BANK SWALLOW DISTRIBUTION AND NESTING ECOLOGY ON THE SACRAMENTO RIVER, CALIFORNIA

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Throughout its Holarctic breeding range, the Bank Swallow (*Riparia riparia*) is generally regarded as a riparian species, although it has not been shown to be dependent on riparian vegetation. It is a colonial bird that nests in earthen banks and bluffs, as well as in sand and gravel pits.

Once locally abundant in lowland California (Grinnell and Miller 1944), the Bank Swallow has declined in numbers in recent years and no longer breeds in much of its former range (Remsen 1978). The Bank Swallow has a rather localized distribution in California along rivers, lakes, and ocean coasts (Grinnell and Miller 1944). We estimate that approximately 70-80% of California's remaining Bank Swallows nest along the Sacramento River. The steep earthen banks that are selected for nesting by Bank Swallows are subject to frequent erosion (Freer 1979, Mead 1979). This nest-site selection characteristic conflicts with proposed erosion control projects, which threaten a substantial portion of existing Bank Swallow nesting habitat along the Sacramento River.

The objectives of our study were (1) to determine Bank Swallow population size and distribution along the Sacramento River, (2) to determine reproductive success and colony occupancy, (3) to describe the habitat of nesting colonies, and (4) to identify and assess detrimental impacts to swallow populations and habitat.

STUDY AREA AND METHODS

Our study was conducted from May to August 1986 along the Sacramento River from Shasta Dam, Shasta County, to the Sacramento/San Joaquin Delta, Contra Costa County. We concentrated our research along a 160-mile stretch of river from Red Bluff, Tehama County, to the confluence of the Feather River, Sutter County. We surveyed the river by boat to locate colonies. At each colony, we made field estimates of the number of burrows and plotted locations on aerial photographs. At 34 colonies, complete burrow counts were made and compared to field estimates derived by visual inspection. The estimates were lower than actual counts by an average of 94%, so we divided all estimates by 0.94. Field estimates were adjusted because burrows continued to be excavated after the initial surveys, field estimates were inaccurate, and some burrows were lost because of bank erosion.

We estimated occupancy and reproductive success at 26 colonies from a random sample of 10-100 burrows per colony. Burrows with young, eggs, or a nest were considered occupied. We excluded from analysis collapsed burrows or burrows of unknown status. The number of breeding pairs per

colony was estimated by multiplying the adjusted burrow estimates (field estimates divided by 0.94) by an average occupancy rate of 55.9% (MacBriar and Stevenson 1976).

We assigned colonies to one of three groups based upon number of burrows: (1) small, 1-130 burrows (N = 21), (2) medium, 131-375 burrows (N = 20), and (3) large, >375 burrows (N = 19). Thirty-two colonies (11 each from the small and medium groups and 10 from the large group) were randomly selected for intensive study.

At the selected colonies, we made three vertical transects of unequal length at equally spaced locations across the bank and recorded colony and bank length, height of the bank and burrow column, distance from bank to water, and aspect and slope of the bank. These measurements were averaged for each colony. We took soil samples from areas adjacent to transects by using seamless sample tins and determined soil type from bulk density measurements (Hausenbuiller 1978) and U.S. Soil Conservation Service County Soil Surveys. We assessed detrimental impacts to swallow populations and habitats by reviewing proposed erosion control projects and recording land use practices around swallow colonies.

RESULTS AND DISCUSSION

Population Size and Distribution

We located 60 colonies ranging in size from 12 to 1784 breeding pairs (Figure 1); the average was 269 (± a standard error (SE) of 47.9) pairs per colony. Thirty-five (58.3%) colonies had ≤150 pairs, 13 (21.7%) colonies had 151-450 pairs, and 12 (20.0%) colonies had ≥525 pairs. We estimate the total breeding population for the Sacramento River as 16,149 pairs (95% confidence interval = 14,597-17,700). Burrow occupancy was 55.9% (± 2.7% SE) on the basis of 1330 burrows checked at 26 colonies. The number of young per nest averaged 2.84 (± 0.07 SE) on the basis of 211 burrows checked at 14 colonies. We found 43 (71.7%) colonies between River Mile (RM) 140 and RM 240, 10 (16.7%) colonies downstream from RM 140, beneath which the river is channelized by levee systems, and 7 (11.7%) colonies upstream from RM 240, an area of hard sandstone banks and bluffs (Figure 2). Approximately 11,300 (70.0%) pairs were located between RM 150 and RM 220. The largest concentration of 3860 (23.9%) pairs was found between Chico Landing and Woodson Bridge State Recreation Area (RM 200 to RM 220).

Habitat Measurements

Colony banks (N = 32) averaged 3.3 (± 0.3 SE) m tall (range = 1.3-7.3) with a slope of 83.3° (± 0.9° SE, range = 68.3°-96.7°). Bank length averaged 454.6 (± 77.9 SE) m (range = 13-1900). There were 2.2 (± 0.2 SE) burrows per transect (range = 0.0-5.3) for a density of 0.8 (± 0.1 SE) burrows/m (range = 0.0-1.9). Burrow columns were 0.5 (± 0.1 SE) m tall (range = 0.0-1.7), and colony banks were 4.1 (± 0.8 SE) m (range = 0.0-21.8) from water. The length of the colony averaged 66.4 (± 12.4 SE) m (range = 2-366). Most colonies (56 of 99 transects) were adjacent

to open grass fields. Approximately 25% of the transects were associated with agricultural lands, either row crops (N = 11) or orchards (N = 16). The remaining transects (N = 16) were under riparian and oak forests.

Bank Swallow colonies generally occur in soft soils. Of the 86 soil samples collected, most were taken from fine sandy loam (N = 19, 22.1%), loam (N = 33, 38.4%), and silt loam (N = 7, 8.1%) soils, while the remainder were in sand (N = 3, 3.5%), sandy loam (N = 6, 7.0%), clay loam (N = 2, 2.3%), clay (N = 8, 9.3%), and aggregated clay (N = 8, 9.3%) soils. Spencer (1964) reported a preference for loamy soils by Bank Swallows in Pennsylvania and Vermont. Most colonies (N = 99) faced north (35%) and east (32%). West exposures accounted for 24%, whereas southern exposures were only 8%. Soil moisture and/or presence of suitable banks may be factors in colony orientation.

Detrimental Impacts

Proposed bank stabilization and flood and erosion control projects represent the largest single threat to Bank Swallow colonies and habitat on the Sacramento River. Existing colonies will be destroyed, as will potential habitat. Such construction activity also may adversely affect swallow behavior. A minimum of 32 (53.3%) colonies are threatened by proposed projects, and an additional 3 (5.0%) colonies also may be affected by construction (Figure 2). Construction activities with the greatest potential impact are planned from

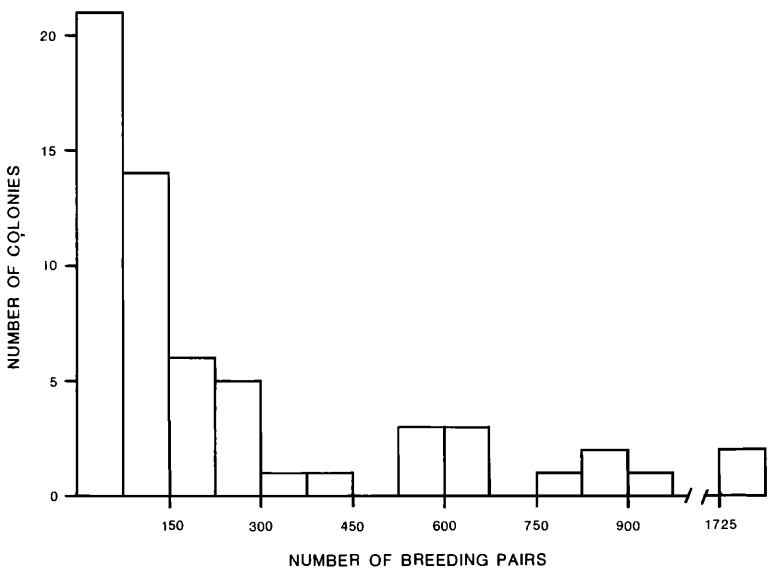

Figure 1. Frequency distribution of Bank Swallow colonies by colony size, Sacramento River, California, 1986.

RM 143 to RM 243 (Army Corps of Engineers 1983, The Reclamation Board, 1986). Coincidentally, this is the region of greatest Bank Swallow abundance.

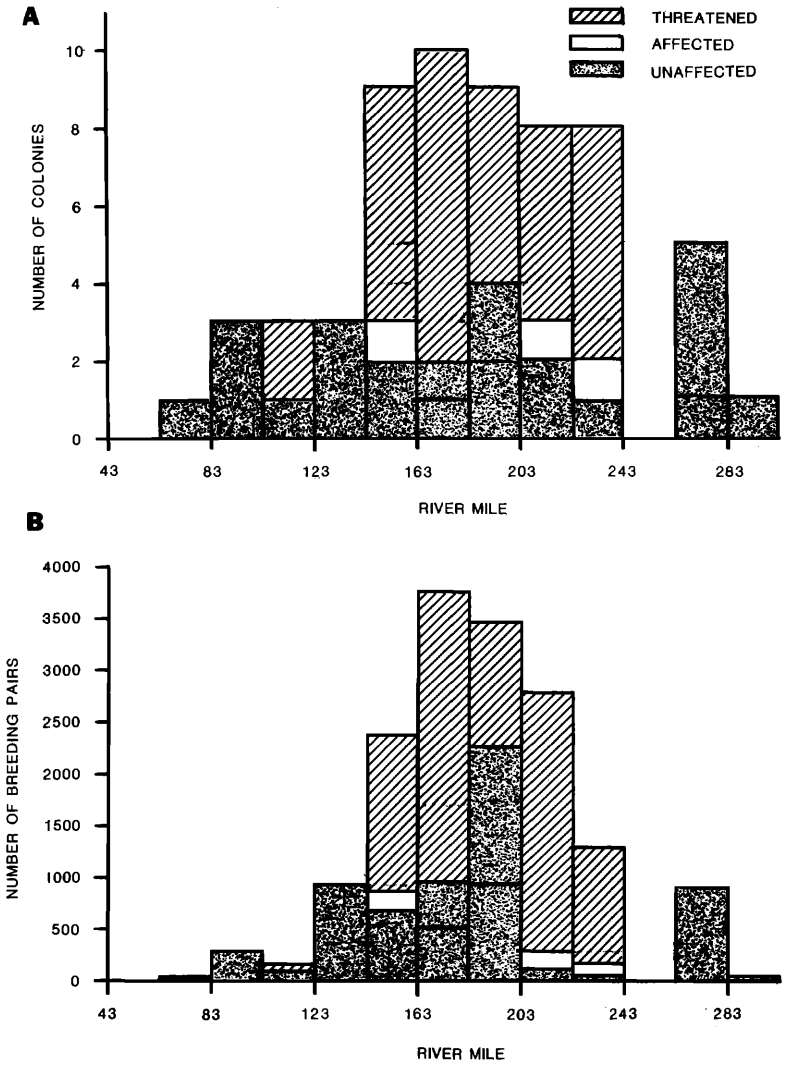

Figure 2. (**a**) Frequency distribution of Bank Swallow colonies by 20-river-mile sections that are threatened, affected, or unaffected by proposed erosion control projects. (**b**) Number of breeding pairs of Bank Swallows by 20-river-mile sections that are threatened, affected, or unaffected by proposed erosion control projects, Sacramento River, California, 1986.

A minimum of 9280 (57.5%) pairs are threatened, and an additional 416 (2.6%) pairs may be affected by construction (Figure 2). These declines will likely occur within the next 5-10 years if all proposed projects are carried out.

The colony at Woodson Bridge State Recreation Area (RM 218.6) is one of the two largest. An experimental bank protection method known as palisading was implemented there in August 1986. The integrity of the bank face was retained, and the colony site was not destroyed. The full impact of this bank protection method on Bank Swallows cannot be evaluated fully for several years. If bank erosion at Woodson Bridge is curtailed, the suitability of the bank for swallow nesting will decline through time as the bank face becomes less vertical because of sluffing. Blem (1979) has demonstrated that when this happens, predation increases and Bank Swallow colonies decline and are eventually abandoned.

CONCLUSIONS

Proposed erosion control projects threaten over 50% of the Sacramento River Bank Swallow population. On the basis of our findings, Threatened status for the Bank Swallow in California may be appropriate. Further research on the statewide distribution of Bank Swallows is scheduled for 1987. Efforts should be made to protect existing colonies and develop mitigation techniques. Alternative means of bank protection that have minimal impact on bank-nesting avifauna and riparian vegetation should be developed and tested. Above all, resource management agencies must realize that a river free from erosion is not compatible with the maintenance of healthy populations of bank-nesting birds.

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Bank Swallows *Sketch by Tim Manolis*