

**MOVEMENTS OF TRICOLORED BLACKBIRDS
BANDED IN THE CENTRAL VALLEY OF CALIFORNIA,
1965-1972**

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Before 1965, about 24,000 Tricolored Blackbirds (*Agelaius tricolor*) were banded (Van Velzen, 1965; Mike San Miguel, pers. comm.); there were 93 recoveries from 1924 through 1940 (Neff, 1942) and 43 returns and recoveries from 1941 through 1964 (DeHaven and Neff, 1973). These data showed general movements of tricolors, mostly within California's Central Valley. During 1965-72, while studying blackbird damage to rice, we banded 45,660 tricolors in the Central Valley. Through December 1972, 298 of these birds have been recovered, giving additional data on seasonal movements of tricolors throughout their range.

METHODS

Of the total tricolors banded (Table 1), 33,058 (72.4%) were nestlings from 21 colonies in the Sacramento Valley (Tehama, Butte, Glenn, Colusa, Sutter, Yuba, and Sacramento counties) and 11 colonies in the northern San Joaquin Valley (San Joaquin,

TABLE 1.
Numbers of Tricolored Blackbirds banded and recovered by year in the Central Valley, California, 1965-72.

Year banded	Banded as nestlings		Banded from traps		Total	
	No. banded	No. recovered	No. banded	No. recovered	No. banded	No. recovered
1965	0	0	862	13	862	13
1966	0	0	835	8	835	8
1967	400	2	16	0	416	2
1968	2,350	13	2,743	21	5,093	34
1969	13,030	110	1,575	25	14,605	135
1970	6,550	32	2,081	13	8,631	45
1971	10,728	31	3,449	30	14,177	61
1972	0	0	1,041	0	1,041	0
Totals	33,058	188	12,602	110	45,660	298

Stanislaus, and Merced counties). Together, these two valleys form the Central Valley. The remaining 12,602 birds were banded from large decoy traps (6 x 16 x 30 feet or 6 x 30 x 60 feet) similar to those described by Meanley (1971) and Burt and Giltz (1971). Although birds were trapped at several Sacramento Valley locations, most were banded from a single trap about four miles west of Colusa (Colusa Co.). Although trapping effort varied considerably among years, traps were usually operated during the post-

breeding period (mid-August through November) when mostly immature birds were caught, and during spring (April through June) in 1971-72 when the majority caught were adult males.

We recovered 246 banded tricolors by decoy trapping, by collecting birds for food-habits and other studies (mostly near Colusa), and by collecting banded birds at breeding colonies throughout the Central Valley. The other 52 recoveries were made by the public. (In this paper, a recovery denotes any bird taken outside the 10-minute latitude-longitude block where banded, or any bird retaken at least 90 days after banding.)

RESULTS AND DISCUSSION

Movements from Breeding Colonies to Colusa (113 Recoveries). A total of 107 tricolors banded as nestlings in the Sacramento Valley were trapped near Colusa during the postbreeding period (Table 2, Fig. 1). Although none of these movements were more than 75

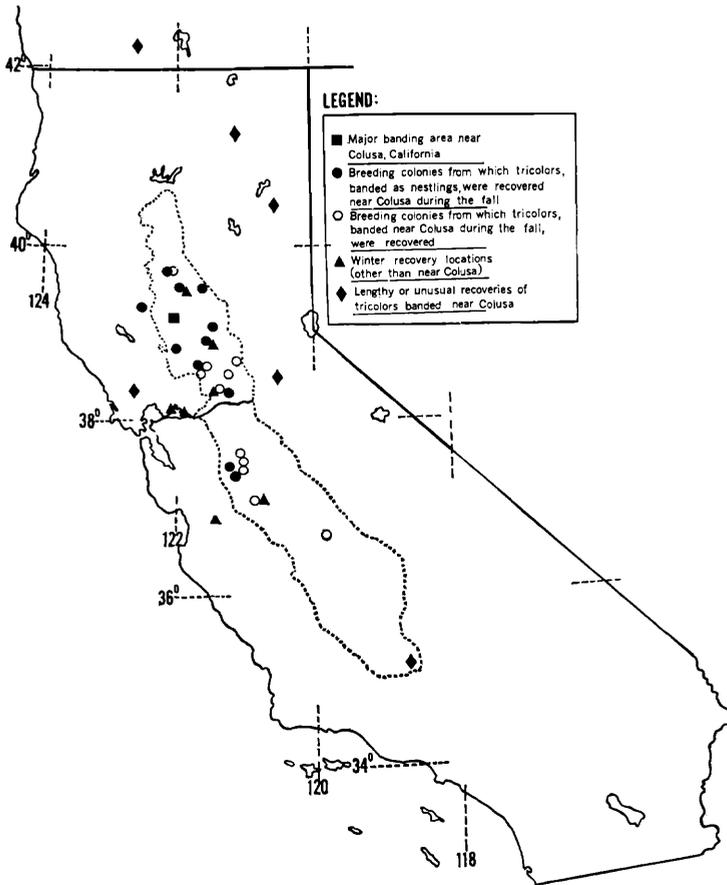


FIGURE 1. Recovery locations of Tricolored Blackbirds banded in the Central Valley, California, 1965-72. Most of the symbol locations denote more than one recovery.

TABLE 2.
Postbreeding (mid-August through November) recoveries near Colusa, California, of Tricolored Blackbirds banded as nestlings in the Central Valley, California 1967-71.

Vicinity ¹	Banding(s) Year(s)	No. (total)	No. of recoveries		Distance (miles) and direction to Colusa from banding site
			First fall	Later falls	
				Total	
<i>Sacramento Valley</i>					
Colusa (Colusa Co.)	1969, 71	2,550	23	1	24
Gridley (Butte Co.)	1969	711	2	0	2
Meridian (Colusa Co.)	1969	653	1	0	1
Afton (Glenn Co.)	1969-71	2,900	8	0	8
Tudor (Sutter Co.)	1968	1,750	5	2	7
East Park Res. (Colusa Co.)	1967-69	2,470	5	1	6
Dunnigan (Colusa Co.)	1969	2,414	15	4	19
Oroville (Butte Co.)	1970-71	800	4	0	4
Knights Landing (Yolo Co.)	1969	800	5	1	6
Wheatland (Yuba Co.)	1970	1,700	5	0	5
Orland (Glenn Co.)	1970-71	2,000	10	0	10
Clay (Sacramento Co.)	1969-71	6,324	15	0	15
Subtotals		25,072	98	9	107
<i>San Joaquin Valley</i>					
Patterson (Stanislaus Co.)	1971	500	5	0	5
Crows Landing (Stanislaus Co.)	1971	1,100	1	0	1
Subtotals		1,600	6	0	6
All Locations	1969-71	26,672	104	9	113
					135 N 138 N

¹More than one breeding colony at some locations in some years.

miles, an annual local migration to the rice-growing area near Colusa is indicated in three ways. First, we banded nestlings in 21 colonies in the valley (at least one in each known breeding area), and at least one bird from 18 (85%) of these moved to Colusa. The three colonies not represented were ones where fewer than 500 nestlings were banded. Second, there were two or more recoveries for 16 (90%) of the 18 colonies, which suggests that a fairly large portion of each colony's offspring moved to Colusa. And finally, of the 107 recoveries, 98 (92%) were in the same year as banding and more than one-half were within 90 days of banding, showing a relatively rapid movement to the Colusa area.

From the San Joaquin Valley, only six nestlings, from 2 of 11 colonies, were trapped at Colusa during the postbreeding period, but these were taken within 80 days after banding (Table 2; Fig. 1). Thus, the extent of the local migration to Colusa from this valley may be less than from the Sacramento Valley. However, because we banded a lower average number of birds per colony in the San Joaquin Valley (478 compared with 1,324 in the Sacramento Valley), and observed generally poorer nestling survival there (but did not measure it), the differences, if any, may not be as large as indicated. Neff (1942) and DeHaven and Neff (1973) also showed movements of tricolors from San Joaquin Valley colonies to the rice district near Colusa and suggested that such a movement might occur to some extent from throughout the valley.

Whether the movements of adults are similar to the movements of these immature tricolors is unknown because we did not band adults at breeding colonies. However, large numbers of adults are present near Colusa during late summer and fall (Payne, 1969), and it is doubtful that inexperienced first-year birds could move to Colusa so rapidly unless they were with experienced adults, with whom they presumably stay for at least the first few weeks after fledging. Banding of adults at colonies is needed to confirm this feature.

Overall, this postbreeding movement of tricolors to the Colusa area appears to be related to food supplies and roosting habitat. Major breeding areas found during a recent study (DeHaven et al., 1975) were in Stanislaus, Merced, and southern Sacramento counties, and these areas are relatively hot and dry during the summer months and food probably becomes scarce there in late summer. At this time, the flooded areas of weeds, maturing rice, and other grains in the central Sacramento Valley offer abundant food. Thus tricolors may move to these rich feeding grounds to obtain rice and watergrass (*Echinochloa* spp.), which comprise about three-fourths of their diet during fall (Crane and DeHaven, Ms). They may particularly prefer the area near Colusa because it contains one of the rice district's few remaining extensive marsh areas (on private and government refuges) capable of supporting large blackbird roosts. Such a pattern of postbreeding convergence based on food abundance has been suggested by Ward (1971) for the Red-billed Quelea (*Quelea quelea*), another colonial-nesting passerine.

Movements to Wintering Areas (10 Recoveries). Our general observations and those of Neff (1937; 1942), Orians (1961a), and Payne (1969) indicate that during winter (November-February) tricolor numbers decline in the rice district near Colusa and increase in the northern San Joaquin Valley and San Francisco Bay-Delta area. Of 10 winter recoveries (Colusa retraps excluded), 6 followed this pattern. Two tricolors banded 1 October 1970 at Colusa were recovered in November and December 1970 at Sherman Island (Solano Co.) in the bay-delta area; one banded 27 September 1971 at Colusa was shot 30 October 1971 near Benecia (Solano Co.); three banded as nestlings at Sacramento Valley colonies were recovered in the San Joaquin Valley (Merced Co.) the first winter after banding.

Neff (1942) reported that some nestlings from the rice district (north of Colusa in Glenn Co.) were recovered during winter in the bay-delta area (Contra Costa Co.) and in San Joaquin Co. And Neff (1942) and DeHaven and Neff (1973) reported that many nestlings from Merced Co. were next recovered in the bay-delta area during winter. However, they did not trap in the rice district in fall to determine if many tricolors moved there first from breeding colonies before moving to wintering areas, as our data suggest.

Of the other four winter recovery records, two were from the rice district and one each was from the lower Sacramento Valley and the San Benito River Valley (south of San Francisco Bay). Neff (1942) and DeHaven and Neff (1973) reported a few winter recoveries from the lower Sacramento Valley, lower San Joaquin Valley, and foothill areas bordering the Central Valley. Thus, although a relatively large, but perhaps variable, portion of the Central Valley population probably winters in the bay-delta region or northern San Joaquin Valley, other tricolors winter at widely scattered points throughout the species' range.

Movements from Colusa to Breeding Colonies (28 Recoveries). Of about 8,500 tricolors banded from the Colusa-area decoy traps during the postbreeding period, 28 were recovered at breeding colonies (Table 3; Fig. 1). These movements are the reverse of the breeding colony-to-Colusa movements and confirm that birds present in the rice district in the fall use many different breeding locations throughout the Sacramento Valley and part of the San Joaquin Valley. The best example is four tricolors banded at Colusa within a two-week period during fall 1969 and shot in spring 1970 at four different breeding colonies located from 38 miles north to 140 miles south of Colusa. The remaining 24 recoveries were made at 10 breeding colonies in the Sacramento Valley and 6 in the San Joaquin Valley. Several recoveries in the San Joaquin Valley were at colonies at least 100 miles south of Colusa; the farthest, taken in June, was 245 miles south of Colusa. Of the 28 recoveries 12 (ca 43%) were fall-banded birds recovered the next spring.

TABLE 3.
Recoveries at breeding colonies of Tricolored Blackbirds banded near Colusa, California, during the postbreeding periods (mid-August through November), 1965-71.

Year banded	Recoveries			Distance (miles) and direction from Colusa to recovery site
	Year	No.	Vicinity	
1965	1967	1	Turlock (Stanislaus Co.) ¹	140 S
	1970	1	Crows Landing (Stanislaus Co.)	140 S
	1971	1	Afton (Glenn Co.)	13 NE
1966	1967	1	Elverta (Sacramento Co.) ¹	50 SE
		1	Williams (Colusa Co.) ¹	<10
1967	1968	1	Los Banos (Merced Co.)	166 S
1968	1969	2	Meridian (Colusa Co.)	<10
	1970	1	Roseville (Placer Co.) ¹	55 SE
		1	35 mi SW Fresno (Kings Co.) ¹	245 S
		1	Clay (Sacramento Co.)	75 SE
	1971	2	Galt (Sacramento Co.)	74 S
1969	1970	1	Orland (Glenn Co.)	38 N
		1	Woodland (Yolo Co.)	45 SE
		1	Herald (Sacramento Co.)	79 SE
		1	Crows Landing (Stanislaus Co.)	140 S
	1971	1	Galt (Sacramento Co.)	74 S
	1972	4	Knights Landing (Yolo Co.)	32 S
		1	Galt (Sacramento Co.) ¹	74 S
1970	1971	1	Modesto (Stanislaus Co.)	125 S
	1972	1	Herald (Sacramento Co.)	76 SE
		1	Modesto (Sacramento Co.)	130 S
1971	1972	1	Galt (Sacramento Co.)	74 S
		1	Standish (Lassen Co.) ¹	120 NE
Total		28		

¹Recovered during breeding season (April-June), but not at a breeding colony.

Movements Among Colonies (33 Recoveries). Many tricolors apparently do not breed at the colony location where they were hatched. Of a total of 33 tricolors that were banded as nestlings and later shot at breeding colonies (9 females and 4 males after one year; 14 females and 6 males after two or more years), only 13 (39%) had returned to within 10 miles of their natal colony. Of those breeding elsewhere, 9 had moved 11 to 50 miles, 10 moved 50 to 125 miles, and 1 moved 132 miles (Table 4).

TABLE 4.

Recoveries at breeding colonies of Tricolored Blackbirds banded as nestlings in the Central Valley, California, 1968-71.

Banding vicinity ¹	No. recovered		Distance (miles) and direction from banding site to furthest recovery
	<10 miles from banding site	>10 miles from banding site	
Patterson (Stanislaus Co.)	1	0	<10
Gustine (Merced Co.)	1	0	<10
Crows Landing (Stanislaus Co.)	1	0	<10
Tudor (Sutter Co.)	0	1	12 E
Sacramento Natl. Wildl. Refuge (Glenn Co.)	0	1	20 N
San Luis Natl. Wildl. Refuge (Merced Co.)	0	1	35 N
Manteca (San Joaquin Co.)	0	1	40 NNE
Knights Landing (Yolo Co.)	0	1	46 S
Herald (Sacramento Co.)	9	1	70 SSW
Gridley (Butte Co.)	1	2	78 S
Ladoga (Colusa Co.)	0	5	100 S
Dunnigan (Colusa Co.)	0	3	105 S
Colusa (Colusa Co.)	0	3	125 S
Afton (Glenn Co.)	0	1	132 S
Totals	13	20	

¹More than one breeding colony at some locations in some years.

Shifts occurred within and between the two major valleys in the Central Valley. For example, three tricolors shot at a colony in the Sacramento Valley near Woodland (Yolo Co.) in 1970 had been banded as nestlings the year before at three Sacramento Valley colonies (near Colusa; near Gridley, Butte Co.; and near Stoneyford, Colusa Co.). Of four tricolors shot at a colony near Modesto (Stanislaus Co.) in the San Joaquin Valley in 1972, two had been banded the year before in the San Joaquin Valley (near Crows Landing, Stanislaus Co.; and at the San Luis National Wildlife Refuge, Merced Co.), and two had been banded in the Sacramento Valley (near Afton, Butte Co.; and near Colusa) the previous year.

We do not know what proportion of tricolors, after first breeding, returned and bred in the same colony in successive years because adults were not banded at colonies. Obviously, many adults changed sites, because even though some local sites are regularly used for breeding, the tricolor's general region of breeding abundance in the Central Valley shifts from year to year (Neff, 1973; Orians, 1961a; Orians and Collier, 1963; Payne, 1969; DeHaven et al., 1975). It is not known whether these shifts occur because tricolors tend to breed at the first suitable site they find each

spring, or whether they first return to previously used sites and search further only if these are not suitable. Whatever the method, locations of breeding sites are likely related to food, with insect supplies the most critical requirement for nesting (Lack, 1954; Payne, 1969; Orians, 1961b). To understand more fully the movements among breeding colonies will require additional observations and banding of adults as well as nestlings at colonies.

Long-distance and Unusual Movements (? Recoveries). The longest tricolor movement was a nestling banded near Colusa in June 1969 and recovered in September 1970 over 300 miles south near Bakersfield (Kern Co.) at the extreme southern end of the San Joaquin Valley (Fig. 1). Neff's (1942) longest tricolor movement was similar—from Glenn Co. in the rice district to near Sanger (Fresno Co.), about 225 miles south.

Two tricolors banded during the first week of December 1965 at Colusa were recovered nearly 400 miles apart in March 1967. One was taken about 170 miles south near Dos Palos (Merced Co.) and the other about 220 miles north near Medford (Jackson Co.), Oregon (Fig. 1). The Oregon recovery was the first recorded movement out of the Sacramento Valley to the northern periphery of the species' range. Later, two Colusa-banded tricolors were recovered, one at Lookout (Modoc Co.), northeast of the Sacramento Valley, and one at Standish (Lassen Co.), east of the Sacramento Valley. Lookout, Standish, and Medford are all in comparatively low-lying agricultural valleys among mountains. By providing corridors where tricolors are likely to find food, such valleys may facilitate movement.

The first recovery ever recorded from Sonoma Co. near Santa Rosa (Fig. 1) in September 1970 was a tricolor banded as a nestling a year earlier at East Park Reservoir in Colusa Co. Santa Rosa is near the northern limit of the species' coastal breeding range.

Two recoveries, one of ours that was banded at Colusa in 1970 and taken northeast of Auburn (Placer Co.) in March (1971) (Fig. 1), and one reported by DeHaven and Neff (1973) near Camino (El Dorado Co.) in February, show that some tricolors winter at elevations above 1,000 feet in the foothills bordering the Central Valley. Payne (1969) also noted this feature.

Altogether, these seven recoveries show the highly mobile, somewhat nomadic nature of some tricolor flocks. Apparently, some degree of population interchange or movement may occur throughout the entire length of the Central Valley and between the Central Valley and the California plateau region, southern Oregon, and the San Francisco Bay-Delta region. However, our recoveries suggest no interchange of tricolors between the Central Valley and coastal southern California (south of about 35° N latitude). The distinctness of these populations was noted by DeHaven and Neff (1973).

Returns to Colusa (107 Recoveries). The remaining 107 of the 298 total recoveries were tricolors trapped at Colusa and retaken there up to 6 years later. In general, these recoveries suggest an annual

return to the Colusa area during the postbreeding period, and they show that some individuals may remain there throughout the year. However, the data will not be discussed in more detail here because of its restricted value in describing movements, and because trapping effort among years at Colusa was quite variable, making interpretation and comparison to other recovery data of questionable value.

SUMMARY AND CONCLUSIONS

From 1965 through 1972, 45,660 Tricolored Blackbirds were banded in the Central Valley, California. Most of the resulting 298 recoveries obtained through December 1972 showed the following general patterns.

1. During the postbreeding period, many tricolors from throughout the Sacramento Valley and San Joaquin Valley converge on the rice-growing area near Colusa (in the Sacramento Valley), probably because of abundant food and suitable roosting habitat.
2. During winter, a sizable but variable portion of the Central Valley tricolor population migrates to the San Joaquin Valley and San Francisco Bay-Delta area, but other tricolors winter throughout their range, including the foothill areas above 1,000 feet adjacent to the agricultural valleys.
3. During spring, individual tricolors are not likely to breed at the sites where they were hatched or where they had bred before. Breeding probably occurs wherever insects are abundant, and thus the general distribution of colonies varies between years.

Other recoveries showed that some tricolors travel nomadically the entire length of the Central Valley and from there into the San Francisco Bay-Delta area, the northern and eastern plateau region of California, and southern Oregon. Central Valley tricolors moved nearly everywhere within the species' range, although no recoveries were reported from coastal southern California. The belief of Grinnell and Miller (1944) that the tricolor was resident within California, but partly migratory within the Sacramento-San Joaquin drainage system, thus seems an adequate description of the species' distribution today.

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