley. This estimate was further subdivided into three main regions of the Central Valley: 80 pairs were estimated south of and including the Merced River, 35 pairs north of Sutter Buttes in Sutter County, and 315 pairs between these areas. Using

survey data and population estimates derived by biologists working in the Great Basin region, the population for that area was estimated to be 110 pairs (Estep 1989). In addition, five pairs were estimated for the Owens Valley area, and five for the Mojave Desert area (Estep 1989). The species was assumed to be extirpated from Southern California and coastal valleys. The individual estimates were combined to form a total statewide estimate of 550 breeding pairs in 1988 (Estep 1989). Neither Bloom 1980 nor Estep 1989 methods to estimate the population of hawks was sufficient to provide a statistically rigorous estimate.

More recently, Anderson et al. (in prep) completed a survey of the statewide breeding Swainson's Hawk population in 2005 and of the Central Valley breeding population 2006, and estimated the number of breeding pairs statewide at 1,893 (95% CI, 1462-2325) in 2005 and an estimated the number of breeding pairs in the Central Valley at 2,251 (95% CI, 1811-2690) in 2006. Another recent survey of nesting Swainson's Hawk was conducted in a portion of the Central Valley (Butte to San Joaquin counties) during the period 2002 to 2009 (Gifford et al. 2012). The latter survey yielded yearly estimates for numbers of breeding pairs of Swainson's Hawks in the Central Valley north of the Stanislaus River and south of Red Bluff: in 2002 the estimate was 593 (388-798) breeding pairs; in 2003 the estimate was 1,008 (720-1,296) breeding pairs; and in 2009 the estimate was 941 (692-1,190) breeding pairs (Gifford et al. 2012). Both Anderson et al. (in prep) and Gifford et al. (2012) methods employed to estimate the population of hawks were sufficient to provide a statistically rigorous population estimate, and are designed to be repeatable in order to accurately detect changes in the breeding population of Swainsons's Hawks within each of their study areas.

Compared to historical distribution and abundance, current surveys have indicated a smaller population occupying a restricted range that includes the core habitat areas of the Central Valley and Great Basin. Surveys subsequent to Bloom's 1979 inventory (Bloom 1980) have resulted in higher population estimates within these core areas, but it is unknown if this was due to an increase in survey effort or an actual increase in the population. Recent surveys employing repeatable survey designs hold promise for future comparative analysis.

IX. POPULATION TREND

Raptors may experience year-to-year changes or fluctuations in their population numbers due to a variety of factors including changes in prey abundance, habitat, and weather. In order to detect long-term changes over time (i.e. trends) in California's Swainson's Hawk population, it is necessary to collect data over a sufficient number of years to span any short-term population fluctuations or cycles (Hatfield et al. 1996; Newton 1998; Lewis and Gould 2000).

Historical statewide population estimates were based on a limited number of annual surveys and were not designed to be repeated (Bloom 1980, Estep 1989). Anderson et al. (in prep.) used repeatable survey efforts statewide with a repeatable survey design over

two years to estimate the number of nesting hawks. Gifford's et al. (2012) also used repeatable survey efforts and covers a seven year interval; however, the study area is limited to the northern portion of the Central Valley and again, and the time period is insufficient to span population fluctuations or cycles (Hatfield et al. 1996; Newton 1998; Lewis and Gould 2000). Due to differences between the two studies in survey design, duration and scope, neither of these surveys can currently be used to accurately estimate a statewide trend for Swainson's Hawk.

The Breeding Bird Survey (BBS) is a dataset that spans a sufficient length of time to be useful in detecting trends in the Swainson's Hawk populations. The BBS is a long-term, large scale avian monitoring program initiated in 1966 (1968 in California) to track the status and trend of North American bird populations. Each year during the height of the avian breeding season, participants skilled in avian identification collect bird population data along randomly selected roadside survey routes. The raw data for survey routes in California are accessible on the BBS website, http://www.pwrc.usgs.gov/BBS/. In addition to collecting and storing raw data the website also provides tools for trend analysis.

The BBS data has been used in over 450 publications and is often the only long-term data set available for avian trend analysis. However, use of BBS data is controversial because of a number of possible sources of error. These include missing data, observer bias, alternating observers, biases due to road-only surveys, and BBS's index method for population abundance (rather than a true estimate of the population). The BBS data on Swainson's Hawk for California are marked as "data with an important deficiency" (USGS 2012). Data may be so marked because:

1. The regional abundance is less than 0.1 birds/route (very low abundance),
2. The sample is based on less than 5 routes for the long-term (very small samples), or
3. The results are so imprecise that a 5% per year would not be detected over the long-term.

Cautious of the potential for errors in interpretation, the BBS appears to be useful for analyzing population trends for Swainson's Hawk populations in California. More than 30 routes monitored over the last 40 years have recorded the occurrence of Swainson's Hawk (Sauer et al. 2011; USGS 2012). The roadside surveys are conducted in peak breeding season while Swainson's Hawk are active, visible and easily identified as they rear young. Therefore, the data collected by BBS presents a potentially valuable resource for trend analyses.

The trend analysis presented in Figure 3 for Swainson's Hawk populations is taken from the BBS website and is based on the current BBS hierarchical model for population change (Sauer and Link 2011, Sauer et al 2011). The analysis tools used were from the Species Group Summaries Results where the species group is Neotropic Migrant, the Period is 1968-2009, and the Region is California. This tool gives a Swainson's Hawk trend index of 3.6 at ($P<0.05$, $N=38$), which translates into an increasing trend of 3.6%

per year. The index value is a measure of percent change per year, and in this case is listed as "significant." The P value is the likelihood that the result is attributable to chance alone, and in this case the P value is significant. Figure 3 suggests that a low initial value for Swainson's Hawk detected followed by a slow rate of increase thru the 1990s, followed by a faster rate of increase in 2000's.

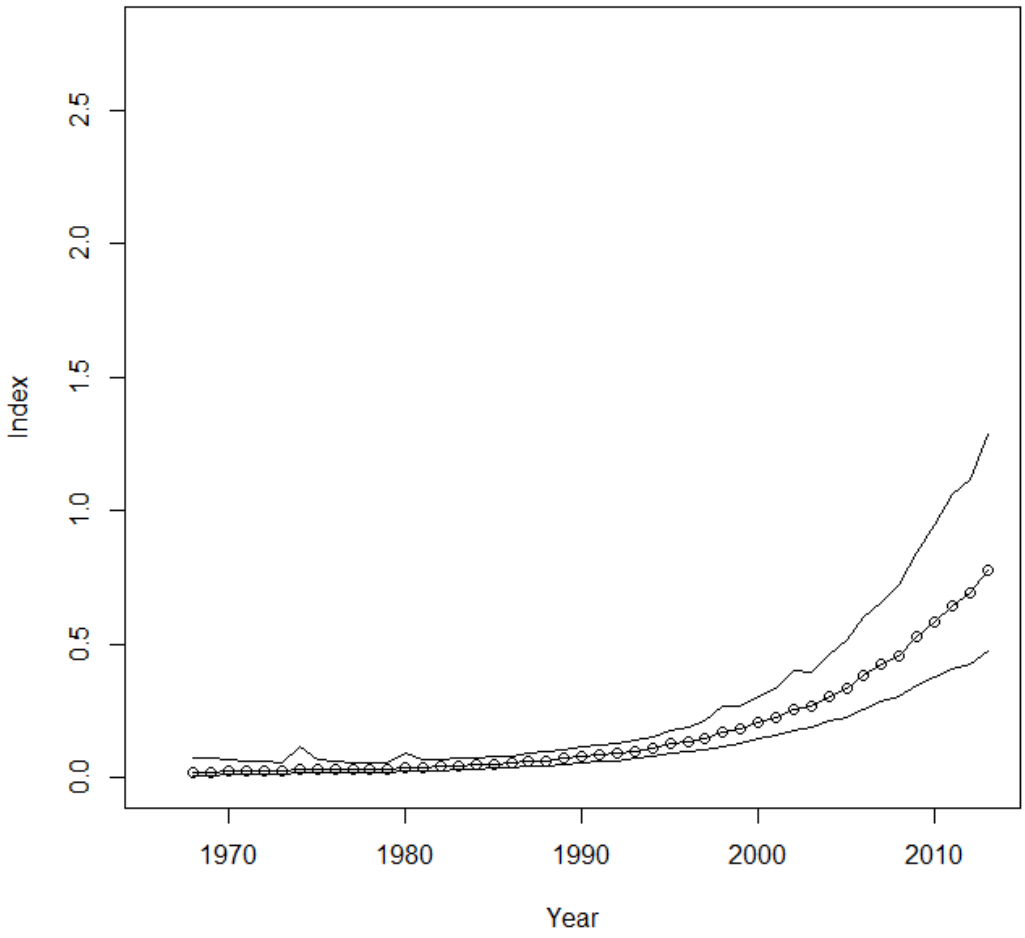

Figure 3. Breeding Bird Survey trend (with 95% confidence intervals shown) for the Swainson's Hawk from 38 survey routes in California from 1966 to 2013. The x axis is year and the y axis is the relative abundance estimates for all years, estimated as yearly predicted abundances from the hierarchical model analysis (see Sauer and Link 2011).

As mentioned earlier there are only three statewide estimates for breeding pairs of Swainson's Hawk ranging from 1980 to 2007 (Bloom 1980; Estep 1989; Anderson et al. in prep). The 1979 and 1988 surveys yielded comparable population estimates: 375 (±50) and 550 breeding pairs respectively (Bloom 1980; Estep 1989). The 1988 survey effort was designed to be repeatable and consisted of several years of surveys. The 2005 statewide survey yielded a higher population estimate (1,893 pairs; Anderson et al. in prep.). This more recent effort was a stratified random sample that involved numerous

biologists throughout the state; a level of effort substantially greater than previous efforts which undoubtedly influenced its greater population estimate.

Based on the results of the three statewide surveys occurring in California, it is possible to conclude that the population is increasing over time. However, this perception is tempered by the differences in effort, design, technique and time frame of data collection of the three studies. The latest population estimate (Anderson et al. in prep) is still below the historical population estimate, and there is little evidence to indicate that this hawk has reoccupied much of its former range in the central and south coast valley and Southern California. Although the three statewide estimates are not sufficient to form a trend line, cautious speculation that the Swainson's Hawk population has experienced a modest increase within the Central Valley may be warranted .

X. EXISTING MANAGEMENT EFFORTS

Regulations, Protections, and Conservation

California Endangered Species Act (CESA; Fish and G. Code, § 2050 et seq.). The Swainson's Hawk was listed as a threatened species in 1983 by the California Fish and Game Commission pursuant to CESA, (Cal. Code Regs., tit. 14, § 670.5(b)(5)(A).)

Under CESA it is unlawful to take (Fish & G. Code, §86) a species listed as "threatened" of "endangered" (or a candidate) by the State of California unless 1) the take is incidental to an otherwise lawful activity, 2) the impacts of the lawful take are fully minimized and mitigated, 3) the take is consistent with Fish and Game Code sections 2112 and 2114, and 4) adequate funding to implement the permitted take's mitigation and monitoring measures is ensured.

Section 2053 of the Fish and Game Code states, in part, "it is the policy of the state that state agencies should not approve projects as proposed which would jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat essential to the continued existence of those species, if there are reasonable and prudent alternatives available consistent with conserving the species and or its habitat which would prevent jeopardy." Section 2054 states "The Legislature further finds and declares that, in the event specific economic, social, and or other conditions make infeasible such alternatives, individual projects may be approved if appropriate mitigation and enhancement measures are provided."

Loss or alteration of foraging habitat or nest site disturbance which results in: (1) nest abandonment; (2) loss of young; (3) reduced health and vigor of eggs and/or nestlings (resulting in reduced survival rates), may ultimately result in the take of nestling or fledgling Swainson's Hawks incidental to otherwise lawful activities. The taking of Swainson's Hawks in this manner can be a violation of CESA. This interpretation of take has been judicially affirmed by the 1992 landmark appellate

court decision, *Department of Fish and Game v. Anderson-Cottonwood Irrigation District* (8 Cal.App. 4th, 1568), which emphasized that the intent and purpose of CESA applies to all activities that take or kill endangered or threatened species, even when the taking is incidental to otherwise legal activities.

California Environmental Quality Act (CEQA, Pub. Resources Code, § 21000 et seq.). CEQA requires adoption of mandatory findings of significance if a project's impacts to threatened or endangered species are likely to occur (§21001 (c), §21083, Guidelines §15380, §15064, and §15065). Impacts must be avoided or mitigated to less than significant levels unless the CEQA Lead Agency makes and supports findings of Overriding Consideration. Mitigation for impacts to Swainson's Hawk foraging habitat varies among CEQA lead agencies, but essentially does not occur at a rate greater than 1:1 habitat lost to habitat protected.

Fish and Game Code §§ 3503, 3503.5, and 3800. These Fish and Game Code sections prohibit the take, possession, or destruction of birds, their nests or eggs.

Migratory Bird Treaty Act (MBTA). Swainson's Hawks are protected under the federal MBTA of 1918 (16 U.S.C. 703 711). The MBTA makes it unlawful to take, possess, buy, sell, purchase, or barter any migratory bird listed in §50 of the Code of Federal Regulations (C.F.R.) Part 10, including feathers or other parts, nests, eggs or products, except as allowed by implementing regulations (50 C.F.R. 21).

Conservation Plans

Regional conservation planning efforts take a comprehensive approach to ecosystem conservation while allowing land use authorities the ability to manage anticipated growth and development. A few regional conservation plans currently being administered are designed to provide conservation of nesting and foraging Swainson's Hawk habitat within the bird's nesting range, including: the San Joaquin County Multi-species Habitat Conservation and Open Space Plan, the Natomas Basin Habitat Conservation Plan, the Metro Air Park Habitat Conservation Plan, and the East Contra Costa County Habitat Conservation Plan and Natural Community Conservation Plan. Each of these plans has a unique strategy for providing conservation value for the Swainson's Hawk; however none of these provide habitat at a rate greater than 1:1 habitat lost to habitat protected. In addition to the plans described above, there are several jurisdictions with conservation plans in the development stage which aim to provide good conservation value to the Swainson's Hawk, including: Butte County, Yolo County, Solano County, Sacramento County, Yuba and Sutter Counties, and Placer County.

XI. DATA GAPS

The Swainson's Hawk has been listed under the California Endangered Species Act since 1983, and yet there is still much to learn about the species. Several surveys have been conducted throughout the state, but the purposes and methodologies have been independent for each. Some long-term studies have been or are being conducted in Yolo

County and Butte Valley; however, these studies provide information at a regional scale rather than statewide (Estep pers. comm. 2012).

A long-term repeatable statewide breeding/nest survey, possibly using a stratified random sampling survey design, is needed to assess the population's trend, distribution and range, temporal variation, and abundance. Surveys outside of the known range should be included to determine if range expansions are occurring and at what level.

Additional research is needed to inform managers who are responsible for conserving the species. Research topics of need include: assessing survival, recruitment levels, breeding success, characteristics of migration, disease and parasites, and contaminant studies, specifically how contaminants may affect egg shells.

XII. INFORMATION SOURCES

Anderson, D. 2012. Personal Communication.

_____. 2014. Personal Communication.

Anderson, D. R. Anderson, J. Dinsdale, and R. Schlorff. 2007. California Swainson's Hawk Inventory: 2005–2007. Final report. Department of Fish and Game Resource Assessment Program, California Department of Fish and Game. Sacramento, CA, U.S.A.

Anderson, R., J. Dinsdale, C. Chun, K. Fien and R. Schlorff. 2011. Foraging value of crops/habitats for Swainson's hawks of California's Central Valley- Final Progress Report. Final report. Department of Fish and Game Resource Assessment Program, California Department of Fish and Game. Sacramento, CA, U.S.A.

Anderson, R.L., J.L. Dinsdale, C.L. Battistone, K.M. Cripe, C. Chun, R.W. Schlorff, M.A. Bradbury, J.A. Estep, S.G. Torres. In Preparation. Population inventory of Swainson's hawk in California: A statewide sampling framework for population monitoring.

Babcock, K. 1995. Home range and habitat use of breeding Swainson's hawks in the Sacramento Valley of California. Journal of Raptor Research 29(3):193–197.

Bechard, M. 1982. Effect of vegetative cover on foraging site selection by Swainson's hawk. Condor 84:153-159.

Bechard, M. J., C. S. Houston, J. H. Sarasola and A. S. England. 2010. "Swainson's Hawk (*Buteo swainsoni*)." The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/265.

Bloom, P. 1980. The status of the Swainson's hawk in California, 1979. Federal aid in wildlife restoration, Project W-54-R-12, Nongame Wildl. Invest. Job Final Report 11-8.0. 24p. + appendix.

Bradbury, M. 2012. Personal Communication.

Bradbury, M. 2009. Friends of the Swainson's hawk Conservation Strategy for Swainson's hawks in California. 32pp.

Briggs, C. 2012. Personal Communication.

Briggs, C. 2007. Survival and nesting ecology of the Swainson's hawk in Butte Valley California. MS Thesis. Department of Natural Resources and Environmental Science, Program in Ecology, University of Nevada, Reno, 202 Ross Hall, Reno, NV 89512 USA.

California Department of Fish and Game (CDFG). 1993. 5-year Status Review: Swainson's hawk (Buteo swainsoni). Prepared for the California Fish and Game Commission. Nongame Bird and Mammal Program 1416 Ninth Street, Sacramento, CA.

_____. December 1, 2015. California Natural Diversity Database. http://www.dfg.ca.gov/biogeodata/cnddb/mapsanddata.asp

California Department of Fish and Wildlife (CDFW). 2016. A Rapid Assessment of the Vulnerability of Sensitive Wildlife to Extreme Drought. Wildlife Branch, Nongame Wildlife Program

California Department of Conservation Agricultural Land Mapping. 2010. http://www.conservation.ca.gov/dlrp/Pages/qh_maps.aspx

California Department of Conservation. 2014. California Farmland Conversion Report 2008-2010. http://www.conservation.ca.gov/dlrp/fmmp/Documents/fmmp/pubs/2008-2010/fcr/FCR%200810%20complete.pdf

Cayan, D., M. Tyree, D. Pierce, T. Das. 2012. Climate change and sea level rise scenarios for California vulnerability and adaptation assessment. California Energy Commission. Publication number: CEC-500-2012-008.

Christensen T.K., P. Lassen, and M. Elmeros. 2012. High exposure rates of anticoagulant rodenticides in predatory bird species in intensively managed landscapes in Denmark. Archives of Environmental Contamination and Toxicology 63:437-444

Craighead, J. and F. Craighead, Jr. 1956. Hawks, owls and wildlife. Stackpole Books, Harrisburg, PA. 443pp.

Department of Water Resources and the California Department of Fish and Wildlife. Letter to: U.S. Army Corps of Engineers. 2010 Apr 15.

Detrich, P. 1986. Status of the Swainson's hawk (*Buteo swainsoni)* in the upper Sacramento Valley - Shasta and Tehama counties, California. Dept. Biol. Sciences. Calif. State Univ., Chico.

eBird. 2012. eBird: An online database of bird distribution and abundance [web application]. eBird, Ithaca, New York. Available: http://www.ebird.org.

England, A. 2012. Personal Communication.

England, A., J. Estep, and W. Holt. 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.

Estep, J. 2012. Personal Communication.

_____. 1989. Biology, movements and habitat relationships of the Swainson's hawk in the Central Valley of California, 1986-87. Report for the Calif. Dept. Fish and Game, Nongame Bird and Mammal Sec. Rep.

_____. 2008. The Distribution, abundance and habitat associations of Swainson's hawk (*Buteo swainsoni*) in Yolo County. Prepared for the Yolo Natural Heritage Program, Woodland, CA.

_____. 2009. The Influence of vegetation structure on Swainson's hawk (*Buteo swainsoni*) foraging habitat suitability in Yolo County, California. Prepared for the Yolo Natural Heritage Program, Woodland, CA. http://www.yoloconservationplan.org/yolo_pdfs/reports/veg-struc-swains-hawk-feb2009.pdf

Fahrig, L. 2003. Effects of habitat fragmentation on biodiversity. Annual Review of Ecology, Evolution and Systematics. 487-515.

Feliz, D. 2012. Personal Communication.

Fish, A. 2012. Personal Communication.

Gifford D., P. Hofmann, A. Truex, and D. Wright. 2012. Monitoring Swainson's hawk nest density in the Sacramento Valley, California. California Department of Fish and Game, North Central Region, 1701 Nimbus Road, Rancho Cordova, CA 95670.

Goldstein, M., B. Woodbridge, M. Zaccagnini, and S. Canavelli. 1996. An assessment of mortality of Swainson's hawks on wintering grounds in Argentina. J. Raptor Res. 30:106-107.

Hatfield, J., W. Gould IV., B. Hoover, M. Fuller and E. Lindquist. 1996. Detecting trends in raptor counts. Wildlife Soc. Bull. 24: (3): 505-515.: http://fresc.usgs.gov/products/papers/479_Hatfield.pdf

Herzog, S. 1996. Wintering Swainson's hawks in California's Sacramento-San Joaquin River delta. Condor 98:876-879.

Jackson, L.E., F. Santos-Martin, A. D. Hollander, W. R. Horwath, R. E. Howitt, J. B. Kramer, A. T. O'Geen, B. S. Orlove, J. W. Six, S. K. Sokolow, D. A. Sumner, T. P. Tomich, and S. M. Wheeler. 2009. Potential for Adaptation to Climate Change in an Agricultural Landscape in the Central Valley of California. California Energy Commission Report, Climate Change Center, http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2009-044-F

Kingsley, A. and B. Whittam. 2001. Potential impacts of wind turbines on birds at North Cape, Prince Edward Island. Unpublished report for the PEI Energy Corp. Available online: http://www.bsc-eoc.org/peiwind.html

Kochert, M.N., M.R. Fuller, L.S. Schueck, L. Bond, M.J. Bechard, B. Woodbridge, G.L. Holroyd, M.S. Martell, and U. Banasch. 2011. Migration patterns, use of stopover areas, and austral summer movements of Swainson's Hawks. Condor 113:89-106

Lewis, S., and W. Gould. 2000. Survey effort effects on power to detect trends in raptor migration counts. Wildlife Soc. Bull. 28 (2): 317-329. Allen Press http://www.jstor.org/stable/3783687

Miller, R.F., and J.A. Rose. 1999. Fire history and western juniper encroachment in sage-brush steppe. Journal of Range Management 52: 550-559

Miller, R., C, Baisan, J. Rose, and D. Pacioretty. 2001. Pre- and post-settlement fire regimes in mountain big sagebrush steppe and aspen: the Northwestern Great Basin. Final Report to the National Interagency Fire Center.

Murray M. 2011. Anticoagulant rodenticide exposure and toxicosis in four species of birds of prey presented to a wildlife clinic in Massachusetts, 2006-2010. Journal of Zoo and Wildlife Medicine 42(1):88-97.

Nemeth, N., D. Gould, R. Bowen, and N. Komar. 2006. Natural and experimental West Nile Virus infection in five raptor species. Journal of Wildlife Disease 42(1):1-13

Newton, I. 1998. Population limitation in birds. Academic Press Limited: http://books.google.com/books?hl=en&lr=&id=gU-7snBvdd8C&oi=fnd&pg=PP1&dq=wildlife+population+cycles+in+birds&ots=KG7LsiCEbp&sig=X8pfXRJcEIPqbKI79TZnO6_XXkY#

Orloff, S., and A. Flannery. 1992. Wind turbine effects on avian activity, habitat use and mortality in Altamont Pass and Solano County Wind Resource Areas. Report to the Planning Departments of Alameda, Contra Costa, and Solano counties and the California Energy Commission. Grant Number 990-89-003. BioSystems Analysis, Tiburon, California, USA.

Pierce D.W., T. Das, D.R. Cayan, E.P. Maurer, N.L. Miller, Y. Bao, M. Kanamitsu, K. Yoshimura, M.A. Snyder, L.C. Sloan, G. Franco and M. Tyree. 2011. Probabilistic estimates of future changes in California temperature and precipitation using statistical and dynamical downscaling. [Internet] Springer-Verlags [cited 2015 Jun 8] Available from (doi:10.1007/s00382-012-1337-9)

Rogers, Krysta. 2015. Personal Communication.

Sacramento County, California. 2011. Sacramento County 2030 General Plan.

San Joaquin County, California. 1992. San Joaquin County General Plan 2010.

Sarasola, J., J. Negrol, V. Salvador, and J. Maceda. 2005. Hailstorms as a Cause of Mass Mortality of Swainson's hawks in their wintering grounds. Journal of Wildlife Diseases. vol. 41 no. 3 643-646.

Sauer, J., J. Hines, J. Fallon, K. Pardieck, D. Ziolkowski, Jr., and W. Link. 2011. The North American breeding bird survey, results and analysis 1966 - 2009. Version 3.23.2011.USGS Patuxent Wildlife Research Center, Laurel, MD. http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

Sauer, J. and W. Link. 2011. Analysis of the North American breeding bird survey using hierarchical models. Vol. 128(1): 87-98.

Schlorff, R., and P. Bloom. 1983. Importance of riparian systems to nesting Swainson's hawks in the Central Valley of California. pp. 612- 618. In: R.E. Warner and K.M. Hendrix (Eds.). California. Riparian Systems (University of Ca. Davis, Sept. 17-19, 1981). University of California Press, Berkeley.

Schmutz, J. 1987. The effect of agricultural practices on ferruginous and Swainson's hawks. J. Range Manage. 40:438-440.

Sernka, K. 1999. A biogeographical analysis of Swainson's hawks breeding in the Central Valley of California. MS Thesis. Department of Biological Sciences, California State University Chico, Chico, California.

Sharp, C. 1902. Nesting of Swainson's hawk. Condor 4:116-118.

Smallwood, S. 1995. Scaling Swainson's hawk population density for assessing habitat use across and agricultural landscape. J. Raptor Res. 29: 172-178.

Stone, W.B., J.C. Okoniewski, J.R. Stedelin. 2003. Anticoagulant rodenticides and raptors: recent findings from New York, 1998-2001. Bulletin of Environmental Contamination and Toxicology. 70:34-40

Swolgaard, C., K. Reeves, and D. Bell. 2008. Foraging by Swainson's hawks in a vineyard-dominated landscape. J. Raptor Res 42(3):188-196. http://www.bioone.org/doi/abs/10.3356/JRR-07-15.1

Thomas, P.J., P. Mineau, R.F. Shore, L. Champoux, P.A. Martin, L.K. Wilson, G. Fitzgerald, and J.E. Elliot. 2011. Second generation anticoagulant rodenticides in predatory birds: probabilistic characterization of toxic liver concentrations and implications for predatory bird populations in Canada. Environ. Int. 37:914-920

U.S. Army Corps of Engineers (USACE). Engineering Technical Letter (ETL) No. 1110-2-571 Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, 2008 April 10.

USGS Patuxent Wildlife Research Center. 2012. North American Breeding Bird Survey Internet data set (http://www.pwrc.usgs.gov/bbs/retrieval/).

Wilcove D., C. McLellan, and A. Dobson. 1986. Habitat fragmentation in the temperate zone. Pages 237-256 in Soul6 ME, ed. Conservation biology. Sunderland (MA): Sinauer Associates.

Woodbridge, B. 1985. Biology and management of Swainson's hawk in the Butte Valley, California. U.S. Forest Service Report, 19 pp.

_____. 1991. Habitat selection by nesting Swainson's hawks: a hierarchical approach. M.S. Thesis, Oregon State Univ., Corvallis, Oregon.

XIII. REPORT PREPARED BY:

Carie Battistone
California Department of Fish and Wildlife
Nongame Wildlife Program
Wildlife and Fisheries Division

Jenny Marr, Todd Gardner and Dan Gifford (retired)
California Department of Fish and Wildlife
Region 2

April 11, 2016

XIV. CONTACT FOR FURTHER INFORMATION:

Carie Battistone, carie.battstone@wildlife.ca.gov

XV. JUNE 6, 2012 DRAFT REVIEWED BY:

Allen Fish, Golden Gate Raptor Observatory
Brian Ehler, California Department of Fish and Wildlife Region 1
Chrissy Sousa, California Department of Fish and Wildlife Region 4
Christopher Briggs, Golden Gate Raptor Observatory
Cristen Langner, California Department of Fish and Wildlife Region 4
Dave Feliz, California Department of Fish and Wildlife Region 4
David Wright, California Department of Fish and Wildlife Region 2
Debra Hawk, California Department of Fish and Wildlife Region 6
Erin Tennant, California Department of Fish and Wildlife Region 4
Jim Estep, SWHA Researcher
Kent Smith, California Department of Fish and Wildlife Nongame Program
Lara Sparks, California Department of Fish and Wildlife Region 4
Michael Bradbury, Department of Water Resources
Neil Clipperton, California Department of Fish and Wildlife Nongame Branch
Paul Hoffman, California Department of Fish and Wildlife Region 2
Sid England, University of California, Davis
Terry Palmisano, California Department of Fish and Wildlife Region 4

Note: Reviewer comments and the Department's response to each can be provided upon request.