CALIFORNIA DEPARTMENT OF FISH AND GAME

WILDLIFE MANAGEMENT DIVISION

BIRD AND MAMMAL CONSERVATION PROGRAM

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Five-Year Status Review: BANK SWALLOW *(Riparia riparia)*

Reported to:

California Fish and Game Commission

1995

FIVE-YEAR STATUS REPORT

I. COMMON NAME: Bank Swallow

SCIENTIFIC NAME: *Riparia riparia*

CURRENT CLASSIFICATION: Threatened

II. RECOMMENDED ACTION:

Retain Threatened Classification

III. SUMMARY OF REASONS FOR RECOMMENDED ACTION:

The bank swallow is a native migratory bird species with significant portions of its range in California seriously threatened due to habitat destruction and human disturbance. Its distribution in California is rather localized along rivers, lakes, and ocean coasts. Bank swallows are generally a riparian species throughout their North American and Eurasian breeding ranges where they nest in colonies in earthen banks and bluffs, and sand and gravel pits. Bank swallow numbers, once abundant in local lowland California (Grinnell and Miller 1944) have declined in recent years statewide, and the species is now absent as a breeding bird in southern California [Remsen 1978, Humphrey and Garrison 1987, Garrison et al. 1987, Laymon et al. 1988, California Department of Fish and Game (CDFG) 1993].

Remsen (1978) reported that reasons for the species' decline are unknown for coastal populations where breeding cliffs appear to be intact. However, he suggested that bank stabilization programs have destroyed former inland nesting sites, and other human disturbances are threatening certain colonies. In addition, Remsen (1978) stated that the "channelization of rivers is the most insidious long-term threat to the bank swallow; almost all colonies in the Sacramento Valley will be destroyed by planned bank protection projects by the Army Corps of Engineers".

In 1985, U.S. Army Corps of Engineers (Corps) bank protection projects destroyed at least three large nesting colonies on the Sacramento River during the breeding season resulting in the loss of potentially thousands of eggs and young bank swallows (CDFG files). Additional causes of the population decline have been suspected, including pesticides, loss of wintering habitat, and declines in various aquatic and terrestrial insect prey populations.

Bank swallows spend the winter in north-central South America, where their primary wintering habitats are grasslands, savannahs, and freshwater and brackish wetlands. These wintering habitats are suffering habitat destruction similar to that occurring with tropical rain forests (Rappole et al. 1983). Robbins et al. (1986) analyzed breeding bird survey data on bank swallow populations from 1965 to 1979 and found considerable variation in the annual counts, which made it difficult to detect long-term changes. A conservative analysis was conducted using the number of survey stations at which bank swallows were recorded, and Robbins et al. (1986) reported no significant population changes for the western, central, and eastern regions of the United States.

There is little evidence to suggest declines in prey populations. Three eggs collected and analyzed in 1986 contained pesticide residue levels far below those considered detrimental (CDFG files). The population decline and range constriction noted by Remsen (1978) and others prompted the CDFG to undertake a comprehensive study of the population distribution, status, and nesting ecology of the bank swallow in California during 1986 and 1987 (Humphrey and Garrison 1987, Laymon et al. 1988).

During a study of the statewide distribution of bank swallows, Laymon et al. (1988) found 66, of 111 colonies (59.4 percent) on the Sacramento River. Laymon et al. (1987) actually reported 53 colonies on the Sacramento River in 1987, but a recent change in the definition of what constitutes a colony resulted in descrepancy between earlier literature and what appears in Table 1 of this report. An additional 18 colonies (16.2 percent) were found on the Feather River. Other concentration areas included Cache Creek (five colonies), and Klamath Basin and Modoc County areas (14 colonies). Most historical records of bank swallow nesting colonies were from central and southern California where populations no longer exist. Only four colonies were found south of San Francisco Bay; the southernmost was on the Salinas River near King City, Monterey County.

The Sacramento River population (66 colonies; 25,339 burrows) and the Feather River population (18 colonies; 6,529 burrows) comprised about 76 percent of the colonies and 71 percent of the burrows in the California population in 1987. Since these early baseline studies, annual population monitoring by the CDFG's Bird and Mammal Conservation Program staff has revealed a continual decline in the numbers of burrows (an index of population abundance) and the total number and average size of individual colonies (Table 1). Results of a 1994 survey indicated that the population continues to maintain a low level relative to 1986-87.

TABLE 1
BANK SWALLOW POPULATION INFORMATION
by River Reach on the Sacramento River, California
1986 to 1994

River Reach	1986	1987	1988	1989	1990	1991	1992	1993	1994	Avg.
RM 81 - 143 Verona to Colusa										
Number of Colonies	13	12	8[b]	6	6	6	9	8	6	8[c]
Total Burrows	2,480	3,720	1,940	750	980	1,870	1,650	1,610	2,470	1,940
Avg. Burrows/Colonies	190	310	240	130	160	310	180	200	410	240
RM 144 - 168 Colusa to Butte City										
Number of Colonies	15	13	18	14[b]	15	9	14	15	11	14
Total Burrows	6,060	6,600	7,790	6,370	7,440	6,110	6,840	5,230	4,870	6,370
Avg. Burrows/Colonies	400	510	430	460	500	680	490	350	440	460
RM 169 - 199 Butte City to Hamilton City										
Number of Colonies	15	16	28	21	15	14	15	11	10	16
Total Burrows	7,530	5,070	9,570	6,970	4,850	3,960	4,500	1,950	3,400	5,310
Avg. Burrows/Colonies	500	320	340	330	320	280	300	180	340	330
RM 200 - 243 Hamilton City to Red Bluff										
Number of Colonies	23	20	15b	15b	15	13	14	10	10	15
Total Burrows	11,530	8,540	6,220	6,220	6,880	4,300	4,050	3,820	4,440	6,220
Avg. Burrows/Colonies	500	430	410	410	460	330	290	380	440	410
RM 244 - 292 Red Bluff to Redding										
Number of Colonies	6	5	5[b]	5[b]	3	5[b]	5[b]	5[b]	5[b]	5
Total Burrows	1,660	1,400	1,290	1,290	820	1,290	1,290	1,290	1,290	1,290
Avg. Burrows/Colonies	280	280	260	260	270	260	260	260	260	260
SURVEY TOTAL - RM 81 - 292 Verona to Redding										
Number of Colonies	72[d]	66	74	61	54	47	57	49	42	58[e]
Total Burrows	29,260	25,330	26,810	21,600	20,970	17,530	18,330	13,900	16,470	21,130
Avg Burrows/Colonies	410	380	360	350	390	370	320	280	390	360
Estimated Number of Breeding Pairs[f]	13,170	11,400	12,060	9,720	9,440	7,890	8,250	6,260	7,410	9,510

[a] All averages rounded to the nearest single colony and 10 burrows.

[b] Indicates year without surveys. Averages for that Reach were included as an estimate for years without surveys.

[c] Reach averages based on available survey data for that Reach; these data are the most illustrative of populations trends within the Reach; Reach averages calculated with surveyed years.

[d] Annual survey totals include Reach averages for years without surveys; yearly totals are not as accurate for inferring population trends as Reach averages.

[e] Includes annual totals that have estimates based on Reach averages.

[f] Based on an occupancy rate of 45 percent; 0.45 x Total Burrows = Breeding Pairs, rounded to nearest 10 pairs.

The 1994 count was slightly larger than the 1993 count, which was the lowest recorded population since the 1986 baseline study. By applying a factor to account for the proportion of burrows dug that are actually used for nest sites (about 45 percent), it is estimated that the population of breeding pairs of bank swallows has declined from about 13,170 pairs in 1986 to 7,410 pairs in 1994. The 1994 numbers are a slight improvement over the 1993 population estimate of 6,260 pairs.

The 1994 population of Sacramento River bank swallows is approximately 56 percent of that recorded eight years ago in 1986. Colonies and populations located in other parts of the range may have also declined, but no annual monitoring of the type conducted on the Sacramento River has occurred at these sites.

Using data from the 1986 baseline survey on the Sacramento River and the Corps, Humphrey and Garrison (1986) projected a "worst-case" impact to bank swallow populations: 31 of 72 colonies (43.0 percent) and 8,935 of 16,386 pairs based on a 56 percent occupancy rate (54.5 percent) threatened by proposed bank protection projects. Humphrey and Garrison (1987) actually reported a total of 60 colonies and 16,149 pairs in the 1986 bank swallow population, but noted previously a new definition of a colony resulted in revised estimates.

Since the 1986 study on the Sacramento River, there has been a continued periodic loss of bank swallow colony sites due to bank protection projects. Garrison (1989) reported that bank protection work from 1986 to 1988 resulted in the loss of nine documented colony sites. Additional colony sites and potential habitat could be lost if proposed work under currently authorized bank protection contracts is completed. A further round of proposed bank protection projects under a new phase of bank protection continues to threaten both existing and potential bank swallow habitat on the Sacramento and Feather rivers. Construction activities may also adversely impact bank swallow behavior and cause direct mortality during the nesting season when projects proceed in close proximity to active colonies. Construction activities that may have the greatest potential to impact bank swallow habitats have been considered for several years for the reach of the Sacramento River that extends from river mile (RM) 143 near Colusa to RM 243 near Red Bluff (U.S. Army Corps of Engineers 1983). This is coincidentally the region of greatest bank swallow abundance in the State.

Based on this information, it is clear that bank swallow population levels have deteriorated since it was listed as threatened by the Fish and Game Commission in 1989. The number of breeding pairs and colonies has declined steadily, and there appears to be no abatement in the activities that pose the greatest threat to habitats and populations.

However, it is recommended that the current threatened status be maintained while further monitoring proceeds to determine precise causes of the decline, determine potential mitigation for projects that threaten breeding habitat, and seek means to effect recovery of this species. If the trend for important breeding habitat being eliminated by bank stabilization projects continues, there may be a need to list the species as endangered in the near future.

IV. NATURE AND DEGREE OF THREAT:

The proposed rip-rapping of miles of river bank as part of flood and erosion control projects represents the greatest single threat to bank swallow populations and habitat on the Sacramento River. Erosion is the natural process that creates and maintains bank swallow habitat, and this process is being controlled by rip-rap projects. According to documents available from the Corps (1983) and the State Reclamation Board (Jones & Stokes Associates, Inc. 1987), existing colony locations will be destroyed, as will potential habitat.

In additon, extensive rip-rap actually reduces the availability of future nesting areas by curtailing bank erosion necessary to create and maintain nest sites. Construction activity on adjacent sites may also have an adverse impact on bank swallow nesting and foraging behavior. Construction activities with the greatest potential impact have been considered for many years on a reach between RM 143 near Colusa and RM 243 near Red Bluff (Corps 1983). This is the region of greatest number of colonies and greatest bank swallow population abundance (Table 1).

Using 1986 population information from the Sacramento River, Humphrey and Garrison (1987) projected that a minimum of 31 of 72 colonies (43.1 percent) were possibly threatened by proposed Federal and State bank stabilization projects, and an additional five colonies (6.9 percent) may be adversely affected by these activities. These estimates represent minimum threats, since once completed, the projects may by their nature exacerbate the local hydrology and cause the need for maintenance activities, which, if allowed without a formal environmental review process, may remove bank swallow colonies near the site.

In 1986, Humphrey and Garrison predicted that a minimum of 8,935 breeding pairs, using a 56 percent occupancy rate (54.6 percent), were threatened with loss of nesting habitat, and an additional 1,064 pairs (6.5 percent) would be affected by proposed activities near colonies if projects were completed. Currently there appears to be an emphasis by the Corps on the completion of work at sites south of Colusa on the Sacramento River where few remnants of bank swallow colonies still exist. However, the area of greatest bank swallow abundance has been identified for possible future bank protection. Such projects pose a serious threat to this population.

The bank swallow population declines previously described will likely occur from the present to a point five to 10 years in the future if bank protection work begins to pick up again after about a four-year hiatus. A currently authorized work site contract has proposed to rip-rap about 5,200 lineal feet of river bank in 1995. That will leave an additional 81,800 feet of work to be completed under the current (second) phase of the Sacramento Bank Protection Project (CDFG files). This work will likely take about five to eight new contracts and be completed in the next five to 10 years. The CDFG's staff assigned to water projects estimates that much of this work will be completed in the area from Colusa south to the Delta.

Bank protection projects destroyed habitat at five colonies (four completely, one partially) in 1986 and 1987. Habitat at an additional two colonies was eliminated in 1988 during construction of projects in the Butte Basin reach, RM 169, Butte City, to RM 199, Hamilton City, of the Sacramento River. Bank swallow habitat at Woodson Bridge State Recreation Area supported one of the two largest colonies (1,784 pairs) ever found in California during 1986. Construction of the palisades flow modification project occurred after the 1986 bank swallow nesting season. In 1987, only a third of the number of bank swallows returned to nest at the site. Two years later, the site was abandoned. During the 1990-94 surveys no colony was recorded at the site. The Corps' Sacramento River Bank Protection Project threatened one colony in 1987 and 16 sites of potential habitat identified during 1987 (Jones & Stokes Associates, Inc. 1987).

Since its listing in 1989, a recovery plan for the bank swallow, was completed (CDFG 1993). It is the first such plan for a solely State-listed species. A recovery team made up of representatives of the CDFG, State Reclamation Board, U.S. Army Corps of Engineers, State Lands Commission, and members of the public was formed. Some of the issues discussed at team meetings since 1989 include development of the recovery plan, mitigation experiments at bank protection projects, and annual population surveys.

Results of a population viability analysis (PVA) of Sacramento River populations of bank swallows indicated that a small population of about 10,000 pairs has a substantial risk of falling to 1,000 pairs or disappearing entirely (Buechner 1992) within 50 years. This is especially troubling since the latest (1994) population estimate is approximately 7,500 pairs of adults. If the current trend continues, the population will warrant being reclassified as endangered and could face extirpation in the foreseeable future. The PVA indicated that even under very optimistic conditions the number of breeding pairs required to ensure a large continuing population of bank swallows is considerably larger than the current population size.

Utilizing the “most likely” model from the PVA, an estimated 100,000 pairs of breeding bank swallows (about 13 times the current level) would be-necessary in order to ensure a less than 50 percent chance of falling below 5,000 pairs in 50 years. While the current PVA is only preliminary, this model represents our best estimates of existing conditions and probable future scenarios for the Sacramento River population of bank swallows. As more information becomes available through research and monitoring, refinement of the population analyses and risk estimates will be possible.

V. HISTORIC AND CURRENT DISTRIBUTION:

The bank swallow once bred locally throughout lowland California (Grinnell and Miller 1944). It once bred at coastal sites from Santa Barbara County south to San Diego County. It has now disappeared as a breeding bird from southern California. Once common in Santa Cruz County, the species is now extirpated (Remsen 1978). No published information exists on historical populations of bank swallows on the Sacramento River where most of the population exists today. The magnitude of habitat loss can only be estimated, based on the amount of rip-rap placed on the banks of the river in the past several decades by State and Federal agencies attempting to control erosion of stream banks. For example, the Sacramento River Bank Protection Project, which was authorized by the U.S. Congress in 1960, has resulted in over 140 miles of rip-rap, on the Sacramento River (CDFG files).

During 1986, a survey located active bank swallow colonies on the Sacramento River between RM 81.81 R near the confluence of the Feather River and RM 291.8 L near Redding (Humphrey and Garrison 1987). During 1987, a repeat survey of the Sacramento River located 66 colonies in the same area (Laymon et al. 1988). The 1987 survey located a total of 111 active colonies statewide (Laymon et al 1988). A total of 107 colonies (41,880 burrows), including the 66 Sacramento River colonies, were found north of San Francisco Bay. Only four colonies (1,960 burrows) were found south of San Francisco Bay. The Sacramento River, with the largest number of breeding pairs, is clearly the center of the current population distribution in the State.

The Sacramento River and its tributary, the Feather River, represent most of the Central Valley population of bank swallows and account for more than half of the State’s population of this threatened species. Without securing this segment of the population, it will not be possible to recover the bank swallow.

During the 1987 statewide population survey, burrow counts were used as a relative estimate of colony size. Burrow counts were also used to estimate the number of breeding pairs. Number of breeding pairs in a colony was based on

an empirically derived burrow occupancy rate developed on the Sacramento River since 1986 (56 percent in 1986, but currently 45 percent). Data from each year of population monitoring is the basis for the total burrow counts and estimated number of breeding pairs, which is computed by multiplying the burrow count by the occupancy rate (Table 1).

VI. HISTORIC AND CURRENT ABUNDANCE:

Historically, the bank swallow has been described as common throughout lowland California (Grinnell and Miller 1944). There is relatively little published research on the bank swallow in California, so few details exist on its historic abundance, distribution, and ecology. However, egg collection records can be used to determine former breeding range. More recent reports and sightings document some of the current reductions in the species' range and also instances of habitat loss. For example, habitat at three Sacramento River colonies consisting of 1,300 burrows was destroyed at a Corps bank protection work site during the height of the 1985 breeding season (CDFG files). There may have been a full year's loss of nestlings and eggs, because construction proceeded during the breeding season. it is entirely possible that this kind of loss has occurred often in the past at active colony sites where bank protection work routinely occurred during the breeding season (April to mid-July) prior to 1986.

Of the 72 colonies located in 1986 on the Sacramento River, two were lost to Corps rip-rapping that year (Humphrey and Garrison 1987). Also, in 1986, the State Reclamation Board sponsored "Palisade Project" constructed at the site of a very large colony (1,784 pairs estimated using the 1986 occupancy level of 56 percent, 3,192 total burrows) may have caused a reduction in colony size of about 67 percent in 1987.

In 1987, four existing colony sites were lost and a fifth site was partially destroyed due to Corps rip-rapping on the Sacramento River. A report by Jones & Stokes Associates, Inc. (1987) indicated that, based on 1986 CDFG survey information, about 35 different colony locations occurred within the Sacramento River Bank Protection Project study reach where approximately 25 miles of bank protection (both rip-rap and palisades) could potentially be constructed. The potential impact on the bank swallow population at that time would have been catastrophic, because about 53 percent (35 of 66) of the 1987 number of colonies would have been lost.

In 1986, 72 colonies with an estimated 29,260 burrows and a 56 percent burrow occupancy rate for that year resulted in a population estimate of 16,386 pairs of bank swallows on the Sacramento River (Humphrey and Garrison 1986). In 1987, there were 66 colonies with 25,330 total burrows counted (no burrow occupancy rate was derived, thus, no estimate of pairs was made) on the

Sacramento River. Between 1988 and 1994 bank swallow populations have been monitored on the Sacramento River in a cooperative effort by State and Federal agencies in an effort to determine population trends. Results have indicated considerable fluctuation, but an apparently significant decline has occurred from 1986 to the point were the 1994 population, expressed as estimated number of breeding pairs of bank swallows, is only about 56 percent of the 1986 estimate (See Table 1).

Based on data acquired from agencies planning bank protection projects on the Sacramento and Feather rivers, further decline of over 50 percent of the 1986-87 breeding population was possible if all proposed rip-rapping occurred. This projection was part of the basis for the original decision to recommend the species for addition to the list of threatened species in the State. Although it is now recognized that many of the proposed work sites may not be constructed, the mere potential for such an enormous impact on the current existing small population remains a serious threat to the bank swallow.

There are relatively few purely natural phenomena that can result in factors serious enough to threaten the bank swallow population. Some predation of young and adults occurs. Predation by gopher snakes *(Pituophis melanoleucus)* on nestlings often has been observed at individual colonies. In a few cases, gopher snake predation has been severe enough to eliminate all nestlings in large sections of a colony. Snake predation has been related to declines in habitat suitability at bank swallow colonies as Blem (1979) demonstrated. Reducing natural erosion on river banks through the use of palisading and other recently proposed methods could possibly increase snake predation at colonies. Another potentially serious threat exists from bank sloughing at colony sites during the breeding season. High stream flows in summer caused by the manipulation of water levels at Shasta Dam and high waves caused by recreational boaters weaken banks which can slough off and fall into the river. If this sloughing occurs during a critical time in the breeding season (April to June) a significant loss of reproduction (eggs and young birds) can be the result at the affected colony. Preventing these sorts of events becomes very important in the case of a listed species such as the bank swallow. However, bank swallows are superbly adapted to truly natural erosion processes. These natural processes are responsible for maintaining existing bank habitat, as well as creating new habitat.

VII. SPECIES DESCRIPTION AND BIOLOGY:

The bank swallow is the smallest of the North American swallows and is a colonial nester in lowland river bank habitats and coastal bluffs (Bent 1939). It is distinguished from other swallows by its distinctive brown breast band contrasting against clean white underparts and dark brown upper parts. Sexes

are similarly marked and cannot be separated on plumage characteristics alone. Bank swallows are a migratory species spending the winter months in north-central and South America (Rappole et al. 1983).

Hickling (1959) described three main types of bank swallow nesting habitat: sea cliffs or hard consolidated sand, river banks of sand and sandy earth, and active sand and gravel pits. On the Sacramento River, bank swallows nest in steep earthen banks of sandy silty-loamy soils that are subject to frequent erosion. These cut banks constitute a natural component in a cross section of the riparian zone (Strahan 1984).

Nest sites consist of burrows dug into the bank to a depth of 18-36 inches. Burrow entrances are about two-inches tall and three inches wide (oval-shaped) and most often found in soils that are fine sandy loam to loam in texture. After a short courtship, both sexes actively dig the nest burrow into the side of banks that generally deviate less than seven degrees from vertical (90 degrees). Burrows that remain from a previous season may be used by a pair if available or after a bit of renovation. Burrows are located in colonies that may be relatively small (10 burrows) to quite large (3,000 burrows).

Since 1986, an average of a little under a half (45 percent) of the available burrows have been occupied by a breeding pair of birds (Garrison unpublished data). Birds arrive in late March to mid-April and begin courtship and pairing. When the burrow is completed, a clutch of three to five pure white eggs is laid. On the Sacramento River, egg laying begins mid-April. Nestlings are fed soft bodied insects by adults until they move out of the burrow, fledge, and can feed themselves. By mid-July most nesting activities are completed and the colony sites are abandoned and overgrown with vegetation. Bank swallows begin their southward migration in August and September.

Bank swallows are a relatively short-lived species with an average life span of two to three years with five years being exceptional. Mortality results from a number of causes, including disease, parasites, and predation. Gopher snakes constitute an important predator of eggs and nestlings, and raptors such as Peregrine falcons *(Falco peregrinus)* and American kestrels *(Falco sparverius)* take recently fledged young and perhaps some adults. Collapsed burrows, due to natural or man-caused sloughing of banks or destruction of nest sites, appear to be the most significant causes of mortality.

The food of bank swallows consists of various species of flying terrestrial and aquatic insects. Because they forage a few inches over water, they catch May flies and other aquatic insects just as they emerge from the nymph stage. However, most of their foraging activities occur over land above the dominant vegetation. For Sacramento River bank swallows, foraging birds have been

observed over annual grasslands, riparian areas, and agricultural fields, as well as aquatic habitats.

The colony is the focus of all social and breeding activities of the bank swallow. The birds' interactions with the physical features of the colony bank are such that the colony may be thought of as a living entity composed of several individual contributing units. This is often the nature of any colonial species be they birds, insects, or mammals. Burrows are dug into selected strata of a bank face based on a number of criteria, such as soil moisture, texture, orientation of the bank face, verticality of the face, and proximity to foraging areas. Unique combinations of optimal features may affect the size and success of individual colonies.

VIII. HABITAT REQUIREMENTS:

Bank swallows require an earthen bank that is more or less vertical and of sandy silty-loamy soil suitable for excavation of their nesting burrows. Banks that presently exist in portions of the Sacramento and Feather rivers, some lakes and reservoirs, certain coastal bluffs and cliffs, and some sand and gravel quarries fulfill this requirement in California. By far, the most extensive area of such habitat exists on the upper Sacramento River over a 100-mile stretch roughly from RM 143 near Colusa to RM 243 near Red Bluff. Bank swallows dig burrows in colonies in bank faces that are very nearly vertical and often erode completely from one season to the next depending on winter water levels. Soil type and bank position are important features, and they determine the location and extent of individual burrows and entire colonies (Garrison 1989). The aspect of each burrow determines the microclimatic features within the 1.5- to 3.0-foot deep burrow that are necessary for successful hatching and brooding of young.

Environmental features of the breeding site are important for the survival and comfort of adults and young and also affect the activity of terrestrial and aquatic flying insect prey. All the optimum features of habitat described here exist in certain portions of California, but in relatively short supply, as evidenced by the very restricted distribution of bank swallow breeding colonies in the State. At the present time, Sacramento River stream banks are the most important and most threatened of all habitats bank swallows occupy in California (Garrison 1989). Ongoing and proposed bank protection projects represent the single greatest threat to the species' habitat and a significant impediment to recovery of the population in the State (CDFG 1993).

IX. CURRENT AND RECOMMENDED MANAGEMENT:

Bank swallows are threatened because of past and continuing loss of nesting habitat, primarily through rip-rapping of colony locations by State and Federal agencies trying to control erosion on the Sacramento River (CDFG 1993). The

Sacramento River system provides nesting habitat for the majority of the State's bank swallow population (Laymon et al. 1987, Buechner 1992, CDFG 1993). The Sacramento River, in addition to being a breeding center, may also serve as a source of breeding birds for other populations in California. These breeding adults are likely to be birds that fledge from colonies located on the Sacramento River, but in later years breed at scattered locales around the remainder of the State, primarily in northern counties. Thus, protection of the Sacramento River population may have unknown, but far-reaching beneficial effects elsewhere in California.

The idea that we can shift the focus of species recovery from the primary breeding center in the State to other smaller sites may be flawed, because these latter sites may depend heavily on the Sacramento River population for their source of breeding adults. However, further research is needed to refine our knowledge on the relationship of the Sacramento River to other bank swallow populations in the State. The Central Valley population, comprised of the Sacramento River and Feather River breeding birds, clearly must be the focus for management and recovery of the species, because it represents most of the State's population of this threatened species (CDFG 1993).

The continued destruction of bank habitat through rip-rap projects is the most serious threat to the species. This loss of habitat to bank protection is one of the forces that has brought about the need for the original listing petition. It is critical that alternatives to this nesting habitat-destroying activity be found. If alternatives to rip-rapping and effective mitigation techniques to replace lost habitat are not found, then the prospect for the long-term survival and eventual recovery of the bank swallow on the Sacramento River system, and perhaps the remainder of the State, is very poor (Buechner 1992, CDFG 1993).

Because the bank swallow is listed as a State-threatened species, the Corps, and their State sponsor for the bank protection project, the Reclamation Board, are required by the California Endangered Species Act (CESA) to consult with the Department when their proposed construction activities have the potential to cause adverse impacts to the species and its habitats. This protection afforded by the CESA has already greatly modified the way bank protection proceeds in the State (CDFG files).

Since the listing of the bank swallow in 1989, no construction activities are allowed within 1/2 mile of active bank swallow colonies. The exclusion zone is enforced from April 1st to August 1st each year to avoid the nesting season of the bank swallow and has been a standard condition included in several State-prepared Biological Opinions specifically to prevent take of the species. This exclusion zone has prevented the direct mortality of nestlings and eggs during

the nesting season, an impact that apparently was widespread prior to the protections afforded by the CESA and recovery planning efforts (1980-1985).

While the direct take of the species issue has been resolved satisfactorily through avoidance measures, the destruction and degradation of essential habitats resulting from bank protection activities has yet to be adequately addressed. Since the Sacramento River Bank Protection Project has caused losses and still is a serious threat to the continued existence of the bank swallow, it is vitally important that losses of the eroding bank habitats be reduced to the minimum levels (CDFG 1993).

Since rip-rapping projects have the potential to severely reduce bank swallow habitat and populations and prevent recovery, the need to develop effective mitigation and habitat conservation is of paramount importance. Retention of State-threatened status for the bank swallow is warranted due to the uncertain and fluctuating population status and continued threats to habitat. The continued listed status of this species may encourage habitat conservation and management planning efforts by concerned agencies.

Although it is unfortunate, planning and conservation efforts needed to reverse or halt population declines are often deferred until a species is officially listed as threatened or endangered. This has been the case with the bank swallow. Between the time the species was first studied and its critical habitat needs were identified and conveyed to responsible agencies involved in bank protection in 1986 and it received protection of CESA in 1989, habitat at several important colonies had been lost. During this period, the breeding population declined about 24 percent (CDFG files, Table 1).

Before being afforded protection of the CESA, bank swallows, as migratory birds, were ostensively protected under the Migratory Bird Treaty Act which protects nests and young from take and disturbance during the nesting season. Unfortunately, this provision of the Treaty was not enforced by the Federal authorities until after 1985. Between 1985 (when CDFG reported taking of bank swallows at colonies during bank protection activities) and the listing of the bank swallow in 1989, the Federal law was enforced at Sacramento River colonies, and bank protection work was delayed or modified to prevent taking of eggs and young at active sites. The timing of operations to avoid the bank swallow nesting season (April 1 - August 1) will prevent mortality which has been documented (CDFG files).

At present, other than the take avoidance measures described and the delay and modification of certain construction activities on a case-by-case basis through CESA consultation, there are no habitat conservation or management actions, either private, State, Federal, or local being specifically implemented to protect bank swallows and their unique habitat. However, a number of actions that may

need to be implemented are contained in the bank swallow recovery plan, the first such document for a solely State-listed species (CDFG 1993).

It may be necessary to preserve, through conservation easement, purchase in fee title, or dedicated protection, of existing and potential bank swallow habitat. Some of the current efforts to preserve habitat through the Sacramento River National Wildlife Refuge and the activities of Riparian Habitat Subcommittee of the Upper Sacramento River Advisory Council may eventually result in significant habitat preservation that would help improve the status of the bank swallow. In addition, a working agreement was recently signed by several State and Federal agencies and conservation organizations for the Riparian Habitat Joint Venture of the California Chapter of Partners in Flight. The Wildlife Conservation Board has a long record of riparian habitat conservation, including acquired parcels that now provide habitat for bank swallows.

Traditional measures currently employed by local, State, and Federal agencies to control erosion of Sacramento River banks directly conflict with the habitat needs of the bank swallow. The bank swallow is a bird adapted to natural riparian ecosystems where periodically eroding river banks are one of the habitat features critical to its survival. Nesting habitat is created and maintained by the natural forces of erosion. In order to preserve the bank swallow and its habitat, substantive changes in the methods currently employed by those agencies charged with bank protection and flood control activities will be necessary.

Although some attempts were made to use artificial banks to provide substitute nesting habitat in the vicinity of construction work sites, these were largely failures due to the lack of maintenance by the agencies. This led to eventual abandonment by bank swallows. These largely experimental attempts to replace lost habitat at a site where natural colonies were destroyed by rip-rap were evaluated for their feasibility. Garrison (1991) concluded that, although early results were encouraging (birds appeared to breed normally at the experimental banks that were built on top of rip rap installations thereby providing earthen substrate for nest sites), the inherent problems of long-term site maintenance costs and the risk of placing a large segment of the population in a totally artificial system would be difficult to overcome, and the use of artificial banks could not play a major role in the recovery of the species. Therefore, the technique does not figure prominently in the Department's recovery plan (CDFG 1993). Other measures have been proposed to curtail erosion that do not employ traditional rip-rap, but they too have been unacceptable, because they prevent the creation and natural maintenance of critical habitat features, namely eroding river banks (CDFG 1993).

Efforts to continue a credible program of research and monitoring despite a lack of significant dedicated funding have been relatively successful. The

1986 (Humphrey and Garrison 1987) and 1987 (Laymon et al. 1988) CDFG studies were completed by employing contract biologists. Since that time, there has been little funding available to repeat similar research. However, annual monitoring has proceeded to cover the most important reaches of the Sacramento River through the use of CDFG and other agency personnel and equipment (Table 1).

CDFG, Corps, Reclamation Board, and U.S. Fish and Wildlife Service (Service) personnel have all participated in monitoring populations of bank swallows annually on the Sacramento River, usually during late May to early June (CDFG files). Without annual monitoring, it will be impossible to determine the status and trend of the bank swallow population. There has not been a similar effort to track the trend of other populations of bank swallows elsewhere in the State as was done in 1987 (Laymon et al. 1988). The results of the Sacramento River monitoring program have revealed the population and colony number declines mentioned earlier (Table 1).

Additional research funded by the Service and the Reclamation Board with assistance from the CDFG has contributed to our current understanding of the ecology and management of the bank swallow (Garrison 1989, Garrison 1991). The CDFG funded the PVA that was discussed previously and is vital to our ability to assess the risks faced by the bank swallow population under various habitat and environmental scenarios (Buechner 1992). Department staff produced the recovery plan (CDFG 1993) and have prepared annual reports on the status of populations for the Fish and Game Commission since 1990 (CDFG files). The status of conservation efforts for the bank swallow has been reported in the Department's Annual Report on the Status of Threatened and Endangered Species to the State Legislature (CDFG files). This report is the first five-year status review written since the bank swallow was listed in 1989.

Independent research (Garrison unpublished data) is also proceeding on the bank swallow population. Since 1991 two colony sites have been continuously monitored on the Sacramento River at RM 166.0 R (right) and RM 166.5 R near Princeton (Garrison unpublished data, Table 2). The colony at RM 166.0 R was active from 1991 to 1994, while the other site at RM 166.5 R was active only in 1991 and 1992. Habitat at RM 166.5 R appeared suitable for nesting bank swallows in 1993 and 1994, but no breeding occurred there. In 1993, high water levels in early June caused the bank at RM 166.0 R to slough off during the middle of the nesting period. Although mortality of eggs and young occurred at this site, the colony later was successful in re-establishing and fledging young in July.

Considerable annual variation in reproductive statistics has been observed during the colony study. Colony size in numbers of burrows ranged from 185 to

619 at RM 166.0 R, while the number of burrows remained relatively stable at RM 166.5 R (234 in 991 and 229 in 1992). Burrow occupancy rate has ranged from 27.2 percent during the 1993 re-nesting at 166.0 R to a high of 56.1 percent in 1992 at RM 166.5 R.

Adult and nestling bank swallows have been banded with Federal aluminum leg bands each year at these two study colonies Returns to the colony sites from birds banded in previous years has averaged only one to two percent, a level that is considerably below that reported in other studies of bank swallows in North America and Europe. Switching between the two adjacent study colonies by banded birds that were recovered has occurred as frequently as the incidence of birds returning to the same site from which they were originally banded. This long-term study is not formally funded but relies on some assistance from the CDFG's Wildlife Management Division and volunteers to help with the banding and data gathering at the colonies.

The main conservation strategies outlined in the recovery plan call for avoidance measures wherever feasible combined with habitat purchases to preserve known and potential nesting areas. It is also recommended that large portions of the Sacramento River be returned to natural riparian function through the use of set-back levees, the so-called meander belt concept. Groups such as the Riparian Habitat Subcommittee are currently studying the feasibility of implementing such a strategy on portions of the Sacramento River. Such a concept, if it is to become reality, will require extraordinary coordination and cooperation among the agencies and groups concerned. It will also be very expensive and difficult to implement equitably. Further discussion of mitigation measures and conservation strategies appear in the recovery plan (CDFG 1993).

While relatively little of the management and acquisition actions contained in the recovery plan have been implemented to date, there has been some progress in ongoing coordination efforts between the concerned agencies. The Department employs staff whose task it is to monitor bank protection projects that may impact sensitive resources, such as bank swallow habitat. Several CESA consultations have rendered Biological Opinions that protect bank swallows from take (CDFG files).

There has been no construction related take of the species since it was listed. In fact, early coordination prior to listing (1985-89) also prevented mortality of eggs and young at active colonies by delaying construction at work sites. Some important habitat has been acquired by both the State and the Federal refuge system. As an outcome of the passage of Senate Bill 1086 (Chapter 885, Statutes of 1986), several representatives of agencies, conservation organizations, and the public are involved in efforts to preserve riparian habitat on the Sacramento River.

TABLE 2

Reproductive Measures from Two Colonies near Princeton, California, on the Sacramento River that have been Continuously Monitored from 1991 to 1994.

YEAR	RM 166.0 R (Princeton)			RM 166.5 R (Princeton)		
	# Burrows	% Occupancy	Avg. # young Nest w/young	# Burrows	% Occupancy	Avg. # young Nest w/young
1991	185	38.7%	4.4 (n=20)	234	47.2%	2.6 (n=5)
1992	619	39.0%	4.3 (n=25)	229	56.1%	4.2 (n=31)
1993[a]	503 / 570	45.2% / 27.2%	4.1 / 3.8 (n=34)/(n=12)	Not Active		
1994	298	31.6%	4.7 (n=17)	Not Active		

[a] Numbers represent reproductive measures before and after colony site was washed out by high water from a rainstorm in early June 1993.

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