Tricolored Blackbird (*Agelaius tricolor*) Nesting Failures in the Central Valley of California: General Trends or Isolated Phenomena?

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Abstract. The tricolored blackbird (*Agelaius tricolor*) is a candidate for listing under the federal Endangered Species Act. During 1986, approximately 47,000 tricolored blackbirds attempted to nest at Kesterson Reservoir, Merced County. Since at least 1981, the reservoir inflow consisted almost completely of subsurface agricultural drainage water, which contained elevated concentrations of salts and numerous trace elements, including selenium. In April 1986, 266 dead tricolored blackbird nestlings were found on levee roads surrounding Kesterson Reservoir. Almost 85% of a sample of 162 nests examined were either empty or contained dead chicks or addled eggs. In contrast, only 35% of 86 nests examined at nearby San Luis National Wildlife Refuge (NWR) were empty, and none contained dead chicks or addled eggs. Studies were expanded during 1987 to include four other colonies in the Central Valley. Only about 10,000 tricolored blackbirds attempted nesting at Kesterson Reservoir in 1987, and about 100 nestlings were fledged. Most nesting attempts failed because of early abandonment or hazing. The U.S. Fish and Wildlife Service (USFWS) conducted hazing to discourage birds from nesting within the contaminated Kesterson Reservoir. Colonies of 1,500 and 5,000 nesting adults at San Luis NWR, Merced County, and near the city of Folsom, Sacramento County, respectively, were generally successful. In contrast, colonies of about 2,000 adults failed completely at both the Butte Sink, Sutter County, and the Colusa NWR, Colusa County. Preliminary laboratory results from Kesterson Reservoir indicate that livers salvaged from dead nestlings in 1987 had higher concentrations of selenium ($\bar{X}$ = 12.39, range = 5.0 to 30.00 ppm dry weight) than livers from red-winged blackbirds (*Agelaius phoeniceus*) collected at Merced NWR, Merced County in 1986 ($\bar{X}$ = 3.7, range = 3.2 to 4.1 ppm dry weight). Selenium is believed to be responsible for numerous embryo deformities and deaths of bird embryos, chicks, and adults at Kesterson Reservoir. Observational data suggest that predation by hawks and herons may have caused the Colusa NWR failure. These studies suggest that the causes and magnitudes of nestling mortality vary substantially among tricolored blackbird colonies; further research is needed to determine whether the nesting failures observed were isolated phenomena or indicative of a general decline of the species population.

INTRODUCTION

The tricolored blackbird (*Agelaius tricolor*) is a candidate for listing under the federal Endangered Species Act. During 1986, approximately 47,000 tricolored blackbirds attempted to nest at Kesterson Reservoir, Merced County. Since at least 1981, reservoir inflow consisted almost completely of subsurface agricultural drainage water, which contained elevated concentrations of salts and numerous trace elements, including selenium. During observations of this colony, 266 dead tricolored blackbird chicks (1-5 days old) were found on the levee roads. During the 1986 nestling period (18-23 April), surveys of 162 tricolored blackbird nests at Kesterson Reservoir revealed that 84.6% of them were either empty or contained dead chicks or addled eggs. In contrast, only 34.9% of 86 nests examined at a marsh at San Luis National Wildlife Refuge (NWR) were empty during the nestling period. Observations during the next few weeks confirmed this trend, as only about 100 tricolored blackbird fledglings were observed from the entire Kesterson Reservoir colony. These re-

sults suggest that a major nesting failure occurred at this colony during 1986 (U.S. Bureau of Reclamation 1986).

To further investigate the status of tricolored blackbirds at Kesterson Reservoir, two surveys were conducted during winter and spring 1987. The objective of the winter survey was to estimate the size and preferred roosting locations of the Kesterson Reservoir tricolored blackbird population. The objective of the spring nesting survey was to determine the size of the breeding population at Kesterson Reservoir and to assess its reproductive success relative to four colonies (without histories of selenium contamination) located elsewhere in the Central Valley.

Methods

Roosting Surveys

The roosting population of tricolored blackbirds at Kesterson Reservoir was censused on 10 dates in January and February 1987. One to two biologists were stationed on levee roads to observe the departure of blackbirds in the morning (0630-0745 h) and their arrival in the afternoon (1600-1745 h). The following tricolored blackbird observations were recorded on preformatted data sheets: time of observation, estimated number in flock, and flight direction.

Nesting Surveys

Tricolored blackbird nesting colonies were monitored to assess the extent of nestling mortality and nesting success at Kesterson Reservoir and in four other colonies located at San Luis NWR (Merced County), near the city of Folsom (Sacramento County), Butte Sink (Sutter County), and Colusa NWR (Colusa County) (Fig. 1). Four colonies were selected for surveys because a single area might be influenced by some unknown mortality factors.

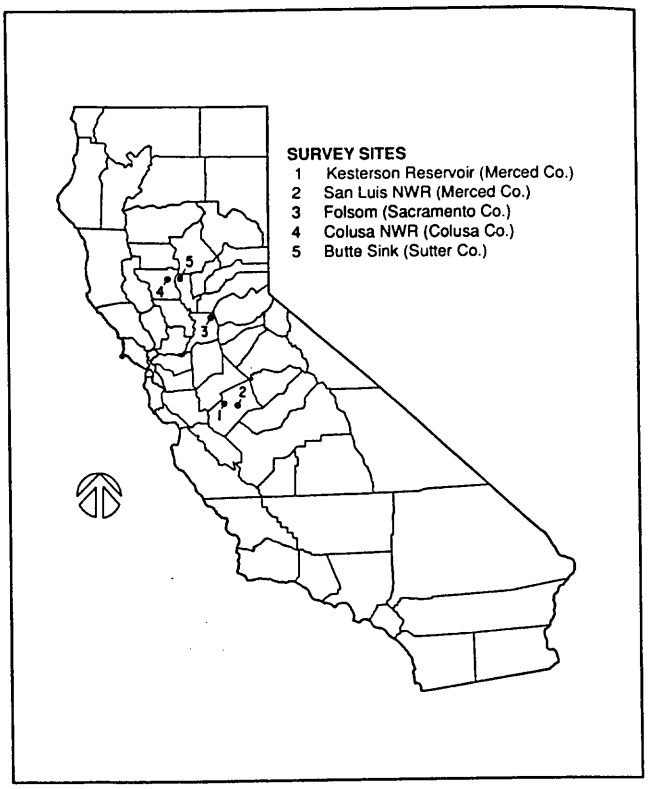

Figure 1. *Approximate locations of Central Valley tricolored blackbird nesting colonies surveyed during 1987.*

Systematic observations (using the methods described below) were made at each colony except Colusa NWR. Reconnaissance-level field surveys were undertaken at that site, and nests were examined after the breeding season. U.S. Fish and Wildlife Service (USFWS) personnel surveyed the Colusa NWR colony five times from May to June and also examined nests after the adults had departed (D. Mauser, Colusa National Wildlife Refuge, Colusa, California, in litt.).

Prior to censusing, reconnaissance-level field surveys were conducted at each of the four other colonies to estimate the size of their breeding tricolored blackbird populations and the occupied nesting area. After defining the extent of each colony, five stations were established at approximately 20-50 m intervals to make systematic observations of the tricolored blackbirds. To avoid causing nest abandonment, the birds were moni-

tored from sampling stations 15-30 m from the edge of each colony.

Each monitoring station was positioned for direct observation of a 100-m^2 area (a 20-m x 5-m section marked with surveyor's flagging) that appeared to contain a high density of breeding birds at the start of the study. The vicinity of one of the five stations at each colony was disturbed to collect eggs for a nestling bird feeding study. The vicinities of the four other stations at each colony were not entered until the young had fledged or the adults had departed.

All five sampling stations at each colony were censused frequently (at least weekly) to encompass major reproductive events, including nest building, egg laying, incubation, and feeding of nestlings and fledglings. Field biologists waited 5 min after arriving at the colony to allow the tricolored blackbirds to recover from the initial disturbance. After this interval, each marked study plot was censused continuously for 15 min. The following information was recorded: time of observation, the total number of individuals present (adults and immatures, males and females), the number of individuals arriving and departing within the observation period, the direction and destination (if known) of flight, and the amount and type of food brought back to the nestlings by the adults. Weather data, including cloud cover, wind speed, precipitation, and temperature, were also recorded at the start and end of each survey.

During May and June 1987, tricolored blackbirds, fledgling success, and foraging behavior of immature birds and adults were monitored. These observations were made during the fledgling period, after the young had left the nests but before they became completely independent. During each visit, the entire perimeter of each colony was carefully searched for evidence of nestling mortality. All dead nestlings found in fresh condition near the colonies were preserved in buffered formalin (10%) for pathological and histological examination, or were frozen for subsequent chemical analysis.

After the young had fledged, colony nests were examined. If the lack of adults or fledglings indicated that a nesting failure had occurred, the subject colony was immediately entered. Condition of the first 20-30 fresh nests (identified by fresh plant material, feathers, or feces) encountered within the observation area and a total of more than 100 nests were examined at each colony. All eggs (whole and partial), dead nestlings, and other material found in the nests were salvaged and refrigerated.

All fresh dead nestlings and developing embryos collected from the colonies were examined externally by Mr. Gary Santolo (Department of Avian Sciences, University of California, Davis, pers. comm.) for signs of gross, external deformities or other abnormalities. After this examination, Mr. Santolo dissected the livers from the nestlings and conducted internal histopatho-logical examinations.

Eleven liver samples from dead nestlings salvaged from Kesterson Reservoir were sent to the Environmental Trace Substances Research Center (University of Missouri, Columbia) for analysis of selenium content.

Results

Roosting Surveys

Nine tricolored blackbird surveys conducted between 21 January and 11 February indicated that approximately 20,000 individuals ($\overline{X}$ = 20,544, SD = 6,956 individuals, n = 9 censuses) roosted at Kesterson Reservoir each night. The 1987 winter roosting population was significantly smaller than the large populations (more than 50,000 individuals) censused by USFWS in 1986. In both years, the flocks were synchronized in their departure (0700-0740 h) and arrival (1615-1730 h) times.

Nesting Surveys

Figure 2 shows the relative locations of nesting tricolored blackbird colonies in ponds 1, 5, and 7 at Kesterson Reservoir. Figure 3 and Appendices A-D summarize the major reproductive events and successes of individual colonies. Table 1 provides a summary of the materials salvaged from nests at the end of the breeding season. Population trends and specific reproductive events of individual colonies are discussed below.

Kesterson Reservoir Pond 1. Approximately 200 breeding adults (censused at Plots K4 and K5, Appendix A) initiated nesting in the northeast corner of this pond during the second week of April 1987. Plot K5 was entered on 17 April to collect 21 fresh eggs from active nests for a different study (R. Grau, Department of Avian Sciences, University of California, Davis, pers. comm.). Full tricolored blackbird clutches typically contain 3-4 eggs (Harrison 1978); the relatively small clutch size ($\bar{X}$ = 2.3, *SD* = 1.4 eggs per nest) from the nests examined suggested that laying had not been completed by that date. Possibly from disturbance during collecting, Plot K5 had subnormal nesting success and the entire colony declined to 100 adults during the next few weeks (Appendix A).

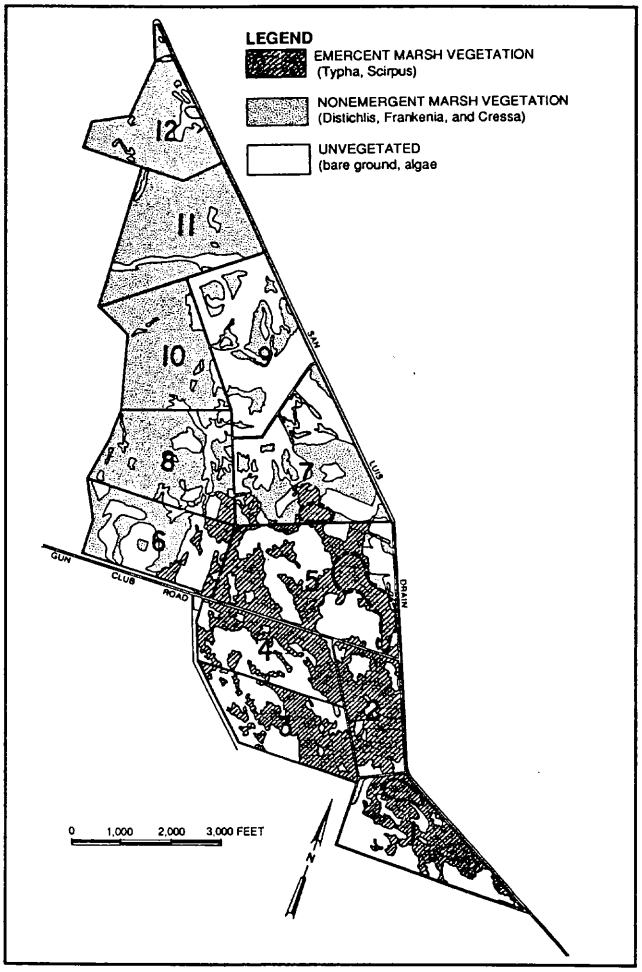

Figure 2. *Locations of tricolored blackbird nesting colonies at Kesterson Reservoir during 1987. Dashed lines indicate the approximate boundaries of individual colonies.*

Nineteen dead nestlings were salvaged from the levee roads near Pond 1 and the San Luis Drain during the first week of May (Table 1). The age and appearance of these nestlings were similar to nestlings found near Ponds 2 and 5 during April 1986. External examinations of 11 nestlings in fresh condition revealed that two individuals had "club feet" while the others had no external deformities (Table 2). Results of liver selenium analyses from these nestlings are provided in Table 2.

Approximately 100 young tricolored blackbirds were fledged from the Pond 1 colony despite the observed mortality and relatively small colony size (Fig. 3). The proportion of successful nests (indicated by the number of fledglings) appeared to have been higher than that observed at Ponds 2 and 5 during 1986 (100 fledglings from a colony estimated by USFWS at 47,000 breeding adults).

While feeding young, adults from the Pond 1 colony foraged primarily in pastures nearby (Appendix A). Some individuals, however, foraged on the mudflats and exposed shorelines of Pond 2 (F. Paveglio, San Luis National Wildlife Refuge, U.S. Fish and Wildlife Service, Los Banos, California, in litt.; Severson, USFWS, pers. comm.). Most of the insect food fed to nestlings of this colony was captured off site; however, at least some food was probably taken from Kesterson Reservoir.

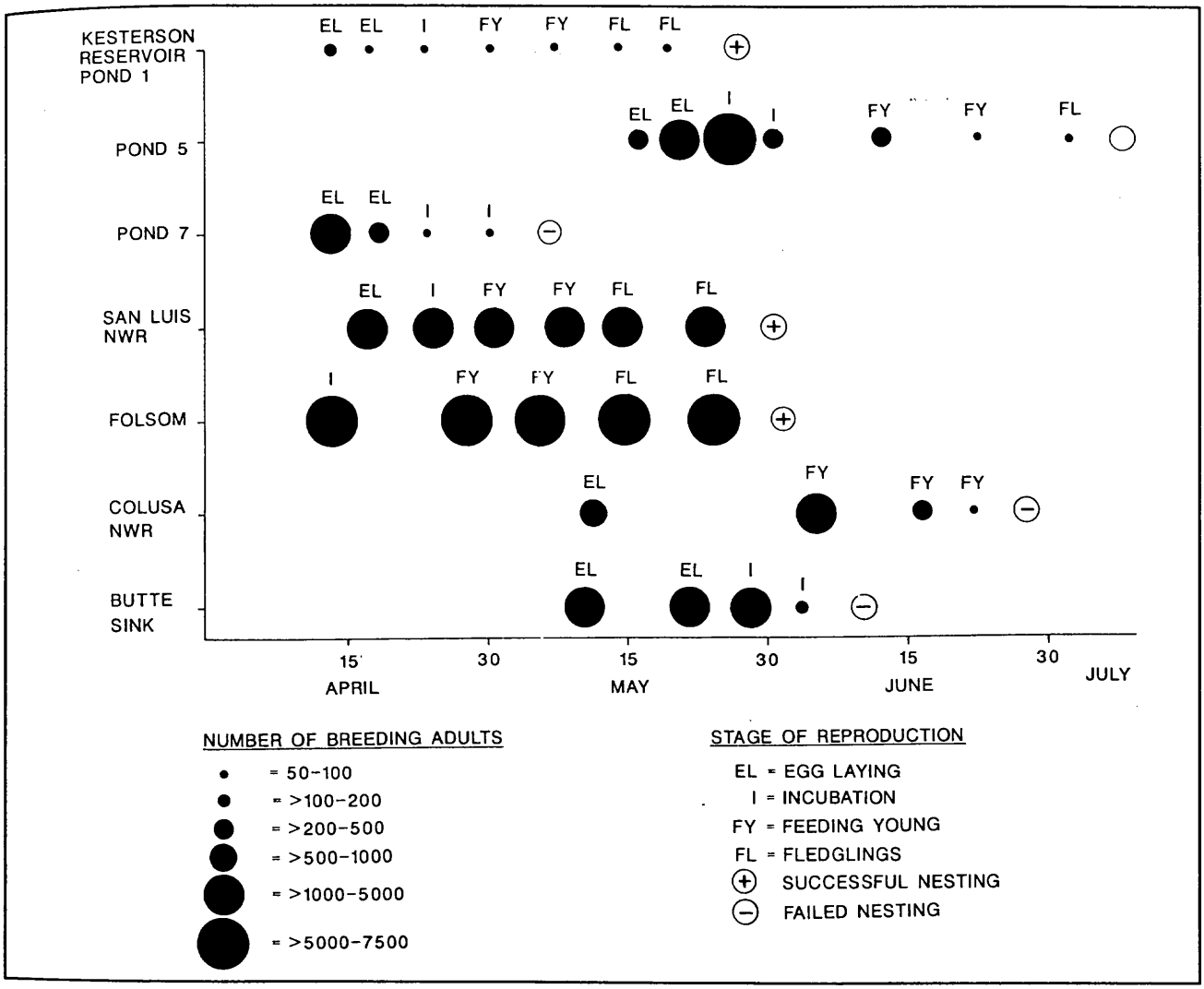

Figure 3. *Tricolored blackbird observations at Central Valley locations (arranged from south to north) during 1987. Dots (.) indicate observations made during this study.*

Kesterson Reservoir Pond 5. A colony of 5,000-7,500 adults attempted to breed in the eastern half of this pond during mid-May 1987. Adults from Pond 5 foraged primarily in nearby pastures of Freitas Ranch. Some birds were also observed foraging along the shorelines of Pond 7 (F. Paveglio, San Luis National Wildlife Refuge, U.S. Fish and Wildlife Service, Los Banos, California, in litt.).

USFWS actively hazed these birds for 13 days during May and June (Fig. 3) in an attempt to force them to relocate to nearby uncontaminated cattail marshes. The hazing largely succeeded in displacing the colony, as only about 50 adults remained at the end of the breeding season. Approximately 50 tricolored blackbirds were fledged from the Pond 5 colony in mid-July (G. Basey, Kesterson NWR, Los Banos, California, pers. comm.). Detailed observations were not made of this colony because the hazing activities disrupted normal blackbird reproductive behavior.

On 10 June, 73 eggs were collected from active nests at Pond 5. The relatively low clutch size ($\bar{X}$ = 2.8, SD = 0.7 egg per clutch) suggested that the females were still laying on this date. A return

Table 1. *Tricolored blackbird eggs and dead nestlings salvaged from four colonies in the Central Valley during April-June 1987.*

Colony	Date	Total Nests Examined	No. of Empty Nests	Other Nests (No. of Nests/ Contents)	Comments
Kesterson Reservoir					
Pond 1	5-1				8 dead nestlings & 1 whole egg salvaged from levee road
	5-2 to 5-5				11 dead nestlings salvaged from levee roads
	5-20	47	40	2/1 dead nestling 2/1 egg 1/3 dead nestlings 2/shell fragments	
Pond 5	7-2	111	102	6/shell fragments 2/pecked eggs 1/dried yolk	
Pond 7	5-1	79	71	2/3 eggs 2/2 eggs 2/1 egg 2/shell fragments	
San Luis NWR	5-29	116	113	1/broken egg 1/1 egg 1/shell fragments	
Folsom	5-25	60	60	—/—	
	6-10	41	41	—/—	
Colusa NWR	6-24	148	143	1/broken egg 1/2 eggs 1/1 egg	Nestling less than 1 day old
				1/1 dead nestling 1/1 dead nestling	Nestling about 6 days old
				1/shell fragments	
Butte Sink	6-10	135	132	2/shell fragments 1/dried yolk	

visit to this area on 2 July revealed that most of these nests had been abandoned. During this visit, the contents of 111 nests were examined, and broken eggs and shell fragments were salvaged (Table 1). No dead nestlings were found in the nests or in open terrain during any observations of this colony.

Kesterson Reservoir Pond 7. Approximately 2,000 adult tricolored blackbirds initiated nesting in the southern portion of this pond in mid-April. Surveys of this site (Plots K1, K2, and K3, Appendix A) on 23 April revealed that most of these birds had abandoned their nests and only about 100 adults remained (Fig. 2).

Table 2. *Results of selenium analyses of livers from tricolored blackbird nestlings salvaged from Pond 1 at Kesterson Reservoir during 1986.*

Nestling No.	Selenium Concentration (ppm dry wt.)	Comments
1	11.0	No external deformities
2	5.0	No external deformities
3	9.6	No external deformities
4	10.0	No external deformities
5	7.0	No external deformities
6	13.0	No external deformities
7	16.0	Club feet
8	9.8	No external deformities
9	30.0	Club feet
10	7.9	No external deformities
11	17.0	No external deformities

This colony may have failed by 1 May because only a few adult tricolored blackbirds and numerous territorial red-winged blackbirds (*Agelaius phoeniceus*) were observed during a 1.5-h survey. Observations during 1986 suggested that red-winged blackbirds at Kesterson Reservoir do not establish nesting territories close to active tricolored blackbird colonies.

The contents of 79 nests in the Pond 7 colony were examined after it was abandoned. Most nests were empty, although 12 unhatched eggs were salvaged from nests. The reason for the abandonment of the Pond 7 colony is unknown. The adults left while incubating the eggs; in contrast, previous tricolored blackbird nesting failures at Kesterson Reservoir involved posthatching deaths of nestlings.

San Luis NWR. This colony of about 1,500 tricolored blackbirds nested in the same cattail marsh in 1986 and 1987. On 17 April, Plot S2 was entered and 20 eggs were collected. The low clutch size ($\bar{X} = 1.9, SD = 1.0$) suggested that the females had not completed laying by this date.

Plot S2 was abandoned by 23 April, although the four other plots used to monitor the colony had high levels of tricolored blackbird activity. By 30 April, both Plots S2 and S5 were abandoned. It was likely that disturbance of Plot S2 associated with monitoring caused the birds to leave. The cause of abandonment of Plot S5 is unknown. These two plots were not recolonized during the 1987 breeding season. The remaining three plots (S1, S3, and S4, Appendix D) continued to have high levels of nesting activity. More than 1,000 fledglings were observed on 22 May, indicating that the San Luis NWR colony was successful.

After the breeding season, the colony was entered and the contents of 116 nests examined. Most nests were empty, although material for laboratory analyses was salvaged (Table 1).

Folsom. Approximately 5,000 tricolored blackbirds began nesting in clumps of blackberries (*Rubus* spp.) along Old Placerville Road during early April. This colony was entered on 16 April, and 46 eggs were collected from active nests at Plot F1 (Appendix C). Clutch size ($\bar{X} = 2.7, SD = 0.7$) indicated that the females had not completed laying by this date. Unlike the plots at other colonies where eggs were collected, the tricolored blackbirds did not abandon Plot F1 after we entered it. The blackberries at this colony provided a more secure substrate for nests than the cattails at other sites, and it is likely that microhabitat disturbance at Plot F1 was less than that at other collection sites.

Weekly observations of the Folsom colony indicated that tricolored blackbirds at all five plots (F1-F5) nested successfully and fledged several thousand young. The Folsom study plots were entered on two dates (25 May and 10 June) and the contents of 101 nests examined. Most nests were covered by feces, indicating active use by tricolored blackbird fledglings. None of the nests contained eggs, dead nestlings, or other evidence of nesting failure. No dead chicks were found near this colony.

Colusa NWR. USFWS biologists observed 1,000 adults initiating breeding activities in Tract 21 of Colusa NWR on 12 May 1987. This colony expanded to approximately 2,000 breeding adults by 5 June (D. Mauser, Colusa National Wildlife Refuge, Colusa, California, in litt.). The site was visited on 10 June, by which time the number of breeding adults had declined by almost one-third. Remaining birds were seen carrying food into the colony, indicating the presence of young on this date.

On 17 June, only about 500 breeding adults remained at this colony, and by 22 June their numbers were reduced to fewer than 100 (Fig. 2). When this site was visited on 24 June, it was discovered that the tricolored blackbird colony had been abandoned. The contents of 148 nests were examined after the colony had failed, and eggs, shell fragments, and dead nestlings were salvaged for laboratory analyses (Table 1). Approximately 30% of the nests showed possible evidence of disturbance by predators.

The tricolored blackbird colony was adjacent (<200 m) to a nesting colony of 1,200 black-crowned night-herons (*Nycticorax nycticorax*), 500 snowy egrets (*Egretta thula*), 30 cattle egrets (*Bubulcus ibis*), and 240 white-faced ibis (*Plegadis chihi*). Several black-crowned night-herons were observed in the tricolored blackbird colony and 1-3 northern harriers (*Circus cyaneus*) foraged in this area almost constantly while nesting was in progress. The tricolored blackbirds made unsuccessful attempts at mobbing the northern harriers and chasing them from the colony. Predation may have played an important role in causing the Colusa NWR colony to fail; however, the lack of systematic observations from this area made exact determination of the cause of nesting failure impossible (D. Mauser, Colusa National Wildlife Refuge, Colusa, California, in litt.).

Butte Sink. This colony on West Butte Road (near the Sacramento Outing Duck Club) had about 2,000 breeding adults on 10 May 1987. Observations made at this site indicated that most of the nesting tricolored blackbirds foraged on nearby rice fields and in adjacent pasturelands (Appendix D). On 21 May, 102 eggs from 57 active nests were collected at this colony (Plot B1). Average clutch size of these nests ($\bar{X}$ = 1.79, SD = 0.84 egg per clutch) indicated that females had not completed laying by this date.

Later surveys of this colony revealed that Plot B1 (Appendix D) was abandoned. The other plots (B2 and B3) continued to have high levels of breeding bird activity on 4 June, but the entire colony was abandoned by 10 June. The colony was entered on this date when it was discovered that most of the 135 nests examined were empty (Table 1). The cause of this nesting failure is unknown. The USFWS has submitted 30 eggs from this colony for trace element and pesticide analyses (D. Palawski, U.S. Fish and Wildlife Service, Sacramento, California, pers. comm.).

Discussion and Conclusions

Reproductive Performance at Kesterson Reservoir Colony

A majority of the 1987 tricolored blackbird nesting attempts at Kesterson Reservoir failed due to prehatching (Pond 7) and posthatching (Pond 1) problems and extensive USFWS hazing (Pond 5). Two of the colonies established during 1987, however, were partially successful (100 fledglings at Pond 1 [100 nesting adults] and 50 fledglings [50 nesting adults] at Pond 5).

Possible reasons for the observed nest abandonment and nestling mortality at Kesterson Reservoir in 1986 and 1987 are unknown; previous observers have also documented tricolored blackbird nesting failures. Historical literature describes major tricolored blackbird nesting failures caused by predation by mammals (Evermann 1919, Heermann 1853, Mailliard 1914). Belding (1890) described a colony near Stockton that suffered significant posthatching mortality from an unknown cause. Neff (1937) reported several instances of massive desertions in tricolored blackbird colonies but no egg destruction; he cited predation

as a potential cause of tricolored blackbird nesting failures. Lack and Emlen (1939) also described mass desertions and destruction of eggs at colonies near Marysville and Davis, and implied that predators were responsible.

The historical literature suggests that tricolored blackbird colonies are extremely sensitive to a variety of disturbances, including predation. Predators such as northern harriers often flew above the tricolored blackbird colonies at Kesterson Reservoir and were occasionally mobbed. During the surveys conducted in 1986 and 1987, however, no harriers or other predators were observed taking tricolored blackbird nestlings, fledglings, or adults. Similarly, nests examined after the breeding season at Kesterson Reservoir in 1987 did not show evidence of predation (e.g., tilted nests, obvious disturbance around nests, or partially consumed eggs or nestlings).

It is unlikely that food shortages were a problem for blackbirds because insect prey were observed to be abundant at Kesterson Reservoir and at nearby pastures, and because adults returning to the colony appeared to have ample food for their nestlings.

Selenium concentrations of composited livers from tricolored blackbird nestlings salvaged from Ponds 2 and 5 at Kesterson Reservoir in 1986 ranged from 9.0 to 15.0 ppm (dry weight), with a mean of 11.3 ppm (F. Paveglio, San Luis National Wildlife Refuge, U.S. Fish and Wildlife Service, Los Banos, California, in litt., July 1987). These values were similar to the selenium concentrations of individual tricolored blackbird livers from Pond 1 in 1987 ($\bar{X}$ = 12.4, range = 5.0 to 30.0 ppm dry weight). In contrast, composited liver samples from red-winged blackbird fledglings collected from Merced NWR (an area with no history of selenium contamination) in 1986 ranged from 3.2 to 4.1 ppm (dry weight) with a mean of 3.7 ppm (F. Paveglio, San Luis National Wildlife Refuge, U.S. Fish and Wildlife Service, Los Banos, California, in litt.). The selenium concentrations of tricolored blackbird livers from Kesterson Reservoir in both 1986 and 1987 were significantly different ($P < 0.05$) from those of the red-winged blackbird livers. These differences may have resulted from the contaminated food items from Kesterson Reservoir that were fed to the tricolored blackbird nestlings.

Recent collections of aquatic insects at Kesterson Reservoir indicate that many taxa continue to have high concentrations of selenium (>90 ppm dry weight) (U.S. Bureau of Reclamation 1987). A dose-response relationship for selenium has not been derived for tricolored blackbirds or for other insectivorous bird species (R. Grau, Department of Avian Sciences, University of California, Davis, California, pers. comm.). Further research is needed to determine if selenium toxicosis was the cause of the tricolored blackbird nestling mortalities observed at Kesterson Reservoir.

Reproductive Performance of Other Colonies

The San Luis NWR and Folsom colonies successfully fledged large numbers of young during 1987, while the Colusa NWR and Butte Sink colonies experienced total nesting failures. All four of these control colonies are located in areas without documented histories of selenium contamination. San Luis NWR is, however, within a few miles of areas where agricultural drainwater has been applied (F. Paveglio, San Luis National Wildlife Refuge, U.S. Fish and Wildlife Service, Los Banos, California, in litt., July 1987).

It is likely that predation played a role in the failure of the Colusa NWR colony, but a lack of systematic observations (or fresh eggs collected from this site) limits the interpretation of other factors that may have contributed to tricolored blackbird nesting problems. The cause of nesting failure of the Butte Sink colony is unknown. Analyses of eggs collected at this site for trace element contamination and pesticide content may provide information regarding possible causes of the observed abandonment.

The results of the tricolored blackbird observations at Kesterson Reservoir (during 1986 and 1987), Colusa NWR, and the Butte Sink suggest that this species is probably sensitive to a variety of environmental perturbations while breeding. Predation is a documented source of mortality, and this problem may increase as the continued loss of wetlands and other tricolored blackbird nesting habitat forces nesting colonies into increasingly confined areas. Contamination by trace elements (such as selenium) and pesticides is a potential cause of nesting failures. These factors, however, require further documentation.

These studies suggest that the cause and magnitude of nestling mortality vary substantially among tricolored blackbird colonies; further research is needed to determine whether the nesting failures observed were isolated phenomena or indicative of a more widespread general decline of this species.

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Appendix A. *Summary of tricolored blackbird observations made during April and May 1987 at Kesterson Reservoir, Merced County.*

Plot Number	Date	Total Adults in Plot	Percent (M/F)	Flight Activity				Reproductive Activity		Comments
				Number Arrive	Number Depart	Direction	Destination	Young Present	Type of Food Brought	
K1[a]	4-23	100	10/90	17	18	N, NW	Flew from view	No	None	Incubation
K2	4-23	50	10/90	6	3	N	Flew from view	No	None	Incubation
K3	4-23	75	10/90	48	16	N	Flew from view	No	None	Incubation
K4	4-23	100	15/85	14	23	N, NW	Flew from view	No	None	Incubation
K5[b]	4-23	25	0/100	9	4	N, NW	Flew from view	No	None	Incubation
K1	4-30	20	20/80	27	8	N, NE	Flew from view	No	None	Reduced activity
K2	4-30	20	50/50	5	1	N, W	Flew from view	No	None	Reduced activity
K3	4-30	25	25/75	25	12	N, E	Flew from view	No	None	Reduced activity
K4	4-30	75	20/80	51	31	N, E	Freitas Ranch	Yes	Not identified	Nestlings calling
K5	4-30	25	20/80	9	4	N, E	Freitas Ranch	Yes	None	Nestlings calling
K1	5-7	10	50/50	13	6	N, E	Flew from view	No	None	A few adults in area
K2	5-7	0	—	0	0	—	—	No	None	Abandoned
K3	5-7	20	20/80	0	0	N, NE	—	No	None	Abandoned
K4	5-7	75	40/60	113	92	N, NW	Freitas Ranch	Yes	Coleoptera, caterpillars	Nestlings calling
K5	5-7	20	40/60	8	9	N, NW	Freitas Ranch and Pond 2	Yes	Coleoptera, caterpillars	Nestlings calling
K1	5-14	0	—	0	0	—	—	No	None	Abandoned
K2	5-14	0	—	0	0	—	—	No	None	Abandoned
K3	5-14	0	—	0	0	—	—	No	None	Abandoned
K4	5-14	100	40/60	113	126	W, NE	Freitas Ranch and Pond 2	Yes	Not identified	Fledglings present
K5	5-14	25	50/50	17	14	W, NE	Freitas Ranch and Pond 2	Yes	Not identified	Fledglings present
K1	5-19	0	—	0	0	—	—	No	None	Abandoned
K2	5-19	0	—	0	0	—	—	No	None	Abandoned
K3	5-19	0	—	0	0	—	—	No	None	Abandoned
K4	5-19	0	—	0	0	—	—	No	None	Young fledged
K5	5-19	25	50/50	85	175	W	Freitas Ranch	Yes	Not identified	Fledglings present
K1	5-29	0	—	0	0	—	—	No	None	Abandoned
K2	5-29	0	—	0	0	—	—	No	None	Abandoned
K3	5-29	0	—	0	0	—	—	No	None	Abandoned
K4	5-29	0	—	0	0	—	—	No	None	Fledglings present
K5	5-29	0	—	0	0	—	—	No	None	Fledglings present

[a]Plots K1, K2, and K3 were in Pond 7, and Plots K4 and K5 were in Pond 1.
[b]Plot K5 was entered on 17 April 1987 to collect eggs from active nests.

Appendix B. *Summary of tricolored blackbird observations made during April and May 1987 at San Luis National Wildlife Refuge, Merced County.*

Plot Number	Date	Total Adults in Plot	Percent (M/F)	Flight Activity: Number Arrive	Flight Activity: Number Depart	Flight Activity: Direction	Flight Activity: Destination	Reproductive Activity: Young Present	Reproductive Activity: Type of Food Brought	Comments
S1	4-23	200	10/90	3	38	N, E, W	Flew from view	No	None	Incubation
S2[a]	4-23	0	—	0	0	—	—	No	None	Abandoned
S3	4-23	250	10/90	19	41	N, NE	Flew from view	No	None	Incubation
S4	4-23	300	10/90	153	46	E, S	Flew from view	No	None	Incubation
S5	4-23	200	10/90	53	46	E	Flew from view	No	None	Incubation
S1	4-30	150	20/80	50	46	N, NW	Nearby fields (<0.5 km)	Yes	Brownish Odonata	Nestlings calling
S2	4-30	0	—	1	5	NW	—	No	None	Abandoned
S3	4-30	100	20/80	39	45	N, NW	Nearby fields	Yes	White Orthoptera	Nestlings calling
S4	4-30	50	95/5	104	146	E, SE	Nearby fields	Yes	Green caterpillars	Nestlings calling
S5	4-30	0	—	1	0	SE	—	No	None	Abandoned
S1	5-7	150	50/50	94	83	E, SE	Nearby fields	Yes	White Orthoptera	Nestlings present
S2	5-7	0	—	0	0	—	—	No	None	Abandoned
S3	5-7	75	40/60	47	63	S, SW	Nearby fields	Yes	Brownish Odonata	Nestlings present
S4	5-7	250	40/60	410	270	S, S	Nearby fields	Yes	Not identified	Nestlings present
S5	5-7	0	—	0	0	—	—	No	None	Abandoned
S1	5-14	150	40/60	104	48	SE, SW	Nearby fields	Yes	Not identified	Fledglings present
S2	5-14	0	—	0	0	—	—	No	None	Abandoned
S3	5-14	0	—	0	0	—	—	No	None	Fledglings present
S4	5-14	300	50/50	468	255	All directions	Nearby fields	Yes	Not identified	Fledglings present
S5	5-14	0	—	0	0	—	—	No	None	Abandoned
S1	5-22	0	—	0	0	—	—	No	None	Adults & fledglings near colony site
S2	5-22	0	—	0	0	—	—	No	None	Adults & fledglings near colony site
S3	5-22	0	—	0	0	—	—	No	None	Adults & fledglings near colony site
S4	5-22	0	—	0	0	—	—	No	None	Adults & fledglings near colony site
S5	5-22	0	—	0	0	—	—	No	None	Adults & fledglings near colony site

[a]Plot S2 was entered on 17 April 1987 to collect eggs from active nests.

Appendix C. *Summary of tricolored blackbird observations made during April and May 1987 near Folsom, Sacramento County.*

Plot Number	Date	Total Adults in Plot	Percent (M/F)	Flight Activity				Reproductive Activity		Comments
				Number Arrive	Number Depart	Direction	Destination	Young Present	Type of Food Brought	
F1[a]	4-26	200	10/90	17	21	E, SE	Flew from view	Yes	Winged insects	Nestlings calling
F2	4-26	250	15/85	124	38	S, SE	Flew from view	Yes	Not identified	Fecal sacs dropped
F3	4-26	300	20/80	146	50	N, NE	Flew from view	Yes	Not identified	Fecal sacs dropped
F4	4-26	250	10/90	49	43	N, NW	Flew from view	Yes	None	Fecal sacs dropped
F5	4-26	250	20/80	96	85	N, NW	Flew from view	Yes	Caterpillars	Fecal sacs dropped
F1	5-3	150	10/90	60	29	W, NW	Flew from view	Yes	Orthoptera	Nestlings begging
F2	5-3	250	30/70	250	185	S, SW	Flew from view	Yes	Orthoptera	Nestlings begging
F3	5-3	200	30/70	119	87	N, S, W	Flew from view	Yes	Not identified	Nestlings begging
F4	5-3	150	30/70	55	50	N, NW	Flew from view	Yes	Not identified	Nestlings begging
F5	5-3	400	40/60	565	810	W, SW	Flew from view	Yes	Not identified	Nestlings begging
F1	5-8	100	30/70	27	42	E, SE	Adults foraging near colony	Yes	Caterpillars	Loud begging from nestlings & fledglings
F2	5-8	250	50/50	469	96	E, SE	Adults foraging near colony	Yes	Coleoptera, caterpillars	Loud begging from nestlings & fledglings
F3	5-8	200	30/70	102	52	E, SE	Adults foraging near colony	Yes	Not identified	Loud begging from nestlings & fledgings
F4	5-8	100	30/70	37	34	S, SE	Adults foraging near colony	Yes	Orthoptera	Loud begging from nestlings & fledgings
F5	5-8	300	40/60	216	219	S, SE, N	Adults foraging near colony	Yes	Not identifed	Loud begging from nestlings & fledging
F1	5-15	0	—	3	3	NW, SE	Adults foraging near colony	No	None	Fledglings have moved
F2	5-15	150	50/50	129	85	S, SE	Adults foraging near colony	Yes	Not identified	Fledglings present
F3	5-15	0	—	6	6	SE	Adults foraging near colony	No	None	Fledgings have moved
F4	5-15	0	—	1	1	N, SE	Adults foraging near colony	No	None	Fledglings have moved
F5	5-15	200	40/60	297	222	S, SE, E	Adults foraging near colony	Yes	Not identified	Fledglings present
F1	5-25	0	—	0	0	—	—	No	None	Adults & fledglings in trees near colony
F2	5-25	0	—	0	0	—	—	No	None	Adults & fledglings in trees near colony
F3	5-25	0	—	0	0	—	—	No	None	Adults & fledglings in trees near colony
F4	5-25	0	—	0	0	—	—	No	None	Adults & fledglings in trees near colony
F5	5-25	0	—	0	0	—	—	No	None	Adults & fledglings in trees near colony

[a]Plot F1 was entered on 16 April 1987 to collect eggs from active nests.

Appendix D. *Summary of Tricolored Blackbird Observations Made During April and May 1987 at the Butte Sink, Sutter County.*

Plot Number	Date	Total Adults in Plot	Percent (M/F)	Flight Activity				Reproductive Activity		Comments
				Number Arrive	Number Depart	Direction	Destination	Young Present	Type of Food Brought	
B1[a]	5-28	10	50/50	2	1	N	Flew from view	No	No	Abandoned
B2	5-28	150	40/60	119	27	W, NW	Flew from view	No	No	Incubation
B3	5-28	200	40/60	157	66	W, NW	Flew from view	No	No	Incubation
B1	6-4	0	—	0	0	—	—	No	No	Abandoned
B2	6-4	75	50/50	12	23	W, NW	Flooded rice field	Maybe	Not identified	Abandoned
B3	6-4	150	60/40	78	68	W, NW	Flooded rice field	Yes	Orthoptera	A few adults feeding young
B1	6-10	0	—	0	0	—	—	No	—	Abandoned
B2	6-10	0	—	0	0	—	—	No	—	Abandoned
B3	6-10	0	—	0	0	—	—	No	—	Abandoned

[a]Plot B1 was entered on 21 May 1987 to collect eggs from active nests.