Bank Swallows on the Sacramento River, a 10-year Update on Populations and Conservation Status

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The Bank Swallow (*Riparia riparia*) is one of the most wide ranging neotropical migratory passerines in the world (Garrison 1999). In Europe and Africa, the Bank Swallow is known as the Sand Martin. The species' common and scientific names both describe the nesting habitat of these colonial swallows, which typically excavate nest burrows in tall vertical banks along rivers and other large water bodies. Their nesting colonies are transient as the swallows have evolved to exploit the dynamics of erodable cliffs and banks formed by storms and floods.

California Status

Historically, the Bank Swallow was considered a common species throughout California in the mid-1800s (Newberry 1857 as cited by Laymon et al. 1988). Grinnell and Miller (1944) described the Bank Swallow as the least numerous of the swallow species in California and limited in range due to its unique nesting habitat requirements, although they also recognized it as locally common. In addition to nesting along rivers, Bank Swallows nested at suitable vertical cliffs along the coast. Human disturbance, however — including development, habitat loss due to channelization of rivers to direct water (i.e., for irrigation), loss of freshwater foraging habitats, and recreational activities — likely caused abandonment of many of these sites and led to extirpation of the species in Southern California (Remsen 1978, Laymon et al. 1988). Armoring of river banks to prevent erosion was, and continues to be, a principal cause for decline of the existing California population (Remsen 1978, California Department of Fish and Game [CDFG] 1992, Garrison 1998, Schlorff 1997). Friable, eroding banks targeted for bank protection projects are the specific nesting habitat that swallow colonies require. The Bank Swallow was listed by the California Fish and Game Commission as a State-threatened species in 1989 (CDFG 1992).

Currently, the Bank Swallow occurs primarily along major rivers; an estimated 70% of the California Bank Swallow population nests along the banks of the Sacramento River in the Sacramento Valley and its tributary,

the Feather River (Garrison et al. 1987, CDFG 1992, Schlorff 1997). The Bank Swallow is a focal species in both California Partners in Flight Riparian Bird Conservation Plan (Garrison 1998) and The Nature Conservancy's (TNC) program, "Linking Biological Response to River Processes" (Stillwater Sciences 2007).

Sacramento River Bank Swallow Decline

Remsen (1978) documented the Bank Swallow's declining population in the Sacramento Valley in the late 1970s and noted that bank armoring projects were a major threat. An example of direct killing of Bank Swallows from armoring projects occurred in 1985 when bank protection installed by the US Army Corps of Engineers (ACOE) destroyed at least three large Bank Swallow colonies on the Sacramento River during the breeding season, resulting in the probable loss of thousands of eggs and nestlings (Schlorff 1995), as well as the potential future use of these sites. This practice has stopped in response to threats by the U.S. Fish and Wildlife Service (USFWS) to take enforcement action under the Migratory Bird Treaty Act against state and federal bank protection agencies.

In 1986, Garrison et al. (1987) intensively studied Bank Swallow colonies, especially along a 160 mile stretch of the Sacramento River. They estimated that 70-80% of the California population bred along the Sacramento River. They located 60 colonies supporting from 12 to 1,784 breeding pairs and estimated a total breeding population of 13,170 pairs (Figure 1). Following review of proposed erosion control projects, Garrison et al. (1987) concluded that over 50% of the Sacramento River Bank Swallow population could be in jeopardy, warranting a State status of threatened. In 1987, a statewide survey found that 71% of the 111 known California colonies, and 80% of the population, existed along the Sacramento and Feather Rivers, with only four colonies found south of the San Francisco Bay (Laymon et al. 1988, Schlorff 1997).

Annual surveys conducted by CDFG and USFWS during 1988-1996 recorded a declining trend to a low of 4,990 pairs in 1995 and a slight increase to 5,770 pairs in 1996 (Schlorff 1997). In 1992, a Recovery Plan was published to address this decline and develop a strategy for species habitat protection and conservation. The plan included results of a population viability analysis (PVA) that used data collected during Sacramento River surveys to determine probabilities of population persistence and extinction (CDFG 1992). Results suggested that within 50 years, a population of approximately 10,000 pairs had a high risk of declining to 1,000 pairs or disappearing entirely. This forecast raised substantial concern considering that the total estimated Sacramento River population had been below 10,000 pairs since 1986 (Schlorff 1997). Status reviews in 1995 and 2000 recommended that the threatened classification of Bank Swallow be retained (Schlorff 1995, Hight 2000).

This paper reports on the recent status of the Sacramento River Bank Swallow population, by updating the last published account in 1997 (Schlorff 1997). We include recent and previous survey results and other estimates to evaluate the status of the entire Sacramento River population over the 22-year period from 1986 to 2007. We also discuss recovery and mitigation recommendations for this population.

STUDY AREAS

Bank Swallow surveys were initiated in 1986 along the Sacramento River from Red Bluff in Tehama County, downstream 160 miles to the confluence with the Feather River in Sutter County (Garrison et al. 1987, Humphrey and Garrison 1987). The 1987 statewide survey focused on the entire California population status and included the 1986 Sacramento River study area (Laymon et al. 1988).

From 1988 through 2007, surveys have been conducted annually on the Sacramento River along the 100-mile stretch from Red Bluff (River Mile [RM] 243) to Colusa (RM 144). This reach serves as the population core for the Sacramento and Feather Rivers and has included more than 50% of the California nesting population (Laymon et al. 1988, Schlorff 1997).

We also incorporate information from two areas on the Sacramento River that have not been surveyed annually: Redding to Red Bluff (RM 244-292) and Colusa to the confluence with the Feather River at Verona (RM 144-80). The Redding to Red Bluff reach mostly contains geologically unusable nesting habitat. The Colusa to Verona reach has extensive riprap, resulting in limited nesting habitat.

METHODS

Research investigations and surveys of the Sacramento River colonies in 1986 included burrow counts, reproductive and banding studies, and habitat evaluations (Garrison et al. 1987, Humphrey and Garrison 1987). From 1988 to 2007, CDFG (in partnership with USFWS since 1999) conducted annual boat surveys along the Sacramento River between Red Bluff and Colusa (RM 243-144) except in the period 1993-1995 and in 2006. Colonies were documented using consistent methods described by Schlorff (1997). Generally, 3 or 4 observers and a boat operator completed surveys within 2-4 days in early June, documenting the location and number of colonies and number of active burrows per colony. Colony locations were reported by RM and right (R) or left (L) bank (when facing downstream).

To determine the number of nesting pairs in a colony, burrows that appeared active were counted by two experienced counters. The two counts were averaged and rounded to the nearest 10 and then multiplied by a 45% burrow occupancy rate (Humphrey and Garrison 1987, Laymon et al.1988, Schlorff 1997, Garrison, unpubl. data, CDFG files).

As estimations of populations in the unsurveyed reach from Redding to Red Bluff, we used the estimates of 5 colonies and 580 nesting pairs, based on results of the 1986 and 1987 surveys (Schlorff 1997, unpubl. data, CDFG files). Similarly, for the reach from Colusa to Verona, we assumed that they supported 8 colonies and 480 nesting pairs, based on estimates reported by independent researcher Craig Swolgaard in 2000 (unpubl. data, CDFG files). Because of limitations imposed by geologic controls and riprap, we have assumed that potential habitat and colonies in these reaches have not increased above the most recent estimates. The estimated number of pairs and colonies for these two reaches not surveyed annually together contribute approximately 5% of the totals on the Sacramento River (Redding to Verona).

RESULTS

Figure 1 shows the number of colonies and breeding pairs for both the annually surveyed reach (Red Bluff to Colusa) and the entire Sacramento River population (Redding to Verona) incorporating estimates for reaches not surveyed annually. Since 1987, Bank Swallows on the annually-surveyed reach declined to an estimated low of 4,410 pairs in 1998, and then rebounded in 1999 through 2001 to a high of 8,640 estimated pairs (Schlorff 1997, Figure 1). Since then, the annually surveyed population has fluctuated between 6,320 and 8,530 pairs. In 2007, we estimated 8,010 pairs.

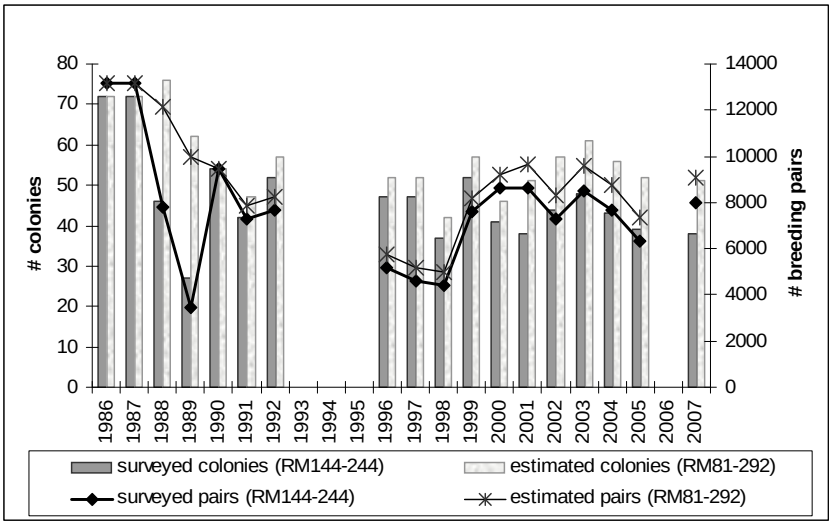


Figure 1. Number of Bank Swallow colonies and nesting pairs on the Sacramento River. Totals are shown for the surveyed reach (RM144-244) and the entire river which includes the surveyed reach plus estimates for the upper reach (RM243-292), and lower reach (RM143-81). No surveys were conducted in 1993-95 or in 2006.

The pattern for the entire Sacramento River population is similar to that of the annually surveyed reach (Figure 1), except for 1988 and 1989 when less area was surveyed. Including the estimates from the upper and lower reaches (Redding to Red Bluff and Colusa to Verona), the total nesting population is estimated to have ranged from 4,990 to 9,680 since 1997 (Figure 1).

The number of colonies within the annually surveyed reach has followed a similar trend, declining by 47% from 72 in 1986 to 38 in 2007 (Figure 1). Including estimates from the unsurveyed reaches, the number of colonies declined 29%, from 72 to 51 (Figure 1). Further, in 2007, only eight colonies supported 49% of the entire Sacramento River breeding population, posing a risk that one or several bank protection projects or episodic summer storm events could cause a catastrophic population loss.

DISCUSSION

Causes for the population increase that occurred in 1999 and the subsequent period of stability through 2005 are not understood, but may have included reduced mortalities associated with the reduction of riprap installation at active nesting colonies since 1985. Accounts from CDFG biologists and other observers indicate that from 1960 to 1985 active nesting colonies, containing both adults and nestlings, were routinely destroyed by agency bank protection projects (unpubl. data, CDFG files). The population may have taken years to recover after a 25 years of accumulated and widespread losses of many colony sites.

Environmental factors such as precipitation, resulting river flows and bank erosion patterns, and consequent variations in habitat quality along the Sacramento River, could also affect Bank Swallow numbers. Variation in weather patterns and habitat quality on the wintering grounds in South America and along migratory routes are also likely to affect swallow numbers on the summering grounds, but these factors have not been investigated.

Nonetheless, annual surveys through 2007 reported fluctuating numbers that remained below the baseline of 13,170 pairs, and below the critical population threshold of 10,000 pairs suggested in the PVA (Buechner 1992). In summer 2007, CDFG drafted a petition to change the legal status of the Bank Swallow from threatened to endangered, for presentation to the California Fish and Game Commission. Further population declines, or losses of habitat due to bank protection projects, could trigger submission of the petition.

1992 Bank Swallow Recovery Plan

The Bank Swallow Recovery Plan established a goal of maintaining a self-sustaining wild population by ensuring no further decline in range or

abundance and sufficient habitat availability so "the species will be able to survive as a member of California's native avifauna" (CDFG 1992). Concepts of the plan include impact avoidance, habitat preserves, and a series of set-back levees to allow the river to meander, thereby creating and maintaining essential nesting habitat.

Existing Conservation Lands

In 1988, agency and nonprofit groups including USFWS and TNC initiated the Sacramento River Project with the primary goal to restore the riparian ecosystem of the Sacramento River from Red Bluff to Colusa (Golet et al. 2003). The Sacramento River National Wildlife Refuge ("Refuge") was established in 1989 with authorization for acquisition of 18,000 acres of riparian and floodplain lands between Red Bluff and Colusa (USFWS 2005). As of 2007, the USFWS had acquired 10,140 acres of riparian and floodplain habitat and flood-prone agricultural lands (primarily walnut orchards and row crops) for the Refuge. A total of 4,512 acres of these agricultural lands have been restored to habitat; and, combined with the remnant native habitat, the Refuge totals 8,468 acres of riparian and floodplain wildlife habitats including over 200 acres of riparian grasslands. CDFG manages about 4,000 acres of riparian habitats at the Sacramento River Wildlife Area. The California Department of Parks and Recreation, Department of Water Resources (CDWR), and TNC also own or manage riparian habitat between Red Bluff and Colusa.

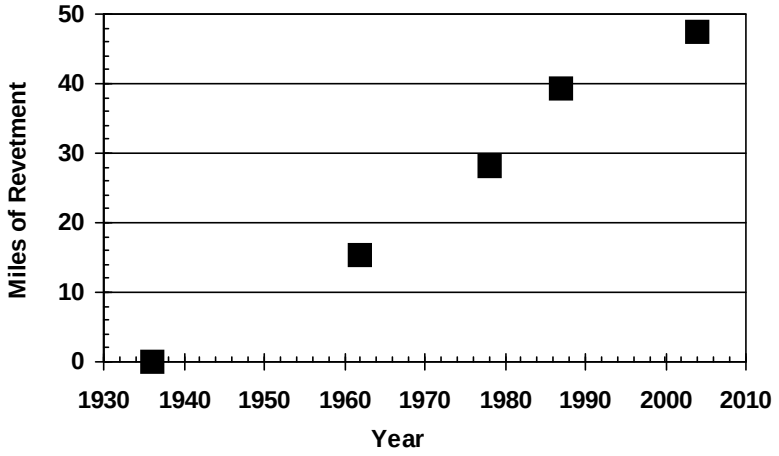
During the 2007 Bank Swallow survey, 38 colonies were documented between Red Bluff and Colusa; 18 (47%) of these colonies were located on the banks within the Federal Refuge and State Wildlife and Park lands. While some properties are contiguous, many exist in a "string of pearls" arrangement interspersed with private properties where there is no easily enforceable protection against illegal unloading of rock on eroding banks.

Impact Avoidance Conflicts

While placing rock over active colonies was stopped by agencies in 1986, colony sites have continued to be destroyed outside the nesting season without mitigation. Since the 1930s the CDWR, U.S. Bureau of Reclamation, ACOE, and private property owners have armored over 48 miles of the erodable banks of the Sacramento River between Red Bluff and Colusa with riprap and rubble for bank stabilization projects (Figure 2). From 1989, when the Bank Swallow was listed, through 2002, 7 miles of riprap were added to these river banks. This amount of armoring has had a cumulative detrimental impact by reducing the availability of nesting habitat for the Bank Swallow.

The needs of landowners and other protected species also pose conflicts with protection of Bank Swallow habitat. For example, a levee

Figure 2. Cumulative number of miles of Sacramento River bank stabilized between Red Bluff and Colusa (RM 244-144) from 1935 to 2002 (Data provided by A. Henderson, CDWR, pers. comm.).



maintenance project armored prime nesting habitat along the bank of a Wildlife Area in 2006. During 1986-2005 surveys, active Bank Swallow colonies were documented at this bank in 15 (79%) of the 19 years, and supported an average of 170 nesting pairs, and a high of 630 nesting pairs in 2004. Post-project mitigation is currently being discussed for this impact.

Privately placed rock and rubble (e.g., demolition concrete, asphalt) also continues to threaten and displace colony sites. These bank protection activities are mostly conducted at eroding walnut orchards or on other agricultural lands being prepared for conversion to orchard. While the scales of individual private rocking activities are small compared to agency projects, they add to the cumulative impact on Bank Swallow nesting habitat.

Managed Bank Flows

Managed bank flow releases from Sacramento River and tributary dams have changed the flood regime to protect properties along the river, maintain flows in the Sacramento- San Joaquin Delta for fisheries, and provide irrigation, resulting in reduced high winter flows and increased high summer flows. Natural high winter flood events both remove and create nesting habitat for Bank Swallows arriving in the spring, but have a net positive effect (Moffatt et al. 2005). Renewal of bank surfaces is important to Bank Swallows. They may abandon old burrows in non-eroded banks after a few years due to parasite load, overgrowth of vegetation and slumping of vertical faces which facilitates predator entry into burrows (Garrison 1999), and hardening of surfaces that are no longer suitable for

burrowing. Although summer flows released for agriculture and to maintain flows for downstream Sacramento–San Joaquin Delta fisheries are unlikely to reach burrow level, they may saturate and undercut banks and cause slumping and sloughing (Stillwater Sciences 2007), resulting in swallow mortalities or colony abandonment (Humphrey and Garrison 1987). Ultimately, managed flows have changed the natural regime of the Sacramento River and have detrimentally affected Bank Swallow habitat and populations (CDFG 1992, Moffatt et al. 2005, Stillwater Sciences 2007).

Recovery Recommendations

A number of recommendations that may enhance the Sacramento River Bank Swallow population have been suggested in the Recovery Plan (CDFG 1992) and by various researchers (Garrison and Humphrey 1986; Garrison et al. 1987; Laymon et al. 1988; Buechner 1992; CDFG 1992, 2000; Moffett et al. 2005; Stillwater Sciences 2007). These actions can be implemented as mitigation measures.

Habitat preserves – Purchase of long, high, erosion-prone banks with current or potential use by Bank Swallows for permanent protection as habitat preserves is the most likely alternative to ensure long-term viability of the species (CDFG 1992).

Set back levees and rock removal – Properties should be identified at locations where levee setbacks can create a larger meander zone and/or where bank armor removal might occur (CDFG 1992, Moffatt et al. 2006, Stillwater Sciences 2007). It is essential to evaluate these lands for key nesting habitat characteristics including height, length and depth of bank, aspect, proper soil type and vegetation cover, and proximity to other colonies (Garrison and Humphrey 1986, Stillwater Sciences 2007). Larsen et al. (2006) modeled several different setback distances from the Sacramento River's current channel conditions over a 100 year period assessed along a 17-mile long reach. They found that setbacks of 100-800 meters (330-2,400 feet) would allow the river to meander and rework two to eight times more floodplain area than the current armored conditions allow (Larsen et al. 2006), thereby creating potential new habitat for bank swallows. Removing rock has proven successful for swallows. In 1999, the Refuge removed a private levee and riprap at RM 233. The following spring an estimated 2,770 burrows (~1250 pairs), were documented at this site (Golet et al. 2003), the third largest colony counted in survey history.

Native grassland restoration – Many colonies are found along stretches with herbaceous ground cover (Schlorff 1997), which likely provides increased insect prey and less resistance or obstructions to burrowing, due to its shallower root system than trees. Moffat et al. (2005) found that colonies are more likely to persist when closer to grassland. The Refuge is restoring riparian grasslands including one adjacent to a Bank Swallow colony.

Managed flow releases to promote natural patterns of bank erosion – Optimal magnitudes of seasonal flow releases still require evaluation but may include higher flows prior to the breeding season (August-March) to create fresh banks, and lower flows during the breeding season (April – August) to prevent sloughing and nest inundation during the nesting season (Stillwater Sciences 2007).

Continued monitoring – Continued standardized annual monitoring, as conducted by CDFG and USFWS, is imperative to track population trends and determine the need for and effectiveness of specific conservation measures. Monitoring should be conducted more frequently within a nesting season to determine colony fate. Monitoring should also include the reaches north of Red Bluff and south of Colusa Landing for more precise population estimates.

Landowner incentives and outreach – Currently, agency and non-profit incentives and programs exist and are being developed to assist landowners and encourage restoration of riparian vegetation along banks or to allow natural erosion processes. Purchase of properties with potential bank swallow habitat is also available to willing sellers (B. Anderson, Sacramento River Conservation Area Forum, pers.comm).

Specific research – Additional research needs include the influence of nest ectoparasites on reproductive success, banding studies to determine site fidelity and population dynamics, and wintering habitat and ecology (Stillwater Sciences 2007). D. Garcia is currently conducting an analysis of colony population trends as affected by bank revetment and river channel migration rates. An updated PVA is scheduled to be published in 2008 (S. Greco pers. comm.). Further, identification of potential Bank Swallow habitat across portions of Sacramento River floodplain is being developed in cooperation with the Refuge, CDWR, TNC and other agencies and organizations.

In summary, Bank Swallows require near vertical banks of friable soil for colony sites, which are created or renewed through flooding, erosion, and channel migration; the physical processes of an intact alluvial river ecosystem (USFWS 2005). Bank protection projects employing riprap are likely to continue to occur and in each case, mitigation should be required to secure no net loss of habitat. With increased agency and landowner cooperation, and implementation of the recovery recommendations, the Sacramento River Bank Swallow population may be secured and restored, the essential component to the statewide recovery of the species.

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and complexities of bank revetment. Finally, we dedicate this publication to the memory of the late Barrett (Barry) Garrison, our good friend, respected colleague, and the undisputed authority on the biology, ecology, and habitat relationships of the Bank Swallow in California. Over a span of 20 years, Barry designed and participated in many research projects on the species, including the earliest investigations in 1986-87. This work has formed the essential baseline information for Bank Swallow population monitoring, habitat assessments, conservation planning, and other recovery efforts.

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Nesting Use of Bridges by the Northern Rough-winged Swallow in the Sacramento Area

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Key word: Northern Rough-winged Swallow, *Stelgidopteryx serripennis*, nesting, habitat, bridges, nest site competition

The Northern Rough-winged Swallow (*Stelgidopteryx serripennis*) is a widespread breeding species in North and Central America (De Jong 1996). The Breeding Bird Survey shows that the species has declined in California at a relatively high average annual rate of 3.2% since 1966 (Sauer et al. 2007), although it remains relatively common in the Central Valley (Bell et al. 1998, Green 2005), with no recent population decline detected there (Sauer et al. 2007). Its localized occurrence is determined by the availability of suitable nest sites (De Jong 1996). Northern Rough-winged Swallows nest in burrows and crevices located in rocky gorges, banks, road cuts, railroad embankments, gravel pits, eroded streams, and other exposed banks of clay, sand, or gravel. It also uses cavities and crevices in vertical surfaces, including gutters, culverts, drainpipes, and crevices or holes in walls, wharves, and bridges (De Jong 1996).

Use of bridges and other transportation structures by the Northern Rough-winged Swallow has received little attention in scientific literature (Green 2005, De Jong 1996). Our recent observations of the species' use of overpasses and elevated freeways ("bridges") in urban Sacramento suggest that these structures provide nesting opportunities that may allow Northern Rough-winged Swallows to occupy urban areas that otherwise would be unsuitable for them. Better knowledge of the timing of nesting use of bridges may be useful to establish protection measures for maintenance and construction activities on bridges and adjacent lands. Bridges in Sacramento also are known to be occupied by several other hole-nesting species, which raises questions about species interactions and differences in nest site selection within bridges.

We provide initial information on frequency and timing of bridge use and the characteristics of nest sites within bridges used by Northern Rough-winged Swallows in urban Sacramento. We also compare nest site selection by swallows and other bridge nesting species, which may allow coexistence of multiple species at bridge sites.

STUDY AREA

We observed Northern Rough-winged Swallows nesting in bridges of the steel and concrete box girder design (Airola and Grantham 2003) primarily during studies of Purple Martins (*Progne subis*) in Sacramento (Airola and Kopp 2007). Surveyed sites included occupied Purple Martin bridge sites surveyed intensively over the breeding season, other sites suitable for Purple Martin use that were not used by martins (Leeman et al. 2003), and shorter overpasses not considered suitable for Purple Martins. Occupied Purple Martin bridge sites and other suitable martin sites tended to be longer spans (generally >80 m [250 ft]) than the more common overpasses present throughout the area (Airola and Grantham 2003, Leeman et al. 2003). The smaller overpasses were surveyed opportunistically for swallows during general travel around the city. Nest sites within bridges consist of large chambers that are accessed through vertical holes in the undersides of the structures ("weep holes"; Airola and Grantham 2003).

As a result of observed use patterns (see Results), we focused attention on use and characteristics of holes near bridge abutments (i.e., ends of bridge spans; Figure 1). We refer to holes immediately adjacent to abutments as "abutment holes" and holes in the main portion of bridges as "main span holes". Most abutments are diagonally shaped except for a

Figure 1. Sloped abutment at west side of the Arden Way overpass of railroad tracks in Sacramento, California. Note weep-hole entrances to bridge nesting chambers in upper foreground. Weep holes here are 0.8 m (2.3 ft) away from the 1.6 m (5 ft) tall vertical abutment wall. One of these holes adjacent to the abutment wall was used in three different years by Northern Rough-winged Swallows.

short (1-2 m; 3-6 ft) vertical wall at the far upper end ("sloped abutments"), Figure 1). A few of the surveyed sites, generally at shorter overpasses, had "vertical abutments", in which the bridge ends in a full-length vertical wall.

METHODS

We recorded the presence and evidence of breeding use of bridge sites by Northern Rough-winged Swallows during Purple Martin surveys from early February through early August during 2002-2007 (Airola and Grantham 2003, Airola and Kopp 2007). We characterized bridge sites as likely occupied by nesting pairs if we observed swallows during the nesting period. During repeated visits to bridge sites, we mapped holes used by swallows and recorded behaviors that would indicate breeding use (e.g., carrying nest material, removing eggshells, carrying food to young, young seen or heard begging, and dependent fledglings seen outside the nest; see Airola and Grantham 2003). We also used these observations to determine nesting periods and the timing of nesting activities.

We characterized attributes of swallow nest sites from locations where we observed hole use, including entrance-hole heights above the ground and distances to bridge abutments. We compared nest site characteristics of the different species breeding within bridges to determine the possible effects of other species' presence on swallow nest site selection. We compared the proportions of swallow nest sites within abutment holes and main span holes at sites that were both occupied and not occupied by Purple Martins and other cavity nesting species. Comparisons were evaluated statistically using the χ^2 goodness-of-fit test.

RESULTS

We observed a total of 53 pairs of Northern Rough-winged Swallows over the 6 years of the study at 20 different sites. Thirty-six (68%) swallow pairs were at Purple Martin colony sites, and 13 pairs (25%) were at longer bridge sites not occupied by nesting martins. We observed four pairs (7%) opportunistically at shorter overpasses not considered suitable for martins.

The number of swallow nesting pairs at sites occupied by Purple Martins varied from 0 to 2 pairs per year, with an average of 0.5 pairs per martin site. Six survey sites that were not occupied by martins supported 0 to 5 pairs of swallows annually. The greatest number of swallows at a single site (5 pairs in one year) was observed in Interstate 5 above Discovery State Park, a long span not occupied by martins, where swallows used main span holes. Among 43 sites where annual surveys detected nesting swallows (including observations in multiple years at a single site), only 5 (12%) revealed multiple pairs at a site.

Northern Rough-winged Swallows were observed in nesting areas between 11 March and 20 July (N = 123 observations). Swallows were

observed entering weep holes from 31 March through 20 July (N = 62). Nest building was observed between 31 March and 27 April (N = 7), and hatched young were present in nests (based on observations of eggshell removal, adults feeding young, or young heard calling) between 30 April and 7 June (N = 4). Dependent fledglings were observed near nesting areas from 11 to 21 June (N = 3).

Of a total of 40 holes observed used by Northern Rough-winged Swallows (presumably mostly as nest sites), 18 (45%) were within abutment holes located near sloped bridge abutments (Figure 1), 2 (5%) were at vertical abutments, and 20 (50%) were in main span holes. The pattern of swallow use among sites with and without nesting Purple Martins differed substantially. At martin colonies, 18 (60%) of 30 holes used by swallows were located near abutments, while only 2 (20%) of 10 holes in non-martin sites were near abutments. This pattern of hole use at martin and non-martin sites differed significantly ($\chi^2_{1\ d.f.} = 4.80$; $p < 0.05$).

In contrast to the 60% use rate of abutment holes by swallows at martin sites, these holes comprise only 10% of the available holes at sites we studied. Thus, swallows used abutment holes within martin sites substantially more often than would be predicted based on their availability ($\chi^2_{1\ d.f.} = 83.3$, $p < 0.001$). This use pattern suggests that swallows actively seek out abutment holes for nesting use within martin colonies. Our opportunistic data collection methods at non-martin sites does not allow us to rigorously evaluate site selection within these areas, but the use of holes near abutments in only 20% of cases suggests the possibility that when martins are absent, swallows more readily use holes in the main span and are less relegated to abutment holes.

Fourteen rough-winged swallow nest sites measured in abutments at 6 different bridge sites were located an average of 0.7 m (2.0 ft) from the vertical abutment wall with a range of 0.5-0.8 m (1.6-2.6 ft) away from the wall. The height (above ground level) of weep holes used by swallows near sloped abutments averaged 1.4 m (4.3 ft; N=13), and ranged from 1.2-1.6 m (3.6-5.0 ft). Heights above ground within main spans and vertical abutments were not measured individually, but sites were at heights typical of main spans, which were previously characterized as >6 m (18 ft) (Airola and Grantham 2003).

DISCUSSION

Northern Rough-winged Swallows have made widespread use of both longer bridge structures, and perhaps shorter ones, in the Sacramento region. The relative importance of bridges to local rough-winged swallow populations is not known precisely, as the species also is known to make use of river banks, railroad trestles, and other sites within the local area (Airola and Kopp pers. observ.) but the sizes of populations nesting in these habitats have not been quantified.

Examination of nest site characteristics indicates that, at sites we surveyed for Purple Martins, Northern Rough-winged Swallows actively select abutment holes. The swallow's small size and maneuverability (De Jong 1996) apparently allows it to occupy abutment sites, which provide substantially less horizontal and vertical space around the entrance than is present under main span holes.

The frequent use by Northern Rough-winged Swallows of abutment holes at martin colonies, in contrast with the greater use of main span holes in areas where Purple Martins are absent, suggests that interspecific competition may be causing rough-winged swallows to use abutment holes. The competition, however, may not be solely with martins, as most martin colony sites also support nesting White-throated Swifts (*Aeronautus saxatalis*) and European Starlings (*Sturnus vulgaris*) (Airola and Grantham 2003, Leeman et al. 2003). None of these three other species have ever been recorded nesting in abutment holes in Sacramento (Airola and Kopp, unpub. data). The submissiveness of rough-winged swallows in nest site selection in the presence of other species has been widely noted elsewhere (De Jong 1996). The possibility that Northern Rough-winged Swallows are attracted to sites that support other species is not testable from our data. It is possible that the swallows could be simultaneously attracted to sites where other species are nesting (perhaps for the benefit of predator detection) while also being relegated to abutment holes at these sites.

Densities of Northern Rough-winged Swallows in Sacramento nesting areas are lower than reported elsewhere, where groups of pairs often nest in loose colonies (De Jong 1996). The lower density at Sacramento bridges may result from competition with other species or other unknown factors

The Northern Rough-winged Swallow's small size and greater maneuverability, as well as our limited observations from sites not occupied by Purple Martins, suggest that it may be able to occupy a higher proportion of smaller overpasses in the region than the faster-flying Purple Martin and White-throated Swift. Smaller overpasses are more common in the region than longer ones used by the martin and swift (Leeman et al. 2003), suggesting that bridges could be important in supporting the species' regional nesting population.

The Northern Rough-winged Swallow's use of urban bridge sites suggests that it is relatively tolerant of human activities. The widespread use of bridges, however, suggests a need to consider protection during construction and maintenance activities around occupied sites during the nesting season. At present, the available information on swallow responses to construction and maintenance disturbances is inadequate to prescribe detailed protective guidelines, except for identification of periods of occurrence and nesting use (see Results) that may be used to avoid disturbance that could lead to nest failure. Our characterization of the timing of individual nesting behaviors, however, is based on few observations and could be verified through more study, including direct examina-

tion of nest sites with pole-mounted cameras.

Bridge sites may not necessarily be of high conservation importance to the Northern Rough-winged Swallow in the Central Valley, given the species' relative abundance and apparent stability (Bell et al. 1998, Sauer et al. 2007). The species, however, is declining elsewhere in the state (Sauer et al. 2007) for unknown reasons, so it is possible that adoption of bridge sites may be helping to offset other factors, such as loss of vertical banks and other nesting habitats (Garcia et al. 2008). Regardless of their conservation value, use of urban bridges by Northern Rough-winged Swallows provides welcomed opportunities for city dwellers to regularly observe this interesting species.

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Northern Rough-winged Swallow (*Stelgidopteryx serripennis*).

photo by Steve Abbott

Central Valley Bird Highlights: August 2007 through November 2007

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One of the highlights of the fall season was the Central Valley's and Merced County's first **Yellow-billed Loon** glimpsed and identified at O'Neill Forebay on 16 November (TaEa), then seen there subsequently on 19-23 November (ADeM, PF, KR). This is only the sixth inland location where this species has been found in California. A **Pacific Loon** at Lake Success on 12 November (TK) provided a rare record for Tulare County. Another was at Folsom Lake in Placer County on 14 November (BWe) where this species is somewhat regular. An early **Red-necked Grebe** was along Putah Creek at Lake Solano on 21-28 October (JCS+) for about the fifth Yolo County record and one of few for Solano County. Two **Red-necked Grebes** at Stony Gorge Reservoir and one at Black Butte Reservoir on 10 November (RS, CL, LL) provided the first Glenn and Tehama County records, respectively. The latter bird was still present on 27 November (EPa, FO). Another was on Lake Natoma along the American River in Sacramento County on 23+ November (SHo+). Tuolumne County's long overdue first record of **White Pelican** came with four on the large pond north of Hwy 120 near Hwy 108 on 7 October (EPa, CH). A **Glossy Ibis** at the Vic Fazio Wildlife Area on 25 August (ToEa ph., JCS+) was a first for Yolo County and only the second one found in the Central Valley. Two were found there on 10 October (ToEa ph.+). This species has been dramatically expanding its range westward from the southeastern United States and has recently spread into California, where first recorded in 2000. Rare in the western Sierra Nevada foothills, a **Eurasian Wigeon** at Goffinet Reservoir on 4 November (LL, CL) provided one of few records for Amador County. A rare inland **Long-tailed Duck** was at Gray Lodge on 3 November (PD) and another was at the O'Neill Forebay on 20 November (JLx, JSL, FO). A **White-winged Scoter** at the Feather River Fish Hatchery in Oroville on 17 October (SK) was one of few Butte County records of this coastal species. A **Surf Scoter** in a small pond along the American River Parkway in Rancho Cordova on 28 December (JLa) was a surprise as this species, of rare occurrence inland, is usually found in large reservoirs in the region.

An immature gray-morph **Gyrfalcon** in southeastern Kings County on 21-23 November (SSu, EPa ph.) was an extraordinary find. If accepted by the CBRC it would be the southernmost record for California and only the third Central Valley record.

A report of two **Black-bellied Plovers** at the northern area of Black Butte Reservoir on 24 September (KP) was one of few records for Tehama County. A **Semipalmated Plover** at the Salt Springs Valley Reservoir on 6 August (JSL, EPa, FO) provided only the third record for Calaveras County. The fourth record soon followed with three there on 24 August (JLx). This

species along with Black-bellied Plover, Dunlin, Short-billed Dowitcher, Pectoral Sandpiper, Baird's Sandpiper, Marbled Godwit, Willet, Whimbrel, phalaropes and others that are regular in the Central Valley floor are extremely rare in the Sierra Nevada foothills. Seven **Red-necked Phalaropes** at the sewage ponds in Valley Springs on 24 August (JLx) provided only the second Calaveras County record. Although a regular breeder at a few evaporation ponds in the lower San Joaquin Valley, a **Snowy Plover** at Lake Success in the foothills on 21 September (TK) was at an unexpected location in Tulare County for this species.

Two **Dunlin** near Black Butte Reservoir on 9 October (BED) and more on 27-28 November (EPa, FO, BED) provided two of few Tehama County records. Dunlin is common in flooded rice fields but this habitat is very scarce in Tehama County as compared to neighboring Butte and Glenn counties. A **Pectoral Sandpiper** on a small pond at Angel's Camp on 29-30 September (DM ph., FO) was a first record for Calaveras County. An adult **Red Knot** and **Sanderling** at the Woodland Sewage Ponds on 6-8 August (JHu, JCS ph., RA+) provided the second record of the former in Yolo County this year after this species had not been recorded in the county in many years. The Davis Wetlands typically attracts rare shorebirds during migration and this fall was no exception with an adult **Sanderling** and two **Semipalmated Sandpipers** found there on 5 August (ToEa, FSt, RA+). Also in Yolo County, a **Ruff** found at the Vic Fazio Wildlife Area on 9 October (ZS) was joined by a second bird on 19 October (ToEa) and two juvenile **Sharp-tailed Sandpipers** on 25 October (ToEa). Butte County's fifth record of **Semipalmated Sandpiper** came from a flooded rice field near Nelson on 12 August (JSn). In Merced County, a **Solitary Sandpiper** was at the Gustine Sewage Ponds and a **Ruff** was along the Sante Fe Grade on 27 September (PM). Another **Ruff** was at the Gustine Sewage Ponds on 6 November (PM). At the Fresno Sewage Ponds on 21 August, the county's fifth **Red Knot** was discovered (GW). Nearby at the large ponds on Hwy 43 and Ave 56, an immature **Red Knot** on 1 September (JW, JLk) was an overdue first Tulare County record. A **Snowy Plover** was also present there. At these same ponds on 22 September, a **Stilt Sandpiper** was discovered (JLk) and another was at Pixley NWR on 9-13 October (SSt). This species is of annual occurrence in Kings and Merced counties, and may prove to be more regular in large flocks of dowitchers in neighboring counties. At Fresno Sewage Ponds birders were treated to a rare **Parasitic Jaeger** on 28 August (GW ph.+) for the second Fresno County record of a jaeger species. This is a common pelagic species that is occasionally found at large bodies of inland waters in northern California during fall migration. It was once thought to be by far the most common jaeger inland, but recent records suggest that it is less common than **Long-tailed Jaeger**. A juvenile **Long-tailed Jaeger** at the Davis Sewage Ponds on 25 August (JCS+) was probably the same bird seen flying over the Vic Fazio Wildlife Area on the same day (SE, ToEa+) and was only the third Yolo County record.

Although regular in small numbers in the Sacramento and Delta areas, an adult **Western Gull** on 20 September at the Davis Landfill (ToEa, JHu) seems early for this wintering species. Kutras Lake along the Sacramento River in Redding, Shasta County, and the Feather River Fish Hatchery in Oroville, Butte County are the best locations for rare gulls in the valley north of Yolo-Sacramento-Placer counties. Surprisingly rare north of Yolo-Sacramento-Placer counties and away from the gull hotspots in Redding and Oroville, a first-cycle **Glaucous-winged Gull** was along Hwy 99 in flooded fields near Bobelaine Preserve on 28 October (SGl, FO) for one of few Sutter County records. Similarly rare in this area, a first-cycle **Thayer's Gull** was at the Sacramento NWR in Glenn County on 28 November (JCS) and an adult **Western Gull** was in se Sutter County on 7 November (CH) for a first county record. A first-cycle **Mew Gull** was present at Kutras Lake on 29 October (RB) where this species is now an annual visitor, and another was joined by a **Glaucous-winged Gull** at the Feather River Fish Hatchery on 10 November (RS, LL, CL). In the San Joaquin Valley south of the Delta influence, **Mew Gulls** are still considered fairly rare, so one in sw Kings County on 19 November (ToEa, TaEa) and another at the Gustine Sewage Ponds in Merced County (ToEa, JCS+) on 16 November were noteworthy records. The Yolo County **Franklin's Gull** found on 1 July was last reported at the Davis Wetlands on 8 September (SHa) along with three juvenile **Common Terns**, with two terns remaining until 13 September (SHa). Possibly a different **Franklin's Gull** was at the Davis Landfill pond on 27 October (GE) and 11 November (RA). In Kings County, a **Sabine's Gull** at the ponds on the west side of Highway 41 between Jersey and Kent Avenues, and a **Franklin's Gull** in the Tulare Basin 14 September (JSe) was a typical date and locations for these rare, but regular fall migrants. Other **Franklin's Gulls** were at the Thermolito Afterbay in Butte County on 21 September (TM) and the Gustine Sewage Ponds in Merced County on 11 October (MR, MM, FT, RJ).

A first for the Sierra Nevada foothill region was a **White-winged Dove** attracted to feed set out for racing pigeons near Placerville during mid-August, which is a first record for El Dorado County, as well (DB ph., fide BWe). This species is a rare vagrant in northern California with the vast majority of records from the coast as far north as Del Norte County. Inland it has been seen as far north as Alpine County on the east side of the Sierra Nevada and Kings County in the San Joaquin Valley floor. The status of **Long-eared Owl** in the Central Valley and adjacent foothills is not well understood due to it nocturnal habitats and tendency to roost in dense vegetation. Therefore, one found at the Bufferlands in Sacramento County on 29 October (CC) was noteworthy. An immature **Broad-tailed Hummingbird** visited a feeder in Rancho Cordova at dusk on 26 September (ToEa ph.) for one of few records for Sacramento County and the Central Valley. A **Costa's Hummingbird** in the city of Madera on 6 November (MSM Jr) was a good find for Madera County, for which there are few records (*fide* JD). Last winter's

Red-naped Sapsucker returned to Larchmont Park in Sacramento County on 9 November (GE). A **Yellow-bellied Sapsucker** was along Clayton Road in western Solano County 19+ November (RMu, JCS ph). Another was in Bakersfield in Kern County on 18 November (KK, BK).

Yolo County's first well-documented **Least Flycatcher** was at the Grasslands County Park on 20-24 September (ToEa+). A female **Vermilion Flycatcher** at Gray Lodge on 9+ November (TR+) was the third Butte County record. A **Red-eyed Vireo** put in an appearance along with many other migrants along Babel Slough on 10 September (AE) for the second Yolo County record. Another was at the Cosumnes River Preserve on 1 September (JTr). A regular fall migrant in region, single **Sage Thrashers** were near Folsom on 2 October (BA) in Sacramento County; and in Tulare County at Lake Success campground on 3 November (JLk) and near Strathmore on 11 November (TK).

The warbler of the season was the **Bay-breasted Warbler** found along the American River at Gristmill Park on 9-13 September (JLa, CC ph.+), in the same area in which a **Northern Parula** (ToEa ph.) was seen later in December. Birders searching that same area found a **Chestnut-sided Warbler** on 21 September (BA). This location has had numerous vagrant warblers in previous years. A **Tennessee Warbler** at UC Davis on 19 September (AE) was one of few reports for Yolo County. The Cosumnes River Preserve did not produce its normal share of vagrant warblers this fall, but an **Ovenbird** there on 3 November (SW) was an exceptional find. Lagoon Lake near Fairfield once again was the site of a rare fall vagrant with a **Northern Waterthrush** on 3-5 September (TJ, FSc, JC, JCS ph.). A **Prairie Warbler** at Hart Park in Bakersfield on 16 October (JSL) was one of few records for the Central Valley and Kern County of this species that is most often found in California along the coast. Rounding out the eastern warbler records was a **Palm Warbler** in Vacaville on 1 November (DBe) for perhaps only the second Solano County record. More **Rose-breasted Grosbeaks** were found than expected with a male on the Solano County side of Putah Creek on 24 August (AE), a female at Hart Park near Bakersfield on 10 November (KK, BK, ph.), a male along the American River Parkway on 24 August (MMa), and a female in a Sacramento neighborhood on 14 September (MP). Three adult **Indigo Buntings** were found on the Cosumnes River Preserve on 5 August with two males still present on 12 August (JTr) including one feeding two fledglings for the first Sacramento County breeding record since 1996! Another male was along Cache Creek in Yolo County on 7 August (ToEa). A male in the cattails at Llano Seco on 5 October (MSk) was the second record for Butte County. Rare on the valley floor during migration was a **Green-tailed Towhee** at the Bufferlands on 17 September (CC); even rarer as a wintering bird, one visited a backyard birdfeeder in Rancho Cordova on 25+ November (TaEa, ToEa). **Brewer's Sparrows** are rare but regular migrants through the Central Valley, but are more common in the lower foothills along the east side of the valley during

spring migration. However, one on the valley floor at the Chico State Farm on 4 August (JSn) was unusually early for a fall migrant and was the first record for that month in Butte County. Other **Brewer's Sparrows** reports included one along Putah Creek on 24 August (AE) in Yolo County, one along the American River Parkway on 20 August (DJ), and one at the La Barranca unit of the Sacramento NWR in Tehama County on 5 September (MR). More unusual on the valley floor, especially away from preferred habitat, a **Bell's Sage Sparrow** was at the Cosumnes Preserve on 25 September (JTr). Only one **Chestnut-collared Longspur** could be found at the traditional site in the southern Dunnigan Hills area of Yolo County on 23 October (ToEa). However, one **McCown's Longspur** in sw Kings County on 19 November (ToEa, TaEa) provided a first county record.

An immature **Baltimore Oriole** along Putah Creek near Pedrick Rd. on 22 September (ToEa) was a first record for Yolo County and was also seen across the river in Solano County. As a very rare lowland visitor, one **Cassin's Finch** at the Cosumnes River Preserve on 4 November (JTr) was an exciting find and a first for that location for its discoverer.

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