Results of the 2005 survey for Breeding Purple Martins in the Sacramento region

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The Sacramento population of Purple Martins (*Progne subis*) is a remnant of a formerly more widespread population in the Central Valley of California and is recognized as a species of special concern (California Department of Fish and Game 1992). We have conducted intensive studies of this population, which nests in overpasses and elevated freeways ("bridges"), to estimate annual breeding populations, assess limiting factors, and evaluate effectiveness of management actions (Airola and Grantham 2003, Leeman et al. 2003, Airola et al. 2004). The Sacramento population currently supports approximately 12-21% of the estimated total nesting population in the state (Airola and Williams, in press).

Surveys in 2003 and 2004 showed substantial increases in the known breeding population (12.6% and 13.8%, respectively (Airola et al. 2004) after more modest growth (average = 2.5% per year) during 1992-2002 (Airola and Grantham 2003). Therefore, a major objective of monitoring in 2005 was to determine if the recent higher growth rate would continue, which could contribute more rapidly to regional recovery of the species.

We report here on results of the 2005 breeding survey and update the longer term trend in populations for the Sacramento area. We also report on adult and nestling mortality, including observation of higher-than-usual mortality at one colony. Other 2005 activities, including monitoring survival and nest site fidelity of color-banded breeding birds, will be reported elsewhere (Airola and Kostka, in prep.).

STUDY AREA

The study area consisted of the previously-described bridges in Sacramento that were occupied or considered suitable for use by Purple Martins (Airola and Grantham 2003, Leeman et al. 2003). We also surveyed the US 80/Pole Line Road overpass in the City of Davis that supported several breeding pairs in 2003 (Airola et al. 2004) and the Crosstown Freeway (between Interstate 5 and State Highway 99) in Stockton, a suitable site that was not previously surveyed.

METHODS

We and trained volunteers conducted colony surveys as described in previous reports (Airola and Grantham 2003, Leeman et al. 2004). As in previous years, we assisted less experienced monitors at all sites to

augment and verify monitoring results, but Airola was somewhat less available for this effort in 2005 than in previous years. As a result, the proportion of the population for which breeding was confirmed (by diagnostic nesting behaviors) rather than inferred (based only on frequencies of hole use) was lower in 2005 (71%) than in 2002-2004 (83-88%). As in past years, Airola interpreted all observations to estimate breeding populations (as per Airola and Grantham 2003).

We searched for dead adult and live and dead hatchling martins beneath colonies ("fallouts") during breeding surveys (Airola and Grantham 2003). Young may be found below nests as a result of accidental falls through the vertical nest-hole entrances, jumping in response to intensive parasite infestation, or removal by non-breeding subadult males (Brown 1997). Fallout surveys could not be conducted systematically at all sites as a result of inaccessibility, dangerous conditions at railroad tracks, and presence of vegetation that hampered searching, as well as attempts to avoid disturbing nesting birds at certain sites. Most surveys were conducted during the late nesting period when we more carefully searched for young (every 1-4 days) beneath holes at selected sites. The most intensive surveys were conducted at the El Camino colony.

Age and sexes of adults were determined based on Pyle (1997) and Hill (1992, 2002). Ages of young were determined by comparison with known-age photographs (Hill 1999). Young estimated to be < 20 days post hatching were considered nestlings, while those recorded as ≥21 days were considered to have prematurely fledged.

RESULTS

The number of sites occupied by breeding martins increased from 11 to 12 in 2005. The new site at the Airbase Drive overpass of Roseville Road and the Union Pacific Railroad tracks had martins present in some previous years (B. Williams, pers. comm.; Airola, unpubl. data), but no nesting has been documented. A total of 160 pairs were documented as breeding at Sacramento area colonies, representing a decline by 7.5% from the 2004 population (Table 1). The nesting populations decreased at 8 of 11 colonies where martins were present in 2004, while numbers remained the same at 2 colonies and increased at 1 other (Table 1).

No colony declined substantially in size (Table 1); the maximum decrease at any colony was 4 pairs, and the maximum proportional decrease was 37.5%, which occurred at the small Sutterville colony. Several colonies where populations had increased dramatically in recent years (El Camino and Redding Road) suffered modest declines. Conversely, the 2005 population declines also were modest at several colonies that had declined substantially in recent years (35th St. and Roseville Road).

No martins were observed again in 2005 at the Pole Line colony in Davis where they nested in 2003 (Airola et al 2004). Approximately 13 pairs of

Table 1. Breeding Purple Martin pairs at colony sites in the Sacramento region in 2005 and recent years[a]

Colony	*2002*[b]	*2003*[c]	*2004*[d]	*2005*
I Street	37	29	35	32
20th Street	14	21	23	23
Sutterville	4	6	8	5
Broadway	8	7	7	7
S Street	14	14	16	14
35th Street	29	19	15	14
Redding Rd.	0	3	12	10
El Camino	ns[e]	15	23	21
Marconi	ns	1	4	3
Roseville Rd.	29	39	27	24
Arden	ns	0	3	6
Airbase	ns	0	0	1
Pole Line[f]	ns	2	0	0
Total	135	156	173	160

[a] Numbers reported represent pairs reaching nestling stage.
[b] Sources for 2002: Airola and Grantham 2003.
[c] Source for 2003: Leeman et al. 2003.
[d] Source for 2004: Airola et al. 2004
[e] ns = no site survey conducted that year.
[f] this site, in nearby Davis, Yolo County, was not included in previous summaries.

European Starlings (*Sturnus vulgaris*), which are potential nest competitors, nested at this small site adjacent to a flood detention basin that provides abundant food. Ten (77%) of the starling pairs there nested in holes excavated in the Styrofoam bands at the tops of support columns that were left from construction, rather than in weep holes. No martins were observed at the Stockton site, despite conditions that appear suitable for martins.

The pair that colonized at Airbase Drive contained a second year (SY) male, consistent with the previous observation that a higher proportion of SY males than ASY males bred at newly-colonized sites in Sacramento (Airola et al. 2004).

We found 14 dead adults beneath colonies in 2005. Twelve were found at the El Camino colony, including 4 ASY males, 2 females (age undetermined), and the remainder either SY males or females. We also found 1 ASY female at 20th St. and another female (age undeterminable) at Roseville Road. All dead birds were found between or immediately adjacent to the tracks for Sacramento Regional Transit District's light rail trains, except the dead female at Roseville Road, which was adjacent to the Union Pacific Railroad tracks.

We found a total of 31 nestlings and 3 additional prematurely fledged young beneath the 99 nest holes we monitored regularly for fallouts. Twelve nestlings and 1 prematurely fledged young were found alive and sent to rehabilitation. Eleven of these birds were raised successfully, banded (including 4 color-banded), and released at the colonies where they were found.

DISCUSSION

Possible Causes for Population Declines

Three potential causes for the observed decline in the 2005 breeding population include: an actual population reduction, reduction in breeding activity by adults, or errors in population estimation. While we cannot conclusively attribute the decline to any one of these, we explore each possibility.

The most direct possible cause for our observation of a reduced breeding population is a true reduction in adult breeders due to either lower reproduction in 2003 or 2004, or higher mortality between 2004 and 2005. We have no information on nest site productivity, so do not know if reductions in productivity during previous years could have affected the 2005 breeding population. During 2005, we monitored the annual survival of 38 color-banded birds that were known to be breeding in this population in 2004. The minimum annual survival rates of adults in 2004-2005 was at least 61%, and possibly as high as 76% with correction for potential non-detection of banded birds, (Airola and Kostka, in prep.). This relatively high survival

rate was similar to that recorded between 2003 and 2004, when the nesting population increased. Also, this rate is comparable to other studied populations (Brown 1997). Together, this information suggests that high mortality of adults did not result in a reduction of the 2005 breeding population.

The El Camino colony where 12 mortalities were observed was not a focus of the banding study and so was not included in the survival estimates reported above. Although the breeding population at this site declined only by 2 pairs (8.7%) from 2004 (Table 1), our monitoring method could have resulted in some nesting attempts, where adults suffered late mortality, being recorded as "occupied by nesting pairs," and hence may have underestimated the breeding effects of mortality on this colony. This colony had grown by over 50% from 2003 to 2004, so high adult mortality may have reversed growth that otherwise might have occurred there. Also, however, some of the birds killed at this site may have been SY birds that were not breeding (Airola et al. 2004).

A second potential cause for a lower breeding population is that a higher than normal number of martins returned but did not breed or failed and then abandoned nest sites, and thereby were not counted. Our monitoring protocol does not provide a way to count non-breeders, so we cannot directly evaluate this possibility. Weather conditions during the 2005 breeding season were cooler and wetter than average in May and June and hotter than average in July (National Weather Service 2005). Weather could have affected nesting success directly (by heat stress) or indirectly by reducing insect availability or suitable foraging conditions. Martins at one site in Lake County, California, also apparently had lower nesting success (based on patterns of nest attendance) in 2005 than in the two previous years (D. Woodward, pers. comm.). Cold weather has been documented as having a substantial effect on martin nesting activity and populations in British Columbia and other northern portions of the species' range (Brown 1997, Cousens et al. 2005), but such weather conditions are much more severe than in Sacramento.

A third possibility for apparent population decline is that the lower numbers are simply a result of counting inadequacies or interpretive errors. Unfortunately, we have been unable to develop a monitoring method that provides a measure of uncertainty for population estimates. Rather, we have had to rely on application of a consistent method for sampling and interpreting results as the basis for comparing annual populations (Airola and Grantham 2003). Less-skilled volunteers conducted a greater proportion of the monitoring in 2005 than in previous years, as indicated by the fact that a higher proportion of the breeding determinations were inferred rather than confirmed. However, the sites at which Airola and Kopp monitored intensively in 2005 also showed modest declines from previous years. This information suggests errors or inconsistency in monitoring were not a primary cause for declines in estimated breeding populations.

Overall, available information suggests that the martin population decline in 2005, although minor, was real. The fact that the decline occurred at most of the Sacramento colonies, and was of a generally similar magnitude, also suggests a general cause, such as effects of weather or perhaps previous years' low productivity.

The 2005 population decline was not associated with any human activity. The Sacramento martins adaptability to disturbance is illustrated by one incident in which a full-sized semi-truck crashed through the guard rail and hung off of the Capital City Freeway within 10 meters of the primary nesting area within the S Street colony. Although this accident and the subsequent truck removal and guard rail repair occurred in the middle of the nesting season, martins continued rearing young, and no nest abandonment was evident. This incident highlights the unavoidable risks that urban martin populations face, but also their adaptability to disturbances that do not compromise key habitat conditions (site accessibility and vertical space beneath colonies; see Airola and Grantham 2003).

Adult Mortality at the El Camino Site

The 2005 incidence of high adult mortality at the El Camino site was unusual, as nothing similar has been recorded at this site or elsewhere in previous years. All of these mortalities appeared to be caused by collisions with the light rail trains or their aerial pantographs (conductor arms), based on the locations of carcasses and injuries sustained. We daily observed martins perching on and being flushed from the light rail electrical wires as the trains passed. It is unclear why mortality was high at this site in 2005. This colony grew by over 50% from 2003 to 2004 (Table 1) when the light rail was operating in a manner that appeared identical to 2005.

Although the high adult mortality in 2005 at El Camino was associated with only a modest decrease in the nesting population from the previous year, it is possible that it may have prevented another increase in 2005. The loss of the 4 ASY males alone represents a loss of 16% of the male breeders at this colony (i.e., 4/[21+4]). We believe that it is important to more systematically evaluate this effect in future years, considering the regional scarcity of the species and the incomplete level of past monitoring of adult mortality, and particularly because 8 of the 12 martin colonies active in 2005 were associated with light rail routes.

Fallout of Hatching-Year Birds

In 2005, nestlings fallout occurred at a frequency (0.31 young per nest) that was double that of the previous two years (0.16; Airola and Kopp, unpubl. data). While some of this result may be due to more intensive surveys at several sites in 2005, given the general low rate of scavenging previously documented (Airola and Grantham 2003), it also likely reflects a

higher actual loss rate. No cause for the increase can be determined, but the higher than normal temperatures during July may have had some direct or indirect role.

Implications of the 2005 Population Estimate

The apparent decline in the breeding population of Purple Martins at Sacramento area colonies, following two years of robust population growth in the number of known breeders, can be viewed as a setback to the long term increase in this population. Considering the modest extent of the decline, however, and the longer term pattern of increase (Airola et al. 2004), these results are not alarming.

The different potential underlying causes for the 2005 decline in breeding pairs (elevated mortality of breeders or nest abandonment) have different potential effects on subsequent populations. The causes for declines and resulting effects may become clearer from the longer-term study of survival and mortality of martins at Sacramento colonies (Airola and Kostka, in prep.). The mortalities observed at the El Camino colony also demonstrate the importance of broadening the area evaluated for survival and mortality rates through color-banding, to ensure that sites with light rail lines are represented.

It remains prudent to continue population monitoring and assessment of causes for population changes, given the continued relatively low population in the area and its importance as a source for recovery of the population within California's Central Valley. Lack of information on reproductive productivity (due to inaccessibility of nest sites) remains the largest gap in our knowledge of Sacramento's Purple Martins. Unfortunately, the cost to rent remote, pole-mounted cameras, and lack of a funding source, has precluded the collection of reproductive data. This information could help clarify causes for future population changes and clarify management needs to maintain and increase this population.

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