Breeding Population Status and Mortality Assessment of Purple Martins in Sacramento during 2006

Daniel A. Airola, Airola Environmental Consulting, 2700 6th Avenue, Sacramento, CA 95818

Dan Kopp, ECORP Consulting, 2525 Warren Drive, Rocklin, CA 95677

The Purple Martin (*Progne subis*) is recognized as a California species of special concern (California Department of Fish and Game 1992). The Sacramento area martin population is a remnant of a more widespread population in California's Central Valley that apparently has survived competition from the European Starling (*Sturnus vulgaris*) and possible other threats by nesting in holes ("weep holes") in the undersides of overpasses and elevated freeways ("bridges") (Airola and Grantham 2003). The Sacramento population comprises approximately 12-21% of the total nesting population in California (Airola and Williams, in press).

We present results of population surveys conducted in 2006 for Purple Martins at Sacramento breeding colonies and information on observed mortalities and rehabilitation efforts. Population results from 2006 represent the fifth consecutive year of intensive monitoring of this population (Airola and Grantham 2003, Leeman et al. 2003, Airola et al. 2004, Airola and Kopp 2005). We also provide known information on mortality sources for nestling and adult martins. The mortality assessment has been emphasized recently because the population is relatively low, despite apparently abundant habitat (Leeman et al. 2003), suggesting issues with mortality or reproduction.

One focus of our mortality assessment resulted from our observation of a relatively large number of mortalities (12) from collisions with light rail cars at the El Camino colony in 2005 (Airola and Kopp 2005). In 2006, we contacted the Sacramento Regional Transit Agency (RT) with a suggestion to place a new wire for perching above the existing electrical contact wires where martins were perching above the rail tracks. Perching birds frequently flee these perch sites when trains approach. We hypothesized that collision mortality may be exacerbated at this site as a result of exposure to passing trains and their elevated pantographs (i.e., the "arms" that connect the train to the contact wire). Thus an elevated wire would provide a more stable and safer perch site. RT installed the elevated perch wire during the nesting season in June 2006, so we monitored use of this wire and mortality prior to and following installation.

STUDY AREA

The study area consisted of the previously described bridges in Sacramento area that were occupied or considered suitable for use by Purple Martins (Airola and Grantham 2003, Leeman et al. 2003) and the US 80/Pole Line Road overpass in the City of Davis that supported several breeding pairs in 2003 (Airola et al. 2004). We also visited the Road 102 overpass of Interstate 5 in Woodland, Yolo County, where martins had been reported during early June (R. Melcer pers. comm.) to look for evidence of nesting and evaluate its suitability based on comparison with characteristics of other known sites (Airola and Grantham 2003).

METHODS

Population Monitoring

Our colony survey methods consisted of surveying sites in the Sacramento region that were previously occupied by breeding Purple Martins (Airola and Kopp 2005) and other sites identified as highly suitable by Leeman et al. (2003) or other observers. At occupied colonies, we assessed populations by repeatedly mapping use of weep holes and noting characteristic breeding behaviors over the nesting period (Airola and Grantham 2003). In 2006, more sites were more intensively monitored by the authors and experienced volunteers rather than by less-experienced trained volunteers as in 2005. The proportion of the population for which breeding was confirmed by diagnostic nesting behaviors, rather than inferred as breeding based on the frequency of hole use, was among the highest (87%) in recent monitoring (Airola and Kopp 2005). This increased effort by more experienced observers likely did not alter the overall population estimate, but provides somewhat greater reliability to the individual colony estimates.

Adult and Nestling Mortality

We surveyed for dead or injured adults incidental to other survey work at colonies. In addition to reporting causes for mortalities that were directly observed, we report likely causes for mortalities inferred from the type of injury, as determined by veterinarians at the Wildlife Care Association animal rehabilitation facility (E. Parker pers. comm.) and based on the location of found carcasses. We also searched for live and dead hatchling martins beneath colonies ("fallouts") during breeding surveys as described by Airola and Grantham (2003) and Airola and Kopp (2005).

We attempted to determine indirectly the effect of cat predation in 2006 at the I St. colony, where we observed cats preying on and stalking martins that were collecting nesting material on the ground (see Results). First, we compared the observed 2006 population decline at I St. with the magnitude

of declines at all colonies in 2006 and previous years. Second, we compared patterns of observations of color-banded birds over the nesting season at the I St. colony with the pattern at other colonies. We calculated whether the proportion of color-banded birds seen only prior to or during the nest-building period differed between I St. and the other colonies. Observation of a higher proportion of banded birds seen only during the early breeding season at I St. would suggest that cat predation resulted in a higher rate of mortality here than typically occurs at other sites.

Effectiveness of Perch Wire Installation to Reduce Mortality

We evaluated the potential effectiveness of the perch wire installed by RT at the El Camino colony, to attempt to reduce collision mortality with light rail trains. Monitoring consisted of direct observation of perching behaviors to determine if the wire installation was effective in relocating martins to the safer site. We also monitored for adult mortality both before and after wire installation in 2006 to compare with 2005 observations at an intensity that was similar in both years.

RESULTS

2006 Population

The number of sites occupied by breeding martins decreased from 12 in 2005 to 11 in 2006 (Table 1). The Marconi Road overpass at Roseville Road and adjacent railroad tracks did not support martins in 2006, after hosting 1-4 pairs during 2003-2005. All other sites occupied in 2006 had been occupied in 2005.

A total of 141 breeding pairs were documented at Sacramento area colonies, representing a decline by 12% from 2005 (Table 1). Compared to 2005, the 2006 nesting populations decreased at 5 of 12 colonies, increased at 4 colonies, and remained the same at 3 colonies (Table 1). The most dramatic declines occurred at three of the longest occupied colonies in the downtown and "midtown" areas (see Airola and Grantham 2003): 35th St (-57%), I St. (-47%), and 20th St (-30%). The I St. colony suffered the greatest decline in numbers of breeding pairs, losing 15 pairs from the total in 2005. Greatest increases occurred at more recent and peripheral colonies, including Arden Way (+117%) and Redding Road (+40%), although the midtown S St. colony also increased by 29%.

The Davis site remained unoccupied. No martins were observed at the Road 102 overpass in Woodland, and we judged this site to be unsuitable for breeding based on the volume of traffic beneath it; no other similar site is occupied in the Sacramento area.

Table 1. Breeding Purple Martin pairs at Sacramento area nesting colonies 2002-2006[a]

Colony[b]	2002	2003	2004	2005	2006
I Street	37	29	35	32	17
20th Street	14	21	23	23	16
Sutterville	4	6	8	5	6
Broadway	8	7	7	7	5
S Street	14	14	16	14	18
35th Street	29	19	15	14	6
Redding Road	0	3	12	10	14
El Camino	ns	15	23	21	21
Marconi	ns	1	4	3	0
Roseville Road	29	39	27	24	24
Arden	ns	0	3	6	13
Airbase	ns	0	0	1	1
Pole Line	ns	2	0	0	0
Total	135	156	173	160	141

[a] Numbers reported are pairs reaching nestling stage. Previous year's populations from Airola and Grantham (2003), Leeman et al. (2003), Airola et al (2004), and Airola and Kopp (2005).
[b] See Leeman et al. 2003 for a description of colony locations.
ns = no site survey conducted that year.

Mortality

We recorded 6 adult mortalities in 2006 (Table 2), the first year we observed direct mortalities. Two of these mortalities occurred at El Camino during the early nesting period when single birds collided while in flight with a vehicle and a bridge structure, apparently while distracted during courtship and mate defense. Neither of these observed mortalities was directly associated with perching on the light rail electrical line. Other adult mortalities inferred from locations of carcasses and injuries appeared to be vehicle collisions.

We observed domestic cats at the I St. colony for the first time in 2006. We observed two cats initially, including one seen stalking and capturing a female martin that was collecting nesting material on the ground. The other cat was trapped and removed, but the offender could not be caught, and later was again seen stalking martins at a nest material collection site. Over the past 5 years, cats have been observed in only a few years at 2 other colonies (20th and Roseville Road), but many sites have potential to support cats that are either pets or food-subsidized.

The decline in the I St. breeding population between 2005 and 2006 (15 pairs) was the largest numerical decline observed at any colony over the entire 2002-2006 study period. Our monitoring of color-banded birds showed that 6 (50%) of 12 banded adults observed at the I St. site were not detected after the nest building period, when cat predation would have been most likely to occur (i.e., because birds land on the ground to collect nesting material). However, this proportion did not differ significantly from the proportion (36%) of 11 banded birds seen at other intensively monitored sites that also were not observed after nest building period ($\chi^2_{1\ d.f.} = 0.40$, $p > 0.50$).

We found 31 nestlings during fallout surveys beneath 100 occupied weep holes that were adequately surveyed for fallouts in 2006. Twenty-seven of these young were dead or so injured as to not be amenable to rehabilitation. Four birds were rehabilitated, color-banded, and released at colonies. One of the rehabilitated birds was observed the day after release, being fed by a female with other fledglings. This is the first documented instance of successful rehabilitation of a nestling purple martin in Sacramento.

Perch Wire Effectiveness

Martins frequently used the newly-installed perch wire above the pantograph at the El Camino colony. Despite its greater elevation above the trains passing below, most martins continued to flush from the wire each time a train passed, which constitutes an energy drain, given the 7.5 minute train interval at the site throughout daylight hours. Use of the higher wire increased the martin's distance from the passing trains, however, which

Table 2. Adult Purple Martin mortalities recorded at Sacramento colonies in 2006

Colony	Age[1]	Sex	Mortality Cause	Detection Mode
El Camino	ASY	M	Collided with light rail train during chase	Observed
El Camino	ASY	M	Collided with bridge during chase	Observed
I Street	Unk	F	Caught by cat on the ground while collecting nesting material	Observed
I Street	ASY	M	Likely hit by vehicle when collecting nesting material	Inferred
I Street	Unk	Unk	Likely collided with vehicle on bridge above colony	Inferred
Roseville Road	ASY	M	Likely collided with vehicle on adjacent road or with light rail train or vehicle on bridge above colony	Inferred
Redding Road	Unk	F	Likely collided with vehicle on freeway above colony	Inferred

[1] ASY = After-second year, Unk = age unknown.

presumably reduced the risk of collisions. The number of adult mortalities detected at this site decreased dramatically from 12 in 2005 to 2 in 2006.

DISCUSSION

2006 Population

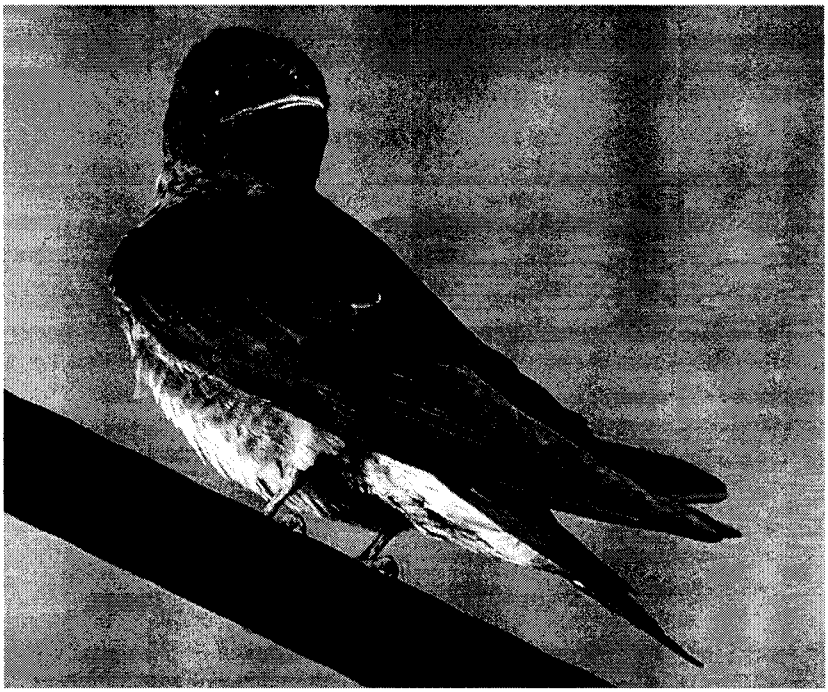
The 2006 results contribute to a 5-year period of monitoring by which to evaluate the status of the Sacramento area Purple Martin population. The 12% decline in the nesting population between 2005 and 2006 is of concern, especially following the 7.5% decline between 2004 and 2005. Clearly, some of the optimism we expressed in 2004 following 2 years of 12-13% annual increase (Airola et al. 2004) has been tempered. Overall, since 2002, the known population has increased by 4.4% (1.4% average annual rate), although lack of monitoring in 2002 of the relatively large El Camino colony (i.e., 15 pairs when discovered in 2003) suggests that the actual population trend could be stable or negative. The trend since 2003, during which all occupied sites has been monitored, represents a decline of 9.6% (i.e., average decline of 2.1%/yr).

The pattern of annual changes in populations at individual colonies in 2006 (decrease at 5 colonies, increase at 4, no change at 3) differed somewhat from past years. In 2005, when the overall population declined, 11 (92%) of 12 colonies either remained stable or decreased. Conversely, in 2004 when the population as a whole increased, nine (82%) of 11 colonies either remained stable or increased. The general similarity of responses of individual colonies prior to 2006 may suggest that populations were responding to more widespread phenomenon, such as weather. The mixed pattern in 2006 suggests that factors influencing individual colony populations may have been more localized. Other than the high perch wire installation, predation by cats appears to be the only potential mortality cause for population changes at individual colonies that differed in 2006 from previous years, although we could not demonstrate this effect statistically through analysis of early-season disappearance of banded birds.

Although the Sacramento area was considered an epicenter for WNV infection in 2005, sampling of 23 martins tested during 2004-2007 by the Yolo-Sacramento Mosquito and Vector Control District has never detected active infection and has only found antibodies (indicating survival from infection) in only one martin (S. Wright, pers. comm.). Although all colonies were within the area sprayed for WNV in 2005, spraying occurred in early to mid-August, by which time most martins appear to have migrated out of the area (Airola, unpub. data). Therefore, WNV does not appear to be a likely cause of martin declines in the area.

The tendency for older established urban colonies to decline more than peripheral colonies in less urbanized colonies is intriguing, but difficult to explain. No similar pattern has appeared in previous years. The decline at

20th St. is notable, as it interrupts an apparent recovery at this site following exclusion of birds during light rail construction in 2000-2002; this site supported 38 nesting pairs in the early 1990s (Airola and Grantham 2003).



Male Purple Martin (*Progne subis*) in second-year plumage.
photo © Dan Kopp

Mortality

Our reporting of mortalities at nesting areas is obviously incomplete, likely biased toward certain forms of mortality and does not address other potential causes of mortality away from the nest sites. For example, most mortalities that may occur through collision with vehicles on the roadways above the colonies are not detectable (except when they fall to the ground below) due to safety concerns with surveys and obliteration by high volumes of traffic. Such mortality has been widely reported at bridge roosting sites in the eastern U. S. (Esposito and Betuel 2006). Also, mortalities that result from predation may not be as easy to observe or infer as are those that result from vehicle collisions. This is illustrated by our inability to find any evidence of the predated martin within 1-2 minutes after we observed it being attacked by the cat. Nonetheless, the observed loss of 5 adults (1.8% of the 2006 breeding individuals) from verified or apparent collisions with trains, autos, or trucks at 4 different colonies, along with

previous mortality information (Airola and Kopp 2005) indicates that this remains a potentially important source of nesting season mortality for this urban population. Unfortunately, there appears to be little remedy for vehicle mortality, except relocation of sources of nesting material to areas with less potential traffic hazard and the installation of alternative perching sies (see below).

Although we documented only one instance of mortality from cat predation, our observations and analysis suggests additional mortalities may have occurred at I St. This evidence includes additional observations of the same cat stalking martins at nest collecting areas and the largest between-year decline in nesting population at any colony over the 5 year study. The higher (but not statistically significant) rate of disappearance of color-banded martins during the early nesting period, when susceptibility to predation is highest, is supportive but not conclusive. In summary, the indirect evidence suggests that cat predation may have been a factor in the large decline in the breeding population at I St., but some evidence is equivocal. Based on this evaluation and given the low number of martins of throughout California, we recommend implementing all feasible efforts to reduce mortality and strongly support trapping and removal of feral cats from nesting areas and discouraging establishment of feral cat feeding stations in these areas.

Perch Wire Effectiveness

We cannot conclude with certainty that the dramatic decrease in mortalities at El Camino in 2006 (2) compared to 2005 (12) resulted from the installation of the high perch wire, because the extent of mortality in previous years was also highly variable (Airola and Kopp 2005). Nonetheless, the installed wire was readily used by martins and thereby placed them at a greater distance from the passing trains. We conclude that the wire was effective at reducing the *risk* of mortality and may have actually reduced mortality at this site.

Conclusions

Our study is beginning to highlight the different mortality factors for martins that nest in urban areas. This and previous years' studies (Airola and Grantham 2003) suggest that mortality and other competitive effects of European Starling, which have been well-documented elsewhere (e.g., Jackson and Tate 1974, Brown 1981), are low enough in bridges to allow martins to persist. Bridge nesting sites also appear to be inaccessible to ground predators, and appear to support low populations of aerial predators. However, urban bridge sites pose mortality risks from sources that do not occur in other more traditional martin habitats, such as vehicle collisions, predation from feral cats (especially during the nest material collec-

tion period), and nestling fallouts. The true magnitudes of urban mortality factors, and their ultimate effect on martin populations and potential for population recovery, remain uncertain and challenging to determine.

We continue to lack information on the counterpart to mortality: reproduction. For 2007, we have received the loan of a remote camera that can be pole-mounted to monitor reproductive success and productivity. As our volunteer-supported workforce is already stretched thin, we encourage additional volunteers, especially those with a desire to conduct the important monitoring of martin reproduction at bridge sites. Reproductive data are important in fully assessing limiting factors to the population and could reveal new management approaches to assist in recovering the martin population.

ACKNOWLEDGEMENTS

We thank those who contributed as volunteers to the 2006 monitoring effort, including site monitors Mike Rushton, Maureen Geiger, and rehabilitator Eva Parker (Wildlife Care Association). Stan Kostka, Lynn Schmidt, Dawn Garcia, Mike Fisher, and Stan and Seth Wright assisted with 2006 martin capture and banding. Mark Hada (California Department of Parks and Recreation, State Railroad Museum), Gabe Avila (Sacramento Regional Transit), and Bob Sleppy (California Department of General Services) and Carl Bradley (Union Pacific Railroad) provided access. We especially thank Larry Davis, Mark Lonergan, and Alan Storey from Sacramento Regional Transit for their cooperation in installing the perching wire at the El Camino colony site. Ron Schlorff and Dale Steele, California Department of Fish and Game, provided advice and assistance with permit acquisition. Sid England and Stan Kostka provided helpful review comments.

LITERATURE CITED

Airola, D. A. and J. Grantham. 2003. Purple Martin population status, nesting habitat characteristics, and management in Sacramento. Western Birds 34:235-251.

Airola, D. A. and D. Kopp. 2005. Results of the 2005 survey for breeding Purple Martins in the Sacramento region. Central Valley Bird Club Bulletin 8:37-44.

Airola, D. A., D. Kopp, and S. Kostka. 2004. Purple Martin population status and colonization patterns in the Sacramento region in 2004. Central Valley Bird Club Bulletin 7:71-77.

Airola, D.A. and B. C. D. Williams. (in press). Purple Martin (*Progne subis*). *In:* California Bird Species of Special Concern 2006: A ranked assessment

of species, subspecies, and distinct populations of birds of immediate conservation concern in California (W. D. Shuford and T. Gardali, eds.). Studies of Western Birds 1.

Brown, C.R. 1981. The impact of starlings on Purple Martin populations in unmanaged colonies. American Birds 35:266-268.

California Department of Fish and Game. 1992. Bird Species of Special Concern, Sacramento. (http://www.dfg.ca.gov/hcpb/species/ssc/sscbird/sscbird).

Esposito, A. and A. Betuel. 2006. Purple Martin roost mortality monitoring at William B. Ulmstead Bridge, Manns Harbor, NC, 2005 season. Purple Martin Update 15: (3) 23-25.

Jackson, J. A. and J. Tate, Jr. 1974. An analysis of nest box use by Purple Martins, House Sparrows, and Starlings in eastern North America. Wilson Bulletin 86:435-449.

Leeman, T. S., D. A. Airola, and D. Kopp. 2003. 2003 status of breeding Purple Martins in Sacramento. Central Valley Bird Club Bulletin 6:61-68.