

# 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.

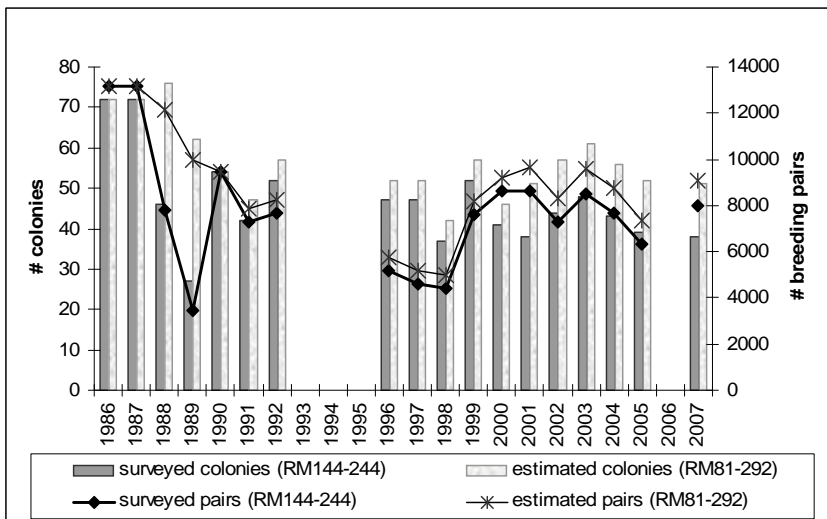


Figure 1. Number of Bank Swallow colonies and nesting pairs on the Sacramento River. Totals are shown for the surveyed reach (RM144-244) and the entire river which includes the surveyed reach plus estimates for the upper reach (RM243-292), and lower reach (RM143-81). No surveys were conducted in 1993-95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

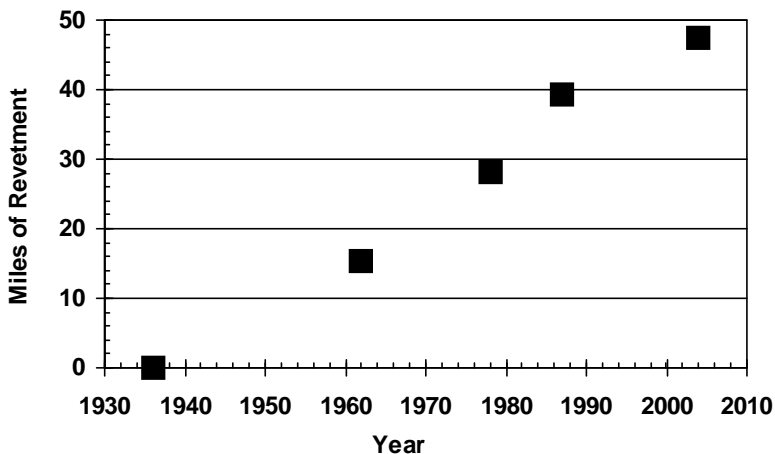
During the 2007 Bank Swallow survey, 38 colonies were documented between Red Bluff and Colusa; 18 (47%) of these colonies were located on the banks within the Federal Refuge and State Wildlife and Park lands. While some properties are contiguous, many exist in a “string of pearls” arrangement interspersed 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; Moffatt 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. Moffatt 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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