Monitoring nesting Swainson's hawks, *Buteo swainsoni*, on properties within the Los Baños Wildlife Area Complex, 2009

Swainson's hawk (dark morph adult). Photo by Kristy Benner.

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Abstract

In 2009, California Department of Fish and Game staff monitored the Swainson's hawk breeding population at the Los Baños Wildlife Area Complex. From March through July we surveyed and recorded twenty nesting pairs of Swainson's hawk for the Los Baños Wildlife Area, including the Mud Slough Unit, O'Neill Forebay Wildlife Area, and Volta Wildlife Areas combined. Overall, 25% of the nests were successful at fledging young and produced an average of 1.0 nestling per nest. Of the total nests surveyed, 35% of the nests were abandoned and the remaining 40% failed, with some nest failures attributed to poor nest quality, wind-broken branches and predation. This species is known for its predisposition for nest abandonment, failures and low nesting success, however the number of breeding pairs nesting on these properties during 2009 was the highest recorded since 2001. Continued monitoring and adaptive management of our wildlife areas to promote quality breeding sites for Swainson's hawks remains an ongoing priority, as well as implementing avoidance measures during the nesting season.

Keywords: *Swainson's hawk, Buteo swainsoni, Los Baños Wildlife Area, raptor nests, breeding population*

Introduction

The Pacific Flyway, which runs through the California Central Valley, is a migration corridor used by millions of birds to travel between summer breeding habitat and wintering grounds. Every year, Swainson's hawks (*Buteo swainsoni*) wintering in Western Mexico, Columbia and Argentina migrate along this flyway toward their breeding grounds in California, Oregon and the Great Plains. Historically, California once provided over 47,600 square miles (123,000 km^2) of Swainson's hawk nesting habitat, which was estimated to hold between 4,200 and 17,000 breeding pairs. As of 1979, only an estimated 375 Swainson's hawk pairs existed in California, 110 of which were located in the Central Valley (Bloom 1980). This reflects over a 90% decline in breeding pairs and in 1983 the Swainson's hawk was listed as a threatened species by the California Department of Fish and Game (CDFG) (California Department of Fish and Game 2010).

Several factors may have contributed to the population decline of Swainson's hawks, including the ingestion of pesticide-contaminated prey on their wintering grounds, poor nest construction, reproductive failure, and habitat loss. At their wintering grounds in the La Pampas region of Argentina, a massive death of Swainson's hawks

resulted in 1985 when the hawks preyed upon a large population of grasshoppers that had been exposed to pesticides (Woodbridge et al. 1995). Although pesticide use is regulated in the Swainson's hawk breeding areas of the California Central Valley, habitat protection and regulatory practices may vary greatly throughout their summer and winter ranges. Once at their breeding grounds, inferior nest construction by Swainson's hawks may also be limiting the success of this species. These hawks tend to build relatively small, flimsy nests that rarely survive more than a year (Hansen and Flake 1995) and often cannot withstand high winds, which are common throughout their breeding habitat. Although they exhibit traits for defending nesting territory, inherent behaviors of these hawks may hinder their reproductive and nesting success as well. Although this species is able to tolerate human activity (especially in areas where it is regular) and may build nests near houses, roads, or areas where crop cultivation takes place, Swainson's hawks are sensitive to changes in activity patterns (e.g. new activity in a formerly undisturbed location) at which point females have been recorded abandoning the nest during the building, egg-laying or the incubation stages of reproduction (Bent 1937, Houston 1974, and Estep 1989). These factors, along with frequent unexplained egg infertility (Bloom 1980) likely have all contributed to the decline of the Swainson's hawk population.

External pressures such as habitat loss affect the population numbers of the Swainson's hawk as well. Historically, the California Central Valley consisted primarily of marshy floodplains that contained riparian habitat suitable for nesting. As people moved into the area to farm, valley rivers were dammed and redirected, and eventually the valley floor was converted into agricultural land. Much of the riparian growth important to this species, such as cottonwood (*Populus* sp.), oak (*Quercus* sp.), sycamore (*Platanus* sp.) and willow (*Salix* sp.) (Bloom 1980), was removed or destroyed during this landscape alteration. Flood control efforts including bank stabilizations, channelization of rivers and creeks, and clear-cutting and burning of riparian stands have further reduced preferred breeding habitat. Bloom (1980) stated that Central Valley Swainson's hawks have an 83% preference to nest within one mile (1.6 km) of a riparian zone and these favored nesting locations have declined significantly as the valley floor landscape has changed. It has been calculated that

California has lost 90% of the habitat suitable for Swainson's hawk breeding (Risebrough et al. 1989), which presents greater competition for nesting sites within the remaining habitat.

Despite the loss of riparian corridors and nesting habitat within California, there are publicly and privately-owned lands within the Central Valley that are still utilized by Swainson's hawks for nesting. The San Joaquin Valley, with its favorable nesting and foraging conditions, was found to contain 95% of California's Swainson's hawk population (Anderson et al. 2007). The Los Baños Wildlife Area Complex (LB Complex) consists of several state-owned properties located within Merced County of the Central Valley and extends into the Coast Range foothills. Managed by the CDFG, some of the lands within the LB Complex provide areas with suitable nesting sites, which include riparian habitat along canals, sloughs, and wetlands. In an effort to monitor the Swainson's hawk breeding population, the CDFG has been conducting nest surveys on these properties since 2001. Initially, these included monitoring nests on some of the LB Complex properties as well as on surrounding private lands. In addition, we monitored nests of other raptor species such as red-tailed hawks (*Buteo jamaicensis*), red-shouldered hawks (*Buteo lineatus*), great horned owls (*Bubo virginianus*) and white-tailed kites (*Elanus leucurus*). Due to a shift in priorities and funding during 2009, we have since been focusing our efforts solely on Swainson's hawks amongst properties of the LB Complex. Because these hawks continue to nest and breed within the Central Valley, nest monitoring could provide crucial information for the management of this species. Gathering information on habitat, nest site selection, fledging success, abandonment and nest failure rates should allow us to manage our lands in a way that protects and continues to provide suitable breeding habitat.

Study Area

The LB Complex is made up of several properties, all managed by CDFG, which is comprised of freshwater wetlands, sloughs, man-made lakes, riparian, upland and grassland habitats. Located in western Merced County, the climate generally consists of hot, dry summers, and cool, wet winters. Favorable nesting trees exist within upland habitat and may be found along some of the riparian waterways that interlace several of

the properties. We monitored Swainson's hawk nests on four wildlife areas within the LB Complex, including the Los Baños Wildlife Area (Los Baños WA) and Mud Slough Unit, O'Neill Forebay Wildlife Area (O'Neill Forebay WA) and Volta Wildlife Area (Volta WA) (Figure 1).

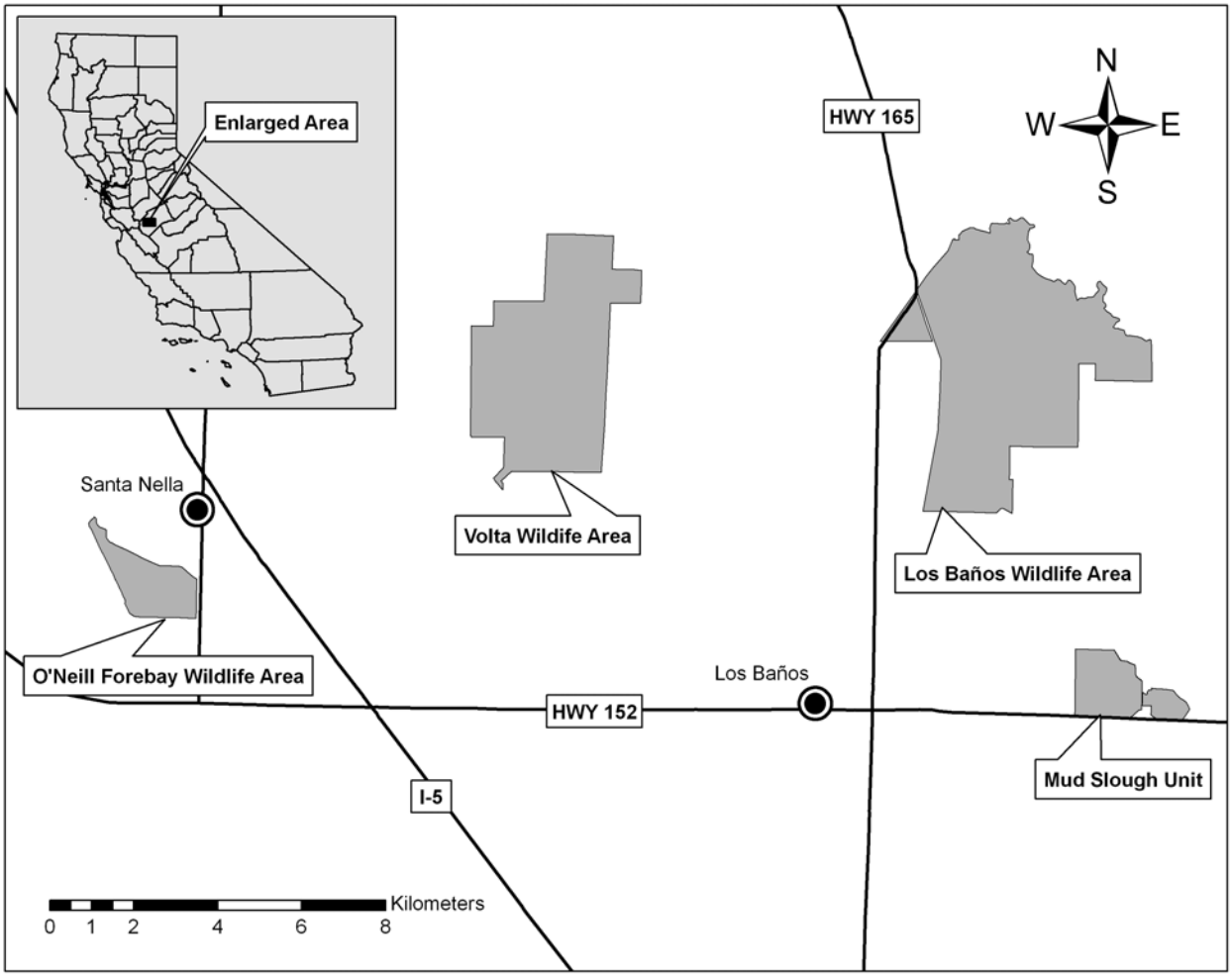

Figure 1. Swainson's hawk nest monitoring sites on California Department of Fish and Game lands, Merced County, 2009.

The Los Baños WA (2,263 ha / 5,600 acres) is located approximately 4 km (2.5 mi) northeast of the town of Los Baños and contains managed permanent, semi-permanent and seasonal wetlands, as well as grasslands, uplands and stands of mixed willow and Fremont cottonwood (*Populus fremontii*) trees. This wildlife area also contains canals, sloughs and man-made lakes that provide year-round water sources. The Mud Slough Unit (290 ha / 716 acres) of the Los Baños WA lies 5 km (3.1 mi) east

of the town of Los Baños and is bordered on the south by Highway 152. Managed wetland and upland fields surround the Mud Sough waterway, as well as associated canals, which are utilized seasonally on the property. The small number of trees that the Mud Slough Unit supports includes blue gum (*Eucalyptus globulus*) and black willow (*Salix gooddingii*).

The O'Neill Forebay WA (273 ha / 675 acres) is situated 3 km (1.9 mi) southwest of the town of Santa Nella Village and 16 km west of the town of Los Baños. It is bordered on the east by Highway 33 and lies a short distance north of Highway 152. This wildlife area is immediately adjacent to the O'Neill Forebay and was created as a mitigation property for construction of the Forebay, the San Luis Reservoir, and the Los Baños Creek Detention Dam, which occurred between 1962 and 1965. Canals and semi-permanent ponds on the property are bordered by riparian and upland habitat, which include stands of Fremont cottonwood, black willow, red willow (*Salix laevigata*) and sandbar willow (*Salix sessilifolia*) of varying ages.

Volta WA (1,529 ha / 3,780 acres), 9 km (5.59 mi) northwest of the town of Los Baños, contains managed wetlands, open grasslands and upland fields with alkaline substrates. The Volta Wasteway, part of a large water delivery system, bisects the area and provides a permanent water source, along with other canals on the property that transport water seasonally. Riparian habitat is sparse and the few trees that exist on this area include black willow and Fremont cottonwood.

Methods

Utilizing property aerials and pre-established driving routes, we began searching for raptor nests in January of 2009. At this time of year trees displayed minimum foliage, allowing us better views of former nesting sites and made it easier to detect the building of nests in new locations. Although Swainson's hawks had not yet returned to the LB Complex, we noted nest locations of raptors that began nesting earlier in the year (great horned owls, red-tailed hawks, etc.) as sites not readily available to the Swainson's hawks. Although the other tree-nesting raptor species were not monitored past the initial recording, we periodically checked their nests to confirm occupancy. Swainson's hawks, like many other raptors, will often attempt to take over an already

active nest upon arrival to their preferred nesting area. Because Swainson's hawks arrive later than other tree nesting raptors and often return to the same nest year after year, they may appropriate an active nest even if it already contains eggs or chicks of another species. Existing raptor nests sometimes fail or are abandoned early in the season, so by checking the status of pre-established nests, we could determine if any were empty and thus available for Swainson's hawks upon their arrival. We surveyed each area by driving all accessible roads and searched for evidence of new raptor nests, as well as any nests still intact from previous years. Upon observing hawks utilizing an old nest or actively constructing a new one, we drew a map depicting the location and surrounding habitat. We assigned each one an identification number and recorded a recommended location to view each nest using a global positioning system (GPS). We also noted which tree species or artificial structure type the nests were found in, and recorded height estimates of the nests and nesting structures; we returned to measure actual heights once the nests were empty. After describing the surrounding land use for each nest, we recorded any noticeable changes or nearby disturbances that occurred throughout the nesting season. We utilized binoculars and spotting scopes in order to observe the nests from a distance and to minimize disturbance of the nesting birds. During favorable weather conditions, we monitored nests every one to two weeks until final nest fates were determined (usually March to July). Monitoring was conducted during morning hours when breeding pairs seemed most active, which allowed us better viewing opportunities of adults and nestlings. Temperatures were also cooler during morning hours, thus minimizing heat wave interference when viewing nests through spotting scopes and binoculars.

During each nest visit we documented the nesting stage (laying, incubating, etc.), number of young seen, maternal presence or absence, and described any exhibited behaviors. Once we observed successful fledging, or after a minimum of three visits with no activity having been recorded, we determined the final nest fate. We considered a nest to be successful if the young had fledged and we observed the young flying or branching out from the nest. Based upon the timing of the nestling period, those that were observed to be close to the fledge stage and capable of flight were also determined to be successfully fledged, even if we did not observe them at the nest in

subsequent visits. We recorded nests as abandoned if incubation was not witnessed following the nest building or egg laying stages, and we recorded nests as failed if they had fallen, been knocked down by the wind or if nestlings were lost through natural death or predation. Any nest that contained eggs or nestlings and was observed to be without an incubating female for a period of two or more weeks was also recorded as a failed nesting attempt. If we determined a nest to be abandoned or failed, we listed suspected reasons if any were observed. Once nests were absent of all bird activity, we used a GPS to record their locations. We attempted to look inside the failed and abandoned nests using a TreeTop Peeper™, a telescoping video inspection system, to better determine if our nest fate observations of failed or abandoned were accurate. From this, we made note of empty nests, unhatched eggs, eggshell remnants, or dead nestlings, which may not have been viewable from a distance.

We entered all data into Excel and calculated fledging success, abandonment and nest failure rates for each property. Coordinates for all nest locations were imported into geographic information system (GIS) software and used for maps and the ability to track locations from year to year. We reported all Swainson's hawk nest locations and the number of fledged young (if any) to the California Natural Diversity Database (CNDDB).

Results

Between March 27 and July 17 of 2009, we monitored Swainson's hawk nests on four separate CDFG properties and visited each nest three to 16 times before determining a final fate. We observed a total of 21 Swainson's hawk pairs on the LB Complex, of which 20 nests were found (Table 1); we saw one pair of hawks copulating but were unable to locate their nest. Combining all four properties within the LB Complex, we observed a 25% nest success rate with a total of five Swainson's hawks fledging. During the nesting season, we recorded a total of seven abandoned nests and eight failed nests, and we did not observe any adults attempting to re-nest.

Table 1. Productivity of Swainson's hawks on the Los Baños Wildlife Area Complex, 2009.

Properties	# of Nests Monitored	% of Successful Nests	# of Fledglings	Average # of Fledglings per Nest
Los Baños WA	13	31%	4	1.0
Mud Slough Unit	1	0%	0	0
O'Neill Forebay WA	4	25%	1	1.0
Volta WA	2	0%	0	0

At the Los Baños WA, we found one Swainson's hawk nest within the canopy of a Fremont cottonwood and the remaining nests were within black willow, which is the most common tree on the property. Four nests successfully fledged young and were located in various places throughout the interior of the property (Figure 2). Of the five nests that failed at the Los Baños WA, two fell to the ground (one contained the remains of a dead nestling), one showed signs of predation with the presence of crushed eggshells, and two nests had females incubating for a few weeks but failed to produce any detectable results. We recorded four nests on the Los Baños WA as abandoned, three of which were located along the edges of the property and we observed heavy agricultural work near one of these. No matter what the nest fate, nearly all were in close proximity to roads regularly traveled by wildlife area staff and/or the public. At the Mud Slough Unit of the Los Baños WA, we located a single Swainson's hawk nest in a blue gum tree (Figure 3), which ultimately failed. This nest contained a young nestling, but it disappeared before maturing to the fledging stage.

While monitoring at the O'Neill Forebay WA, we found a total of four nests and all were located in Fremont cottonwoods (the tallest and most common trees on the property). We observed one successful nest and the remaining three were all abandoned (Figure 4), two of which were located in trees overhanging regularly traveled roads. One of these nests was abandoned early in the season and while this pair remained in the surrounding area for some time, we did not observe them at the nest or attempting to rebuild after our initial sighting.

We monitored two Swainson's hawk nests at Volta WA, both were located in black willow, and both failed (Figure 5). Few trees exist on the Volta WA, and nesting

options on the property are limited. One of the failed nests was situated above a main road that is well-traveled by wildlife area staff, however we did observe a nestling at this site. When we returned on subsequent visits, the nestling was gone and the adults were either nearby or not present at all. The second nest appeared flimsy and failed early; within a month of being built, it fell from the tree.

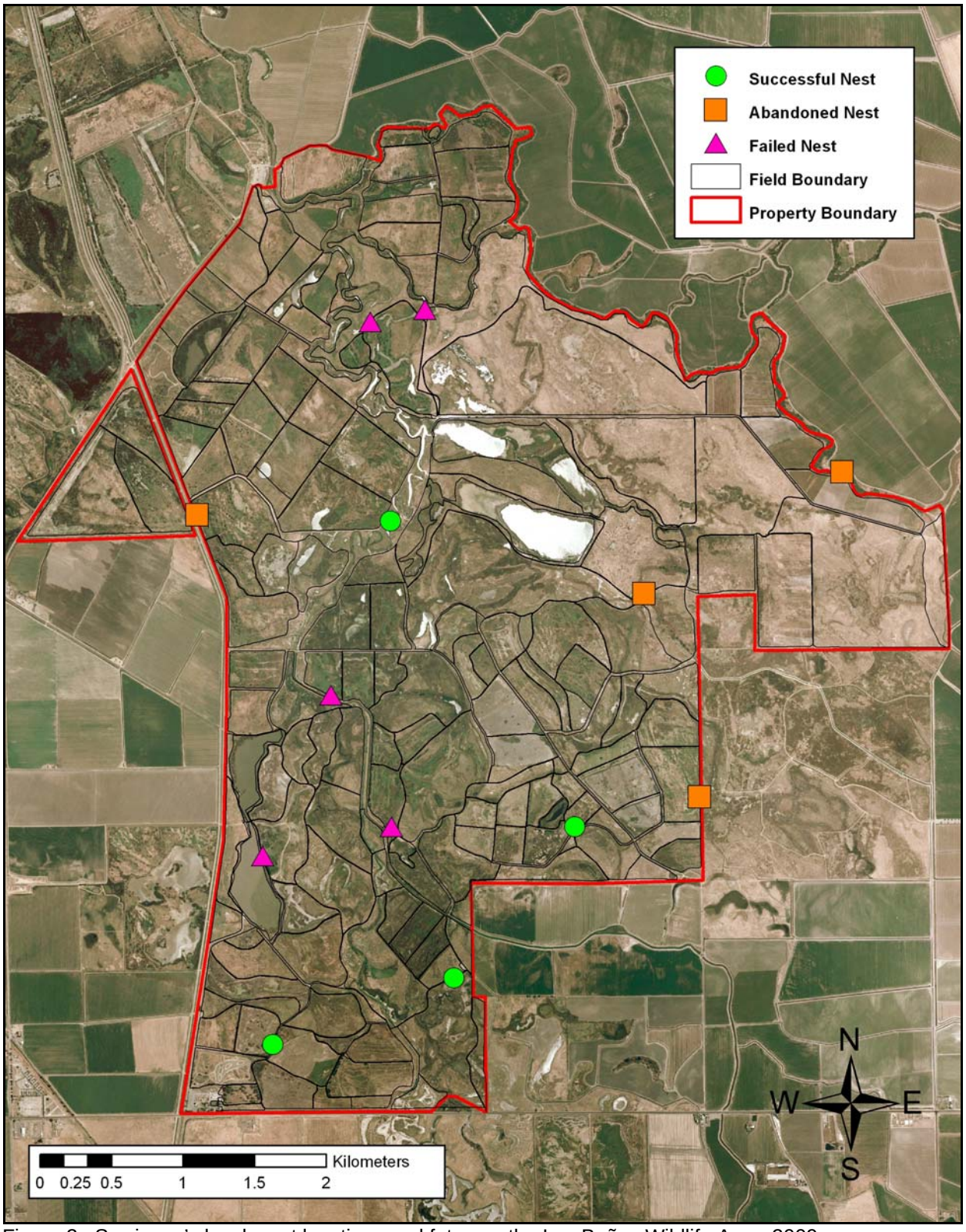

Figure 2. Swainson's hawk nest locations and fates on the Los Baños Wildlife Area, 2009.

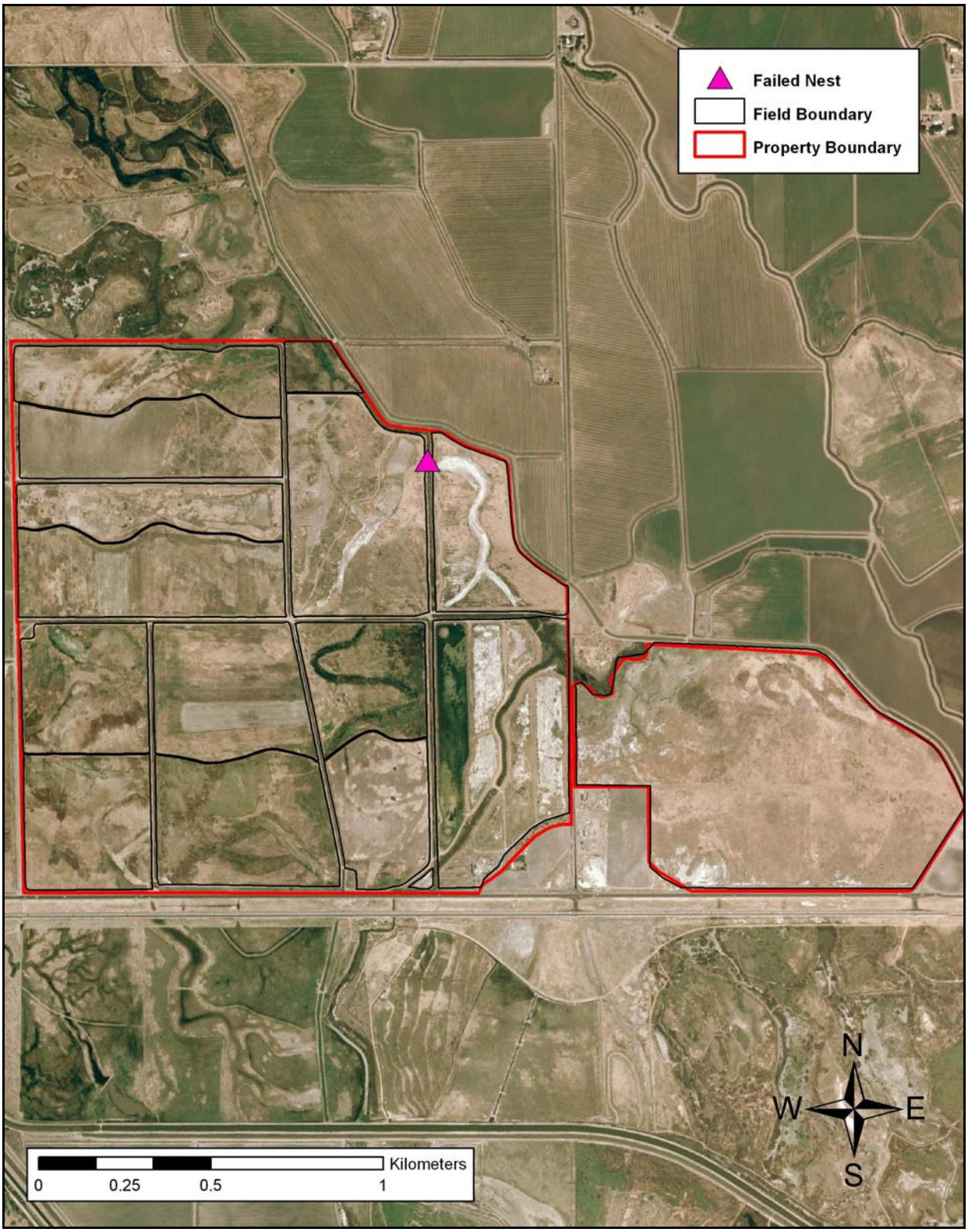

Figure 3. Swainson's hawk nest location and fate on the Mud Slough Unit of the Los Baños Wildlife Area, 2009.

Figure 4. Swainson's hawk nest locations and fates on the O'Neill Forebay Wildlife Area, 2009.

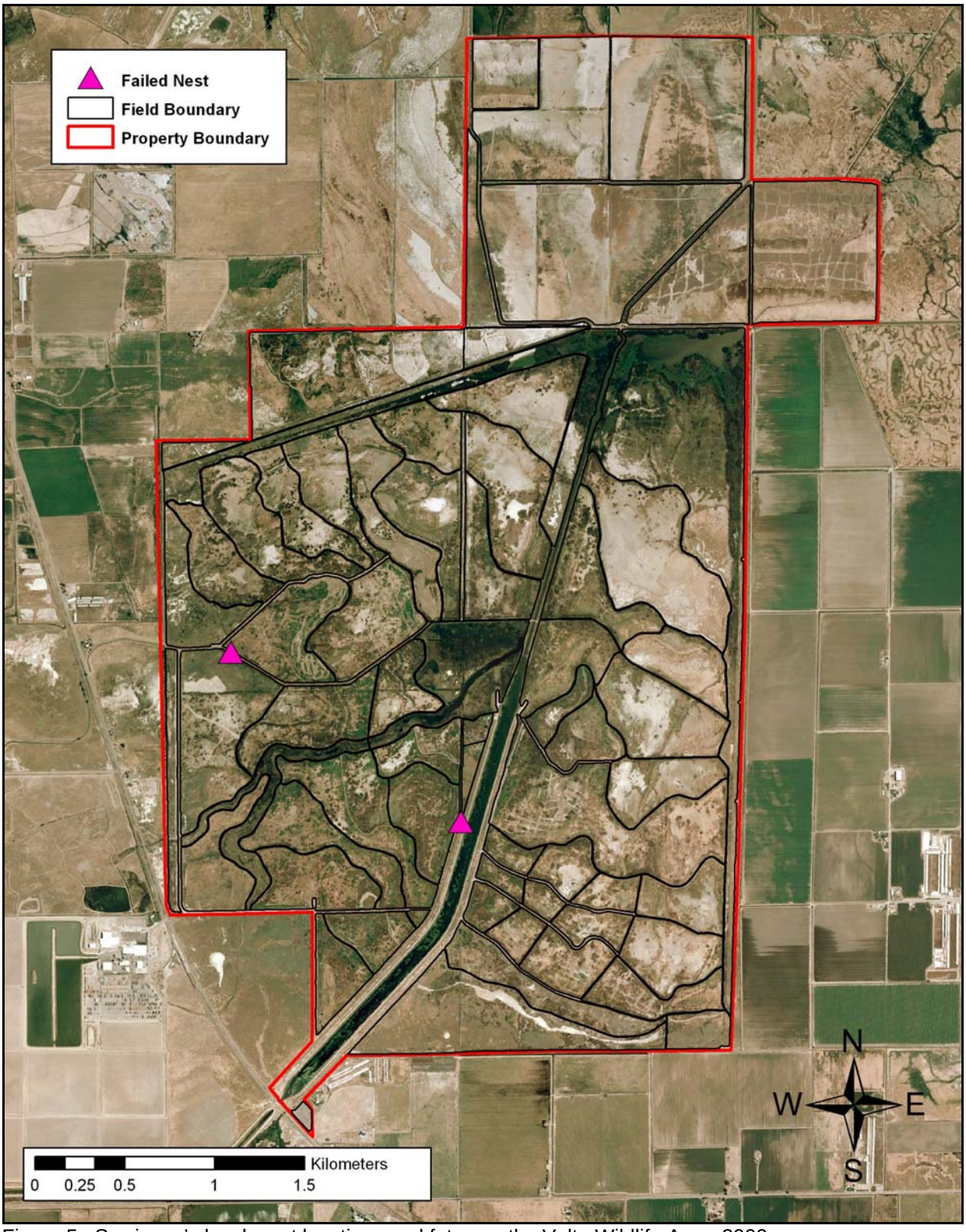

Figure 5. Swainson's hawk nest locations and fates on the Volta Wildlife Area, 2009.

Discussion

Since 2001, we have endeavored to consistently monitor Swainson's hawks and track their reproductive success on the LB Complex. During 2009, we were able to definitively categorize all nests as successful, abandoned, or failed, so there were no unknown nest fates. This year all of the successful nests we located were within the Los Baños and O'Neill Forebay WA's. These two properties offer tall trees with dense nesting foliage, good perch-hunt options and are located near a variety of foraging habitats. Such conditions may allow Swainson's hawks the opportunity to hunt in close proximity to their nesting sites and thus, increase their potential for survivability. When looking at data from previous years, we found that during 2005 and 2006, Swainson's hawk nests averaged a 57% success rate and produced a greater number of young per nest. Prior to the nesting season during those years, winter rainfall was well above average and as a result, there may have been a greater prey base to support adults and multiple young. Also, it may be possible that conditions were favorable at their wintering grounds as well, and that Swainson's hawks maintained a more substantial body weight prior to arrival, thus allowing them to produce more eggs once they began nesting. From 2007-2009, annual rainfall dropped to almost half of the normal average (California Department of Fish and Game 2009) and we observed only a 30% nest success rate. However, during these past three years we have also seen a steady increase in the number of pairs breeding and nesting on these properties. Continuing to monitor nests through an additional wet season should allow us to gain a better understanding of how rainfall affects nest success and/or the number of young produced per nest.

It has been found that between 90 to 95% of California's Swainson's hawks nest in the Central Valley. For the 2005-2006 season, Anderson et al. (2007) estimated that approximately 174 of California's nesting pairs were located within Merced County. Based on those estimates, the 20 nests we monitored on the LB Complex this year would represent approximately 15% of Merced County's expected population. According to a rating described by Bloom (1980) and Anderson et al. (2007), the population of Swainson's hawks on the LB Complex would be considered "dense", which is defined as having greater than or equal to one breeding pair per 10 square miles (approximately 26 km^2). In pristine

Swainson's hawk habitat, the expected density index ranges from a minimum of nine pairs to a maximum of 36 pairs per 100 square miles (259 km^2). The four properties we monitored during the 2009 season make up approximately 17 square miles (44 km^2), and with the number of nests observed, they fit this description. Easy access to available prey may be the primary parameter for selection of the nesting site. Good perch-hunting options, significant tree height and dense nesting foliage are preferable, but the opportunity to hunt ample prey in close proximity to the nest site may be the primary factor in determining survivability. Woodbridge (1991) and Estep (1989) both found that when presented with limited habitat, Swainson's hawks will also tolerate other adjacent pairs from 60 to 400 m away. With the available prey base, density of these hawks and type of riparian habitat available on the LB Complex, it seems that this condensed sympatric relationship may be occurring here.

For the abandoned and failed nests we found this year, we attempted to determine reasons for their outcomes. During 2009, we identified possible causes for nest failure in over 80% of the failed nests we observed this year, which included predation, poor nest construction, windy conditions, and disturbance near the nest. On the ground below one nest, we found the crushed remnants of two eggshells that had likely been predated upon. We also monitored nests containing nestlings but on subsequent visits they were no longer present, suggesting they may have been predated from the nest or the ground below. Swainson's hawks are known to build inferior nests that are weak or flimsy and relatively flat, and we witnessed one failed nest that was built at a downward slant and began to slide apart mid-season. Another that was poorly built lasted only a month before it broke apart and fell to the ground. Wind was also the cause of a few nest failures and because some nests were built on weak branches or had limited support, we found that high winds actually broke one or more supporting limbs and thus the nests fell from the tree.

Disturbance at or near the nesting site may also be responsible for abandonment and some of our nest failures, but was more difficult to determine. We are fairly certain that one Swainson's hawk nest failed early due to nearby agricultural work. This nest was located along the edge of Los Baños WA and was adjacent to private agricultural fields. After the nest was built, we did observe the female incubating

but large and noisy machinery was brought into the nearby field, after which the pair left the area. However, other nests may have had any number of disturbances or may have failed due to natural causes (such as infertile eggs). For example, one of the nests we monitored during 2009 was located in a tree overhanging a main road and was frequently traveled by CDFG staff. Although hawks have successfully nested at that location in previous years when there is traffic, a change in the pattern road of travel, presence and absence of large equipment nearby, or the timing of mowing, herbicide spraying, or other habitat alterations in close proximity may be possible factors for nest failure. However, these factors were not found to be solely associated with nests that were abandoned or failed. The adults at this site also experienced harassment from neighboring passerine flocks on more than one occasion (C. Sousa pers. obs. March – May, 2009), which may be considered a form of disturbance. Because Swainson's hawks are known for abandonment and nest failures, we recommend that observers not only pay close attention to the nest but to the surroundings as well. By recording information on habitat conditions and possible disturbances (type and timeline), it may help to reveal patterns that show why certain nests are unsuccessful or aid in making an educated guess. Checking nests more frequently would increase the chances for a surveyor to observe possible disturbances or causes for failure, but this may also increase the likelihood that the hawks will abandon due to the surveyor's presence, so care must be taken, especially during the early stages of nesting.

Surrounding habitat types were recorded for each Swainson's hawk nest found this year, however we did not designate a specific radius or distance around the nest to consider, and primarily recorded habitat types in the immediate area. Without information on adult foraging patterns or habitat use within their territory, we were unable to draw any conclusions as to habitat preferences for nest site selection. We also could not find any differences in habitat trends between successful and unsuccessful nests. At properties where there are fewer trees such as Volta WA or the Mud Slough Unit, nesting sites are often claimed by red-tailed hawks and great-horned owls before Swainson's hawks arrive, therefore they may not always be able to select their preferred habitat, but instead are forced to utilize whatever areas are still vacant. At both locations, the majority of the trees that are present are also not tall, well-leafed trees such as those preferred by Swainson's

hawks (Hansen and Flake 1995). Therefore, habitat quality and availability can be limiting factors for these birds.

For better habitat trend data analysis, we believe increasing the radius around the nest and standardizing a set distance for habitat classification would be necessary because home ranges of Swainson's hawks can vary from 69 – 8,718 ha (Woodbridge 1998). Based upon the distribution and juxtaposition of nesting habitat, high quality foraging habitat and the temporal fluctuations of prey availability, home ranges are also known to be highly variable. We feel that observing the behaviors of nesting hawks as they utilize their surrounding habitat would be more useful in determining trends for nest site selection preferences. However, this would require a more in-depth and multiple year study where personnel would need to spend a great deal of time observing adults. Because some of the properties we survey support a limited amount of adequate nesting habitat, we recommend continuing to increase riparian habitat, maintaining quality nesting trees that are frequently utilized by raptors, and managing the wildlife areas in a manner that will promote additional quality breeding sites for Swainson's hawks in the future. We also strongly support reporting data to the CNDDB to better share information across the state in hopes that the cooperative effort will provide more accurate population counts.

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