



Results of the 2017 Tricolored Blackbird Statewide Survey



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I thank the county coordinators for applying their intimate knowledge of Tricolored Blackbird distribution and occurrence in California and for recruiting highly qualified survey participants. And finally, I thank the 180 survey participants for making this the most comprehensive statewide survey ever and for helping to thoroughly document the distribution and abundance of California's blackbird in spring, 2017.

Introduction

The Tricolored Blackbird, *Agelaius tricolor*, hereafter “tricolor”, is a unique California passerine that nests in large groups that place heavy demands upon the landscapes surrounding their breeding colonies. Its colonial nesting habit is believed to make it especially vulnerable to landscape changes. The tricolor, originally a marsh dweller found by the millions in both Central Valley and coastal locations (Neff 1937), has responded to widespread, severe reductions in its native breeding and foraging habitats by adapting to a wide range of native and introduced wild and cultivated plant species as nesting habitat and to feed on a diverse array of plant and animal foods using foraging strategies as diverse as any North American passerine.

During the breeding season, the tricolor is insect-dependent as females require insects to form eggs and nestlings require insects for their first 9 days of life. When not breeding, the species is largely granivorous. The combination of coloniality plus breeding-season insectivory places severe constraints on a native passerine living in anthropogenic landscapes, where both insects and blackbirds are typically considered pests.

Because much native nesting habitat has been converted to agriculture and urbanization and stored grains provide an essentially limitless food resource, tricolors have for several decades nested in large numbers in association with dairies. The close association between nesting tricolors and dairies has been especially pronounced since the 1990s, when many dairies moved from southern California to the San Joaquin Valley, and has had serious consequences: first, annually all of the 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, and second, grains do not provide sufficient nutrition required for breeding, so even conserved colonies are often relatively unproductive, with few fledglings produced (Meese 2009).

Following the breeding season, most tricolors are found in the Sacramento Valley, where they aggregate with Red-winged (*A. phoeniceus*) and other blackbird species and feed, often in large flocks, on ripening rice. An unknown number of tricolors is shot each fall due to their similarity in appearance to red-wings, as red-wings are under certain circumstances and with conditions, authorized to be taken (killed) under the Migratory Bird Treaty Act and are legally shot each fall as they feed on ripening rice.

As a result of these and other factors, tricolor populations plummeted in the 20th Century from several million birds to a few hundred thousand (Beedy and Hamilton 1997), and in 2004 the tricolor was petitioned for listing under the California and federal Endangered Species Acts. Although these petitions were denied, the tricolor is listed as a priority species of special concern and its abundance has continued to decrease (Meese 2013). Recent research showed that the species has suffered chronically low reproductive success since 2007 and that reproductive success is correlated with insect abundance (Meese 2013). Currently, the status of the tricolor is being formally reviewed by both the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service for listing as a threatened or endangered species.

Since 1994, the triennial Tricolored Blackbird Statewide Survey has been the primary means by which the species population is monitored, and this report summarizes the results of the 2017 Statewide Survey.

Methods

The goal of the survey is to obtain a count of Tricolored Blackbirds in the state by utilizing a large number of experienced volunteers who attempt to visit all known breeding colony sites and search for new breeding sites at previously unknown locations. Occupancy status is recorded at all sites visited and the number of birds is estimated both at active breeding colonies and at aggregations of nonbreeding birds.

Survey Dates. Tricolored Blackbirds may most accurately be counted when at their breeding colonies, as the birds are relatively sedentary and breeding behaviors may allow observers to make multiple estimates of colony size. In addition, pre-survey colony detection and monitoring efforts may help to document the locations and characteristics (nesting substrates, distance to water and to stored grains) of breeding colonies, increasing the likelihood that a large proportion of the total population will be encountered during the statewide survey. These pre-survey colony detections are conducted both by professional biologists who make systematic searches for active breeding colonies and by private citizens who enter records of colony locations into the Tricolored Blackbird Portal (tricolor.ice.ucdavis.edu), eBird, various birding community listservs, or who report directly to survey coordinators. Tricolored Blackbirds breed throughout a long breeding season that begins as early as late February in some parts of the southern San Joaquin Valley and ends in most years in mid-July when the last colonies have fledged their young and most birds have moved into the Sacramento Valley (Meese, unpub. data). Thus, the exact timing of the statewide survey is an effort at optimization: to time the survey to the interval when the maximum number of birds is found in breeding colonies, before the first colonies to establish have completed the breeding cycle or failed and prior to the period when first breeders disperse north to breed again (Hamilton 1998).

The 2017 Statewide Survey was held over 3 days, from April 7-9. A three day interval is used to minimize the risk of double-counting birds that may have moved from one breeding colony to another (as following a breeding attempt or colony abandonment after a breeding failure). However, due to an intense storm forecast for April 7 and 8th, county coordinators were encouraged to use discretion in their schedules and to begin the survey on Thursday, April 6th if they were concerned that conditions on the 7th and/or the 8th would make field surveys difficult.

Coordination. As with recent triennial statewide surveys, the 2017 survey was organized as a three-tiered effort:

1st tier is a statewide coordinator,

2nd tier is county coordinators, and

3rd tier is volunteer participants.

Statewide Coordinator. The statewide survey coordinator was responsible for general organization and oversight of the survey, including: identification and recruitment of qualified persons to serve as county coordinators, communicating with county coordinators and persons interested in volunteering to participate in the survey, assembling all of the records of observations, ensuring that each record is checked for accuracy, assembling and ensuring the quality of the entire data set, and preparing a final survey report. I served as the statewide coordinator for the 2017 survey.

County Coordinators. County coordinators ensure their assigned county is well surveyed and all data collected by local volunteers are submitted to the statewide coordinator and entered into the database on the Tricolored Blackbird Portal. Beginning in late 2016 I began to communicate with colleagues consisting of agency and NGO staff, environmental consultants, academics, and others with much field experience with Tricolored Blackbirds. I initially communicated with persons who served as county coordinators for the 2014 statewide survey to request their assistance in the 2017 or, if they were unable to participate, to suggest appropriate persons to serve as county coordinators. As in previous statewide surveys, we have found that those with the most local knowledge could best survey a species that occurs throughout lower elevation regions of California but is for many notoriously difficult to find during the breeding season. Several gaps in coverage existed after this initial effort to recruit county coordinators and subsequent efforts to recruit county coordinators were made during January to March, 2017 by myself, Neil Clipperton of the California Department of Fish and Wildlife, Rob Doster of the U.S. Fish and Wildlife Service, and Samantha Arthur of Audubon California. All county coordinators had extensive experience with the species and committed to coordinate thorough surveys of breeding tricolors in their respective counties.

Participants. As in past years, the 2017 survey was largely a volunteer-based effort. Statewide survey participants consisted of the statewide coordinator and the county coordinators plus individuals who were selected by county coordinators, individuals who responded to requests for assistance posted to the Portal and Audubon California appeals, and individuals who contacted survey coordinators directly to offer to participate. In the majority of cases, volunteers had participated in previous statewide surveys so were familiar with protocols and procedures, including data entry via the Portal, but in a minority of cases volunteers were participating in their first statewide survey and received assistance in

protocols and procedures from county coordinators, materials posted on the Portal, or by attending one of the two training sessions.

Statewide Survey Support Materials. The support materials for the 2017 Statewide Survey were greatly enhanced over those provided previously and consisted of 1) a new 3-part field form for recording data while in the field, 2) an updated protocol to standardize the methods by which participants would conduct the survey (Appendix 1), 3) navigational aids consisting of PDF maps for each county, an online map, and a smartphone app, and 4) an on-line survey training video. All of the support materials were available for download from the Portal at:

<http://tricolor.ice.ucdavis.edu/content/2017-statewide-survey>. The field forms were developed over a period of several months prior to the April survey by a committee consisting of Robert Meese of U.C. Davis, Rob Doster of the U.S. Fish and Wildlife Service, Neil Clipperton of the California Department of Fish and Wildlife, and Samantha Arthur of Audubon California, with input from the research subcommittee of the Tricolored Blackbird Working Group. The forms replaced the single form that had been used in previous years, and allowed for the collection of additional data on weather conditions, survey effort, site occupancy, and the suitability of nesting habitat at each location (Appendix 2). The PDF maps, online map, and smartphone app were developed by Audubon California with data from the Tricolored Blackbird Portal. The maps showed the locations of all known breeding colonies used by Tricolored Blackbirds, along with additional information on location names, GPS coordinates, and nesting substrate(s). Survey participants could use the smartphone app to navigate directly to survey locations.

Tricolored Blackbird Portal. The Tricolored Blackbird Portal (tricolor.ice.ucdavis.edu), developed in 2008, was used to help to coordinate at the county and individual levels by disseminating information and documents (field forms, PDF maps, protocol) to county coordinators and volunteer participants, and to allow survey participants to upload survey data directly to the online database.

Timeline. Requests for assistance were sent via email to potential county coordinators in November, 2016 and efforts to recruit county coordinators continued through February, 2017, with the final county coordinator identified in March, 2017. As each county coordinator agreed to participate, he/she was tasked with identifying survey participants for their assigned county. Assistance in recruiting survey participants was provided to the county coordinators as needed. The majority of county coordinators preferred to assemble their own survey teams, but those who requested assistance were put in touch with individuals who had responded to a request for assistance posted to the Tricolored Blackbird Portal, Audubon chapter requests via newsletters and postings to websites, and staff provided by the USFWS and CDFW.

Training Sessions. Two training sessions were held: one on Saturday, March 4, 2017 at the San Luis National Wildlife Refuge HQ outside Los Banos, Merced County, and the second held on Saturday, March 11 on the U.C. Davis campus. The first training session was jointly hosted by Audubon California staff (Samantha Arthur) and myself, and the second was hosted by me. The training sessions consisted primarily of a PowerPoint presentation that covered species characteristics for field identification, a review of the species' natural history, a review of its breeding behavior, breeding colony identification, characteristics, and size estimation, and a review of data entry into the Portal. This was followed by a description and

instructions for using the navigational aids (PDF maps, online map, and smartphone app). An online version of the first training session was subsequently posted to YouTube and a PDF version of the training presentation was posted to the Portal for use by survey participants who were unable to attend a training session.

Data Entry. In general, survey participants entered records of their observations into the Portal. In some cases, participants provided their results to county coordinators, who then entered the results for the entire county into the Portal. And in two instances, county coordinators provided data forms to the statewide coordinator for entry into the Portal.

Fundamentally, 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 birds have been confirmed to breed, as well as locations of aggregations of non-breeding birds. Observation records consist of the who, what, when, where information specific to occurrences of birds at breeding colonies or in non-breeding aggregations. Specifically, observation records consist of:

- Observer
- Location
- Date
- Estimate of number of birds
- Breeding behaviors
- Colony attributes

A review of data entry procedures was provided in training sessions and on the Portal. 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 to add records of their observations to these location records. Note that we emphasized the value of records of non-occupancy (observations of unoccupied sites to confirm absence of birds at unoccupied sites), as the primary metric used to estimate survey completeness was the number of known locations surveyed, and since most sites surveyed were not occupied by breeding birds, it was essential to identify both occupied and unoccupied sites to estimate the thoroughness of the survey effort.

Data Documentation. PDF copies of all field forms were requested from county coordinators in order to verify the records of locations and observations in the Portal, and to compile data collected on field forms that cannot be entered directly via the Portal. These files were provided via email to myself and to Neil Clipperton. Copies of field forms were provided to me by one county coordinator and original field forms were provided to me by two county coordinators. I scanned copies and original field forms to PDF and sent PDF files to Neil Clipperton, California Department of Fish and Wildlife.

Results

The 2017 Tricolored Blackbird Statewide Survey was conducted from April 7 to April 9, 2017. However, due to a severe storm that was forecast for April 7-8, some locations primarily in the San Joaquin and lower Sacramento Valleys were surveyed on April 6, and in a few cases where scheduling conflicts prevented survey work during the survey interval, surveys were not conducted until April 11.

A total of 37 county coordinators and 181 volunteers participated in the survey.

A total of 177,656 birds was counted in 37 counties from 44 counties and 884 locations surveyed (Figure 1). Of this total, 172,499 birds were observed at breeding colonies and 5,157 were observed in non-breeding aggregations or as single birds.

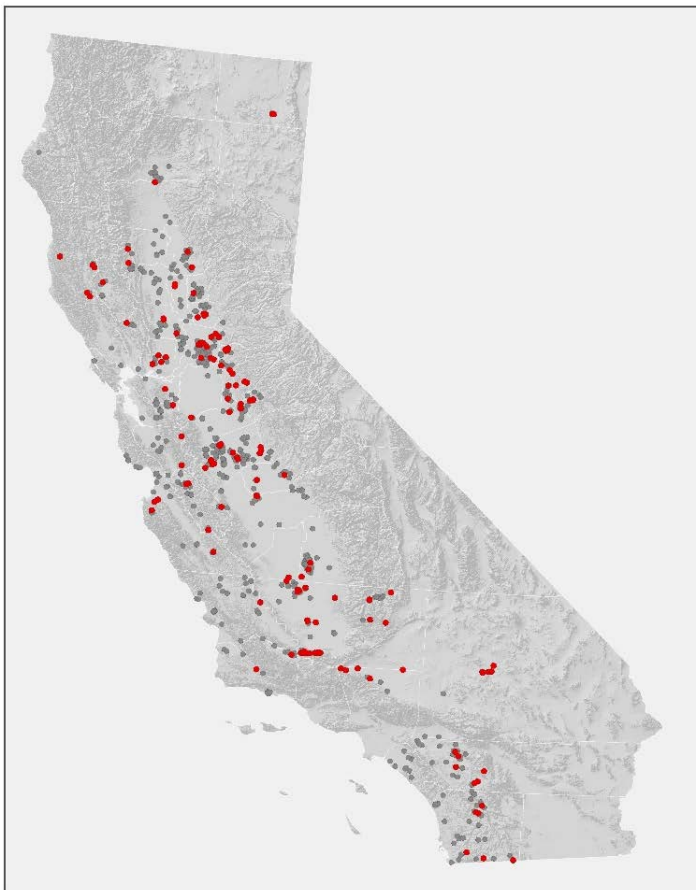


Figure 1. Locations surveyed in 2017 Statewide Survey. Red = occupied locations, gray = unoccupied locations.

Tricolored Blackbirds were observed at a total of 168 locations, 155 of which are known breeding locations with the remaining 13 locations representing aggregations of non-breeding birds (Table 1). The 884 locations surveyed represents a greater than quadrupling of the number of locations surveyed

since the 2000 statewide survey (Hamilton 2000). The survey effort, as measured in the number of locations surveyed, has increased in each statewide survey since 2000:

- 2000 – 206 sites
- 2008 – 361 sites
- 2011 – 608 sites
- 2014 – 802 sites
- 2017 – 884 sites

However, it should be noted that this year, participants were asked to survey only confirmed colony locations – all records of aggregations of birds as well as records with uncertain location accuracy were deleted from those to be mapped and surveyed. Thus, the number of sites surveyed in 2017 actually represents an even larger increase in coverage over that of previous statewide surveys.

The decline in the number of tricolors observed since the 2008 survey appears to have ceased. From 2008 to 2014 the number of tricolors dropped by 64%, from 395,000 to 145,000 birds (Kelsey 2008, Meese 2014) but the number of birds increased by 22% from 2014 to 2017 (Figure 2).

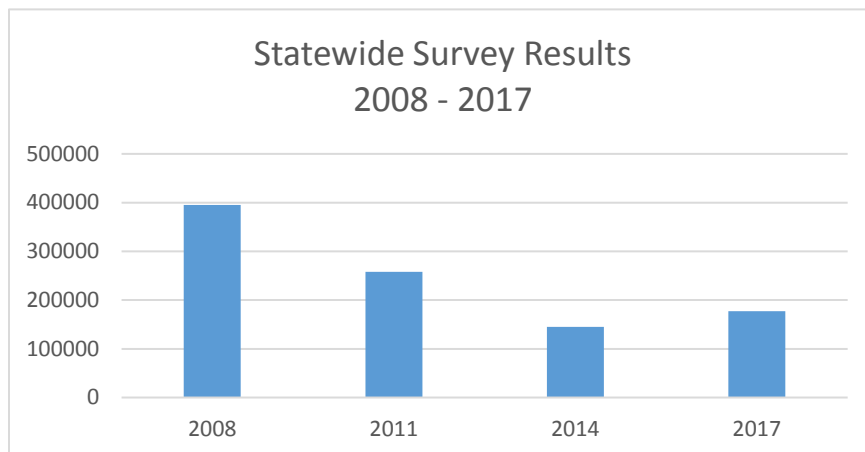


Figure 2. Population trend of Tricolored Blackbirds from 2008 to 2017.

A total of 39 new location records was added to the Portal by 17 different users as result of the 2017 statewide survey (Figure 3), bringing the number of confirmed colony locations in the Portal to 1,307.

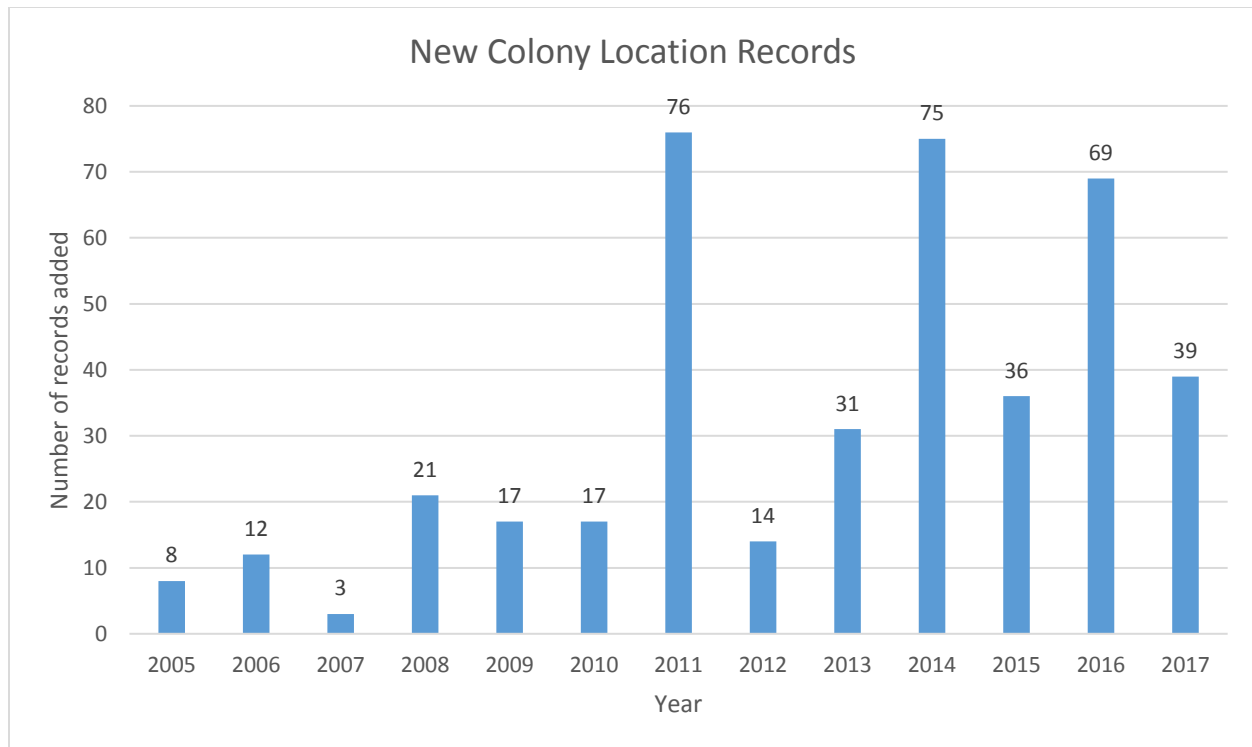


Figure 3. New Tricolored Blackbird colony location records added to Portal.

Tricolored Blackbirds were heavily concentrated into a few counties during the Statewide Survey interval, with only two counties, Merced and Kern, accounting for over 51% (90,736/177,656) of birds seen (Table 1).

Table 1. Statewide Tricolored Blackbird Survey Results by County.

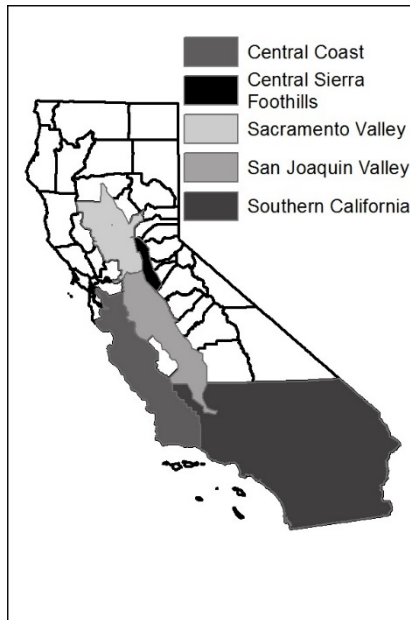
County	Locations Surveyed	Locations Occupied	Number of Birds	Proportion of Total
Alameda	18	1	3000	0.017
Amador	14	4	420	0.002
Butte	22	5	1311	0.007
Calaveras	10	6	1570	0.009
Colusa	32	2	247	0.001
Contra Costa	9	1	30	0.001
El Dorado	11	1	100	0.001
Fresno	29	2	5750	0.033
Glenn	12	2	405	0.002
Humboldt	1	0	0	0
Kern	72	26	60853	0.344
Kings	2	2	4300	0.028
Lake	5	2	3	0.001
Los Angeles	7	4	1410	0.008
Madera	18	3	12552	0.071
Marin	2	0	0	0
Mariposa	2	0	0	0
Mendocino	9	5	213	0.001
Merced	108	16	29883	0.169
Modoc	4	2	530	0.003
Monterey	20	5	2793	0.016
Napa	5	1	40	0.001
Orange	9	0	0	0
Placer	17	5	960	0.005
Riverside	37	6	8180	0.046
Sacramento	100	16	12455	0.07
San Benito	24	7	11226	0.063
San Bernardino	11	5	466	0.003
San Diego	41	8	665	0.004
San Joaquin	4	1	1000	0.006
San Luis Obispo	29	1	3	0.001
Santa Barbara	15	2	760	0.004
Santa Clara	8	3	344	0.002
Santa Cruz	9	0	0	0
Shasta	12	0	0	0
Solano	13	4	1360	0.008
Sonoma	2	0	0	0
Stanislaus	30	4	742	0.004
Sutter	8	2	1000	0.006
Tehama	4	2	515	0.003
Tulare	36	3	8150	0.046
Tuolumne	10	4	850	0.005
Yolo	30	3	2750	0.056
Yuba	23	2	820	0.016
TOTAL	884	168	177,656	1.0

Breeding colonies were established in 15 major nesting substrate types (Table 2), and non-breeding birds were observed around dairies and in foraging areas lacking nesting substrates.

Table 2. Number of Tricolored Blackbird colony locations surveyed and occupied and numbers of breeding birds by nesting substrate type.

Primary Substrate Type	Number/Proportion of Total Locations Surveyed	Number/Proportion of Locations Occupied	Number of Breeding Birds	Proportion of Total Birds
Bull thistle (<i>Cirsium vulgare</i>)	22/.001	4/.026	1,476	0.008
Bulrush (or tule)	92/.109	13/.084	10,777	0.06
California blackberry (<i>Rubus ursinus</i>)	2/.002	0/0	0	0
Cattails (<i>Typha</i> spp.)	269/.32	50/.323	20,744	0.117
Himalayan blackberry (<i>Rubus armeniacus</i>)	198/.235	42/.27	19,703	0.111
Mallow (<i>Malva</i> sp.)	8/.01	4/.026	17,150	0.097
Mallow in triticales	10/.012	2/.013	5,500	0.031
Mesquite (<i>Prosopis</i> spp.)	1/.001	1/.006		
Milk thistle (<i>Silybum marianum</i>)	57/.068	8/.052	7,693	0.044
Mustard (<i>Brassica</i> spp.)	25/.03	4/.026	4,240	0.024
Mustard in triticales	2/.002	1/.006	7,750	0.044
Stinging nettle (<i>Urtica dioica</i>)	25/.03	12/.077	7,908	0.045
Tamarisk (<i>Tamarix</i> spp.)	3/.004	1/.006	4,000	0.022
Triticale (<i>Triticum</i> x <i>Secale</i>)	53/.063	5/.032	45,000	0.255
Wheat (<i>Triticum</i> spp.)	5/.006	2/.013	338	0.001
Willows (<i>Salix</i> spp.)	19/.023	3/.019	390	0.001
Other	51/.061	3/.019	24,987	0.14
TOTAL	842	155	177,656	

The number of birds observed differed markedly by bioregion (Figure 4). Southern California (defined as



Los Angeles, Orange, San Bernardino, Riverside, San Diego, and the desert portion of Kern counties) had 11,121 birds from 24 locations, nearly the same as the 12,386 reported in 2014, the San Joaquin Valley (from Kern County in the south to San Joaquin County in the north) had 118,049 birds from 41 locations, the Central Coast (from Alameda County to Santa Barbara County) had only 18,336 birds from 19 locations, the Sierra foothills (Amador, Calaveras, El Dorado, Mariposa, and Placer counties) had 3,900 birds from 20 locations, and the Sacramento Valley (Butte, Colusa, Glenn, Sacramento, Sutter, Tehama, Yolo, and Yuba counties) had 19,503 birds from 34 locations.

Bird numbers were up from the 2014 Statewide Survey in the San Joaquin Valley, where most breeding birds occur during the April Statewide Survey interval (Figure 5), but were still only 35% of the number seen in 2008 (Table 3).

Figure 4. Bioregions recognized.

Table 3. Recent trend in numbers of Tricolored Blackbirds in San Joaquin Valley colonies.

Year/County	2008	2011	2014	2017
San Joaquin	0	0	515	1,000
Stanislaus	21,910	1,900	8,852	742
Merced	154,674	139,170	10,532	29,883
Madera	117	505	27,166	12,552
Fresno	1,000	400	6	5,750
Tulare	90,800	23,950	18,259	8,150
Kings	2,500	2,950	5,000	4,300
Kern	69,702	61,825	3,152*	54,672*
Totals	340,703	230,700	73,482	118,049

*San Joaquin Valley locations only

The number of birds seen along the Central Coast was up markedly compared to 2008-2014 due primarily to three colonies: a new 7,500 bird colony in the Panoche Valley of San Benito County, a location that was not surveyed previously; a 3,000 bird colony in Alameda County where fewer than 100 birds had been observed on previous statewide surveys, and a 2,500 bird colony in Monterey County in a previously unknown location (Table 4).

Table 4. Recent trend in numbers of Tricolored Blackbirds in Central Coast counties.

Year/County	2008	2011	2014	2017
Alameda	28	2,200	50	3,000
Contra Costa	358	0	N/R	30
Monterey	50	10	399	2,973
San Benito	66	N/R	80	11,226
San Luis Obispo	6,242	197	98	3
Santa Barbara	500	N/R	935	760
Santa Clara	50	0	0	344
Santa Cruz	220	0	0	0
Totals	7514	2407	1562	18,336

The number of birds seen in the Central Sierra foothills showed mixed results, from sharp declines (Amador, El Dorado, and Placer) to marked increases (Calaveras; Table 5).

Table 5. Recent trend in numbers of Tricolored Blackbirds in Sierra foothill counties.

Year/County	2008	2011	2014	2017
Amador	6600	350	5500	420
Calaveras	385	120	404	1,570
El Dorado	0	0	1375	100
Mariposa	N/R	N/R	13	0
Placer	12,050	3,310	17,600	960
Tuolumne	635	170	825	850
Totals	19,670	3,950	25,717	3,900

In southern California the number of birds was similar to that seen in 2014, but were distributed differently, with a large increase in Riverside County and sharp reductions in abundance in Los Angeles, San Bernardino, and San Diego counties (Table 6).

Table 6. Recent trend in numbers of Tricolored Blackbirds in Southern California.

Year/County	2008	2011	2014	2017
Kern*			500	400
Los Angeles	1270	1066	4707	1410
Orange	NS	NS	14	0
Riverside	2150	4132	4368	8180
San Bernardino	700	0	1380	466
San Diego	1367	767	1417	665
Totals	5,487	5,965	12,386	11,121

* Desert region only.

The number of birds in the lower Sacramento Valley was down about 33% from that observed in 2014 due entirely to a decrease of over 57% in Sacramento County; all other counties in the region showed small increases in abundance over 2014 (Table 7).

Table 7. Recent trend in numbers of Tricolored Blackbirds in the Sacramento Valley.

Year/County	2008	2011	2014	2017
Butte	2,541	0	60	1311
Colusa	301	923	0	247
Glenn	NS	500	300	405
Sacramento	3,551	6,105	29,272	12,455
Sutter	0	1	8	1,000
Tehama	NS	NS	300	515
Yolo	1,900	5,080	81	2750
Yuba	10,405	500	268	820
Totals	18,698	13,109	30,289	19,503

Figure 5 shows the trends in abundance among the 5 bioregions during the past 4 Statewide Surveys and shows that even when bird numbers increase elsewhere, as they did in 2014, these increases do not come close to compensating for the losses seen in the San Joaquin Valley.

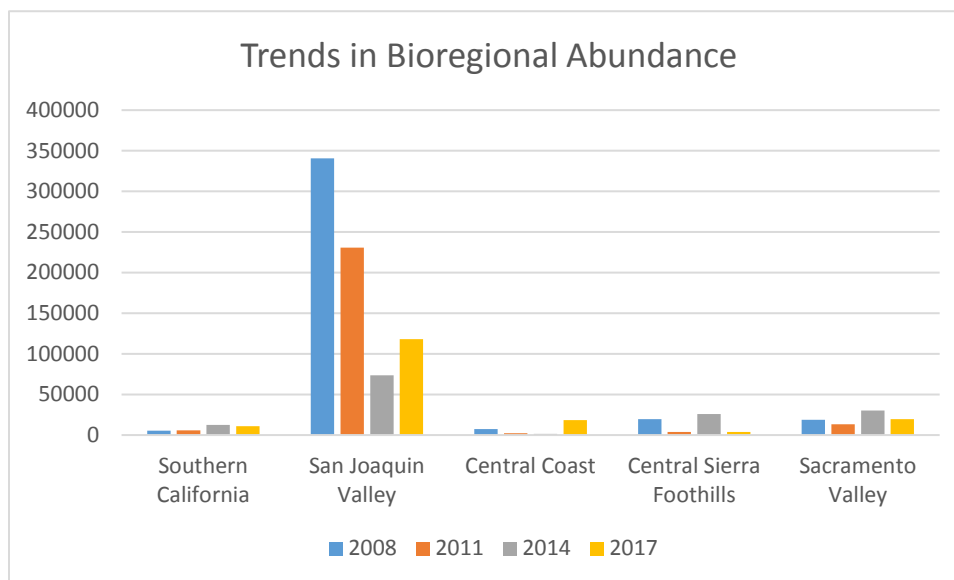


Figure 5. Trends in bioregional abundance.

The following counties along the north coast and northern inland portions of California were not included in the regional trend tables because in these counties the birds are usually not present until mid-to-late May, and thus during the Statewide Survey interval in April these counties typically contain less than 1% of the total Tricolored Blackbird population (Table 1):

- Humboldt
- Lake
- Marin
- Mendocino
- Modoc
- Napa
- Shasta
- Solano
- Sonoma

Figure 6 shows recent trends in the percentage of the Statewide Survey totals for the 5 counties with the largest percentages and shows the dominance of the San Joaquin Valley in the number of birds during the April survey period.

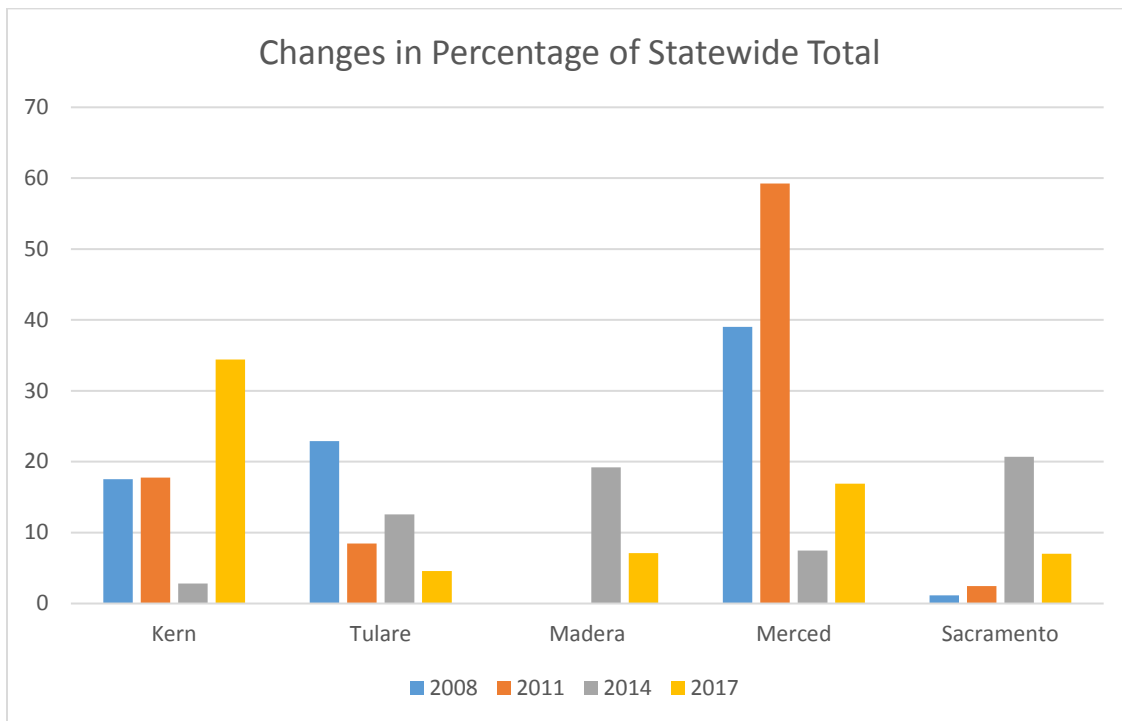


Figure 6. Changes in Percentages of Statewide Total of Tricolored Blackbirds for Select Counties.

The numbers of birds seen at occupied locations ranged from 1 to 17,500, and only 5 colonies consisted of 10,000 or more birds (Table 8). A total of 98,050 birds was seen in the 10 largest colonies, 55% of the statewide population (Table 8). This is a much lower percentage of the statewide population than was seen in the 10 largest colonies in the 3 previous statewide surveys (Table 9) and reflects a downward trend in the sizes of the largest colonies (Figure 7).

Table 8. Characteristics of the 10 largest colonies.

Location Name	County	Bioregion	No. Birds	Substrate
Poso 6	Kern	San Joaquin Valley	17,500	triticale
Pond Road	Kern	San Joaquin Valley	16,500	mixed forage
Avenue 14 and Road 15	Madera	San Joaquin Valley	12,250	triticale
Fahey South	Merced	San Joaquin Valley	12,000	mallow
Poso 2	Kern	San Joaquin Valley	10,000	triticale
Poso 5	Kern	San Joaquin Valley	7,750	triticale
Panoche Creek	San Benito	Central Coast*	7,500	cattails
San Jacinto W.A.	Riverside	Southern California	6,300	bulrushes
Deer Creek	Tulare	San Joaquin Valley	4,250	triticale
Highway 180 North 3	Fresno	San Joaquin Valley	4,000	other

*here placed into Central Coast, but it is not coastal.

Table 9. Trend in percentages of survey total in 10 largest colonies.

Survey Year	Number of Birds	Percentage of Total
2017	98,050	55%
2014	93,000	63%
2011	208,800	81%
2008	306,000	77.5%

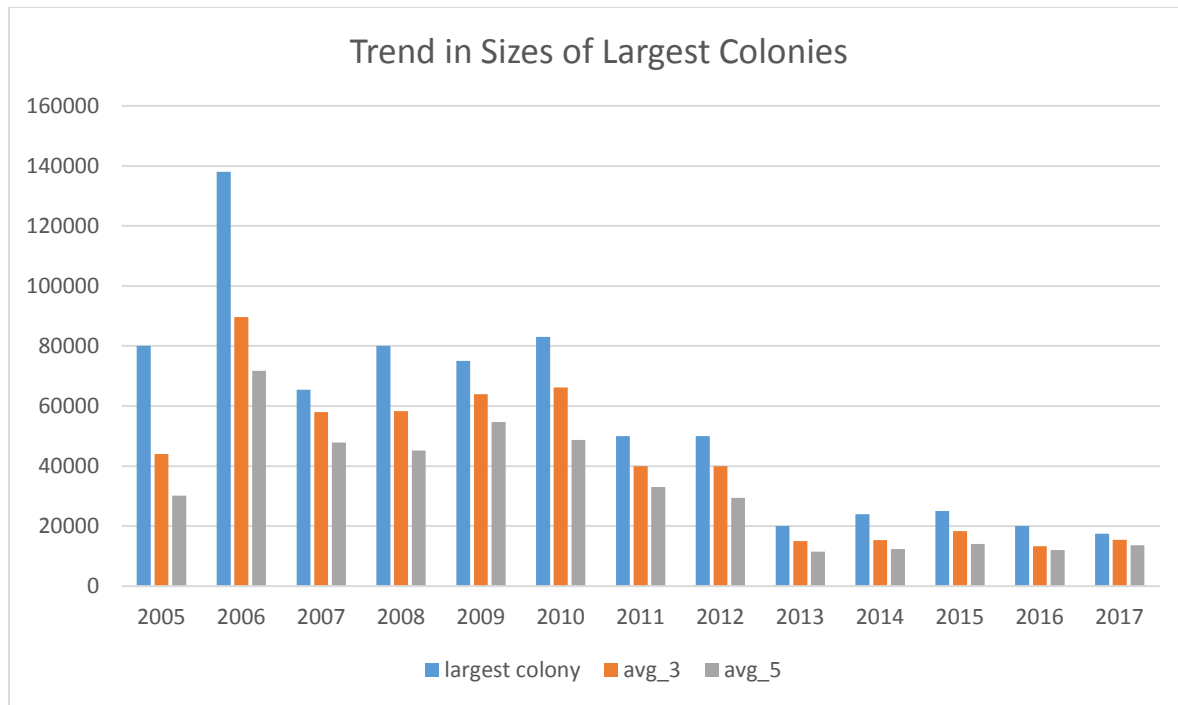


Figure 7. Trend in the Sizes of the Largest Tricolored Blackbird Colonies.

Baja California

In addition to California, the northern region of Baja California was surveyed for Tricolored Blackbirds by Richard Erickson and his collaborators (Enrique D. Zamora-Hernández, Isabel Raymundo-González, and Lonnie R. Rodriguez) in April, 2017. Eight sites were surveyed on April 7, 2 were surveyed on April 8, 3 were surveyed on April 9, and 3 were surveyed on April 14. A total of 3 sites was found to be occupied and a total of 305 breeding birds was documented. In addition, a total of 28 non-breeding birds was observed, 20 at one location and 8 at another (Table 10). These results confirm the continuing decline of the Baja California population.

Table 10. Baja California Survey Results.

Location Name	Date Surveyed	No. Birds	Substrate Suitability
Parque de la Amistad, Tijuana	4/7/17	0	suitable
Chula Vista recreativo	4/7/17	0	unsuitable
Rancho Cienega Redondo	4/7/17	35	suitable
Cienega Redondo	4/7/17	250	suitable
Rancho Japa	4/7/17	20	suitable
Ojos Negros Valley	4/7/17	0	substrate absent
Heroes de la Independencia	4/7/17	0	unsuitable
Leyes de Reforma	4/7/17	0	substrate absent
La Mision	4/8/17	0	unsuitable
Mesa la Mision	4/8/17	0	unsuitable
Presa Rodriguez	4/9/17	0	unsuitable
El Descanso	4/9/17	0	suitable
Cantamas	4/9/17	0	unsuitable

Discussion

The volunteer statewide survey has since 1994 been the primary method by which the number of Tricolored Blackbirds in California is estimated. Although the problems inherent in using a volunteer survey to estimate the number of birds in a territory as vast as California are great (Link and Sauer 1998), and the species' complex biology imposes its own estimation challenges, the triennial Statewide Survey, led by local species experts and supported by standardized field protocols, remains the best tool available for documenting trends in California's Tricolored Blackbird population.

The 2017 statewide survey was likely to have been the most thorough ever conducted. Professional biologists and an increasing number of concerned citizens have in the past 6 years entered hundreds of new colony location records into the Tricolored Blackbird Portal, resulting in a rapid increase in knowledge of where the birds breed, and the number of locations surveyed during Statewide Surveys increased from 114 in 1997 (Hamilton 2000) to 884 this year. The use of the Portal by motivated citizens has facilitated data entry and vastly improved data management. And a total of 22 different users entered 39 new location records into the Portal in the first 6 months of 2017. Thus, the Portal has helped to meet the needs of both professional biologists and citizen scientists to contribute to Tricolored Blackbird conservation by enabling them to enter records of their observations and increase our knowledge of where, when, and how many birds breed.

The results of the 2017 Tricolored Blackbird Statewide Survey suggest that the rapid decline in abundance observed since at least 2008 has been arrested and that there has been an increase in abundance since 2014 of about 32,000 birds. Looking closely at these results shows that the majority of the increase from 2014 to 2017 is due to birds observed in the San Joaquin Valley, where the number of birds estimated increased by more than 44,000 (Table 3, Figure 5). The increase in the San Joaquin Valley was especially apparent in Kern County, which saw an increase of more than 51,000 birds over the three-year period. The number of birds observed in Merced County also increased (by about

19,000), while other counties in the San Joaquin Valley experienced declines (Madera, Stanislaus, and Tulare counties collectively declined by almost 33,000 birds) (Table 3, Figure 6). Numbers of birds were also down in the Sacramento Valley and Sierra Foothills in 2017, with combined declines of more than 32,000 birds since the 2014 survey (Figure 5, Tables 5 and 7).

A review of Table 3 shows that the number of birds estimated from Kern County in the 2008, 2011, and 2017 Statewide Surveys was consistently within the interval of 60,000 to 70,000 birds. The exception occurred only in 2014, when fewer than 4,000 birds were reported. In the adjacent Tulare County, which like the Valley floor region of Kern County is an anthropogenic landscape dominated by dairies and nut trees, instead of an increase over the past 3 years, one finds a steady, uninterrupted decline in abundance, from 90,800 in 2008, to 23,950 in 2011, to 18,259 in 2014, to 8,150 this year, a greater than 91% reduction in abundance (Table 3), quite unlike the increase in abundance observed in Kern County. Why were so few birds reported from Kern County in 2014, and why did the number rebound in 2017? It is highly unlikely that an increase of the magnitude observed from 2014 to 2017 can be attributed to local productivity alone. Given that survival rates of first-year birds is likely low (estimated at less than 20% for most passerines [Cox et al. 2014]), an increase of more than 50,000 birds by local production would require that the 4,000 birds observed in 2014 produced several hundred thousand fledglings over three years. This is clearly unrealistic.

An alternative explanation for the large change in numbers in Kern County is that surveyors missed a large number of birds in 2014, and the actual number of breeding birds there was much larger. This failure to find birds that were present would then have to have been resolved in 2017. However, the number of locations surveyed in Kern County increased each year since 2011 (50 sites surveyed in 2011, 64 sites in 2014, and 72 sites in 2017), and there are no obvious locations that went unsurveyed in 2014 that might have hosted more than 50,000 breeding birds. Although the continued and consistent downward trend in adjacent Tulare County compared to the variable population in Kern County is puzzling, there are no data to suggest that the survey effort in Kern County in 2014 was insufficient. It is of course possible that one or more breeding colonies, even large colonies, occurred in some unknown portion of Kern County in 2014, but this is a possibility true for all counties during all statewide surveys.

The shifts in abundance across counties within and outside the San Joaquin Valley between 2014 and 2017 reflect an aspect of the biology of the species that was documented decades ago: large within and between-year shifts in bird numbers believed to be due to their efforts to identify landscapes possessing the elements (nesting substrate, food, open water) required for breeding. As mentioned above, several San Joaquin Valley counties experienced large declines from 2014 to 2017 (collectively more than a 30,000 bird decline), and may reflect a shift in distribution from these counties to Kern County for the 2017 season. Alternatively, some birds may have moved from Kern County to instead breed further north during the April 2014 survey interval, perhaps as far north as in Placer or Sacramento counties, as both of these counties saw relatively large increases in the number of birds in the 2014 Statewide Survey over those reported previously. These increases were followed by relatively large declines in the number of birds seen this year (Tables 5 and 7), perhaps in part due to a shift back to the San Joaquin Valley in 2017.

Any increase in the population between 2014 and 2017 would have required an increase in recruitment from 2014-2016, during the most severe drought in the state's history. Although few estimates of

reproductive success were made during these years and therefore no evidence exists for such a spike in recruitment, these years correspond to a period when silage colony protection efforts were believed to have been the most successful (i.e. the fewest colonies were known to have been lost due to harvest of the nesting substrates while birds were still breeding) in the last 20 years. Colony productivity was rarely quantified at silage colonies due to lack of access to private lands, but it is likely that the protection of these colonies resulted in a decrease in human-caused mortality and a consequent increase in their productivity, leading to an increase in recruitment to the population. Although perhaps unexpected due to the drought conditions, increases in reproductive success in other regions of the state cannot be ruled out as contributors to an increase in population size from 2014 to 2017.

A final factor which may help to explain the observed increase in numbers in 2017 is an increase in survey effort. The 2017 survey was the most thorough ever conducted. The 181 participants and 884 locations surveyed exceed the comparable totals in all previous surveys, and the 168 locations that were identified as occupied during the survey exceeded the previous high of 143 in 2014. As described above, the 2017 survey also focused exclusively on the locations that where breeding birds were most likely to be found. The relationship between survey effort and number of birds estimated is not known, but it is expected that greater effort results in a larger proportion of the population observed and counted. The survey effort has increased in every survey conducted since 2008, but up until the most recent survey, results have always revealed a declining population. Although a survey methodology that utilizes an increase in effort each year does not confound the ability to detect a declining trend in the population, it does complicate the interpretation of results when the number of birds observed increases. This highlights the need to continue to pursue a survey methodology, in addition to the triennial Statewide Survey, with a standardized level of effort each year.

The number of tricolors apparently increased statewide, but the increase in abundance was not uniform across the state, rather most of the increase in abundance occurred in the San Joaquin Valley and in San Benito County, here included in the Central Coast. The number of birds in the San Joaquin Valley increased by 62% in 3 years, from about 73,500 to 118,049 birds, with the bulk of this increase in Kern and Merced counties (Table 3). Along the Central Coast, the number of birds went up dramatically, from 627 to 17,576 birds, due primarily to three colonies, one of 7,500 birds in a previously unknown location in San Benito County, another in a previously documented location in Alameda County, and a new location in Monterey County (Table 4). The results in San Benito and Monterey counties may largely be due to an increase in knowledge of the locations of Tricolored Blackbird breeding colonies and a large increase in the survey effort there. As the San Benito County coordinator, Debi Shearwater participated in the Statewide Survey for the first time and documented 15 new colony locations, of which 5 were occupied by an aggregate of 14,925 breeding birds. It is likely that these represent birds that have been overlooked in previous years rather than an influx of birds that do not typically breed in the county as the increase is due to birds seen in previously-unknown breeding locations. The increase in the number of surveyed locations in San Benito County from zero in 2011, to 13 in 2014 (80 birds estimated), to 24 in 2017 (over 11,000 birds estimated) suggests that the increased effort likely resulted in the larger number of birds observed. The 2017 Statewide Survey results from San Benito and Monterey counties highlight the importance of having experienced local experts serve as county coordinators and active survey participants.

The status of the Tricolored Blackbird along the Central Coast is dire. With the exceptions of Alameda County, where a single colony of 3,000 birds accounted for a large increase in abundance over 2014, and Monterey County, where an almost identical number of birds was observed at 5 colonies, all other coastal counties showed a continuing trend to the near-extirpation of the species (Table 4). No breeding birds have been observed in Santa Cruz County on Statewide Surveys since 220 were seen in 2008, and the number seen in San Luis Obispo County has decreased from over 6,200 in 2008 to only 3 this year. It is possible that some of the decline along the Central Coast resulted from the severe drought that began in 2013 and ended this year, as the drought is believed to have resulted in a temporary loss of nesting habitat. However, permanent landscape changes such as conversions of coastal scrub and grassland foraging areas to vineyards are reducing the area suitable for breeding by tricolors and losses of native habitats have been widely cited as among the most important causes for the long-term population decline (Beedy and Hamilton 1999).

The number of birds seen in the Central Sierra Nevada foothills decreased dramatically, from over 25,700 observed in 2014 to 3,900 seen this year, but this region seems especially prone to inter-survey variation, with Amador and Placer counties showing large fluctuations in numbers from one survey to another (Table 5). There is no apparent trend in abundance in any county in the region, the suggestion being that inter-annual landscape changes that are believed to be precipitation-mediated are especially powerful drivers of tricolor presence (Airola et al. 2016).

Southern California presents unique challenges to tricolor conservation, as urbanization and the movement of the dairy industry out of southern California and into the San Joaquin Valley in the 1980's have reduced the food supply and the amount of habitat suitable for tricolor nesting and foraging (Unitt 2004). The number of birds seen in southern California was very similar to that seen in 2014, 11,121 this year vs. 12,386 in 2014. Approximately 57% (6,300/11,121) of these were nesting at a single site in Riverside County, the San Jacinto Wildlife Area, where vigorous efforts designed to provide Tricolored Blackbird nesting and foraging habitats are paying off and helping to sustain the species in southern California. Additional, similar efforts are needed in the region as the number of birds here is not sustainable and the species remains strongly conservation-dependent.

The work of Richard Erickson and colleagues documents the continuing, alarming decline in abundance south of the border, in Baja California, the southernmost extent of the species' range. The relatively recent expansion of 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 results of this year's Statewide Survey again highlight the strong regional differences that exist in the trends in abundance of the species. Southern California (and Baja California) is teetering on the brink of losing what was a century ago considered to be the most abundant bird species in the region (Cooper 1870) and all along the Central Coast the species is in similar perilous shape. Given the extraordinarily pervasive and on-going habitat losses to agriculture, most recently primarily nut orchards and vineyards, and the widespread use of neonicotinoid insecticides in California (Starmer and Goh 2012), it is justified to ask whether the Southern California, the San Joaquin Valley, and the Central Coast have suffered a permanent reduction in their ability to support breeding by a native, near-endemic colonial insectivorous passerine? How many breeding birds can Southern California, the Central Valley,

and Central Coast support? If this decline represents a permanent reduction in the carrying capacity of the San Joaquin Valley and the Central Coast to sustain the species, it is difficult to imagine a scenario where tricolor numbers can be recovered to an average of 500,000 to 750,000 individuals that are sustained through time – the scenario that has been used to define “recovery” of the species by members of the Tricolored Blackbird Working Group. For several decades, the San Joaquin Valley has held the vast majority of birds during the statewide survey (e.g., Kelsey 2008, Kyle and Kelsey 2011), so if it is losing its ability to support productive breeding colonies, only a northward shift in the early breeding distribution of the species that includes much of the Sacramento Valley may provide the potential for supporting hundreds of thousands of breeding birds. Although the timing of the Statewide Survey means that an emphasis is placed on first nesting attempts and therefore bird presence in the Sacramento Valley, where breeding occurs later in the year, is poorly represented, the reproductive success of nesting attempts in the Sacramento Valley has been chronically low (Meese 2011, Meese 2013) and there is little reason to believe that the Sacramento Valley is better able to sustain the species than is the San Joaquin Valley. Thus, the entire Central Valley appears to be increasingly unsuited to nesting by a colonial, insectivorous passerine and tricolor abundance may be expected to continue to decline. Vigorous efforts are needed to identify and replicate conditions that exist in association with the few remaining successful, productive colonies in southern California, the Central Valley, and the Central Coast.

The results of this year’s Statewide Survey are somewhat ambiguous, with an apparent rapid increase in abundance in Kern County and an apparent increase in knowledge leading to an increase in abundance in the Coast Ranges (here placed into the Central Coast bioregion), a similar number in southern California and a decrease in abundance in the Central Sierra foothills. Taken together, these results confirm the need for local experts, an active annual survey and monitoring effort, and effective data management to effectively monitor the statewide population. It is hoped that future Statewide Surveys will confirm the increase in abundance seen this year. A vigorous, long-term, well-funded, and strategic approach to conservation that involves a wide variety of stakeholders, including industry, will be needed to ensure a future for California’s blackbird.

Recommendations

The following recommendations are slightly modified from my previous Statewide Survey Final Report (Meese 2014) and reflect on-going needs to conserve and restore the species.

1. Eliminate all known sources of human-caused mortality, including the losses of eggs and young via harvest of their nesting substrate and the shooting of adults in autumn when causing depredations in rice.
2. Continue to implement the existing mechanism to conserve at-risk colonies, especially those in the San Joaquin Valley, San Benito County, and Riverside County. This mechanism consists of 1) field workers who *detect settlements* of birds in ephemeral nesting substrates (e.g., triticale fields), 2) a person or persons to whom the field worker *reports the presence of birds in ephemeral, at-risk locations* and who has the responsibility of contacting landowners and informing them of the protected status of the birds and of funding available to compensate them, 3) a cooperative extension specialist or other independent expert who *estimates the loss in value* of the crop as a result of the harvest delay, 4) a field worker who *monitors and*

documents the results of conservation actions (successful delay until a week past average date of fledging, an estimate of the number of young fledged, a description of the process of harvest in those cases where fledglings are still present in the field when it is being harvested with an emphasis on the effects on the behavior of the fledglings post-harvest). 5) All of these *actions should be documented and then be reported* to a meeting of the Working Group and provided in a report that is posted to the Portal.

3. A legislative fix to eliminate exemption of protection under the MBTA is needed for red-winged blackbirds in California. If red-wings can be shot and shooting continues in autumn in rice, this will also cause the loss of an unknown number of post-breeding adult tricolors that are shot by “mistake” as tricolors and red-wings are superficially nearly identical in appearance and flock together during autumn.
4. Better document conditions which result in relatively high reproductive success. Examine patterns in RS to determine whether, on a time-averaged basis, there is relatively higher RS in colonies in some geographic regions or that are established in different nesting substrates. Use these insights to make recommendations for management actions.
5. Study the effects of harvest on populations of fledglings in crèches that persist on nesting substrates until moments before they’re harvested to best document effects on birds. Study these colonies and document where the birds go when the harvester shows up and what they do when they return to the just-harvested field.
6. Take an ‘all hands on deck’ approach to Tricolored Blackbird conservation that includes representation by all industries that may be affected by a listing and all systems of protected areas, including the National Wildlife Refuge System, State Wildlife Areas, DOD installations, and private preserves.
7. Work with landowners in foothill and other 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 tricolors but who incur a cost in doing so.
8. Research: provide supplemental insect foods (meal worms, possibly others) to investigate whether supplemental feeding may increase RS.
9. Research: provide meal worms or other insects to settling birds at desired locations to see whether the supplemental foods may influence breeding site selection.
10. Seek to create additional breeding sites in regions where they may be lacking (e.g., foothills of Coast Ranges).
11. 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.
12. 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 commercial rice (as has been suggested by relatively high RS at the Conaway Ranch in Yolo County, where both organic and commercial rice is grown).

13. Provide additional funding and guidance for landowners to provide essential resources for nesting tricolors on private property.
14. Actively maintain all wetlands recently used by breeding tricolors, and especially those in coastal locations, to provide the youthful conditions preferred by nesting birds.
15. Develop and disseminate via the Portal handbooks that illustrate best practices for maintaining wetlands and other nesting substrates for breeding by Tricolored Blackbirds.
16. Conduct threat assessments of all areas currently used by breeding tricolors and work with local officials to identify these threats and seek ways to reduce or eliminate them.
17. Maintain the integrity of existing county coordinators and other local experts who serve as participants in the triennial Statewide Surveys. The Statewide Survey is the best method to estimate the number of Tricolored Blackbirds in California (and, in 2017, in Baja California, too) and depends upon the participation of volunteers with extensive local knowledge. Statewide Survey participants should be recruited by local experts; efforts to recruit participants via social media outlets is a threat to the integrity of the Statewide Survey and is strongly discouraged.
18. Assess the concentrations of neonicotinoid insecticides in regions with the lowest insect abundances and highest rates of decline in Tricolored Blackbirds.

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2017 Tricolored Blackbird Statewide Survey April 7-9

Protocol

Thank you for your interest in participating in the 2017 Tricolored Blackbird Survey. A statewide survey is conducted every three years in order 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 a large number 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 obtain a count of Tricolored Blackbirds in the state by utilizing a large number of experienced individuals who attempt to visit all historical 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.

I. Survey Period

The 2017 survey will occur from April 7 to 9. Only observations made during this three day time period will be included as part of the 2017 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.

II. Know your survey area: Scouting colony sites and habitats

It is very useful to plan and 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 colony sites assigned to you.

III. Survey Locations

The statewide survey will attempt to visit all known colony locations in California in order 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 (both occupied and unoccupied). Historical colony locations have been plotted on both online and pdf maps to enhance survey efficiency. These maps, which include location names, coordinates, and substrate type, are available

to survey participants for download from the Tricolored Blackbird Portal (<http://tricolor.ice.ucdavis.edu/content/2017-statewide-survey-maps>). The online map and related smartphone application allow participants to explore their survey area online prior to the survey and to navigate directly to survey locations while in the field if cell phone access is available. Detailed instructions on how to access and use both the online map and pdf maps are located on the Tricolored Blackbird portal (tricolor.ice.ucdavis.edu).

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* survey form contains all of the fields that are required to document and describe new breeding colony locations.

IV. 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. Stand quietly and look both at the nesting substrate and at the surrounding area searching for departing or returning 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 20-100 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 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 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 or not 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 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. 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 or water 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. In order 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.

V. Recording Data

Survey Data Forms

Three data forms will be used during the 2017 survey to record survey effort and observations. A brief description of each form and instructions for completion are provided below:

1. **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.
2. **BREEDING LOCATIONS SURVEY FORM** – Observations of all colony locations surveyed and nesting substrate suitability will be recorded on this form.
3. **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 BREEDING LOCATIONS SURVEY 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.

BREEDING LOCATIONS SURVEY 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** and the county in which the colony occurs. These names are provided to each county coordinator and appear on keys that come with the survey location maps. If you observe birds in a new location, please provide a descriptive site name and 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 whether or not the following behavioral activities were 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 information for all new colony sites, and for established locations if time allows. Indicate whether the active breeding colony site is a known location 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 GPS unit). Please also record the datum in which the coordinates were recorded. The Tricolored Blackbird portal displays locations using the NAD83 datum; if a different datum is used to record coordinates, the data will need to be converted before entry into the Portal database. 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 Tricolored Blackbird Portal can be used to determine the coordinates. When entering a new location record in the Tricolored Blackbird Portal, scroll down to the Google Maps tool near the bottom of the Create Location form and zoom in and place a marker at the location of the colony. The latitude and longitude will automatically be entered when you do this. Be sure to record the coordinates in the Google Maps widget into the latitude and longitude fields on the online form. See the online help web page for more information on creating a new colony site location in the Portal.

Nesting Substrates:

Observers should record the nesting substrate of colonies in new locations. The report form allows you to record both primary (dominant) and secondary substrates. Tricolored Blackbird native nesting habitat consists of young, rapidly-growing freshwater marsh dominated by cattails or tules, but birds also nest in a variety of other vegetation types 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, stinging nettle,

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). 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.).

VI. Online Data Entry and Submittal of Data Forms

All observations (of breeding colonies, unoccupied locations, and aggregations of nonbreeding birds) should be entered directly 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/content/online-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

VII. Training Opportunities

Training materials are available for viewing on the Portal at (<http://tricolor.ice.ucdavis.edu/content/statewide-survey-training>). Two training sessions will also be offered prior to the 2017 survey, the first on Saturday March 4th at San Luis National Wildlife Refuge in Merced County and the second on Saturday March 11th at U.C. Davis.

Supplemental Biological Information

Know your birds: 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, the southern 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 and/or 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 agricultural 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 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 in 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 at: rjmeese@ucdavis.edu.

Appendix II. Statewide Survey Field Forms.

2017 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 breeding locations should be recorded on the BREEDING LOCATIONS SURVEY form.

Observations at occupied breeding locations should be recorded on the OCCUPIED LOCATIONS form.

Enter all observation records into the online 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: rjmeese@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 up; 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 database? (Y/N)

**2017 Tricolored Blackbird Statewide Survey
BREEDING LOCATIONS SURVEY FORM**

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 temperature: _____ End temperature: _____

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.

2017 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 inferred? Y/N/unknown	Adults carrying food? 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 site 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 NAD83 map datum (e.g., 38.54278, -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.