

2022 TRICOLORED BLACKBIRD STATEWIDE SURVEY

CALIFORNIA



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Abstract

The 2022 Tricolored Blackbird Statewide Survey was conducted 15–17 April 2022. A total of 36 county coordinators and 112 participants surveyed 894 locations in 43 California counties. Together we estimated a statewide tricolored blackbird (*Agelaius tricolor*) population of 218,000 adult birds at 158 locations. This estimate represents a 23% increase over the estimate from the 2017 statewide survey and a 50% increase over the lowest statewide survey estimate of 145,000 birds in 2014. Although these numbers are encouraging and suggest an increasing trend, the 2022 estimate was still only 55% of the 395,000 adult birds estimated during the 2008 survey.

The 2022 effort covered more locations, including 44 new colony locations, than during any previous statewide survey. The largest numbers of birds were reported from the San Joaquin Valley. Although the San Joaquin Valley has supported the largest numbers since 2008, the numbers in 2022 were 63% lower than those from 2017. Coincident with the decrease in the San Joaquin Valley was a 208% increase in the Sacramento Valley over the same period. This pattern suggests a potential northward shift in tricolored blackbird distribution between the 2017 and 2022 breeding seasons.

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1.0 Introduction

The tricolored blackbird (*Agelaius tricolor*) is nearly endemic to California and forms the largest nesting colonies of any North American passerine bird (Beedy et al. 2020). Its colonial nesting habit makes it susceptible to catastrophic nesting failure due to predation, major storm events, mechanical removal of the nesting substrate, and other factors. The tricolored blackbird historically nested mainly in freshwater marshes, where some colonies exceeded 100,000 birds (Neff 1937). With widespread and severe reductions in freshwater marsh habitat, most tricolored blackbirds now nest in uplands, especially grain fields near dairies.

The close association between nesting tricolored blackbirds and dairies has been pronounced since the 1990s, when many dairies moved from southern California to the San Joaquin Valley (Hirsch 2006). This association with dairies has had serious consequences. All eggs and nestlings in entire colonies have been lost when the grain fields serving as nesting substrates were harvested as part of normal agricultural operations (e.g., Cook and Toft 2005).

The tricolored blackbird is insect-dependent during the breeding season, when females require insects to form eggs and nestlings require insects to develop during their first nine days of life (Beedy et al. 2020). Tricolored blackbirds are largely granivorous when not breeding. The combination of coloniality and breeding-season insectivory places severe constraints on a bird species living in anthropogenic landscapes, where both insects and blackbirds are typically considered pests.

Following the breeding season, most tricolored blackbirds move into the Sacramento Valley, where they feed on ripening rice with other blackbirds (Beedy et al. 2020). Due to their similarity in appearance to red-winged blackbirds (*Agelaius phoeniceus*), which may be legally taken (killed) without a permit under a depredation order (50 CFR 21.43), many tricolored blackbirds are shot each fall as they feed on ripening rice.

These and other factors caused the tricolored blackbird population to drop substantially since the 1930s. For example, surveys in 1934 estimated > 700,000 birds in just eight counties (Neff 1937). In contrast, surveys in 2014 estimated 145,000 birds in 37 counties (Meese 2014). As a result, the tricolored blackbird was listed as Threatened under the California Endangered Species Act in 2018.

Since 1994, the statewide survey has been the primary means by which the population of this species is monitored. The goal of the survey is to obtain a statewide estimate of the number of adult tricolored blackbirds in California. Tricolored blackbirds may most accurately and comprehensively be counted when at their breeding colonies. Tricolored blackbirds are relatively sedentary at breeding colonies, allowing observers to make multiple estimates of colony size.

The tricolored blackbird breeding season extends from late February in some years to mid-July in most years (Robert Meese, unpublished data). The statewide survey is timed to match the interval when the maximum number of adult tricolored blackbirds are at breeding colonies. This interval generally occurs before the first colonies fledge young or fail and disperse north to breed again (Hamilton 1998).

The survey is typically conducted once every three years. However, due to the COVID-19 pandemic and associated travel restrictions, the anticipated 2020 survey was postponed until 2022. Therefore, this report summarizes the methods and results of the first statewide survey since 2017.

2.0 Methods

Experienced volunteers and agency and non-governmental organization personnel conducted the survey over 3 days, from 15–17 April 2022, using a defined protocol (Appendix A). Together, we attempted to survey all known breeding colony locations and find any new breeding colonies and nonbreeding aggregations. Only counties with previously documented colony locations were surveyed. Although the survey effort focused on California, which supports more than 99% of the tricolored blackbird population (Beedy et al. 2020), the northern portion of Baja California, Mexico was also surveyed. The overall effort involved coordinating, training, surveying, entering data into the Tricolored Blackbird Portal (Portal; UC Davis 2022), and verifying the data.

2.1 Coordinators, Participants, and Support Materials

As with recent statewide surveys, the 2022 survey involved using a statewide coordinator, county coordinators, and participants. The survey was largely a volunteer effort, although some employers paid their professional biologist employees to participate, and the California Department of Fish and Wildlife provided funding for the statewide coordinator under contract No. D2180004. The statewide coordinator was responsible for organizing and overseeing the survey. Specifically, the statewide coordinator identified and recruited county coordinators; communicated with county coordinators and prospective participants; distributed support materials; assembled records of observations; checked each location and observation record for accuracy; and prepared the final survey report. Colibri Senior Scientist and retired University of California Davis Staff Research Associate Robert Meese served as the statewide coordinator for the 2022 survey.

All county coordinators had substantial experience with the tricolored blackbird and committed to coordinate thorough surveys in their respective counties. County coordinators assembled teams of qualified participants, ensured their assigned county was well surveyed, gathered survey data from participants, entered survey data into the Portal, and submitted completed field forms to the statewide coordinator.

Participants included individuals selected by county coordinators, those who contacted survey coordinators directly, and those who responded to requests for assistance posted to the Portal or highlighted in Audubon California or local Audubon chapter appeals. In most cases, volunteers were those who had participated in previous statewide surveys and were familiar with the protocol and procedures, including data entry into the Portal.

The statewide coordinator sent county coordinators the survey protocol, the field forms to record the survey data (Appendix B), and maps of all breeding colony locations in their respective counties. The county coordinators then distributed these support materials to participants.

The maps, which were based on data from the Portal, showed the locations of all known breeding colonies used by tricolored blackbirds. They included location names, Global Positioning System coordinates, and previously used nesting substrates. The maps did not include locations that were (1) uncertain, (2) represented nonbreeding aggregations, or (3) determined to now be permanently unsuitable for nesting tricolored blackbirds.

2.2 Training

To help ensure survey participants understood the protocol and procedures, two online training sessions were held: one Saturday, 19 March 2022, presented by Robert Meese, and another Saturday, 2 April 2022, presented by Xerónimo Castaneda (Audubon California). The training sessions consisted primarily of a PowerPoint presentation that covered species characteristics for field identification; a review of tricolored blackbird natural history; a review of its breeding behavior, breeding colony identification, characteristics, and colony size estimation; and a review of the Portal data entry process.

2.4 Surveying

Surveyors (which included the statewide coordinator, county coordinators, and participants), recorded occupancy status at all locations visited in accordance with the protocol (Appendix A). The number of tricolored blackbirds was estimated at occupied breeding locations and at locations of nonbreeding aggregations. Unoccupied sites were documented to estimate the thoroughness of the survey effort.

Many participants conducted pre-survey colony detection and monitoring efforts that helped them design the most efficient survey routes while documenting the locations and characteristics (nesting substrates, distance to water and stored grains) of breeding colonies. These efforts help ensure a large proportion of the total population will be encountered during the statewide survey. These pre-survey colony detection efforts are conducted by professional biologists who make systematic searches for active breeding colonies. They are also conducted by private citizens who document colony locations in the Portal, in eBird (Sullivan et al. 2009), or on various birding community email forums such as Central Valley Birds (centralvalleybirds@groups.io). Some also report them directly to county coordinators.

2.3 Entering and Verifying Data

County coordinators entered records of their team's observations into the Portal. In some cases, participants entered their own data, and rarely the statewide coordinator entered participant data into the Portal.

The Portal contains two types of records: location records and observation records. Location records consist of geographic and ecological information (e.g., nesting substrate type,

surrounding land uses) that describe specific locations where tricolored blackbirds have been confirmed to breed as well as locations of aggregations of nonbreeding tricolored blackbirds. Observation records consist of the information on the observer, location, date, estimates of the number of tricolored blackbirds (or confirmed zero for unoccupied sites), breeding behaviors, and colony attributes.

As all observation records must be associated with location records, participants were instructed to add all new location records (records of locations of breeding colonies that did not already exist in the Portal) first and then add records of their observations to these location records.

County coordinators sent copies of the field forms to the statewide coordinator. The statewide coordinator then used those copies to verify that records of locations and observations were correctly entered in the Portal.

3.0 Results

A total of 36 county coordinators and 112 participants surveyed 894 locations in 43 California counties over the three-day survey period (Figure 1). The best estimate of the statewide population was 218,000 adult birds (rounded to the nearest 1000), with a minimum estimate of 183,000 and a maximum estimate of 261,000. These birds were distributed among 158 locations, including 44 new breeding colony locations (Figure 1); the other 736 locations surveyed were unoccupied (Figure 1).

Of the 158 occupied locations, 135 were breeding locations and 23 represented aggregations of nonbreeding tricolored blackbirds (Table 1). More locations were surveyed in 2022 than during any previous statewide survey, representing a fourfold increase over the number of locations surveyed during the 2000 statewide survey (Figure 2).

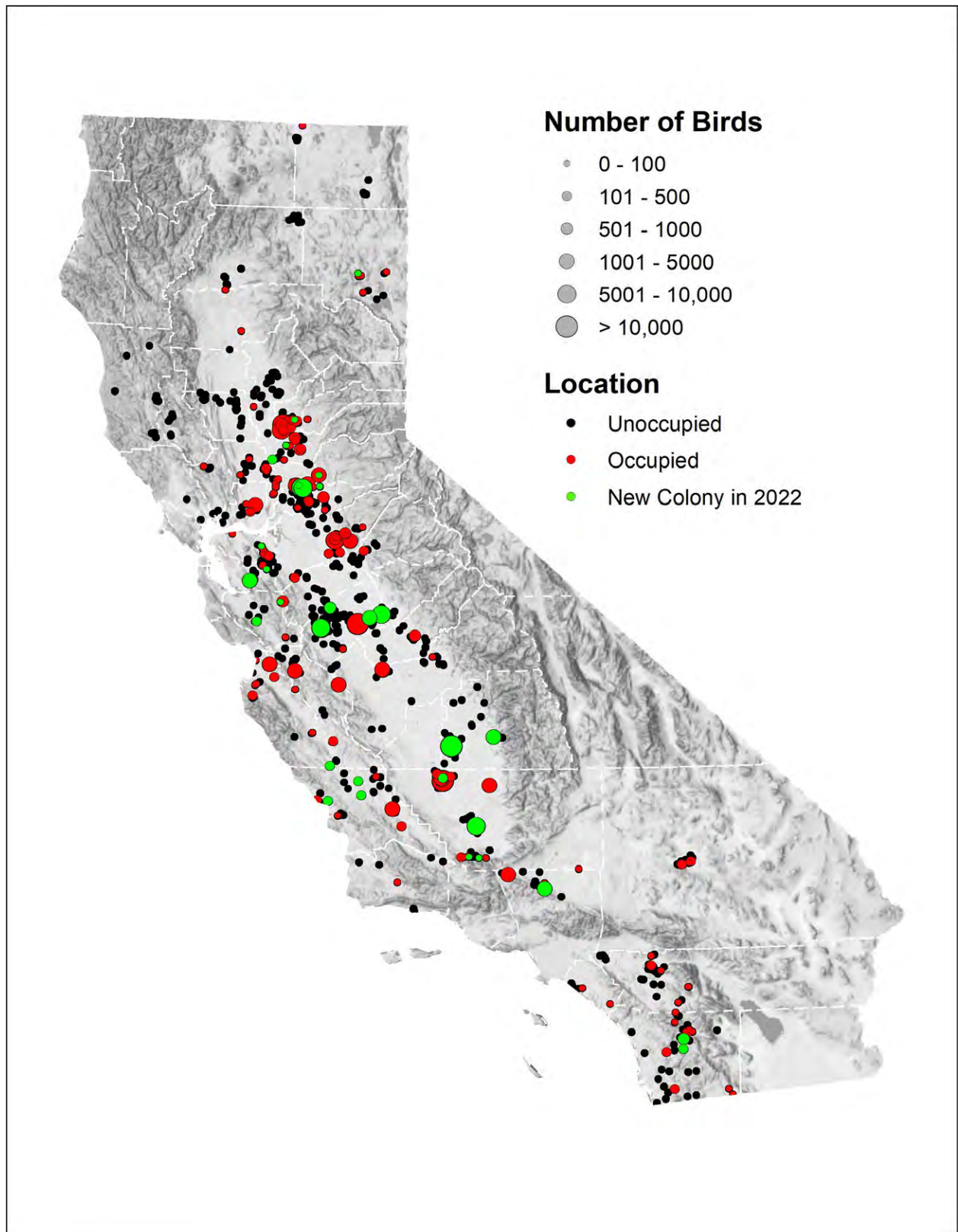


Figure 1. Map showing the distribution of occupied and unoccupied locations surveyed during the 2022 Tricolored Blackbird Statewide Survey.

Table 1. 2022 Statewide Tricolored Blackbird Survey results by county.

County	Locations Surveyed	Locations Occupied	Number of Tricolored Blackbirds	Proportion of Total
Alameda	21	5	3210	0.015
Amador	8	3	854	0.004
Butte	22	0	0	0
Calaveras	16	5	2240	0.01
Colusa	21	0	0	0
Contra Costa	12	5	635	0.003
El Dorado	10	2	1336	0.006
Fresno	27	3	3120	0.014
Glenn	1	0	0	0
Kern	57	14	29,848	0.137
Kings	1	0	0	0
Lake	7	0	0	0
Lassen	10	5	84	0.0004
Los Angeles	12	3	3240	0.015
Madera	17	1	600	0.003
Mariposa	3	0	0	0
Mendocino	11	0	0	0
Merced	121	9	57,946	0.266
Modoc	5	1	120	0.0005
Monterey	21	9	2067	0.009
Napa	8	1	40	0.0002
Nevada	1	1	10	0.0001
Orange	5	1	9	0.0001
Placer	20	4	2250	0.01
Riverside	33	5	675	0.003
Sacramento	95	15	27,690	0.127
San Benito	15	3	7024	0.03
San Bernardino	19	4	451	0.002
San Diego	37	9	1846	0.008
San Joaquin	12	1	330	0.0015
San Luis Obispo	27	8	2830	0.013
Santa Barbara	7	1	75	0.0001
Santa Clara	12	4	815	0.004
Shasta	14	0	0	0
Solano	13	4	2360	0.011
Sonoma	2	0	0	0
Stanislaus	34	4	8570	0.039
Sutter	9	3	45	0.0001

County	Locations Surveyed	Locations Occupied	Number of Tricolored Blackbirds	Proportion of Total
Tehama	3	2	44	0.0001
Tulare	42	5	27,600	0.127
Tuolumne	7	1	200	0.001
Yolo	34	3	650	0.003
Yuba	37	14	29,163	0.134
Total	894	158	217,977	1.0

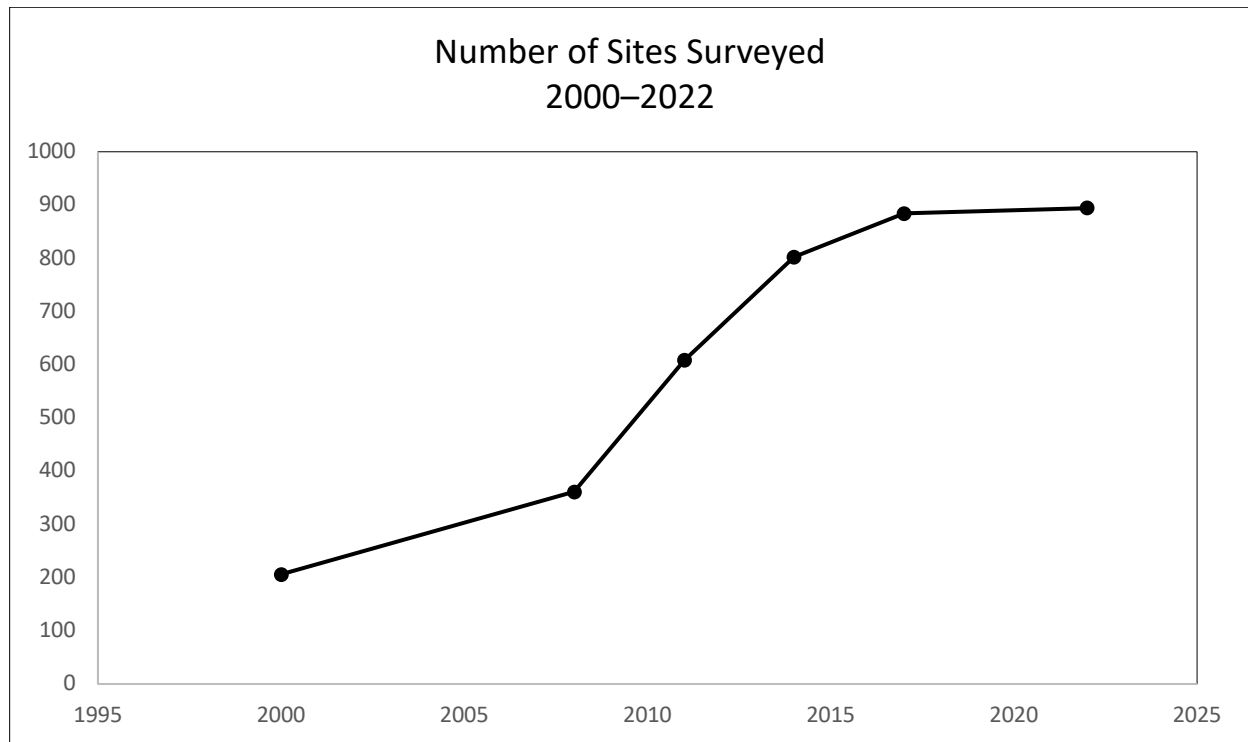


Figure 2. Numbers of tricolored blackbird locations surveyed during statewide surveys from 2000–2022.

A total of 44 new colony location records were added to the Portal by 21 different users because of the 2022 survey (Figure 3). That brought the total number of new colony locations since the 2017 statewide survey to 137 (Figure 3). As of 7 July 2022, the Portal contained 1454 colony location records and 548 non-colony location records.

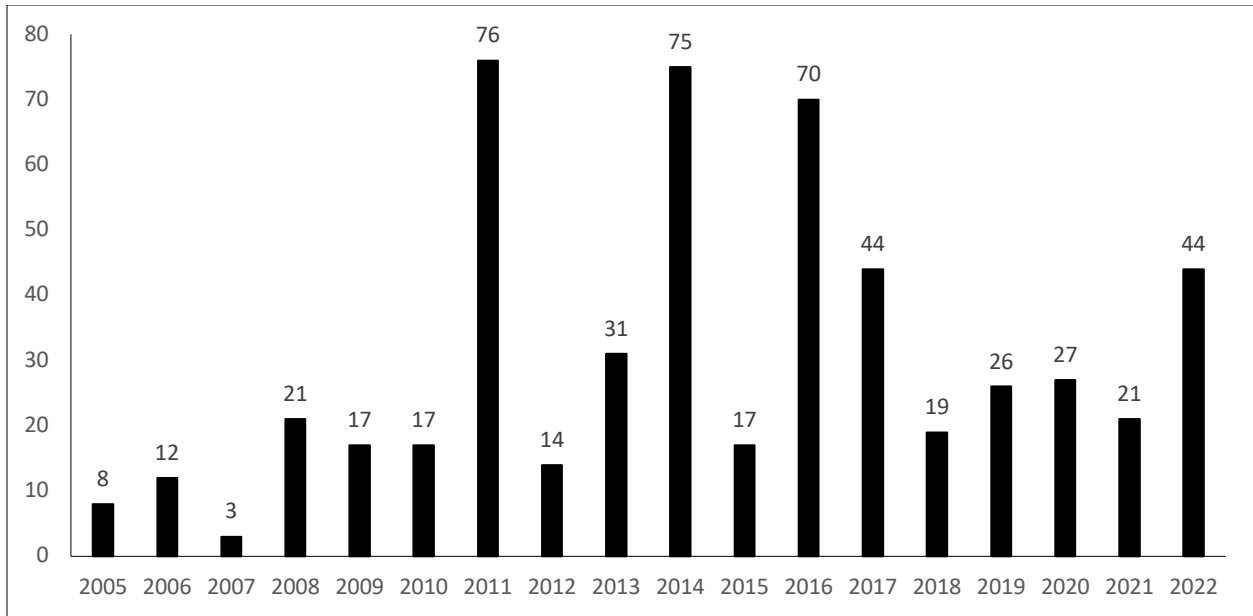


Figure 3. New tricolored blackbird colony location records added to the Portal each year from 2005 to 2022.

Tricolored blackbirds were concentrated in a few counties during the 2022 survey, with five counties (Yuba, Sacramento, Merced, Tulare, and Kern) accounting for 79% of all tricolored blackbirds observed (Table 1, Figure 4).

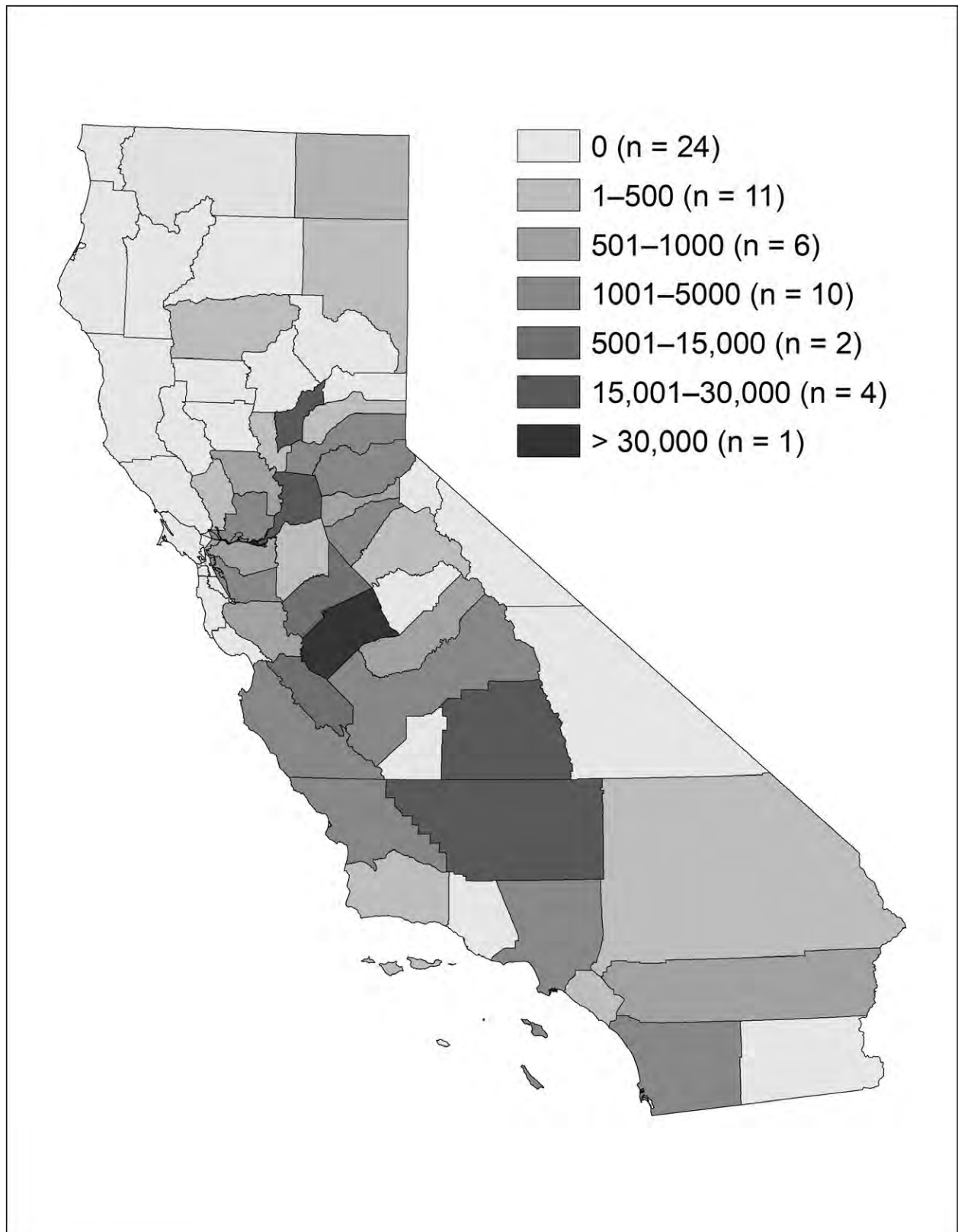
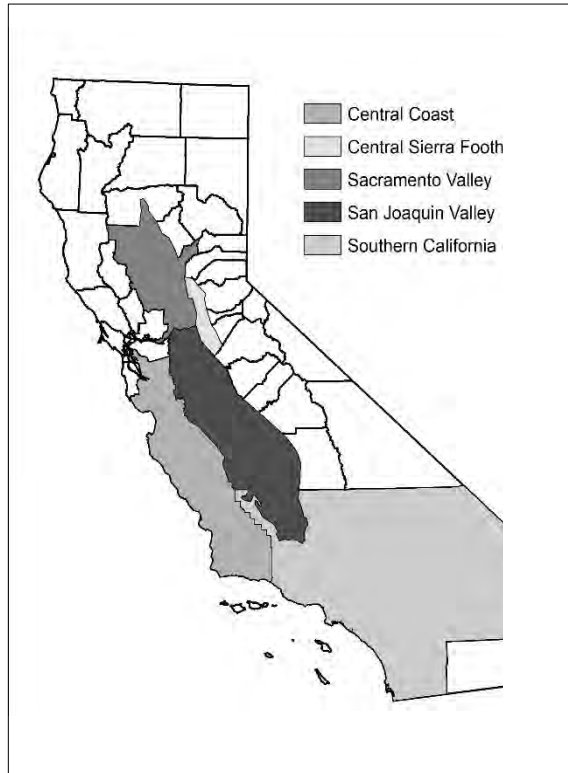


Figure 4. Map showing the relative numbers of tricolored blackbirds observed by county.

Breeding colonies were established in nine major nesting substrate types (Table 2); nonbreeding tricolored blackbirds were observed around dairies and in foraging areas lacking nesting substrates.

Table 2. Tricolored blackbird colony locations by nesting substrate type.

Primary Substrate Type	Number / Proportion of Total Locations Surveyed	Number / Proportion of Locations Occupied	Number of Breeding Tricolored blackbirds	Proportion of Total Tricolored blackbirds
Bull thistle (<i>Cirsium vulgare</i>)	0 / 0	0 / 0	0	0
Bulrush (or tule)	103 / 0.115	17 / 0.126	9422	0.043
California blackberry (<i>Rubus ursinus</i>)	2 / 0.002	0 / 0	0	0
Cattails (<i>Typha</i> spp.)	257 / 0.287	42 / 0.311	22,947	0.105
Himalayan blackberry (<i>Rubus armeniacus</i>)	213 / 0.238	32 / 0.237	57,100	0.262
Mallow (<i>Malva</i> sp.)	7 / 0.008	0 / 0	0	0
Mallow in triticale	18 / 0.02	5 / 0.037	66,900	0.307
Mesquite (<i>Prosopis</i> spp.)	2 / 0.002	0/0	0	0
Milk thistle (<i>Silybum marianum</i>)	59 / 0.066	2 / 0.015	650	0.003
Mustard (<i>Brassica</i> spp.)	25 / 0.028	1 / 0.007	120	0.001
Mustard in triticale	3 / 0.003	0 / 0	0	0
Stinging nettle (<i>Urtica dioica</i>)	31 / 0.035	4 / 0.03	979	0.004
Tamarisk (<i>Tamarix</i> spp.)	1 / 0.001	0 / 0	0	0
Triticale (<i>Triticum x Secale</i>)	61 / 0.068	9 / 0.067	42,916	0.197
Wheat (<i>Triticum</i> spp.)	3 / 0.003	0 / 0	0	0
Willows (<i>Salix</i> spp.)	0 / 0	0 / 0	0	0
Other or Not Recorded	109 / 0.122	23 / 0.017	16,943	0.078
TOTAL	894	135	217,977	1.0



Numbers of tricolored blackbirds observed varied geographically, with birds distributed mainly among five bioregions (Figure 5). The San Joaquin Valley (from San Joaquin County to Kern County) had 118,049 tricolored blackbirds from 41 locations (Table 3); the Central Coast (from Alameda County to Santa Barbara County) had 18,336 tricolored blackbirds from 19 locations (Table 4); the Central Sierra foothills (Placer, El Dorado, Amador, Calaveras, Tuolumne, and Mariposa counties) had 3900 tricolored blackbirds from 20 locations (Table 5); Southern California (including the desert portion of Kern County and Los Angeles, Orange, San Bernardino, Riverside, and San Diego counties) had 11,121 tricolored blackbirds from 24 locations (Table 6); and the Sacramento Valley (Tehama, Glenn, Butte, Colusa, Sutter, Yuba, Yolo, and Sacramento counties) had 19,503 tricolored blackbirds from 34 locations (Table 7).

Figure 5. Bioregions map.

The estimated statewide population size of adult tricolored blackbirds was 23% higher in 2022 than during the last statewide survey in 2017 (Figure 6). However, it was only 55% of the statewide total from 2008. The decline since 2008 is driven by patterns in the San Joaquin Valley, where most early nesting occurs and where the 2022 total was only 34% of the 2008 total (Figure 6, Table 3). In contrast, the Sacramento Valley has shown an increase over this period, with a 2022 total that was 320% higher than the 2008 total (Figure 6, Table 7).

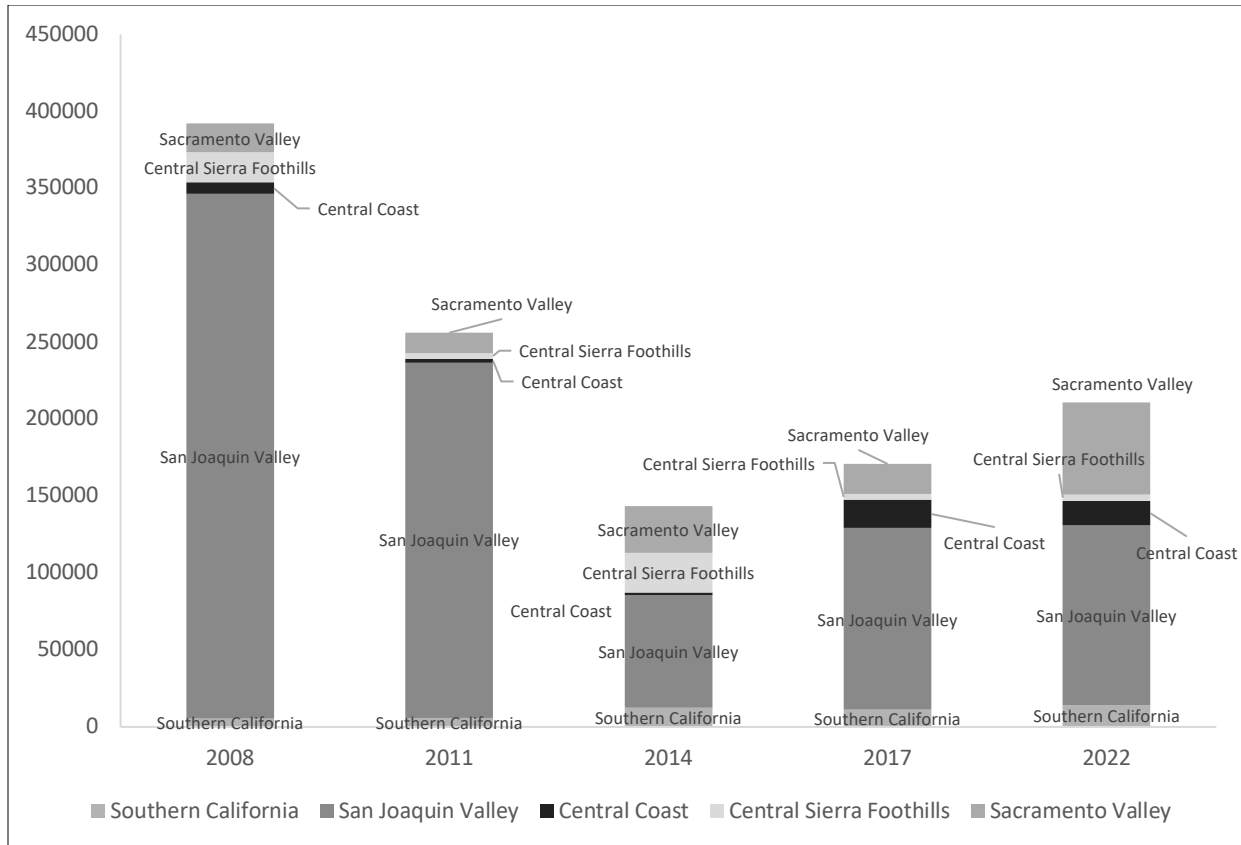


Figure 6. Statewide population of tricolored blackbirds by bioregion from 2008 to 2022.

Table 3. Numbers of tricolored blackbirds in San Joaquin Valley counties from 2008 to 2022.

County	Year				
	2008	2011	2014	2017	2022
San Joaquin	0	0	515	1000	330
Stanislaus	21,910	1900	8852	742	8570
Merced	154,674	139,170	10,532	29,883	57,946
Madera	117	505	27,166	12,552	600
Fresno	1000	400	6	5750	3120
Tulare	90,800	23,950	18,259	8150	27,600
Kings	2500	2950	5000	4300	0
Kern	69,702	61,825	3152*	54,672*	29,550*
Total	340,703	230,700	73,482	118,049	127,716

*Excluding the desert portions of the county.

The number of tricolored blackbirds observed in the Central Coast bioregion declined slightly from 2017 (Table 4). This decline was due mainly to a substantial reduction in the number of tricolored blackbirds in the largest colony in the region, one in Panoche Valley in San Benito County. Several counties continued to show highly variable numbers of tricolored blackbirds through time (Table 4).

Table 4. Numbers of tricolored blackbirds in Central Coast counties from 2008 to 2022.

County	Year				
	2008	2011	2014	2017	2022
Alameda	28	2,200	50	3000	3210
Contra Costa	358	0	--	30	635
Monterey	50	10	399	2973	2067
San Benito	66	--	80	11,226	7024
San Luis Obispo	6242	197	98	3	2830
Santa Barbara	500	--	935	760	75
Santa Clara	50	0	0	344	815
Santa Cruz	220	0	0	0	--
Total	7514	2407	1562	18,336	16,656

Numbers of tricolored blackbirds in the Central Sierra Foothills bioregion increased relative to 2017 but remained low relative to 2008 and 2014 (Table 5).

Table 5. Numbers of tricolored blackbirds in Central Sierra foothill counties from 2008 to 2022.

County	Year				
	2008	2011	2014	2017	2022
Amador	6600	350	5500	420	854
Calaveras	385	120	404	1570	2240
El Dorado	0	0	1375	100	1336
Mariposa	--	--	13	0	0
Placer	12,050	3310	17,600	960	2250
Tuolumne	635	170	825	850	200
Total	19,670	3950	25,717	3900	6880

In Southern California, the numbers of tricolored blackbirds in 2022 were well below those in 2014 and 2017 due to a major decline in Riverside County. The overall decrease was partially offset by increases in Los Angeles and San Diego counties (Table 6).

Table 6. Numbers of tricolored blackbirds in Southern California counties from 2008 to 2022.

County	Year				
	2008	2011	2014	2017	2022
Kern*	--	--	500	400	25
Los Angeles	1270	1066	4707	1410	3240
Orange	--	--	14	0	9
Riverside	2150	4132	4368	8180	675
San Bernardino	700	0	1380	466	451
San Diego	1367	767	1417	665	1846
Total	5487	5965	12,386	11,121	6246

*Excluding San Joaquin Valley portions.

The number of tricolored blackbirds in the Sacramento Valley was up nearly 300% from that observed in 2017 due to increases in Yuba and Sacramento counties; all other counties in the region showed decreases in abundance from 2017 (Table 7).

Table 7. Numbers of tricolored blackbirds in Sacramento Valley counties from 2008 to 2022.

County	Year				
	2008	2011	2014	2017	2022
Butte	2541	0	60	1311	0
Colusa	301	923	0	247	0
Glenn	--	500	300	405	0
Sacramento	3551	6105	29,272	12,455	27,690
Sutter	0	1	8	1000	45
Tehama	--	--	300	515	44
Yolo	1900	5080	81	2750	650
Yuba	10,405	500	268	820	29,163
Total	18,698	13,109	30,289	19,503	57,592

Nine northern California counties that sometimes support breeding tricolored blackbirds (Humboldt, Lake, Marin, Mendocino, Modoc, Napa, Shasta, Solano, and Sonoma) were not included in the bioregional analysis. Tricolored blackbirds typically are not present in those counties until mid-to-late May and therefore are largely absent during the statewide survey in April.

Numbers of tricolored blackbirds observed at occupied locations ranged from 1 to 29,500, with only four colonies supporting 10,000 or more tricolored blackbirds (Table 8). The 10 largest colonies combined contained 132,250 tricolored blackbirds, representing 61% of the statewide population (Table 8). Similar percentages were noted during previous statewide surveys (Table 9) and reflect a downward trend in the sizes of the largest colonies (Figure 7).

Table 8. Characteristics of the 10 largest colonies.

Location Name	County	Bioregion	Number of Tricolored blackbirds	Substrate
Purple Tulip	Merced	San Joaquin Valley	29,500	triticale
Ave. 120 Road 72	Tulare	San Joaquin Valley	24,500	triticale
Hale Road	Yuba	Sacramento Valley	15,000	Himalayan blackberry
Sherwood Ave. 2	Kern	San Joaquin Valley	13,750	triticale
Fahey Levee	Merced	San Joaquin Valley	9000	triticale

Location Name	County	Bioregion	Number of Tricolored blackbirds	Substrate
Gene Andal	Sacramento	Sacramento Valley	9000	Himalayan blackberry
Plumas Arboga 6	Yuba	Sacramento Valley	9000	Himalayan blackberry
Fahey North	Merced	San Joaquin Valley	8500	triticale
Grant Line *	Sacramento	Sacramento Valley	7000	Himalayan blackberry
Milton Road #4	Stanislaus	San Joaquin Valley	7000	Himalayan blackberry

*Portal name: West of Grant Line at Folsom South Canal.

Table 9. Percent of the statewide survey total among the 10 largest colonies combined between 2008 and 2022.

Survey Year	Number of Tricolored Blackbirds	Percent of Total
2008	306,000	78%
2011	208,800	81%
2014	93,000	63%
2017	98,050	55%
2022	132,250	61%

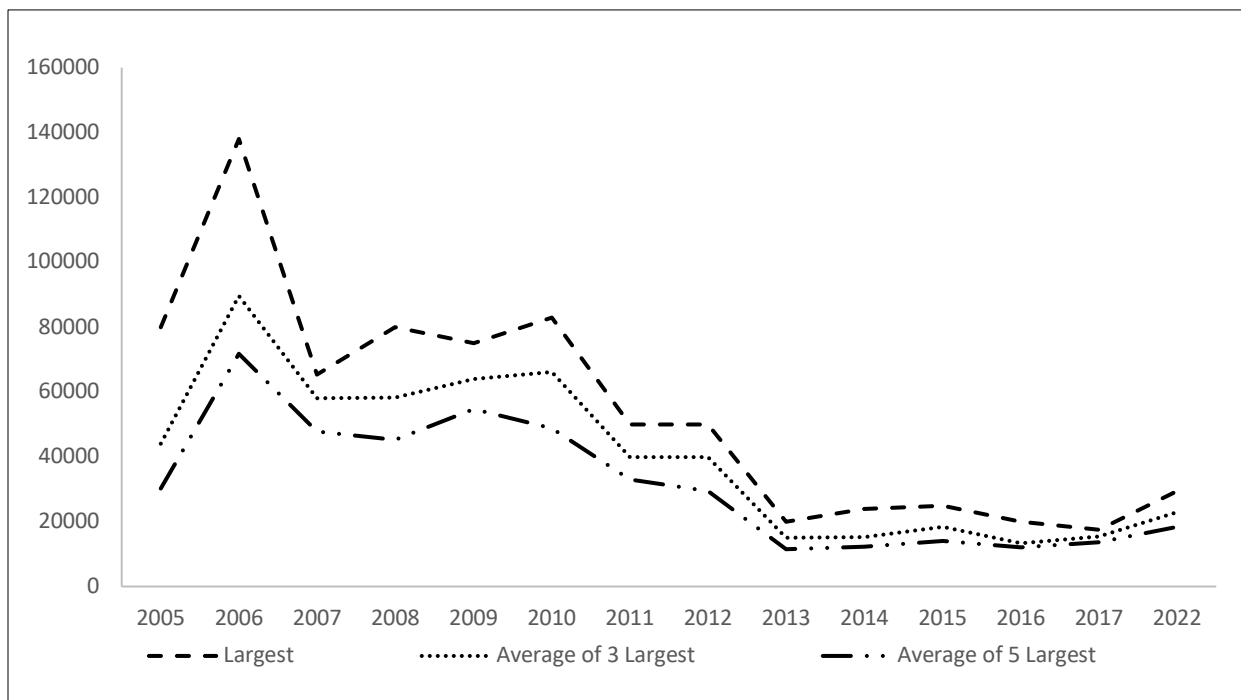


Figure 7. Trend in the sizes of the largest colonies.

Six colony locations were surveyed in Baja California (Table 10). Tricolored blackbirds were observed at three of those, and breeding was confirmed at one (Table 10). These results confirm the continuing decline of the Baja California population (Beedy et al. 2020, Erickson et al. 2021).

Table 10. Baja California survey results.

Location Name	Number of Tricolored Blackbirds	Substrate Suitability	Comments
Rancho Ciénega Redonda	340	suitable	breeding
Ciénega Redonda	0	suitable, limited	--
Rancho Japá	100	suitable	birds vocalizing
Ejido José María Pino Suárez	10	suitable	--
Ejido Jacumé	0	absent	--
Lagunita El Ciprés	0	suitable	--

4.0 Discussion

Since 1994, the statewide survey has been the primary method by which the number of tricolored blackbirds in California is estimated. Counts derived from surveys conducted under standardized conditions by experienced observers are generally regarded as indices to population size (Link and Sauer 1998). Thus, the Tricolored Blackbird Statewide Survey, led by local species experts and supported by a standardized field protocol, provides the best tool available to estimate the size of and document trends in the tricolored blackbird population.

The statewide survey does not use a sampling approach. Instead, it is an attempt to census the entire tricolored blackbird population in California. A three-day survey interval is used to minimize the risk of double-counting tricolored blackbirds that could move from one breeding colony to another if the survey interval were longer.

The overall pattern in tricolored blackbird abundance from 2008 to 2022 is difficult to judge with only five census totals (Figure 6). Nevertheless, the pattern indicates a steep decline in tricolored blackbird numbers from 2008 to 2014 and a less pronounced but sustained increase since 2014, as assessed in 2017 and 2022 (Figure 6). The 2022 estimate of 218,000 tricolored blackbirds represents a 23% increase in the population since 2017 but is still 55% lower than the 2008 estimate. While the overall decline in the population is likely attributable to habitat loss, three mechanisms may have contributed to the increases since 2017:

- 1. An increase in fecundity led to an increase in recruitment.**

In 2017, 2018, 2020, and 2021, colonies in grain fields near dairies in the San Joaquin Valley were monitored throughout the nesting cycle (Colibri 2017, 2018, 2020, and 2021). Reproductive success was qualitatively evaluated based on the number of fledglings observed relative to the size of the colonies. Of 44 colonies evaluated, 68% were deemed to have had high reproductive success. Regardless, assessments prior to 2017 that might allow for general trend analysis are lacking, and few colonies have been studied sufficiently to quantify reproductive success. Therefore, the amount of information available is insufficient to assess whether or to what extent the recent increase in the statewide population was due to an increase in fecundity.

- 2. Mortality declined.**

Since 2017, only colonies in grain fields near dairies in the San Joaquin Valley were studied sufficiently to assess mortality (Colibri 2017, 2018, 2020, and 2021). Of the 44 colonies evaluated during those years, only two (4.5%) were impacted by harvesting activities that resulted in mortality. Active efforts to conserve all known colonies in grain fields in the San Joaquin Valley (Arthur 2015) likely lead to a decrease in mortality by eliminating the harvest of grain-field nesting substrates while eggs and nestlings were still in the nests. This effort, a component of the Regional Conservation Partnership Program of the Natural Resources Conservation Service (NRCS), is intended to identify all silage colonies and conserve the grain fields which act as nesting

substrates until all the young have fledged and left the area. This effort has likely decreased mortality by protecting colonies in grain fields that might have been harvested without the program.

3. The survey effectiveness improved.

An increase in knowledge of tricolored blackbird breeding locations may have increased the effectiveness of our efforts to conduct the statewide survey, as tricolored blackbird colonies can be difficult to find. Much of this detection difficulty reflects the fact that most colonies occur on private property or at closed National Wildlife Refuges where access is limited.

If the number of locations surveyed each time a statewide survey was conducted were constant, then the numbers of tricolored blackbirds observed per survey would be directly comparable (the “all else being equal” standard of scientific inquiry). However, rather than being equal, the number of tricolored blackbird breeding locations grew substantially between 2008 and 2022 (Figure 3).

The extent to which these new colony locations represent previously uncounted tricolored blackbirds is unknown. Regardless, due to the difficulty in locating new colonies, the growing list of colony locations contributes to our ability to document occupied colony locations during the statewide survey. Therefore, the effectiveness of the survey is likely improving, and this may have contributed to the increase in the number of tricolored blackbirds.

4.1 Bioregional Trends

4.1.1 Sacramento Valley

Yuba County showed the largest increase, survey to survey, in the number of tricolored blackbirds (28,343) of any county (Table 7). The increase in the number of tricolored blackbirds observed in this single county accounts for over 69% (28,343/41,000) of the 2017 to 2022 increase. The net increase in statewide totals from 2017 to 2022 is almost entirely driven by increases in Sacramento Valley populations.

Water likely played a strong role in Sacramento Valley increases in tricolored blackbird counts. Both Sacramento and Yuba counties had relatively abundant nesting substrate consisting primarily of Himalayan blackberry, adjacent to or near water. Colusa County, unlike Yuba or Sacramento counties, was extraordinarily dry in 2022 due to the chronic and severe drought that also left many rice paddies dry and fallow (Mike Carpenter, USFWS, personal communication).

4.1.2 San Joaquin Valley

The results in the San Joaquin Valley were mixed, with a major decrease in the number of tricolored blackbirds in Kern County, a large increase in the number of tricolored blackbirds in

Tulare County (due almost exclusively to two colonies in new locations, one on the valley floor and the other near Lake Success in the southern Sierra foothills), and an increase in the number of tricolored blackbirds in Merced County (Table 3). Merced County has supported some of the largest colonies ever documented. Examples include Crane Ranch, first identified in 2008, with 50,000 tricolored blackbirds and Bear Creek, first identified in 2010, with 83,000 tricolored blackbirds (UC Davis 2022). Both locations are now permanently unsuitable due to losses of breeding and foraging substrates.

Taken together, the number of tricolored blackbirds in the San Joaquin Valley is about one-third of the number observed in 2008, despite a massive increase in the number of known colony locations. The loss of nesting and foraging habitat due to widespread and ongoing conversion of natural lands and compatible agricultural fields to nut orchards is likely a primary driver of this change.

4.1.3 Central Coast

The status of the tricolored blackbird along the Central Coast remains precarious. Alameda, Contra Costa, and San Luis Obispo counties were exceptionally well surveyed this year due to the extraordinary efforts of first-time county coordinators, yet except for Alameda, where a modest increase was seen, the numbers of tricolored blackbirds continued to decline. By far the largest number of tricolored blackbirds occurred in San Benito County. Contra Costa, Santa Barbara, and Santa Clara counties all showed a continuing trend of small population size (Table 4). As with elsewhere in the state, the drought and ongoing permanent landscape conversions of coastal scrub and grassland foraging areas to vineyards are reducing the area suitable for tricolored blackbird breeding.

4.1.4 Central Sierra Foothills

There was a modest increase in the number of tricolored blackbirds observed in five of the six counties comprising the Central Sierra Foothill bioregion (Table 5). However, the number of tricolored blackbirds remains far below (about a quarter of) the number estimated during the 2014 statewide survey. Here, too, the effects of the drought appear to be limiting breeding opportunities.

4.1.5 Southern California

There remains much reason for concern throughout the Southern California bioregion, from the Tehachapi Mountains to the Mexican border. Only Los Angeles and San Diego counties showed even a modest increase from 2017, and Riverside County showed a dramatic decrease (Table 6). The increase in the number of tricolored blackbirds in Los Angeles County is due primarily to breeding at two locations: Quail Lake, in the northern portion of the county where 1200 tricolored blackbirds were seen, and Peterson Ranch, a recently established mitigation bank, which reported 2000 breeding tricolored blackbirds.

Southern California presents unique challenges to tricolored blackbird conservation, as urbanization and the movement of the dairy industry into the San Joaquin Valley in the 1980s have reduced the food supply and amount of habitat for tricolored blackbird nesting and foraging (Unitt 2004). Habitat losses due to urbanization are presumably primarily responsible for the dramatic decline in Riverside County. Ventura County was not included in the 2022 Tricolored Blackbird Statewide Survey as there is little remaining habitat for the species anywhere in the county, and breeding has not been observed there since the 1980s.

5.0 Conclusion

The most striking result identified in the 2022 Tricolored Blackbird Statewide Survey is the increase in abundance of tricolored blackbirds in the Sacramento Valley compared to any recent statewide survey (Tables 7 and 8). The rapid change in the major population center of the species away from the southern San Joaquin Valley and into the northern San Joaquin Valley and southern Sacramento Valley is without precedent and was partly anticipated due to a known increase in the number of tricolored blackbirds breeding in April in Yuba County beginning in 2019 (Robert Meese, unpublished data). Prior to 2019, only in 2008 were more than a few hundred tricolored blackbirds found breeding in Yuba County in a statewide survey (Table 7), and 80% of those were observed at a single location that was unoccupied in 2022.

The 2022 Tricolored Blackbird Statewide Survey was likely the most thorough ever conducted. Professional biologists and an increasing number of concerned citizens have entered 137 records of new colony locations into the Portal since the last statewide survey in 2017. This has resulted in a rapid increase in knowledge of where the tricolored blackbirds breed, and the number of locations surveyed during statewide surveys increased from 114 in 1997 (Hamilton 2000) to 894 in 2022. The use of the Portal by concerned citizens has facilitated data entry and vastly improved data management. Thus, the Portal has helped meet the needs of both professional biologists and citizen scientists to contribute to tricolored blackbird conservation by providing effective data management and enabling online data entry of their observations, increasing our knowledge of where, when, and how many tricolored blackbirds breed.

The results of the 2022 Tricolored Blackbird Statewide Survey suggest the rapid decline in abundance observed in earlier statewide surveys and partially reversed beginning in 2017 has been sustained. Looking closely at these results shows that most of the increase from 2017 to 2022 is due to tricolored blackbirds observed in the lower Sacramento Valley, primarily Sacramento and Yuba counties, where the number of tricolored blackbirds estimated increased by more than 43,500, a number greater than the total increase of 41,000 tricolored blackbirds in the statewide total (Table 7).

The shifts in abundance across counties from the San Joaquin Valley to the Sacramento Valley between 2017 and 2022 appear to reflect an aspect of the biology of the species that was documented decades ago: large numbers of tricolored blackbirds may move within years and between years in response to changing landscape conditions that influence the distribution of the nesting substrates, foods, and open water they require for breeding (Beedy et al. 2020). The chronic and severe drought along with widespread and ongoing habitat conversions are presumably limiting the areas in which this colonial, insectivorous passerine can breed.

The small population in Baja California continued to decline, with only one of six locations surveyed occupied by breeding tricolored blackbirds. The relatively recent expansion of incompatible agriculture in the region mimics similar changes in California's Central Valley, especially the San Joaquin Valley, as well as in southern California, where rapid and widespread

urbanization directly threaten the species. The continued decline suggests the species may become extirpated from the southernmost portion of its range (Erickson et al. 2021).

The results of the 2022 Tricolored Blackbird Statewide Survey highlight the regional differences in trends in abundance of the species. Southern California is close to losing what was once considered the most abundant bird species in the region (Cooper 1870); the species is similarly threatened along the Central Coast. Given the pervasive and ongoing habitat losses to incompatible forms of agriculture, primarily nut orchards and vineyards, and the widespread use of neonicotinoid insecticides in California (Starner and Goh 2012), the ability of Southern California, the San Joaquin Valley, and the Central Coast to support breeding tricolored blackbirds may be permanently diminished.

The need for effective monitoring of the statewide population remains, and the statewide survey continues as the primary tool by which the statewide population is estimated. However, multiple county coordinators in 2022 reported difficulties in assembling sufficiently sized survey teams. As the list of colony locations grows, we expect this problem to worsen. The costs associated with the travel required to conduct the statewide survey are considerable and rising, and there is likely to be much turnover in county coordinators and participants. Therefore, survey methods that require fewer volunteers and less effort should be explored. Such a method, referred to as a sample survey, was implemented in 2016 but never repeated. A sample survey would require far less effort by fewer participants surveying a subset of randomly selected locations. Yet it could potentially provide a statistically robust means to estimate the size of the statewide population. It would be prudent to begin discussing the design and implementation of a sample survey and practice this method as soon as possible.

6.0 Recommendations for Conservation

The following recommendations are slightly modified from previous Tricolored Blackbird Statewide Survey reports (Meese 2014, 2017) and reflect ongoing needs to conserve and restore the species:

1. Minimize sources of human-caused mortality, including the loss of eggs and young from harvesting their nesting substrate and the shooting of adults in fall when causing depredations in rice.
2. Continue to implement the existing mechanism to conserve at-risk colonies in ephemeral substrates, especially those in the San Joaquin Valley, San Benito County, and Riverside County.
3. A legislative fix to eliminate exemption of protection under the Migratory Bird Treaty Act is needed for red-winged blackbirds in California. If red-winged blackbirds can be shot, and shooting continues in rice in fall, adult tricolored blackbirds will continue to be shot due to their similarity in appearance to red-winged blackbirds, with which they flock.
4. Support efforts to document changes in the distribution of the species, such as the rapid increase in the number of tricolored blackbirds in Yuba County.
5. Better document conditions that result in relatively high reproductive success. Examine patterns in reproductive success to determine whether there is relatively higher reproductive success in colonies in some geographic regions or in different nesting substrates. Use these insights to make recommendations for management actions.
6. Study the effects of harvest on populations of fledglings in groups that persist on nesting substrates until moments before they are harvested. Study these colonies and document where the tricolored blackbirds go when the harvester shows up and what they do when they return to the just-harvested field.
7. Engage with agriculture, mining, home-building, and other industries to seek their participation and assistance in efforts to conserve the species, especially in the Sierra foothills and southern California.
8. Work with landowners in foothill and coastal locations with extensive rangelands where the availability of nesting substrate may be limiting reproduction; add nesting substrates where they are lacking, enhance nesting substrates where they are limiting, and protect nesting substrates where necessary. Fund landowners who want to conserve tricolored blackbirds but who incur a cost in doing so.
9. Encourage and/or provide monetary incentives to farmers to grow, without insecticides, alfalfa, sunflowers, and rice within 3 miles of active tricolored blackbird colonies or to delay the use of insecticides until after the young have fledged.
10. Investigate the relative abundance of insects in rice paddies under organic culture or where insecticides are not used to that in commercial rice paddies to document whether organic or insecticide-free rice provides a better foraging substrate than does

conventional rice (as has been suggested by relatively high reproductive success at the Conaway Ranch in Yolo County, which transitioned to full organic culture in 2022).

11. Provide additional funding and guidance for landowners to provide essential resources for nesting tricolored blackbirds on private property.
12. Actively maintain all wetlands recently used by breeding tricolored blackbirds, especially those in Southern California and Central Coast locations, to provide the conditions preferred by nesting tricolored blackbirds.
13. Conduct threat assessments of all areas currently used by breeding tricolored blackbirds and work with local officials to identify these threats and seek ways to reduce or eliminate them.
14. Expand survey efforts to Oregon and Washington and use local experts to recruit survey participants.
15. Assess the concentrations of neonicotinoid insecticides in regions with the lowest insect abundances and highest rates of decline in tricolored blackbirds.
16. Identify and prioritize conservation opportunities in Southern California, especially on state and federal properties owned by land management agencies and engage local experts to develop and implement actions to conserve and enlarge breeding opportunities, including surrounding foraging habitats.

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Appendix A. 2022 Tricolored Blackbird Statewide Survey Protocol.

2022 Tricolored Blackbird Statewide Survey April 15-17

Protocol

Thank you for your interest in participating in the 2022 Tricolored Blackbird Survey. A statewide survey is conducted every three years to estimate the size of the Tricolored Blackbird population in California and to provide a basis for documenting trends in the statewide population. This information is critical to guide conservation efforts and could not be accomplished without the help of concerned citizens like you. This protocol is provided to standardize the methods used by all participants in the statewide survey.

The goal of the survey is to estimate the number of Tricolored Blackbirds in the state by utilizing experienced individuals who attempt to visit all known breeding colony sites and search for new breeding sites. The number of birds is estimated both at breeding colonies and at aggregations of nonbreeding birds. This comprehensive survey of Tricolored Blackbirds throughout their range in California is confined to a 3 day interval early in the breeding season to maximize the number of birds at known locations and to reduce the possibility of double-counting birds that move between locations.

Survey Period

The 2022 survey will occur from April 15 to 17. Only observations made during this three day time period will be included as part of the survey results. Tricolored Blackbirds can shift locations over relatively short periods of time during the breeding season, so it is essential that the survey be conducted during a brief interval. The survey may be conducted any time of day during daylight hours.

Know your survey area: Scouting colony sites and habitats

It is useful to plan and to make a reconnaissance of your survey route several days before the survey, especially if this will be your first time covering your survey area. This will allow you to become familiar with the locations you have been assigned as well as other appropriate nesting and foraging habitats where birds may occur during the survey. This will also help you to determine the amount of time that will be required to visit all locations assigned to you.

Survey Locations

Participants in the statewide survey will attempt to visit all known colony locations in California to obtain as complete a count of the population as possible. Each volunteer or team will be assigned a specific survey area as determined by the county coordinator. The primary effort of the survey will be to visit and record observations at all known breeding locations, whether or not they are occupied. Known colony locations have been plotted on maps to enhance survey efficiency. These maps, which include the location names used in the Portal as well as geographical coordinates, are available in pdf format from your county coordinator.

In addition to surveys of known breeding locations, participants should be alert for the presence of birds breeding in previously unknown locations, especially in areas between known locations, as conditions on the landscape change annually and birds can respond quickly to landscape changes. The *Occupied Locations* form contains all the fields that are required to document and describe new breeding colony locations.

Survey Protocol for Viewing Colony Sites, Determining Occupancy Status, and Estimating Numbers

Viewing colony locations

View all colony locations from the nearest public point of access. Sometimes roadsides provide an elevated view of a location, and thus a better perspective from which to determine whether a site is occupied, to estimate the dimensions of the occupied area, and to estimate the number of birds. Similarly, the beds of pickup trucks or roofs of cars may provide an elevated perch from which to view locations. Some find a small step ladder useful to better view birds in emergent vegetation in wetlands or in especially tall stands of Eurasian weeds. Stand quietly and look both at the nesting substrate and at the surrounding area searching for birds.

Avoid disturbing nesting birds by keeping a safe distance from occupied substrates, and do not enter active breeding colonies. Colonies should be surveyed from a distance at which the birds are unaffected by the surveyor's presence. Since colonies may be located in a variety of contexts, it is up to the participant to determine how close is too close, but under most circumstances, colonies can be safely surveyed from 30-100 meters outside the boundary of the vegetation in which the birds are nesting. Be alert for changes in the birds' behavior, and if the birds appear defensive or are disturbed by your presence, move back until their defensive behavior ends. Private property should always be respected: do not enter private property unless you have received permission to access from the landowner.

Duration of Observations

Record the amount of time you spend at each location, whether occupied or not. Tricolored Blackbird colonies are generally very conspicuous; however, during the incubation stage a colony may be relatively quiet and have low levels of activity, and therefore a location may appear to be unoccupied over short observation periods. Be sure to spend enough time at a site to be confident in your conclusion as to whether birds are or are not present.

Determining whether a site is occupied may require up to 15 minutes of observation time. However, when unsuitable nesting habitat or no nesting habitat is present at a site due to habitat alteration or removal (e.g. a grain field site that has already been harvested, a site that has been converted to urban development, or a site that has been converted to an unsuitable orchard crop), it is not necessary to continue surveying for birds at the location. Under optimal viewing conditions it is often possible to determine whether a site is occupied in a minute or less (e.g., in cases where the nesting substrate is located immediately adjacent to a public road) but observing behavior and recording your observations on the data sheets will typically take at least 15 minutes per occupied location.

See the *Supplemental Biological Information*, below, for more information on colony activity at various stages in the birds' nesting cycle. You should expect to spend at least 15 minutes at each *occupied* location as getting a good estimate of the number of breeding birds may require you to

observe birds that move from nesting to foraging substrates and back.

Methods for Estimating Colony Size

Tricolored Blackbird colonies range in size from 20 to more than 20,000 birds. For small colonies, precise counts can be made, but in larger colonies a visual estimate obtained by a scanning survey of either perched or flying birds will be necessary. The method used to estimate the number of birds should be indicated on the data sheet and entered into the Portal.

Precise Counts

For small colonies (approximately less than 500 birds), a precise count of the number of birds will usually be feasible. With care, this should provide a very precise estimate of the number of birds present.

Scanning Surveys

When large numbers of birds are streaming by, dropping into vegetation, or are otherwise extremely active, precise counts will be impossible. For large groups of birds there are two scanning survey methods to estimate number depending on whether birds are flying by or are within the colony.

1. Within the colony: for birds that are perched or flying around within the colony, it is effective to count the number of birds that fill a specific, repeatable field of view, such as the field of view in your binoculars or a portion of a Himalayan blackberry copse. Within this field of view, either count precisely or by fives or tens for more dense concentrations, to obtain a reasonable estimate of the number of birds within that view. Then, multiply that number by the number of fields of view that comprise the entire flock or colony.
2. Flying in Transit: Depending on the time of day and colony status, there may be streams of birds flying between the colony and an off-colony food source. Attempt to count birds in the flight line for the entire duration of the flight to or from the colony. For large groups of birds, count by fives, tens, or other appropriate number to estimate the number of birds in the flight line. Alternatively, the number of birds in these flight lines can be estimated by counting the number of birds that move by in a given amount of time and multiplying this by the total time it takes for the flock to pass.

In some cases, you may need to employ both strategies to estimate both the number of birds flying from a colony and the number of birds that remain once the flight of birds away has stopped. Position yourself somewhere with good visibility and use a timed count of the flying birds as they leave the colony. Once the flow of birds has dropped off, conduct a scanning count of the visible birds remaining within the colony itself. Add the estimate of birds flying away from the colony to the count of birds within the colony. The scanning surveys of the colony should be repeated a few times to improve the estimate.

The *Occupied Locations* form asks you to record 1) the estimated number of birds as well as 2) a minimum and 3) a maximum estimate of number of birds. These minimum and maximum estimates will

provide some sense of how accurate you feel your best estimate is.

Estimating the size of large colonies can be very challenging, and for some, frustrating. Remember that you are providing an approximation of colony size and not an exact count. Be sure to record the amount of area occupied by the breeding birds for the largest colonies. To reduce potential error associated with estimation at large colonies, all large colonies that you find will be revisited by one or more experts. All colonies of 5,000 or more birds should immediately be reported to your county coordinator and to the statewide survey coordinator, Dr. Bob Meese, at rjmeese@ucdavis.edu.

Recording Data

Survey Data Forms

Three data forms will be used during the survey to record survey effort and observations. A brief description of each form and instructions for completion are provided below:

3. **COVER SHEET** – Each surveyor or team lead will complete one copy of this form per survey day. The cover sheet records information on observers, weather conditions, and survey effort measured by time spent surveying, number of sites surveyed, and number of miles driven.
4. **LOCATIONS SURVEYED FORM** – Observations of *all* locations surveyed and nesting substrate suitability will be recorded on this form.
5. **OCCUPIED LOCATIONS FORM** – This form will be used to record detailed observations at each *occupied* breeding location. One form should be completed for each occupied site.

COVER SHEET and SURVEY SUMMARY

Observer Information - Record the name and contact information for the team leader and list any additional observers.

Weather Information - Provide the starting and ending temperature for the time spent conducting the survey, in degrees Fahrenheit. Provide the starting and ending conditions for Wind Speed and Sky Conditions; codes for these weather attributes are provided on the form.

Survey Effort - Indicate the county(ies) in which the survey was conducted, the total number of colony sites surveyed (both occupied and unoccupied), the total time spent surveying, and the number of observers in your group. Use the mileage recorded on the LOCATIONS SURVEYED form to calculate the total number of miles traveled on the survey route (survey route is composed of all miles driven from first colony site to last colony site). Also provide the number of miles driven to and from the survey route (e.g., round trip distance between home and the route on which the survey was conducted).

Summary of Survey Observations - Record the number of occupied locations observed, if any, and whether any colonies were discovered at new locations. Indicate whether nonbreeding birds were observed, and the location and number of any nonbreeding birds.

LOCATIONS SURVEYED FORM

Provide the name and contact information for the primary observer at the top of the form. Record the mileage and temperature information at the beginning and end of the survey day. For every colony site visited during the survey day (both occupied and unoccupied), complete the survey form fields with the following information:

Location Name - Record the colony site name used in the Tricolored Blackbird Portal. If the site is a new breeding colony location, use the OCCUPIED LOCATIONS form to provide a location name and describe Colony Site Characteristics.

Time at location – Record the amount of time spent observing at each location.

Occupied? – Place an “x” next to Yes or No to indicate whether Tricolored Blackbirds were observed at the site.

Nesting Substrate Suitability - Indicate by circling the appropriate substrate suitability category. Choose 1 for locations with vegetation suitable for nesting, 2 for locations where nesting substrate is present but it appears to be unsuitable for nesting (e.g., it is immature, too short, lacks sufficient foliage, too sparse, or has recently been burned); choose 3 for locations where nesting substrate is currently absent but could potentially return (e.g., former grain field currently planted to alfalfa, bare area that previously supported a milk thistle stand, a dry basin that could have cattails with sufficient water), or choose 4 if the site is permanently unsuitable (e.g., has been converted to urban development, orchard, or vineyard). Briefly describe why you came to your conclusion on nesting substrate suitability in Comments.

OCCUPIED LOCATIONS FORM

Observer Information - Provide the name and contact information for the primary observer and list any additional observers.

Colony Observations - For each occupied location observed, record the location *name used in the Tricolored Blackbird Portal* (available on survey maps) and the county in which the colony occurs. If you observe birds in a new location, please provide a descriptive location name and driving directions (see Colony Site Characteristics, below).

Colony Size and Sex Ratio:

Record the estimated number of adults at the colony, as well as the minimum and maximum number of birds (as determined using the colony size estimation protocol described above). Also, record an estimate of the sex ratio (%Male:%Female) of adult birds observed at the colony. A quick estimate of the number of males and females in sub-flocks can be used to estimate an overall sex ratio. Estimate the ratio of males to females in several sub-flocks or fields of view and average them to come up with an overall estimate.

Behavior and Colony Status:

Record the behavior of the birds at a colony to help document the stage of the breeding cycle. This information can be used to examine trends in the timing of breeding. If possible, record the following behaviors observed at occupied locations:

- Singing: pronounced chorus of males heard singing at a colony; may indicate settlement
- Carrying Nest Material: females observed carrying nest material (e.g. grass); indicates nest-building
- Colony Quiet: males are not singing and relatively few birds are seen moving about; may indicate incubation
- Carrying Food: adults observed carrying food (usually insects protruding from bill); indicates nestling stage
- Fledglings: recently fledged young observed out of nests, possibly in association with adults; indicates fledging and successful reproduction. Older fledglings can be difficult to distinguish from adult females, especially when viewed from a distance. Young fledglings are not fully feathered on the head and may retain obvious down feathers and a yellow gape at the base of the bill. Watch for fledglings that are dependent on adults for food. Please try to estimate the number of fledglings and indicate how fledglings were identified.

Colony Site Characteristics - Record colony site characteristics for all new colony sites, and for established locations if time allows. Indicate whether the location is known or a new breeding location.

Recording Latitude and Longitude:

For new sites, provide the latitude and longitude and the method used to determine the coordinates (e.g., a handheld GPS or the metadata from an image file). Please also record the datum in which the coordinates were recorded: the Portal uses the WGS84 datum. If a different datum is used to record coordinates, the data will need to be converted before entry into the Portal. The default for most GPS units is WGS84, but in some cases they may be set to NAD83. If you do not have a GPS unit the Portal can be used to determine the coordinates: when entering a new location record in the Portal, scroll down to the Google Maps tool near the bottom of the Create Location form and navigate to the desired map location and click to place a marker at the location of the colony - the latitude and longitude will automatically be entered. Be sure the coordinates appear in the Google Maps widget. See the Portal Help page (<https://tricolor.ice.ucdavis.edu/help>) for more information on entering a new colony location record in the Portal.

Nesting Substrates:

Observers should record the nesting substrate of colonies in new locations. The Occupied Locations form allows you to record both primary (dominant) and secondary substrates. Tricolored Blackbird native nesting habitat consists of young, rapidly-growing emergent vegetation dominated by cattails or tules and stinging nettles in canyons, but birds also nest in a variety of primarily non-native upland vegetation including grain crops (particularly weedy triticale fields in association with dairy farms in the San Joaquin Valley and southern California), Himalayan and (rarely) California blackberry, milk thistle, mallow, mustard, flooded small willows, flooded small cottonwoods, *Arundo donax*, desert olive, prickly lettuce, mule fat, coyote brush, raspberry, flooded tamarisk, and poison hemlock.

Area of Nesting Substrate:

Estimate the approximate length and width of 1) the breeding substrate available and 2) the breeding substrate occupied by breeding birds. These measures are used to estimate the amount

of nesting substrate available and may also be used to provide a second estimate of the number of breeding birds, especially for larger colonies. You may estimate the length and width of the breeding substrate while in the field by pacing out two sides of the colony (with strides of approximately one meter) or on a computer by viewing aerial photos and using the ruler function in Google Earth.

Colony Surroundings:

In addition to nesting substrate, Tricolored Blackbirds require a source of open water and suitable foraging areas (e.g., upland pasture, grassland, alfalfa, rice paddies). Foraging birds may fly several miles to sources of abundant food (like grasslands with abundant grasshoppers), but most foraging occurs within 2 miles of colonies. Knowledge of locations of stored grains may help observers find additional breeding colonies as birds move between various nesting sites and a centralized food source. Any stream of blackbirds is worth following! If known, record the distance to the water source and the type of water (e.g., wetland, stock pond, canal). Also, record whether stored grains are present nearby and the dominant land use surrounding the colony (e.g., type of agricultural crops, natural vegetation types, etc.).

Online Data Entry and Submittal of Data Forms

Records of all observations (of breeding colonies, unoccupied locations, and aggregations of nonbreeding birds) should be entered into the Tricolored Blackbird Portal (<http://tricolor.ice.ucdavis.edu/>) *within one week* of the survey period. Please confirm via email with the survey coordinator, Bob Meese, when you have finished entering your survey data.

For new colony locations, a location record will need to be entered in the Portal **before** entering an observation record. See the Portal help page (<http://tricolor.ice.ucdavis.edu/help>) for instructions on how to enter records of new locations and records of observations of birds. After data entry in the Portal, please email scanned copies of all survey forms to the survey coordinator and to the Department of Fish and Wildlife at the following email addresses: rjmeese@ucdavis.edu; neil.clipperton@wildlife.ca.gov

Training Opportunities

Training materials are available for viewing on the Portal. Remote training sessions will also be offered prior to the statewide survey and announced via email by county coordinators.

Supplemental Biological Information

Tricolored Blackbird Breeding Biology and Behavior

Breeding season movements

Tricolored Blackbirds generally breed in the southern part of their range early in the nesting season, and many birds will move (often to the coast and Sierra foothills and northern portions of the range) for a second breeding attempt later in the season. During the April survey, many if not most colonies

will be active in southern California, the San Joaquin Valley, portions of the lower Sacramento Valley, and many foothill locations, but sites further north in the Sacramento Valley, the north coast, and areas further north are typically not occupied until mid-to-late May, and therefore are less likely to be occupied during the survey period.

Nesting Habitat

Tricolored Blackbirds nest in a wide variety of vegetation, but are most often found in freshwater marsh, Himalayan blackberry copses, weedy fields dominated by milk thistle, cheeseweed mallow and mustard, and weed-infested grain fields (often triticale) adjacent to dairies. The birds also forage in a wide variety of habitats, including grasslands, dry and moist pastures, shrublands, alfalfa, and rice paddies. In rural areas, birds are especially attracted to stored grains associated with livestock (dairy cows, sheep, goats, horses). If your survey route includes sources of stored grains, be sure to check them for the presence of foraging birds. Should you see birds at sources of stored grains prior to or during the survey weekend, you may frequently be able to find colonies by following birds back from sources of stored grains to their nesting locations.

Nesting Cycle

The birds' behavior changes dramatically depending upon the stage of the breeding cycle. When settling into a new location, males are extremely vocal and active and move from perch to perch high in the nesting vegetation, often jostling with males on adjacent territories (duration ca. 2 days). At this time females move slowly and silently from one territory to another, often several feet below the displaying males. At nest building (duration 3-4 days), the females fly actively from nesting vegetation to sources of nest materials (grasses and mud) and back again. They are silent but very conspicuous on the landscape. Males remain mostly on their territories perched atop the nesting substrate but display and call less frequently than during settlement. Territorial squabbles usually end by the time nests are built.

Following nest-building, both males and females sit out of sight, with males defending their territories from inconspicuous perches while females incubate their eggs (duration 10-12 days). During the incubation stage, occupied locations may appear to be unoccupied even when several thousand birds are present. It is for this reason that we recommend that all locations possessing appropriate nesting vegetation be observed for up to 15 minutes prior to concluding that the location is unoccupied, especially for locations that are distant from your viewing position. During the nestling stage (10-12 days), both parents forage for the young and form long flight lines of birds flying in single file (bill to tail) that may stretch for hundreds of yards and persist for several minutes as birds move from their nests to foraging destinations and back again. These foraging flight lines are often quite conspicuous on the landscape, and it is often these foraging flight lines as they cross roads or other points of access that lead to colony discovery. At fledging and continuing for several days post-fledging, young perch and call conspicuously high in the nesting vegetation in large groups ("creches") but these groups disperse after 4-6 days and small groups or single birds may be found far from the colony location foraging and being fed by the adults less than a week after fledging.

Sex Ratio

The accuracy of the count can depend on the activity at the colony and this will often be reflected in the sex ratio of birds observed. Some colonies that are just forming will have both males and

females active so that most individuals can be seen. Once incubation begins however, it will be mostly males that are seen. This information is critical to record. The data sheet includes space for specifying the ratio of males to females seen and whether the colony is active but quiet (indicating that incubation may have begun).

Questions?

If you have any questions, please contact your county coordinator, or the statewide survey coordinator, Dr. Bob Meese, at rjmeese@ucdavis.edu.

Appendix B. Field Forms.

**2022 Tricolored Blackbird Statewide Survey
COVER SHEET and SURVEY SUMMARY**

Each surveyor or team lead should complete one COVER SHEET per survey day.
Visits to all locations surveyed should be recorded on the LOCATIONS SURVEYED form.
Observations at occupied locations should be recorded on the OCCUPIED LOCATIONS form.

Enter all observation records into the Portal for both occupied and unoccupied sites and for non-breeding birds. For new colony site locations, a site location record will need to be entered into the Portal **before** entering colony observation records. See Portal help page for instructions on creating records of new locations and records of observations (<http://tricolor.ice.ucdavis.edu/content/online-help>). After entry of data to the Portal, please email scanned copies of all survey forms to: rimeese@ucdavis.edu and neil.clipperton@wildlife.ca.gov

Observer Information

Name:	Date:
Phone Number(s):	Email:
Address:	
Additional observers:	

Weather Information

Start Temp (°F):	End Temp (°F):	Start Wind:	End Wind:
<i>Wind speed codes (Beaufort scale):</i> 0 – calm: smoke rises vertically (<1 mph) 1 – light air: smoke drifts (1 - 3 mph) 2 – light breeze: felt on face, leaves rustle (4 - 7 mph) 3 – gentle breeze: leaves and small twigs move (8 - 12 mph) 4 – moderate breeze: dust, leaves, and loose paper rise <u>up</u> ; small branches move (13 - 18 mph) 5 – fresh breeze: small trees sway (19 - 24 mph) 6 – strong breeze: large branches move (25 - 30 mph)		Start Sky:	End Sky:
		<i>Sky condition codes:</i> 0 – Clear or few clouds 1 – Partly cloudy (scattered) or variable sky. 2 – Cloudy (broken) or overcast 4 – Fog or smoke 5 – Drizzle 8 – Showers	

Survey Effort

County(ies) surveyed:	Total # of sites surveyed:
Miles traveled during survey route*:	Total time surveying:
Miles traveled to and from survey route:	Number of observers in group:

*The survey route is composed of all miles driven from first colony site to last colony site.

Summary of Survey Observations and Nonbreeding Birds

Were any active TRBL breeding colonies observed? (Y/N)	How many occupied sites?
Were any new breeding colony sites discovered? (Y/N)	How many new colony sites?
Were any non-breeding TRBLs observed? (Y/N) If yes, list location names, coordinates, and # of birds:	
Location Name(s):	Coordinates:
_____	_____
_____	_____
_____	_____
	Number of nonbreeding birds:

Have data been entered in the Tricolored Blackbird Portal? (Y/N)

**2022 Tricolored Blackbird Statewide Survey
LOCATIONS SURVEYED**

Use this form to document observations at each breeding location you survey, whether occupied or not. If a site is occupied, indicate on this form and use the OCCUPIED LOCATIONS form to document observations.

Observer: _____ Date: _____ County: _____

Phone: _____ Email: _____

Start mileage: _____ End mileage: _____ Start time: _____ End time: _____

Location Name ^a	Time at location ^b	Occupied?	Nesting Substrate Suitability ^c
Los Banos WA Area 42	8:00-8:15	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	1 – suitable substrate 2 – unsuitable substrate 3 – substrate absent 4 – permanently unsuitable
Comments: <i>Temporarily unsuitable. Field recently burned (within 1 month). The cattails have not sufficiently recovered from fire to support nesting by a Tricolored Blackbird colony.</i>			

Location Name ^a	Time at location ^b	Occupied?	Nesting Substrate Suitability ^c
		<input type="checkbox"/> Yes <input type="checkbox"/> No	1 – suitable substrate 2 – unsuitable substrate 3 – substrate absent 4 – permanently unsuitable
Comments:			

Location Name ^a	Time at location ^b	Occupied?	Nesting Substrate Suitability ^c
		<input type="checkbox"/> Yes <input type="checkbox"/> No	1 – suitable substrate 2 – unsuitable substrate 3 – substrate absent 4 – permanently unsuitable
Comments:			

Location Name ^a	Time at location ^b	Occupied?	Nesting Substrate Suitability ^c
		<input type="checkbox"/> Yes <input type="checkbox"/> No	1 – suitable substrate 2 – unsuitable substrate 3 – substrate absent 4 – permanently unsuitable
Comments:			

Location Name ^a	Time at location ^b	Occupied?	Nesting Substrate Suitability ^c
		<input type="checkbox"/> Yes <input type="checkbox"/> No	1 – suitable substrate 2 – unsuitable substrate 3 – substrate absent 4 – permanently unsuitable
Comments:			

Location Name ^a	Time at location ^b	Occupied?	Nesting Substrate Suitability ^c
		<input type="checkbox"/> Yes <input type="checkbox"/> No	1 – suitable substrate 2 – unsuitable substrate 3 – substrate absent 4 – permanently unsuitable
Comments:			

^a Use the location name used in the Tricolored Blackbird Portal. If the site is a new breeding location, use the OCCUPIED LOCATIONS form to record a location name and provide Colony Site Characteristics.

^b See protocol for recommendations on duration of observations.

^c Circle one suitability code and explain choice in Comments. See protocol for additional information on suitability codes.

**2022 Tricolored Blackbird Statewide Survey
OCCUPIED LOCATIONS**

Complete a separate form for each occupied breeding location, including previously used sites and new breeding colony locations.

Observer Information

Name:	Email:
Work Phone:	Cell/Home Phone:
Address:	
Additional observers:	

Colony Observations

Provide for all occupied colony locations

Location Name ^a :		County:	
Date:	Start Time:	End Time:	Total Time ^b :
Estimated Number of Adults:		Min. Estimate:	Max. Estimate:
Estimated sex ratio (%M/%F):	Males singing? Y/N	Females with nesting material? Y/N	
Colony quiet, incubation <u>inferred</u> ? Y/N/unknown	Adults carrying <u>food</u> ? Y/N	Fledglings seen? Y/N	
Foraging Substrates (if observed):			
Comments:			

Colony Site Characteristics

Information in shaded cells is only required for new colony sites

New Colony Site? Y/N	Latitude ^c :	Longitude ^c :	How Measured:
Location description ^d :			
Distance to Water (m):	Type of Water ^e :	Nearby stored grains? Y/N	
Primary Nesting Substrate:	% Primary Nesting Substrate:		
Secondary Nesting Substrate (if any):	% Secondary Nesting Substrate:		
Substrate Length x Width (m):	Total Substrate Area (m ²):		
Occupied Area Length x Width (m):	Occupied Area (m ²):		
Dominant surrounding land use(s):	Landowner contact:		
Comments:			

^a Use established breeding location name from the Tricolored Blackbird Portal. If colony location is new, indicate this in the comments, provide a descriptive Location Name, and provide additional Colony Site Characteristics.

^b For occupied breeding locations, observations of 15 minutes or more are recommended.

^c For new breeding location only, provide location coordinates in the WGS84 map datum (e.g., 38.5427S, -121.74092).

^d For new breeding locations, please provide a location description using cross roads or other landmarks and estimated or measured distances.

^e Examples: stock pond, wetland, stream, lake, canal.

This is form _____ of _____ forms.