



Audubon CALIFORNIA

Results of the 2011 Tricolored Blackbird Statewide Survey



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INTRODUCTION

The Tricolored Blackbird (*Agelaius tricolor*) is a near endemic to California with at least 95% of the world's population restricted to the state and only small breeding colonies in Nevada, Oregon, Washington, and Baja California, Mexico. A highly colonial species, Tricolored Blackbirds form some of the largest colonies of any songbird in North America (Orians 1961, Beedy and Hamilton 1997). Their narrow geographic range and formation of immense breeding colonies has made them highly vulnerable to disturbance and habitat loss resulting in an 80% decline in the past 90 years (DeHaven et al. 1975, Beedy et al 1991, Beedy and Hamilton 1997, 1999, Kelsey 2008). Neff (1937) was the first to conduct comprehensive surveys for Tricolored Blackbirds in California and found several million birds throughout the state. Recent surveys have shown that the population in California is hovering between 250,000 and 400,000 (Kelsey 2008). This abrupt and significant decline makes the Tricolored Blackbird a top bird conservation priority in California.

One of the main causes for their dramatic decline has been the near elimination of native cattail (*Typha latifolia*) wetland complexes throughout the Central Valley following agricultural expansion and conversion of wetlands into arable land. Adapting to the loss of their native habitat in the Central Valley, Tricolored Blackbirds began to exploit the rich cropland that was created. In the early 20th century, Neff (1937) recounts large colonies using the Sacramento Valley rice fields for foraging with colonies nesting in the sloughs and waterways of these farms. A colony with an estimated 260,000 nests was found in a 60-acre marsh in Glenn County in 1934 (Neff 1937). More recently, Tricolored Blackbirds have begun to concentrate their breeding colonies in agricultural fields of the San Joaquin Valley. In particular, they are exploiting the perfect combination of resources available on and around dairies in California. Triticale in particular, a hybrid of wheat and rye grown as silage on dairies for its high nutritional value, provides robust structure to construct their nests and these are commonly associated with abundant food and water in nearby pasture and feed lots. As a result, the expanding dairy industry in the San Joaquin Valley has resulted in a population shift and a consolidation of the species into "mega-colonies" of tens of thousands of birds, all concentrated around dairy farms. Fifty percent of the breeding Tricolored Blackbirds in California in 2008 were observed nesting in silage fields during the 2008 statewide survey (Kelsey 2008) and this has been a recurring pattern for the last decade.

The result of this increasing concentration of breeding birds in agricultural fields has been a need to focus on protecting these agricultural colonies. The peril of using Triticale as nesting habitat is apparent when farmers need to cut the silage crop in mid- to late April, typically in the middle of the Tricolored Blackbird breeding effort. With so many of the breeding Tricolored Blackbirds using agricultural fields, most of the reproduction for this species in any given year is dependent on the success of these colonies. Over the last 15 years public agencies and Audubon California have used public funds for numerous silage buyouts, paying landowners to delay harvest so that the Tricolored Blackbirds are able to finish nesting. So far this has resulted in protection of 600,000 nests and approximately 410,000 Tricolored Blackbird fledglings (Meese 2009a, unpublished data). However, this represents only a temporary solution. Long-term conservation

of the Tricolored Blackbird will depend on reestablishing enough suitable natural habitat in these working landscapes that this species does not rely so heavily on agricultural habitats where disturbance minimizes breeding success. The Tricolored Blackbird Working Group has set a long-term population target of increasing the population to 750,000 birds; meeting this goal will depend on substantial efforts to create new and enhance existing breeding colony sites on public and private lands across California.

This report is a summary of the recent Tricolored Blackbird triennial statewide survey. Data are collected on colony size, location, substrate, and behavior to estimate total population size and increase our understanding of habitat use and distribution of this imperiled species. Results of this survey, combined with data from previous surveys and ongoing research efforts at the University of California (UC), Davis, will help guide conservation efforts of the Tricolored Blackbird Working Group. The following summarizes results of the 2011 statewide survey and provides recommendations for conservation efforts in the coming years.

METHODS

For the 2011 survey we used the same protocols used during the 2008 survey in order to standardize the effort and ensure that results are as comparable as possible. The following are the methods and protocols used.

Volunteer Coordination

The 2011 statewide survey was funded by the US Fish and Wildlife Service (USFWS) and coordinated by Keiller Kyle of Audubon California, with assistance from Danielle Heckman of San Diego Audubon. Audubon California was responsible for overall survey coordination, survey protocols and materials, and maps, as well as coordinating volunteers for areas north of Kern County. San Diego Audubon recruited and coordinated survey volunteers for southern California. Due to the logistical limitations of distance and geography, having a southern California coordinator helped recruit more volunteers, cover more area, and find more Tricolored Blackbirds.

The 2011 survey was completely volunteer-based. Starting in December 2010, volunteers from previous surveys were contacted from the Audubon California list. Advertisements were sent to several major California birding listservs, including Central Valley Birding and California Birding. Audubon chapters were also contacted; several chapters published the survey dates and sign up information in their quarterly newsletters. In addition, eBird California and Audubon California both advertised the survey on their home pages. After expressing interest in the survey, volunteers were instructed to sign up for pre-determined survey areas using the UC Davis-based Tricolored Blackbird Portal. This is the first survey to have sign up information, maps, and survey protocol readily available online.

Survey Timing

The survey was conducted April 15-17 to ensure that the majority of Tricolored Blackbirds had already established nests but prior to most colonies fledging or being disturbed by farmers harvesting their fields. These dates are earlier than previous surveys to better avoid the harvest time of silage crops, which complicated the 2008 count due to a few large colonies being cut

(Kelsey 2008). A three day window for the survey is used to capture as many birds as possible on colonies during their first breeding attempt of the year. Tricolored Blackbirds and colonies can shift locations over relatively short periods of time during the breeding season. Making sure that a comprehensive count is made in a narrow time window helped ensure we were not counting the same birds more than once. We selected dates that included the weekend so that volunteers had the flexibility to survey on their own time and not interfere with work responsibilities. Volunteers were encouraged to survey throughout the day since there is little evidence that Tricolored Blackbird colonies become less active later in the day. Surveying throughout the day also allowed volunteers to cover more ground and survey more potential colony sites than if they were restricted to surveying in the morning.

Survey Areas

All confirmed colony locations from the Tricolored Blackbird Portal were mapped using ArcMap 9.2 (ESRI). For each known colony (or set of colonies in close proximity), we created a survey area map that showed primary and secondary roads, county boundaries, and colony locations. A total of 105 survey areas with corresponding maps by County were created, with each area covering approximately 225 square miles (15 miles by 15 miles). These maps were converted to pdf format and uploaded onto the Tricolored Blackbird Portal for download and use by volunteers during the survey.

There was significant variation in the total area surveyed by each volunteer based on the number of known historic colony sites and the distance between sites for each mapped area. Volunteers were not expected to cover the entire area, focusing instead on the following priorities: 1) known historic colony sites indicated on maps, 2) suitable habitats in vicinity of historically used sites, and 3) other suitable habitats across the mapped survey area. Most volunteers signed up for one survey area although several groups of volunteers covered multiple survey areas over the three day effort. This year, unlike in 2008, no county leaders were established and most of the organization of the survey took place online.

Survey Protocol

We provided a survey protocol (Appendix 1) for each volunteer that outlined survey priorities, guidelines for viewing colonies and duration of site visits, estimating the size of colonies, behavioral observations, and recording colony characteristics (e.g. substrate).

Training

Three training sessions were held for volunteers at three different locations: Kern National Wildlife Refuge, UC Merced, and the Yolo Bypass Wildlife Area in Yolo County. Training sessions included an indoor session and site visits to local colonies. The objectives of these training sessions were to help volunteers distinguish Tricolored Blackbirds from Red-winged Blackbirds, introduce the survey protocol and online database, and to visit local colonies to practice identification and colony size estimation.

Colony Size Estimation

Estimating the number of birds in a Tricolored Blackbird colony that is relatively large is a challenging task and accurate counts of large colonies are nearly impossible. For small colonies (fewer than 100 birds) volunteers were asked to count all individuals (precise count). For larger

colonies, scanning counts were used to estimate the number of birds present (see Protocol-Appendix 1). Three estimates of colony size were reported: minimum number, maximum number, and best estimate. While these are still based on visual estimates, they provide a range that reflects the likely precision of the estimates. Many of the major colonies in the San Joaquin Valley were visited at least once by Bob Meese during his intensive surveys of settlement and breeding by Tricolored Blackbirds. Colony size estimates for these colonies were adjusted based on Meese's own observations at those colonies. In addition to visual estimates of the number of birds, volunteers were asked to report the approximate area of occupied substrate for each colony. These data have been entered along with the visual estimates and can be used in future analyses as a secondary estimate of colony size combined with known average nest densities for colonies. However, using a similar comparison, Hamilton (1998) reported that visual estimates of colony size only varied from estimates based on nest density by an average of 15%.

Colony Observations

For each colony, volunteers were asked to record colony attributes, including: primary and secondary substrate, dimensions of the physical area occupied, presence and distance to open water, and the presence of stored grains. Also, volunteers were asked to record behavioral observations for Tricolored Blackbirds at the colony sites. These included whether the birds were singing or carrying food and if the colony was quiet (indicating a period of incubation). These behavioral observations are important for understanding the status of colonies and also help evaluate the precision of the colony size estimate, since the activity of birds at the colony influences their detection and the numbers estimated.

RESULTS

Abundance

A total of 100 volunteers participated in the survey, visiting 608 historical and new Tricolored Blackbird colony sites in 38 counties (Table 1, Figure 1). Volunteers logged an average 200 miles of driving for the survey. The statewide population estimate was 259,322 birds at 138 sites in 29 counties (Table 2, Figure 2).

The majority of Tricolored Blackbirds (89%) were counted in the San Joaquin Valley and Tulare Basin (Tables 3 and 4), matching the results in prior surveys. The three largest concentrations of birds occurred in Merced (54%), Kern (24%), and Tulare (9%) counties (Figure 3). The top ten largest colonies for 2011 were found in these three counties (Table 5) and 16 of the top 22 were from the San Joaquin Valley or Tulare Basin. Notably, 65% of the population was consolidated into only six colony sites in Merced, Kern, and Tulare counties.

The southern California subpopulation was estimated to be 5,965 individuals at 32 sites in three counties, with a total of 74 sites visited (Table 2). This represents an almost 10% increase in number at eight more colony sites compared to 2008 survey results.

Substrates

Agricultural fields, especially triticale and other silage crops, have held some of the largest colonies during past surveys and they continued to do so in 2011. Agricultural fields represented

a relatively small number of colonies (11.2% of all colonies), but held large portions of the population (44.6%; Table 6, Figure 4). Silage crops in particular represented four of the top ten largest colonies with 42.2% of the Tricolored Blackbird population (Table 5). The largest recorded colony for the year was a silage field of Fava Bean and Barley that supported 17.4% of the total bird population estimate before an important section of this colony was lost to harvest. Milk thistle (*Silybum marianum*) and bull thistle (*Cirsium vulgare*) were also important breeding substrates with relatively few sites (12% of total) supporting 33.9% of the population. In contrast, natural and semi-natural habitats had the opposite pattern with many sites supporting a smaller part of the population. The largest proportion of colony sites (33.6%) occurred in wetlands dominated by cattails or bulrush (*Schoeneoplectus californicus*), but these colonies were small and represented only 4.9% of the total population. Similarly, Himalayan blackberry (*Rubus armeniacus*) colonies were prevalent (23.1% of the colonies found), but represented only 6.9% of the population (Table 6, Figure 4). The remainder of the Tricolored Blackbird colonies observed were in a diversity of substrates with relatively small colonies, including tamarisk, willows, stinging nettle, and mallow (Table 6; Figure 4).

DISCUSSION

The effort put forth by the 2011 volunteers was unprecedented; 72% more sites were visited by fewer volunteers compared to the 2008 survey (Kelsey 2008). Despite the greater effort and efficiency, fewer birds were observed this year. Given the difficulties of getting precise estimates of colony size, especially for the very large colonies that represent most of the population, the total population in California is difficult to estimate precisely. Also, in any survey there are undoubtedly birds that are missed. This year a few counties that are known to have historically supported breeding colonies were either not covered (e.g. Santa Barbara County) or were not surveyed thoroughly (e.g. San Luis Obispo County). However, these areas have historically accounted for a maximum of 6,500 birds. This is not a trivial number by Tricolored Blackbird standards, but this year's estimate of approximately 259,000 birds can safely be compared to previous surveys, all of which used very similar protocols and had similar or less coverage.

This year's population estimate represents a substantial decrease from 2008 of approximately 135,000 birds, or a 34% decline (far more than would have been missed by any gaps in coverage). This number is more similar to the population estimate in 2005. One important probable cause of this decline is low reproductive success that has been documented in reports over the past three years (Meese 2008, 2009, 2010). Several of the largest colonies in recent years have had an average nest success rate of 0.25 young fledged per nest and the reproductive success of these colonies has been declining for several years (Figure 5). This may be a major factor in the observed population decline despite continued conservation efforts (Meese 2009).

Another potential cause of the population decrease is low survival rates of adults and juveniles. These factors are less well studied and quantified. There are few data from which to calculate annual survival rate. Using the best existing estimates for reproductive success (0.25 fledglings per nest; Meese 2008, 2009, 2010), number of nests per individual (0.67, based on 1.5 adults per nest; Beedy et al. 1991) and the 2008 estimated population size (395,000), it is possible to generate a crude estimate the annual survival rate based on a linear population growth formula:

$$N_t = N_0(rt)$$

(Where t = years, N_t = population size in year t, N_0 = starting population size, and r = population growth rate or births/individual – deaths/individual)

Given there were an estimated 395,000 Tricolored Blackbird individuals in 2008 and only an estimated 259,000 in 2011, this would suggest an annual survival rate of 70%. Compared to estimates for other temperate blackbirds that average annual survival between 40% and 50%, this is high (Fankauser 1971, Searcy and Yasukawa 1981). However, this estimate does not account for the fact that Tricolored Blackbirds are well known to re-nest multiple times each year, either at the same location or different sites. Assuming an average of two successful nests per year with the same number of fledglings per nest, our annual survival rate estimate to reach the current population size is 53%, much closer to more rigorous estimates for related species. In general, even though these are coarse calculations, this points to the possibility that low annual reproductive output in this species is overcompensating for a survival rate that is at least comparable to related species and the fact that Tricolored Blackbirds are capable of breeding many times per year. In order to reach the Tricolored Blackbird Working Group's goal of a steady population size of 750,000, it will be imperative to have at least the major Tricolored Blackbird colonies successfully producing more fledglings each year. This will require not only colony protection and creation of stable breeding sites, but also ensuring access to high quality foraging areas, including the protection and maintenance of productive annual grasslands, irrigated pastures, and bird-friendly alfalfa fields near colony sites.

The survey data from 2011 and estimates from previous surveys, show that the proportion of breeding birds during spring continues to increase in the San Joaquin Valley, whereas they are tending to stay low or decrease in other regions (Figure 6). Also, the San Joaquin Valley exhibits the widest fluctuations in number (Figure 7) and this is where reproductive success is known to be low. All of these factors suggest that significant attention should continue to be paid to improving habitat availability and reproductive success in the San Joaquin Valley, especially in Merced, Kern, and Tulare Counties. These three counties alone hold 88% of the global Tricolored Blackbird population in early spring and should be the focus of conservation and research efforts.

Consolidation of Tricolored Blackbirds on Farms

The trend over the past 17 years has been the consolidation of the Tricolored Blackbird population into fewer large colonies. This year 79% of the population was concentrated in colonies with over 5,000 birds. This is similar to 2005 and 2008 survey results, despite the decline in the number of large colonies this year. One possible explanation for this increasing concentration of birds in fewer sites is a lack of usable habitat within the agricultural matrix of the Central Valley. However, the number of active colony sites was the same in 2011 as in 2008 (138 and 135 active colony sites, respectively), despite a 34% population decline. Given the same number of colony sites are being used, it seems more birds are choosing to nest in “mega-colonies” even though many of these colonies are the silage colonies most at risk of disturbance. The advantages of being on or near a dairy farm with plentiful insects, water, and grain are complemented by the consistent and uniform stalks of the triticale plants used for nests.

Consolidation of Tricolored Blackbird colonies in farm fields, particularly silage and other fields associated with dairies, will continue to be a central conservation challenge for this species. Some of these colonies breed successfully and produce large numbers of offspring. However, many of the largest farm colonies continue to completely fail each year either due to harvest or nest predation. Given the increasing concentration of the world's population in fewer, larger farm field colonies, it will be necessary in the short term to protect these colonies to avoid population collapse. The long-term solution, on the other hand, will be to create and protect alternative, stable, and well managed breeding habitats. Success will likely depend on creating alternative habitats in these same areas since birds will continue to be attracted to historic sites due to some degree of site fidelity, and due to the food and water resources that are available on these farms. In the long-term, as the secure colony sites are secured and the population stabilizes, it may become as or more important to work towards creating many smaller colonies so that the impact of any individual colony failure is minimized.

RECOMMENDATIONS

- 1. Continue to promote Public land use by Tricolors** – Merced National Wildlife Refuge (MNWR) was a positive model this year for growing the right type of substrate to attract Tricolored Blackbirds. Combined, MNWR had 60,000 birds in two colonies simultaneously; more than any other site in the state. More public lands that are located in areas with quality foraging opportunities should follow the MNWR model and expand the amount of secure habitat available to Tricolored Blackbirds. Several colonies were found on public lands, including at Brushy Peak County Park in Alameda County, Rancho Jamul Wildlife Area in San Diego County, Delevan National Wildlife Refuge in Colusa County, and Bitter Creek National Wildlife Refuge in Kern County. Many public sites are not currently managing for spring flooded wetlands or upland habitat that could be colonized by Tricolored Blackbirds. The California Department of Fish and Game (DFG) and USFWS both have many refuges and reserves that, with modest changes in management, could serve as valuable breeding and foraging habitat. The Tricolored Blackbird Working Group should prioritize working with public land managers to find effective ways for creating and managing habitat for this species on existing reserves.
- 2. Annual surveys of Merced, Kern, and Tulare Counties** – Given that these three counties represent 88% of the breeding population in 2011, which has been the case for the past decade, surveys should be done annually to assess the yearly responses of Tricolored Blackbirds to weather patterns and habitat creation or protection efforts. Focusing on these three counties would be an effective way to track the majority of the population. A smaller number of volunteers and professionals could cover the area easily in a few days and the cost would be far less than the triennial survey.
- 3. Continue the Triennial survey indefinitely** – In addition to annual surveys of the population strongholds, the triennial survey should be continued to monitor other parts of the state that still house a large portion of the population.
- 4. Colony protection and management in the Sacramento Valley.** Much of the survey and conservation work in recent years has focused on early season breeding colonies in

the San Joaquin Valley, and this will continue to be necessary given the importance of this region for most of the Tricolored Blackbird population. However, many of the Sacramento Valley colony sites are used by the same birds later in the spring and could be as important for producing offspring. An emphasis needs to be placed on the Sacramento Valley colony sites as there is a need for them to be protected and monitored to the same extent as those in the San Joaquin Valley. Historically, the Sacramento Valley, all the way to Modoc County, had colony sites that held hundreds of thousands of Tricolored Blackbirds (Neff 1937, DeHaven 1975). It is not inconceivable that the remaining habitat in the Sacramento Valley could sustain those numbers again if targeted and well supported conservation efforts are implemented.

- 5. Updating the Tricolored Blackbird Portal** – We recommend, as the 2008 report did, that increased use of the Tricolor Portal should be promoted and facilitated by improvements to the website. The Tricolored Blackbird Working Group and the Portal need to take advantage of the emerging social media networks and the growing tendency of birders to share information online. The Portal has not become the clearinghouse for Tricolored Blackbird information that it could due to underexposure and the difficulty of maneuvering around the site. We recommend that the Portal be updated and better connected with the birding communities, so that observations throughout the year more regularly get uploaded and made available for tracking distribution of this species. We also recommend that the data from the Tricolor Portal be made uploaded to the Avian Knowledge Network database, either directly or through eBird.
- 6. Increasing habitat options on private lands** – Based on the results of the 2011 survey it is quite clear that private lands are the linchpin for Tricolored Blackbird conservation. Due to the relative paucity of public land sites in the Central Valley, it continues to be crucial to engage with private landowners to educate them about Tricolored Blackbirds, especially when the birds are nesting on their properties, and give them options for preserving colonies and colony sites. We need to make a concerted effort to increase the amount of secure habitat available on private lands. Currently most Tricolored Blackbirds use dairy farm fields and weed patches to nest, both of which are subject to being harvested or mowed during the breeding season. The main focus of Tricolored Blackbird private lands work should be creating and securing habitat adjacent to these fields using monetary incentives through private as well as state and federal government conservation programs. Specifically, the USFWS should focus Partners for Fish and Wildlife funds on Tricolored Blackbird-specific projects among agricultural landowners, as well as private duck and hunting clubs to change land management practices to incorporate Tricolored Blackbird breeding and foraging habitat into the maintenance schedule of managed wetlands. Several refuges in the San Joaquin Valley have begun to manage for Tricolored Blackbirds, with positive results for both colony size and reproductive success. The Natural Resources Conservation Service is well connected to the agricultural community in California and has established a Tricolored Blackbird-specific fund that, starting in 2012, will be used for colony protection and habitat creation and enhancement. We recommend that this fund be maintained over the next 5-10 years to support recovery of this species. Good examples of what is possible are several managed wetlands that have altered their management with financial help to maintain cattail marshes throughout the

spring. This has resulted in several thousand Tricolored Blackbirds nesting at these sites for three consecutive attempts (Kelly Weintraub, pers. comm.). The birds choose natural habitat consistently when it is made available, and we should be encouraging creation and management of these natural habitats in areas where they can attract Tricolored Blackbirds away from the 'mega colonies' in agricultural fields.

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TABLES

Table 1. Number of counties surveyed and occupied sites Visited, and active colonies in different regions of California.

Region	No. of Counties	Occupied Counties	Sites Visited	Active Sites
Northern California	6	3	30	7
Sacramento Valley	11	9	269	38
Central Coast	6	5	34	7
San Joaquin Valley	7	6	118	25
Tulare Basin	3	3	82	29
Southern California	5	3	75	32
Total	38	29	608	138

Table 2. Number of birds seen by region and by county during statewide surveys 1994-2011

Region//County	1994	1997	1999	2000	2001	2005	2008	2011
Northern California								
Humboldt	100	32	0	0	0	0		
Lake	0	60	0	0	0	0	711	421
Lassen	0	6	0	300		0		
Mendocino	0	12	15	0	0	0	835	315
Modoc	250	250	0	0		0		180
Napa	11	400	600	104		300	0	0
Shasta	2,585	0	0	0		20	1,030	
Siskiyou	947	250	0	0		0		
Sonoma	30	0	0	0		0	0	0
Marin	400	0	0	0		0	0	0
Sacramento Valley								
Amador							6,600	350
Butte	0	0	5,958	5,224	500	0	2,541	0
Calaveras	0	8,313	0	720		30	385	120
Colusa	27	4,175	1,031	2,500	13,000	0	301	923
El Dorado	0	200	0	0		250	0	0
Glenn	2,000	0	0	0		0		500
Placer	1,000	658	4,500	6,200	2,800	1,600	12,050	3,310
Sacramento	94,028	31,338	2,000	14,503		16,400	3,551	6,105
Solano	5	75	33	0	0	2,000	200	2,275
Sutter	235	0	400	200		0	0	1
Tehama	0	35	5,000	0				
Yolo	475	200	0	50	400	3,070	1,900	5,080
Yuba	597	950	0	0		250	10,405	500
Central Coast								
Alameda	24	1,200	4,000	0		200	28	2,200
Contra Costa	400	0	0	0		0	358	0
Monterey	2,220	5,900	1,756	983	3,545	30	50	10
San Benito	0	778	0	1,282			66	
San Luis Obispo	0	660	261	1,000		4,210	6,242	197
Santa Clara	3,500	550	0	0		100	50	0
Santa Cruz	0	0	0	200		0	220	0
San Joaquin Valley								
Fresno	21,150	2,550	39,390	5,061	10,000	1,550	1,000	400
Madera	0					2,960	117	505
Merced	79,100	13,000	3,071	27,100	71,500	17,900	154,674	139,170
San Joaquin	15,978	11,857	0	7,073		0	0	0
Stanislaus	3,928	150	4,126	15	0	12,180	21,910	1,900

Region//County	1994	1997	1999	2000	2001	2005	2008	2011
Tuolumne	0	0	0	175	1,100	250	635	170
Tulare Basin								
Kern	72,255	17,000	1,600	7,875	11,100	155,407	69,702	61,825
Kings	10,000	33,300	0	10,000	950	0	2,500	2,950
Tulare	50,000	55,500	14,000	19,800	59,000	18,500	90,800	23,950
Southern California								
Los Angeles	815	430	1,053	610		5,100	1,270	1,066
Orange	1,034	231	300	195		0		
Riverside	2,175	38,356	4,000	10,000	80	12,200	2,150	4,132
San Bernardino	0	300	1,000	0		0	700	0
San Diego	2,000	3,236	175	1,990	150	395	1,367	767
Santa Barbara	2,000	0	0	0	80	2,900	500	
Ventura	90	0	0	0		0		
Total	369,359	231,952	94,269	123,160	174,205	257,802	394,848	259,322

Table 3. Total numbers of birds seen in each region during statewide surveys 1994-2011

Region	1994	1997	1999	2000	2001	2005	2008	2011
Northern California	4,323	1,010	615	404	0	320	2,576	916
Sacramento Valley	98,367	45,944	18,922	29,397	16,700	23,600	37,933	19,164
Central Coast	6,144	9,088	6,017	3,465	3,545	4,540	7,014	2,407
San Joaquin Valley	120,156	27,557	46,587	39,424	82,600	34,840	178,336	142,145
Tulare Basin	132,255	105,800	15,600	37,675	71,050	173,907	163,002	88,725
Southern California	8,114	42,553	6,528	12,795	310	20,595	5,987	5,965
Total	369,359	231,952	94,269	123,160	174,205	257,802	394,848	259,322

Table 4. Percent of population nesting in each region during statewide survey 1994-2011

Region	1994	1997	1999	2000	2001	2005	2008	2011
Northern California	1.2%	0.4%	0.7%	0.3%	0.0%	0.1%	0.7%	0.4%
Sacramento Valley	26.6%	19.8%	20.1%	23.9%	9.6%	9.2%	9.6%	7.4%
Central Coast	1.7%	3.9%	6.4%	2.8%	2.0%	1.8%	1.8%	0.9%
San Joaquin Valley	32.5%	11.9%	49.4%	32.0%	47.4%	13.5%	45.2%	54.8%
Tulare Basin	35.8%	45.6%	16.5%	30.6%	40.8%	67.5%	41.3%	34.2%
Southern California	2.2%	18.3%	6.9%	10.4%	0.2%	8.0%	1.5%	2.3%

Table 5. Top 22 largest Tricolored Blackbird colonies observed in 2011. Included is the county, percentage of the total population, substrate the birds nested in, and whether grains were present at the site.

County	Colony Name	Number	% of Total	Substrate	Grains Present
Merced	Sandy Mush and 99	45,000	17.4%	Fava Bean/barley	Yes
Merced	Merced NWR: West Farmfield	40,000	15.4%	Milk Thistle	Yes
Kern	Costa's Dairy	24,000	9.3%	Triticale	Yes
Tulare	Deer Creek Dairy	22,500	8.7%	Triticale	Yes
Merced	Merced NWR: Duck Slough	20,000	7.7%	Bull Thistle	Yes
Kern	West Poso	18,000	6.9%	Triticale	Yes
Merced	Owens Creek	15,000	5.8%	Milk Thistle	Yes
Merced	South of Childs	10,000	3.9%	Milk Thistle	Yes
Kern	Basin 6	9,600	3.7%	Tamarisk	No
Merced	Edminster Rd and 2nd Av	4,700	1.8%	Himalayan Blackberry	No
Riverside	Warren Road	3,000	1.2%	Mallow	Yes
Kings	Mid-Hacienda Ranch	3,000	1.2%	Tamarisk	No
Yolo	County Road 92B	2,700	1.0%	California Blackberry	Yes
Placer	Twelve Bridges and Hwy. 65 West	2,500	1.0%	Himalayan Blackberry	No
Sacramento	Elder Creek at Bradshaw Road	2,500	1.0%	Himalayan Blackberry	No
Kern	Wind Wolves: Santiago Springs	2,500	1.0%	Stinging Nettle	No
Kern	Tule Road #2	2,000	0.8%	Cattails	No
Sacramento	White Rock Road at Prairie City SVRA Entrance	2,000	0.8%	Himalayan Blackberry	No
Kern	Wind Wolves: Little Lobo	2,000	0.8%	Willows	No
Merced	Keaton and 4th	1,500	0.6%	Himalayan Blackberry	Yes
Tulare	Dead Pig Pond	1,500	0.6%	Cattails	Yes
Yolo	East of Madison	1,500	0.6%	Himalayan Blackberry	No

Table 6. Proportion of colonies in each substrate observed within each survey region and for California overall. Also shown at bottom is the percent of total birds observed for each substrate across California.

Region	Bull Thistle	Cattail/ Bulrush	Fava Bean/ Barley	Himalyan Blackberry	Milk Thistle	Mallow	Stinging Nettle	Tamarisk	Triticale	Willow	N
Northern California	0.0%	72.2%	0.0%	27.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7
Sacramento Valley	9.2%	13.7%	0.0%	70.2%	0.5%	4.6%	0.0%	0.0%	0.0%	0.0%	38
Central Coast	0.0%	59.1%	0.0%	0.0%	7.7%	0.0%	0.0%	0.0%	17.8%	0.0%	8
San Joaquin Valley	13.4%	0.9%	31.8%	3.0%	46.7%	0.0%	3.8%	0.0%	0.4%	0.0%	25
Tulare Basin	0.1%	5.9%	0.0%	0.0%	0.1%	0.0%	4.7%	13.8%	72.7%	2.4%	29
Southern California	2.5%	24.4%	0.0%	0.5%	0.0%	51.3%	17.5%	0.0%	0.1%	1.9%	31
All Sites	3.7%	33.6%	0.7%	23.1%	8.2%	4.5%	12.7%	1.5%	6.0%	6.0%	138
% Birds for all sites	8.1%	4.9%	17.4%	6.9%	25.8%	1.7%	4.1%	4.7%	25.5%	0.9%	

FIGURES

Figure 1. Colony sites visited in 2011

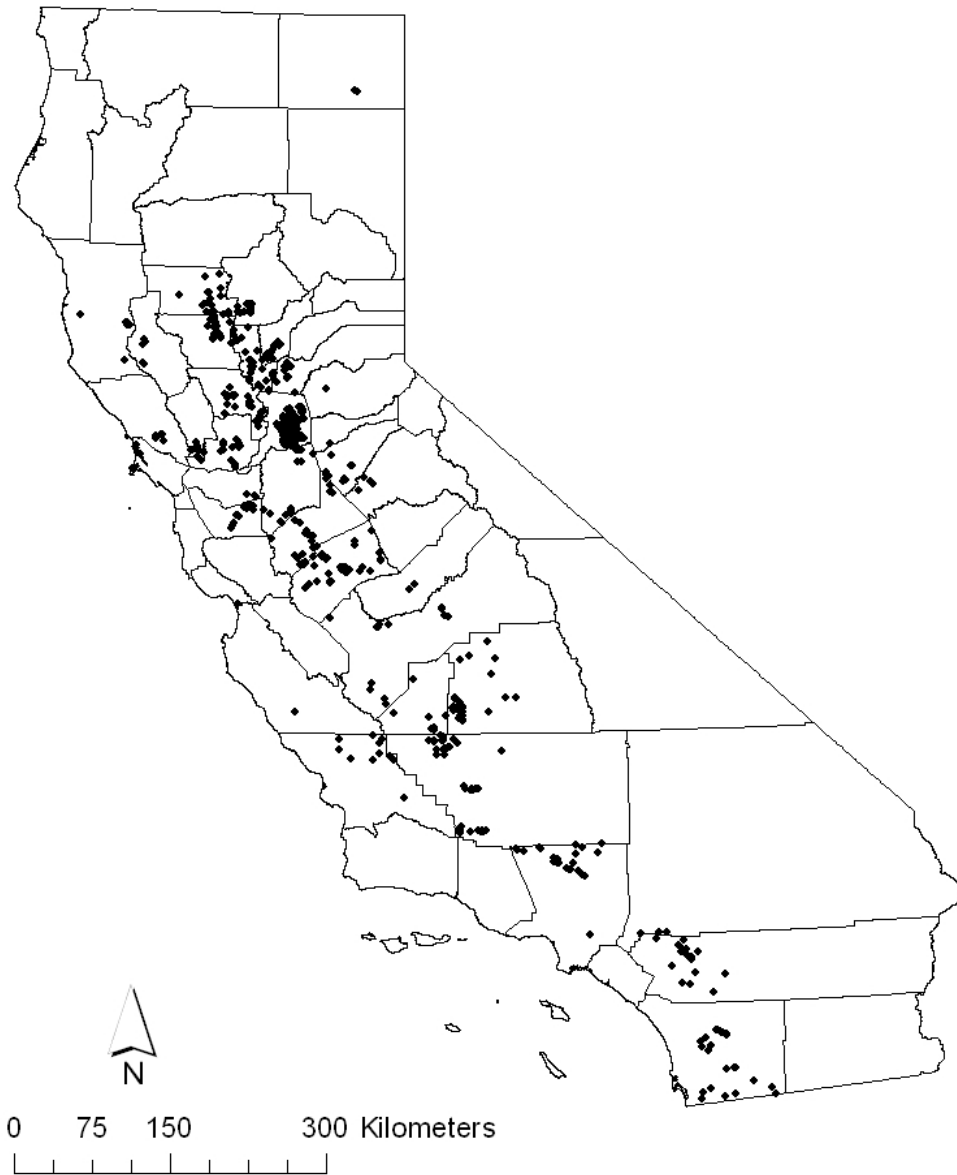


Figure 2. Population estimates from statewide census efforts 1994 - 2011.

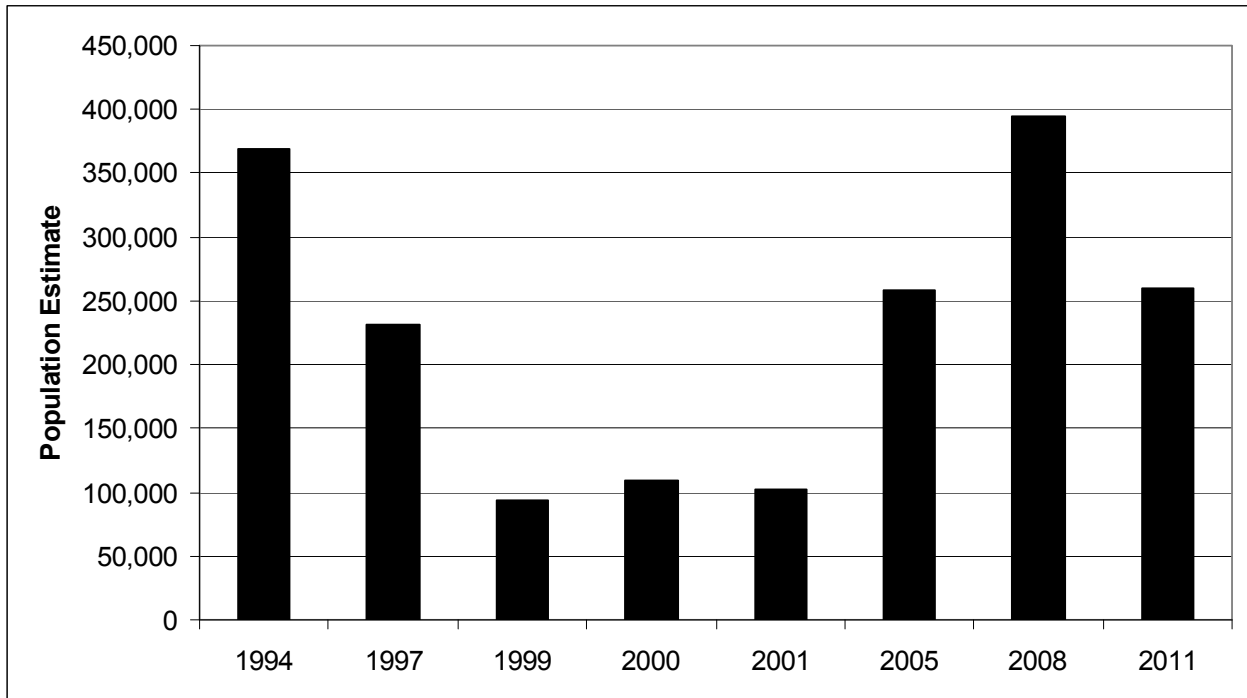


Figure 4. Proportion of birds and colonies observed in different substrates.

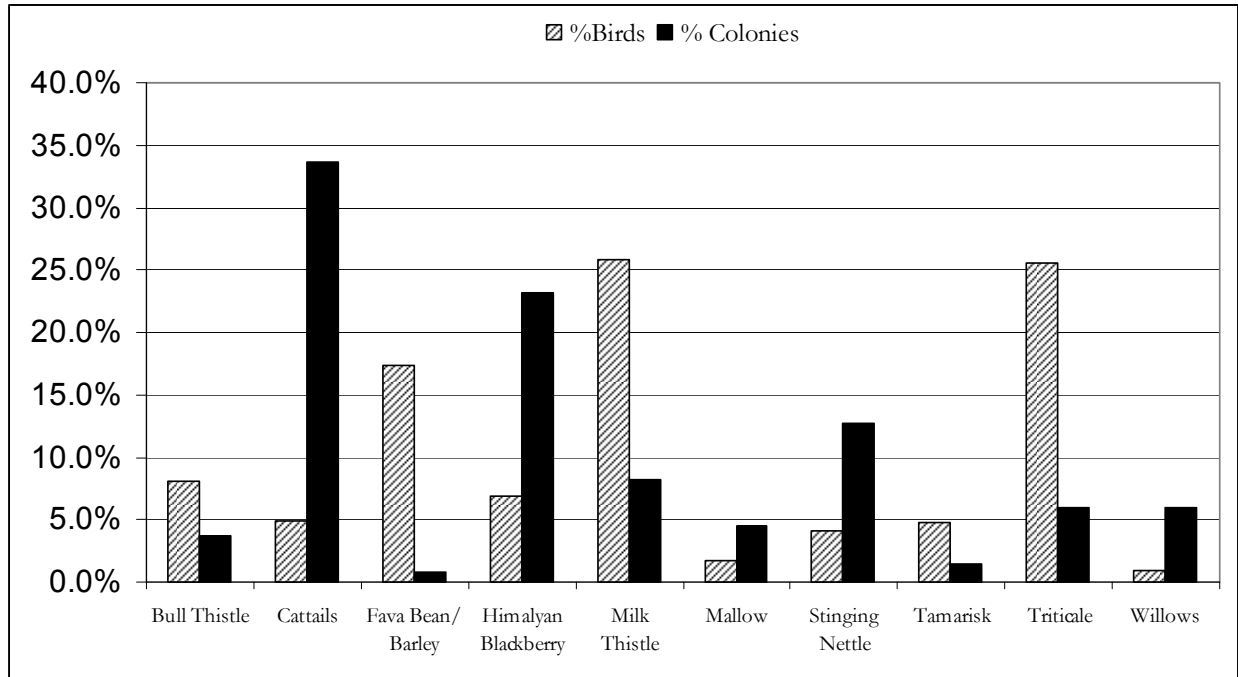


Figure 5. Reproductive success of large colonies in San Joaquin Valley 2005-2010 (Reproduced from Meese, 2009)

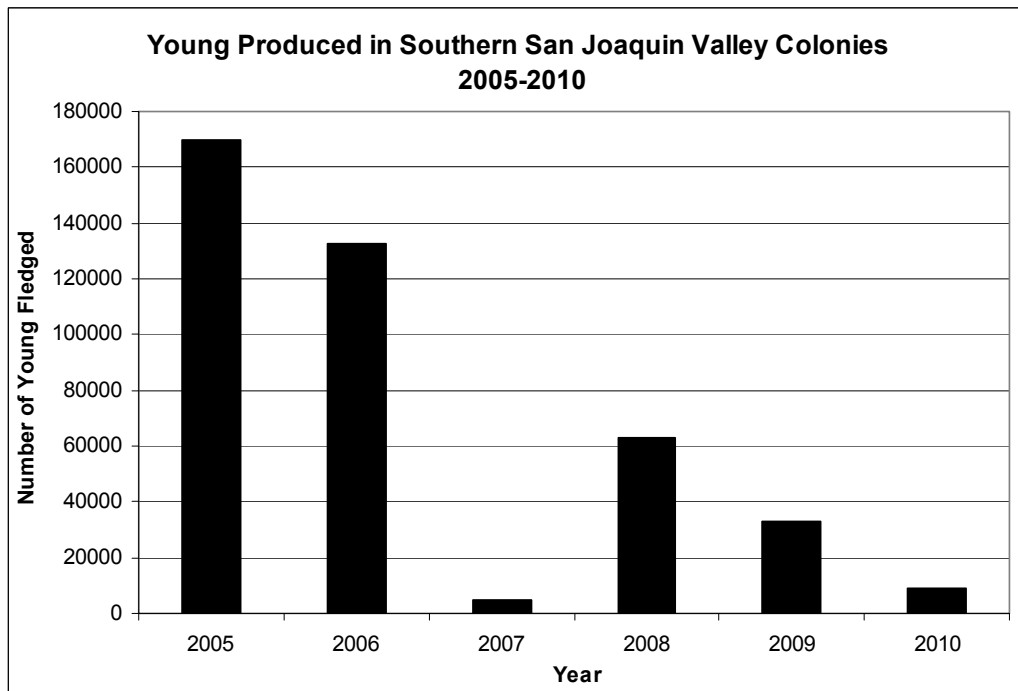


Figure 6. Percent of Tricolored Blackbird population nesting in different regions of California during annual surveys

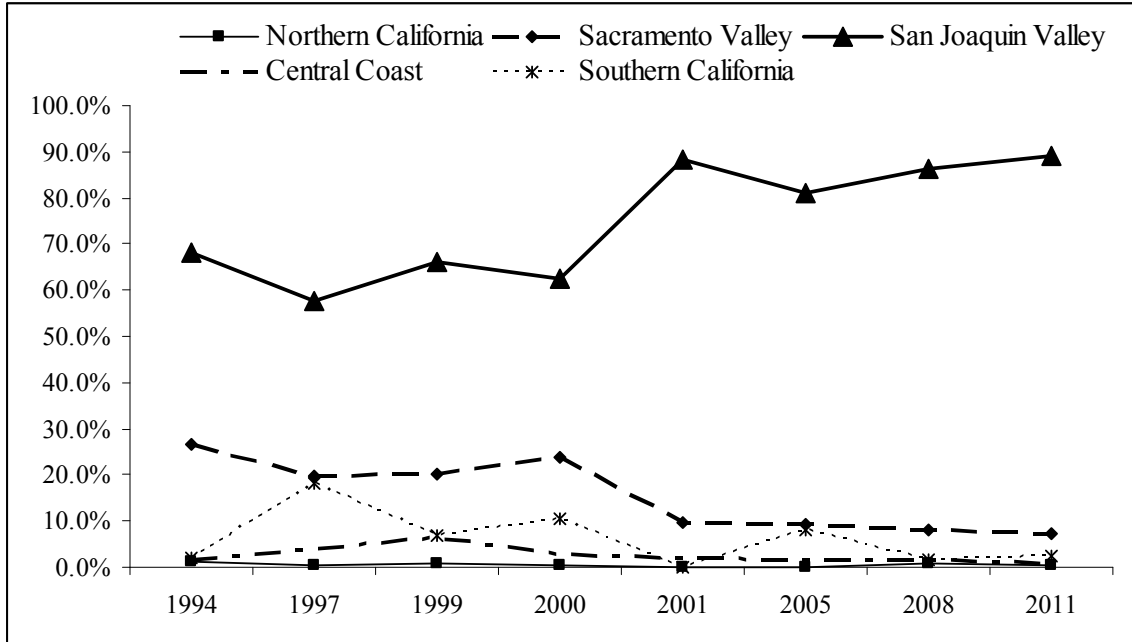
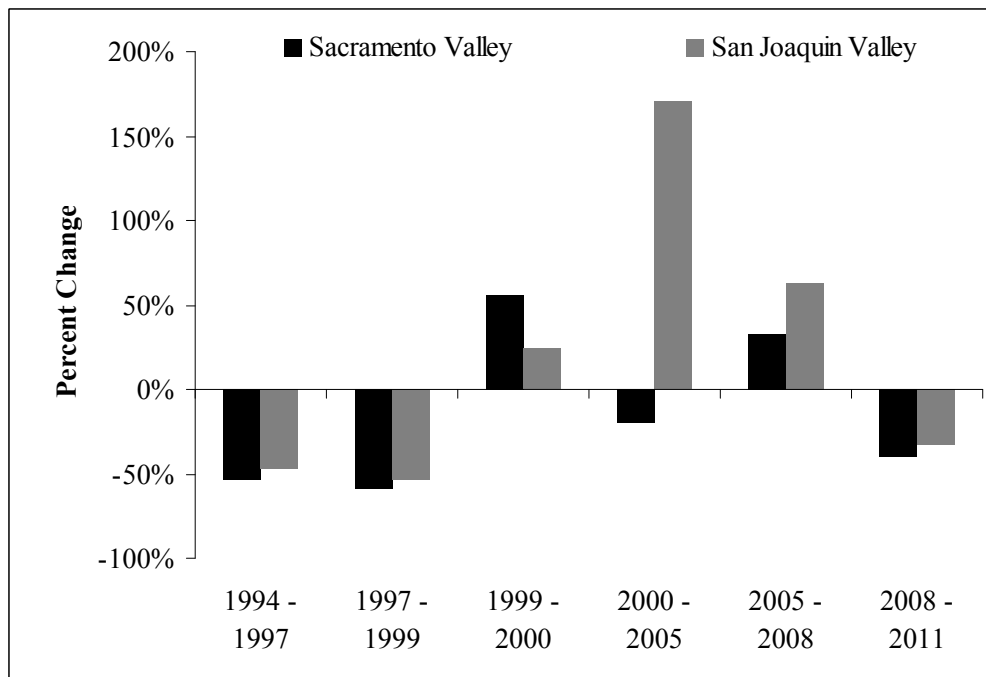


Figure 7. Population estimates from statewide censuses for the Central Valley and southern California subpopulations.



APPENDIX 1

Survey Protocol

Thank you for volunteering to participate in the 2011 Tricolored Blackbird Survey. This survey is conducted every three years in order to estimate population size and track changes in the status of the Tricolored Blackbird population. This information is critical for guiding our conservation efforts and could not be accomplished without your help and the extensive efforts of other citizen scientists across the state. The following protocol outlines the methods to be used during the survey and how to report your observations.

Our goal is to develop the best estimate of the statewide population as possible. The more areas that are surveyed where the presence and number (or absence) of Tricolored Blackbirds is recorded, the better the estimate will be.

I. Scouting

It is very useful to check on nearby sites and search the surroundings before the dates of the official survey. This will streamline the survey and allow you to spend more time at the colonies that require the most effort to observe and count. By April 1 most colonies will be active for their first round of breeding. In the more southerly colonies some nests will already have hatched young. It appears that 2011 could be an 'early' year for Tricolors. Estimating the colony size and observing the behavior and habits of the Tricolored Blackbirds at this point is interesting and good practice.

II. Timing

The 2011 survey window is April 15th to 17th. All observations that will be reported as part of the 2011 survey should be carried out on one or more days between April 15 and 17. Tricolored Blackbirds and colonies can shift locations over relatively short periods of time during the breeding season. Making sure that a comprehensive count is made in a narrow time window helps ensure we are not counting the same birds more than once.

Subsequent observations at any future date should also be noted and can be submitted via the Tricolored Blackbird Portal (<http://tricolor.ice.ucdavis.edu>).

III. Survey Locations and Priorities

Breeding colony locations are on maps provided to you were all discovered on previous censuses dating back to the early 1980s and 1990s, or incidentally discovered and documented at other times. Some sites were found during the last statewide census in 2008. Each volunteer team has been asked to survey a specific area within their county and, in most cases, to visit specific colony sites. Given there are colony sites that span several decades, we have developed a priority order for surveying these sites:

Priority One: visit and document the number (or absence) of Tricolored Blackbirds at colony sites that have been documented between 2001-2010. These are the most updated and recently active sites and should be the focus of the survey. The 1991-2000 and 1981-1990 sites are lower priority and most likely will only need to be driven by to confirm if habitat exists or not. If habitat does still exist in these older colony sites, please scan the area quickly to confirm the presence or absence of Tricolor colonies.

Priority Two: survey suitable habitat in areas around assigned colonies and in areas where Tricolored Blackbirds have been reported or seen before. Focusing on the habitat surrounding the 2001-2010 points will be most efficient and the color maps of your area will help you identify potential habitat areas more easily.

Priority Three: survey other areas in the county where there is suitable habitat. Ideally you are already familiar with these former colony locations, but if not, the locations of 2001-2010 colonies and other reported sites should be easy to find from the maps we provide.

Ideally you are already familiar with these former colony locations, but if not, the locations of previous colonies and other reported sites should be easy to find from the maps we provide.

IV. Survey Protocol

Viewing the colony

In general, it is best to avoid any disturbance of nesting birds, as the disturbance can cause nest failure. This is especially true for Tricolored Blackbirds and other colony nesting species, since pairs are in close proximity to each other, and a single disturbance can cause the failure of many nests. Under no circumstances should volunteers enter the colony. 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 observer to determine how close is too close. Under most circumstances, colonies can be surveyed from just outside the boundaries of the vegetation in which the birds are nesting. The majority of sites will be readily viewable from public roads and allow close and thorough study. Sometimes roadsides provide an elevated view of a colony, and thus a better perspective from which to estimate colony dimensions and numbers of birds.

Private property should also be respected. Do not enter private property unless you have received permission. A Fact Sheet about the survey has been prepared and is available for you to give interested landowners (or others) to inform them about the survey.

Colony Name

Use the colony name given in the list of colonies that you have been provided and that are used to label the colony on the maps (if you have been assigned to specific colonies). If this is a new colony (not already entered in the online database and not in the list of colonies provided), please give the site a logical name. Be sure to not use the name of the private landowner unless you

have permission. Also, please provide directions to the site (if this is a new colony), with enough detail that another observer could get to that location.

Latitude and Longitude

If this is a known colony that you have been assigned to visit, no need to record the site coordinates. For new colony sites, if you have a GPS unit, please use it to collect and record the latitude and longitude of the site during the survey. Record the datum used by the GPS unit (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 there are two ways to identify and record the coordinates. First, when entering your new location on the Tricolored Blackbird Data Portal, you can use the built-in Google Maps tool to zoom in and place a marker at the location. The latitude and longitude will automatically be entered when you do this. Alternatively, you can use Google Earth, an extremely useful and user friendly, free global mapping tool. Search for and zoom into the location in Google Earth. Insert a place mark at the location (be sure to move the marker to the actual spot) and the latitude and longitude will be recorded in the “Properties” of that marker.

Duration

Be sure to record the amount of time you spend at each colony site (including those where there are no Tricolored Blackbirds this year). Spend as much time at each colony as you need to get your best estimate of the number of birds. If after 10 to 15 minutes at a known colony site you have not seen any Tricolored Blackbirds, move on to survey new sites or areas. If Tricolored Blackbirds are present, use your own judgment about how much time to spend at the colony. In general, prolonged viewing of a colony will improve your estimate and the larger the colony the more time should be spent. This is particularly true for very large colonies (> 10,000) where it may take some time to evaluate the number of birds. With such large colonies, the more time you spend at the colony, the more the apparent chaos will give way to a semblance of order, enabling you to better estimate the size of the colony and gather observations of singing males, nest-building females, adults feeding chicks, or fledglings.

However, the time spent at one colony is at the expense of visiting more areas and documenting additional colonies. Do not spend too much time at small colonies where you can estimate the number of birds quickly. In this case, finding and counting new birds will be more valuable for the statewide estimate.

Colony Size

A Tricolored Blackbird colony can range from 20 birds to 100,000 or more birds. For this survey, all estimates will be based on visual counts of the birds at a colony. **Please only count the birds that you can see. Do not estimate the number of birds that are hidden from view in the colony substrate.** For small colonies, precise counts can be made, but in larger colonies a visual estimate will be necessary. The method used should be indicated on the data sheet.

Precise Counts

For small colonies (approximately less than 200 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, and are otherwise extremely active, precise counts will be impossible. To estimate the number of birds in large groups during this survey there are two ways to estimate number depending on whether birds are flying by or 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. In this case, the number of birds in these flight paths 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 many cases observers will need to employ both strategies. Position yourself somewhere with good visibility and use a timed count of the flying birds as they leave the colony. Once the flow of leaving birds has dropped off, then conduct a scanning count of the visible birds remaining within the colony itself. The scanning count of the colony should be repeated a few times to improve the estimate. Add the estimate of birds flying away from the colony to the count of birds within the colony. There is space on the data sheet to record your best estimate of birds, as well as what you think the minimum and maximum number of birds are at the colony. These minimum and maximum estimates will give us 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 us with an approximation of colony size and not an exact count. All large colonies that you find will be revisited by one or more experts, regardless.

Sex Ratio

The accuracy of the count will also depend on the sex ratio of birds observed and this depends on activity at the colony. 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 incubation may have begun). Tricolored Blackbird flocks often separate into groups of males and females. A quick estimation of the numbers in each sub-flock can be used to

determine 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 estimate.

Colony Observations

Locating new colonies and estimating colony sizes are the primary goals of the survey; however, the characteristics of colonies, the surrounding environment, and the behavior of the birds are all valuable for assessing the status and health of colonies.

Nest Substrate

Observers should record the nesting substrate of observed colonies. There is space on the data sheet to record both primary (dominant) and secondary substrates. Tricolored Blackbird native habitat consists of young, freshwater marsh dominated by tules or cattails, but they also nest in a variety of other vegetation types that provide enough structure and cover to build nests. In addition, they also now regularly nest in grain crops, particularly triticale fields in association with dairy farms. Likely substrate plants are: bulrush/tule, cattails, blackberry, milk thistle, nettle, and grains like triticale, wheat and barley. Other substrates include: willows, cottonwood, Arundo, desert olive, mustard, prickly lettuce, mule fat, coyote brush, raspberry, rice, tamarisk, and poison hemlock.

Colony Surroundings

In addition to locating and viewing the colony, it is useful to describe the surroundings. In addition to nesting substrate, Tricolored Blackbirds also require a source of open water and suitable foraging areas (e.g. upland pasture, grassland, and alfalfa). They can fly several miles to sources of abundant food (like farms with stored grains). Knowing about these locations will assist in future surveys and 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!** On the data sheet, if source of water or stored grains are identified, please record the presence of stored grains nearby and the distance to water. Also, note the dominant land use surrounding the colony (type of agricultural crop, natural vegetation type, etc).

Colony Area

Observers should try to record the approximate length and width of the breeding substrate within the colony. These measures will be used to calculate the total area of the colony. Since breeding substrate often occurs in patches over a larger area, size estimation is approximate. Colony area will be used with what is known about the average nest density within Tricolored Blackbird colonies to develop a secondary estimate of the number of birds in the colony.

- *Measuring Width and Length:* Where possible, observers should pace out two sides of the colony, using strides that approximate one meter. Record the number of meters for these two sides on the data sheet.
- *Aerial Photos:* Using satellite photos that are provided, observers can highlight the boundaries of the colony being used. These marked-up photos should be sent in with

paper copies of datasheets following the surveys. These will provide a means for mapping the extent and calculating the total area of colonies observed.

Behavior and Colony Status

Behavior of birds at a colony and the current activity at the colony are also important sources of information for understanding the seasonal timing of breeding and success of particular colonies. Important observations to record on the datasheet include:

- *Singing*: pronounced chorus of males heard singing at a colony
- *Carrying Nest Material*: females observed carrying nest material (e.g. grass)
- *Colony Quiet*: if the colony is relatively quiet (no singing or large groups of males and females moving about) and primarily males are visible, this may indicate that incubation has begun and females are on nests.
- *Carrying Food*: adults observed carrying food (usually insects protruding from bill)
- *Fledglings*: observed young birds in association with adults.

Mapping New Colonies

In order to better ensure that we record the location of new colonies accurately, please use the street and colony maps provided (or another map you have available and can copy) to mark the location of new colonies you find and visit. These will be stored and used later for data quality checking.

Survey Routes

Using the maps provided or other maps you have available to indicate the routes taken during the survey by highlighting the roads and areas surveyed. These should be sent in with the datasheets and aerial photos following the survey.

Total Survey Time and Mileage

Please record the total time, number of observers in your team, and miles you drove for the survey. These can be recorded separately and emailed to Keiller Kyle (kkyle@audubon.org).