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Results of the 2014 Tricolored Blackbird Statewide Survey

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Acknowledgments

I thank the U.S. Fish & Wildlife Service for requesting my assistance in coordinating the 2014 Tricolored Blackbird Statewide Survey and for providing assistance in identifying county coordinators and survey participants. I thank Monica Iglecia of Audubon California for assistance is recruiting county coordinators and survey participants. I thank Neil Clipperton, non-game biologist for California Department of Fish and Wildlife for helping to organize the survey, participating with me in the survey of Yolo County, and for financial support for the preparation of this final report. I thank the county coordinators for applying their vast knowledge of tricolor distribution and occurrence in California and for recruiting highly qualified survey participants. I thank especially Ted Beedy for his vigorous efforts to recruit highly qualified survey participants from the staff of Dudek environmental. And finally, I thank the nearly 150 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, 2014. The 2014 statewide survey could not have been conducted without their participation and passion.

Introduction

The tricolored blackbird, *Agelaius tricolor*, is unique to California and much loved. Among its many interesting attributes, the tricolor is colonial, and nests in large groups that place heavy demands upon the local biota, especially insects. Globally, colonial species are believed to be highly vulnerable, and many have become conservation targets. 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 learning to utilize 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. These two attributes, coloniality and insectivory, place 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 stored grains provide an essentially limitless food resource, tricolors have since the 1980's nested in large numbers in association with dairies. This change in nesting habitat has had serious consequences: first, annually all of the eggs and nestlings in entire colonies are lost when the grain fields serving as nesting substrates are harvested as part of normal agricultural operations, and second, grains do not provide the nutrition required for breeding, so even conserved colonies are often unproductive, with few fledglings produced.

Following the breeding season, most tricolors are found in the Sacramento Valley where they aggregate with red-winged and other blackbird species and feed, often in large flocks, on ripening rice. An unknown number of adult tricolors is shot each fall due to their similarity in appearance to red-wings, as red-wings are exempted from protection 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). The California Fish and Game Commission has included on its August 6, 2014 agenda a consideration for an emergency listing of the tricolor due primarily to the continuing rapid decline in abundance as documented in the 2014 Statewide Survey.

The triennial Tricolored Blackbird Statewide Survey is the primary means by which the species population is monitored, and this report summarizes the results of the 2014 Survey.

Methods

I was asked to coordinate the 2014 Statewide Survey by U.S. Fish & Wildlife Service staff in late autumn, 2013. I accepted this *pro bono* position as I had worked with tricolors for a decade and had numerous professional contacts who would likely help with soliciting qualified individuals to participate as well as help to coordinate the survey.

Survey Dates.

Tricolored blackbirds may most accurately be counted when at their breeding colonies, as the birds are relatively sedentary and much effort has been expended in locating and documenting their colonies, with many concerned citizens entering records of colony locations into the Tricolored Blackbird Portal (tricolor.ice.ucdavis.edu). But the species breeds throughout a long breeding season that may begin as early as late February in some parts of the southern San Joaquin Valley (S. Frazer, pers. comm.) and ends in most years in early August in the southern 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 and prior to the period when first breeders disperse north to breed again (Hamilton 1998).

The 2014 Statewide Survey was held over 3 days, from April 18-20. A three day interval is used to maximize participation by the largest number of volunteer observers while minimizing the risk of double-counting birds that may have moved from one breeding colony (as following cessation of breeding or colony abandonment) to another.

Coordination.

The triennial statewide survey has since 2008 been organized as essentially a three tiered effort, and I followed this design in 2014:

1st tier is a statewide coordinator,

2nd tier is county coordinators, and

3rd tier is volunteer participants.

Statewide Coordinator.

I served as the statewide survey coordinator. The statewide survey coordinator is responsible for identifying and recruiting qualified persons to serve as county

coordinators, producing and disseminating via the Portal documents to support the survey (survey protocol, survey field form, descriptions of colony estimation methods, natural history information, and several others), 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 this final report.

County Coordinators. Beginning in late 2013 I began to communicate with colleagues consisting of agency and NGO staff and environmental consultants with much field experience with tricolored blackbirds. I requested their assistance in the survey effort by serving as county coordinators, with the assumption that those with the most local knowledge and experience could best survey a species that occurs throughout California but is for many notoriously difficult to find during the breeding season. Each county coordinator was known by me or recommended to me by one with much experience with tricolored blackbirds to be highly qualified and knowledgeable about the occurrence of tricolors in their respective counties. I received commitments from each county coordinator to volunteer to organize thorough surveys of breeding tricolors in their respective counties. In spring, 2014 I met with Monica Iglecia of Audubon California who offered to assist my efforts and to use her position to solicit county coordinators for the few counties that still lacked them as well as to advertise via Audubon chapter newsletters and similar venues for interested volunteer participants - concerned citizens who knew about the decline in tricolors and who wished to help to monitor the health of the species.

Participants. 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 one of the 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 and from materials posted on the Portal.

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 on protocols to county coordinators and volunteer participants, providing pdf copies of field forms for download, and pdf copies of colony location maps for download for those county coordinators who requested them.

Timeline. County coordinators were identified and asked to participate from November, 2013 through February, 2014, with the final 3 county coordinators identified during March, 2014. As each county coordinator was identified, he/she was asked whether they needed help in identifying survey team members. The majority of county coordinators preferred to assemble their own survey teams, but the minority who requested assistance were put in touch with individuals who had responded to a request for assistance posted to the Tricolored Blackbird Portal as well as to several Audubon chapter requests via newsletters and postings to websites.

Training Session. A single training session was held on Sunday, April 13, 2014 at the Glide Ranch outside Davis, Yolo County. The training session was jointly provided by Audubon California staff

(Monica Iglecia and Megan Hertel) and myself, and consisted primarily of a PowerPoint presentation that I developed 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. A portable document format (pdf) version of the training presentation was posted to the Portal for use by survey participants who were unable to attend the 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 the results of the county surveys to me and asked me to enter their records 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 were 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 (who saw them, how many were there, where they were, when they were seen, etc.).

For security and data integrity reasons, participants lacking Portal accounts were provided them typically within minutes after they were requested via email, and a review of data entry procedures was provided 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), as the 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.

Results

The 2014 Tricolored Blackbird Statewide Survey was conducted from April 18 to April 20, 2014.

A total of 38 county coordinators and 143 volunteers participated in the survey.

A total of 145,135 birds was counted in 37 counties from 41 counties and 802 locations surveyed. Tricolored blackbirds were observed at a total of 143 locations (Table 1). This represents a near quadrupling of the number of locations surveyed since the 2000 statewide survey, when only 206 sites were surveyed (Hamilton 2000).

The rate of decline in the number of tricolors appears to be increasing. From 2008 to 2011 the number of tricolors dropped by 34%, from 395,000 to 258,000 birds (Kyle and Kelsey 2011), but from 2011 until this year the number of tricolors dropped by 44%, from 258,000 to 145,000 birds (Figure 1).

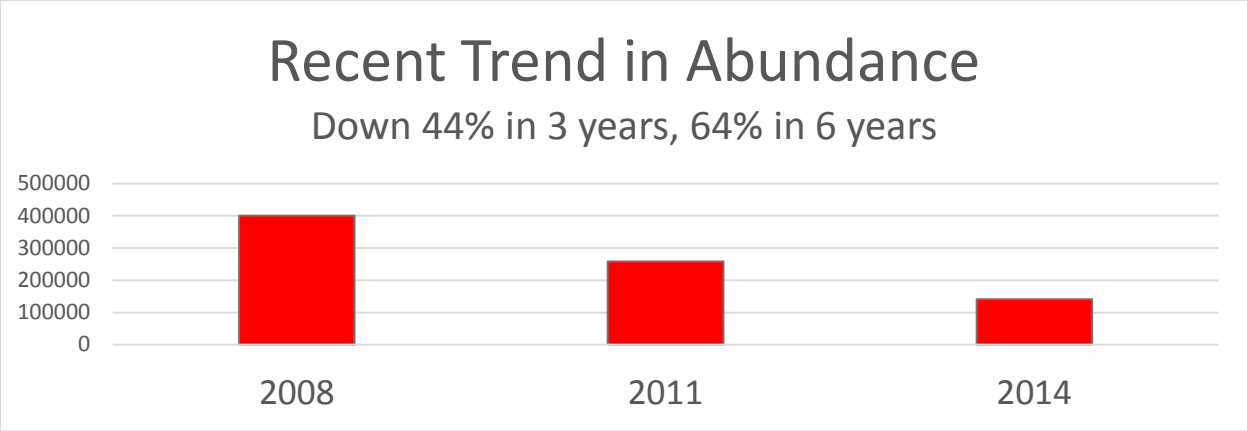

Figure 1. Population trend from 2008 to 2011.

A total of 75 new location records was added to the Portal by 27 different users as result of statewide surveys. This is the same number of new location records as was added as a result of the 2011 statewide survey (Figure 2).

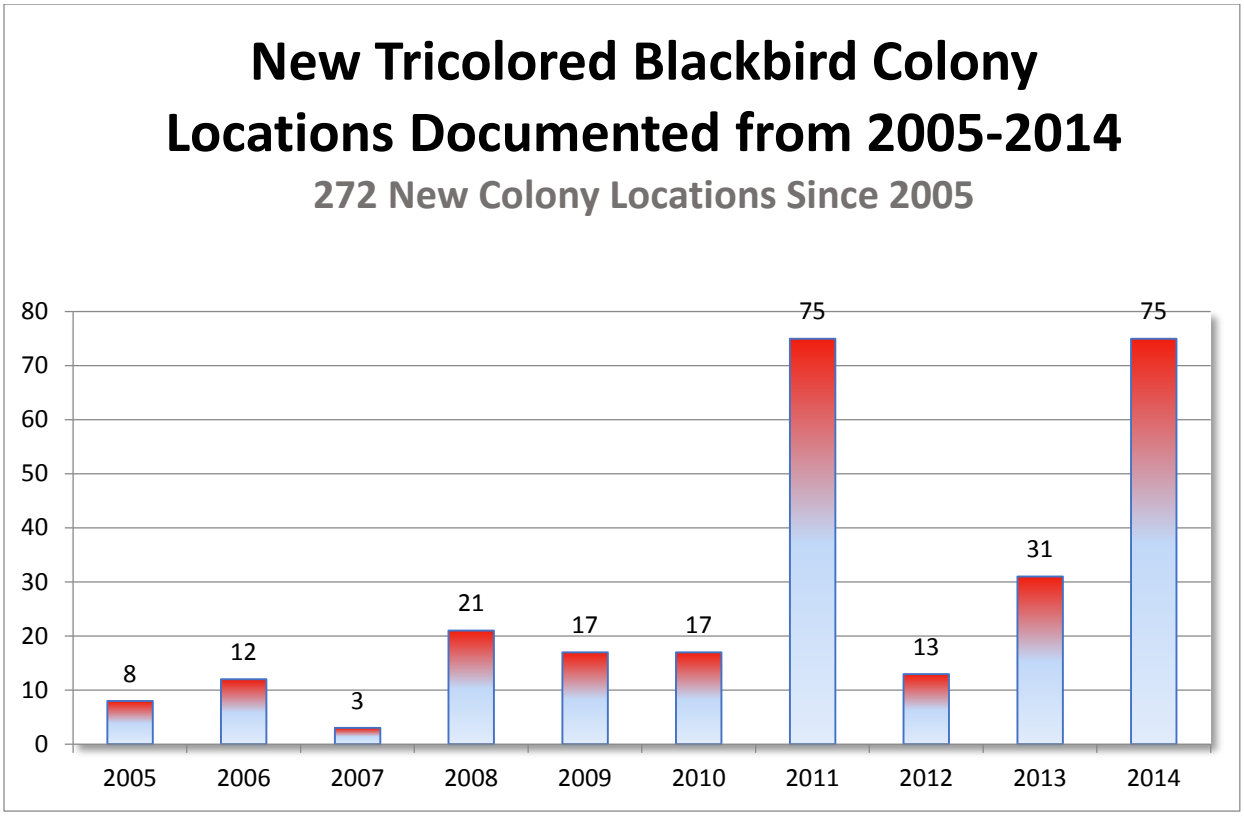

Figure 2. New colony location records added to Portal.

Table 1 presents a summary of the results by county.

Table 1. Statewide Survey Results by County.

County	Locations Surveyed	Locations Occupied	Number of Birds	Proportion of Total
Alameda	27	1	50	0.034
Amador	6	2	5500	3.793
Butte	6	1	60	0.041
Calaveras	9	5	404	0.279
Colusa	23	0	0	0
El Dorado	9	5	1375	0.948
Fresno	25	1	6	0.004
Glenn	29	1	300	0.207
Kern	64	12	3977	2.743
Kings	15	1	5000	3.448
Lake	6	1	150	0.103
Lassen	2	1	232	0.16
Los Angeles	11	6	4707	3.246
Madera	10	2	27166	18.735
Mariposa	1	1	13	0.009
Mendocino	5	1	100	0.069
Merced	46	5	10532	7.263
Monterey	22	6	399	0.275
Napa	11	1	70	0.048
Orange	17	1	14	0.01
Placer	20	4	17600	12.138
Riverside	28	9	4368	3.012
Sacramento	98	19	29272	20.188
San Benito	13	1	80	0.055
San Bernardino	10	6	1380	0.952
San Diego	30	6	1417	0.977
San Joaquin	9	2	515	0.355
San Luis Obispo	29	5	98	0.068
Santa Barbara	18	7	935	0.645
Santa Clara	6	0	0	0
Santa Cruz	8	0	0	0
Shasta	15	1	250	0.172
Solano	15	3	610	0.421
Sonoma	4	0	0	0
Stanislaus	36	10	8852	6.105
Sutter	18	1	8	0.006
Tehama	5	2	300	0.207
Tulare	30	5	18259	12.592
Tuolumne	8	3	825	0.569
Yolo	33	2	81	0.056
Yuba	25	3	268	0.185

Breeding colonies were established in 12 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 colonies and breeding birds by nesting substrate type.

Primary Substrate Type	Number of Colonies	Number of Breeding Birds	Proportion of Total
Bull thistle (*Cirsium vulgare*)	3	1,020	0.007
Bulrush (or tule)	16	6,965	0.048
Buttonwillow (*Cephalanthus occidentalis*)	1	8	-
Cattails (Typha spp.)	44	12,817	0.088
Himalayan blackberry (*Rubus armeniacus*)	41	59,308	0.41
Milk thistle (*Silybum marianum*)	2	2,080	0.014
Mustard (*Brassica* spp.)	2	144	-
Mustard in triticale	1	120	-
Stinging nettle (*Urtica dioica*)	6	528	-
Tamarisk (*Tamarix* spp.)	1	5,000	0.034
Triticale (*Triticum* x *Secale*)	9	55,118	0.38
Wheat (*Triticum* spp.)	1	143	-
Willows (*Salix* spp.)	2	1024	0.007
Other	13	898	0.006

The numbers of birds seen at occupied locations ranged from 1 to 24,000, with only a single colony in Madera County (Road 12 Avenue 24) consisting of more than 20,000 birds and only 3 colonies consisting of 10,000 or more birds.

The number of birds observed differed markedly by bioregion. Southern California (Ventura, the far southern part of Kern, Los Angeles, Orange, San Bernardino, Riverside, and San Diego counties) had 12,386 birds, up from 6,000 in 2011, the San Joaquin Valley (from Kern County in the south to San Joaquin County in the north) had 73,412 birds, coastal locations (from Alameda County to Santa Barbara County) had 1,732 birds, the Sierra foothills (Amador, Calaveras, El Dorado, Placer, and Sacramento counties) had 25,717 birds, and the Sacramento Valley (from Yolo County in the south to Tehama County in the north) had 31,531 birds.

Bird numbers were down markedly from the two previous statewide surveys in the San Joaquin Valley, especially in Kern and Merced counties, where the breeding birds had recently been most concentrated (Figure 2). Overall, the number of breeding birds in the San Joaquin Valley dropped 78% in 6 years, from 2008 to 2014 (Table 3), and the number of birds seen in counties along the Central Coast was less than 10% of that seen in 2008 (Table 4).

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

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

*Central Valley locations only

Table 4. Recent trend in numbers of birds in Central Coast counties.

Year/County	2008	2011	2014
Alameda	28	2,200	50
Contra Costa	358	0	N/R
Monterey	50	10	399
San Benito	66	N/R	80
San Luis Obispo	6,242	197	98
Santa Clara	50	0	0
Santa Cruz	220	0	0
Totals	7014	2407	627

However, the number of birds seen in Sacramento County and the Sierra Nevada foothills showed no decline or marked increases (Table 5, Figure 1). The 29,272 birds seen in Sacramento County exceeded the total seen in any statewide survey since 1997, when 31,338 birds were seen in the county (Beedy and Hamilton 1997).

Table 5. Recent trend in numbers of birds in Sacramento and Sierra foothill counties.

Year/County	2008	2011	2014
Amador	6600	350	5500
Calaveras	385	120	404
El Dorado	0	0	1375
Placer	12,050	3,310	17,600
Sacramento	3,551	6,105	29,272
Totals	22,586	9,885	54,151

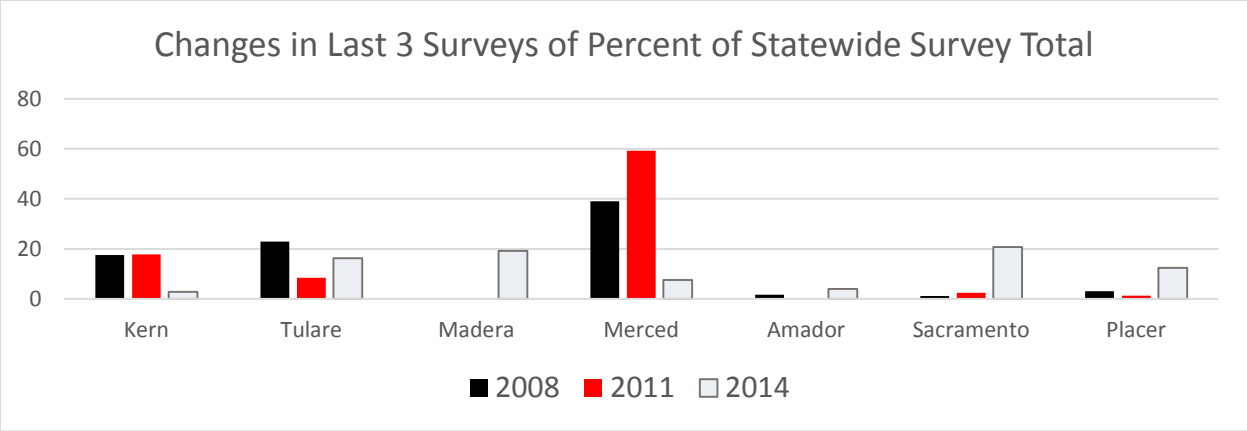

Figure 3. Changes in Percentages of Statewide Total of Select Counties.

A total of 93,000 birds was seen in the 10 largest colonies, 64% of the total. This is a much lower percentage of the total than was seen in the 10 largest colonies in 2011, when 208,800 birds, or 81% of the total, were seen in the 10 largest colonies, and in 2008, when 306,00 birds, 77.5% of the total, were seen in the 10 largest colonies. This reflects a downward trend in the sizes of the largest colonies (Figure 4).

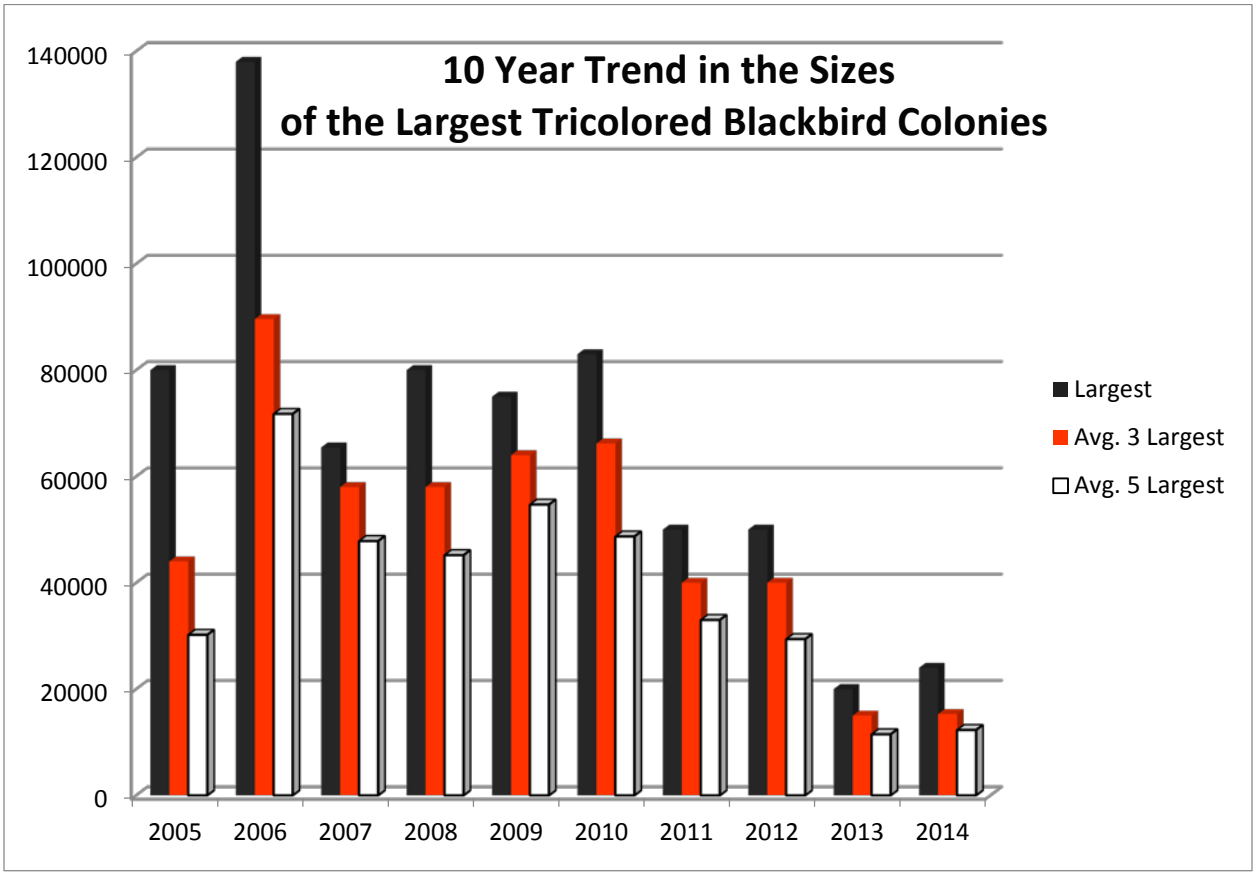

Figure 4. 10 Year Trend in the Sizes of the Largest Colonies.

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), this is the best tool available for documenting trends in California's tricolored blackbird population.

The 2014 statewide survey is believed to have been the most thorough ever conducted. Concerned citizens have entered dozens of new location records into the Portal, resulting in a rapid increase in knowledge of where the birds breed, and the number of locations surveyed increased from 361 in 2008 to 802 this year. Yet despite this rapid increase in knowledge, the number of birds in California as estimated by the Statewide Survey again declined sharply.

The use of the Portal as a citizen-supported web-based resource for data entry and management has greatly improved our knowledge of the breeding season distribution of the species. As recently as 1997 only 114 locations were surveyed during the Statewide Survey (Hamilton 2000), but this year the number of locations surveyed exceeded 800 for the first time. And a total of 27 different users entered 75 new location records into the Portal in the first 6 months of 2014. Thus, the Portal has helped to meet the needs of concerned Californians 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 2014 Tricolored Blackbird Statewide Survey show that there are far fewer birds now than in the recent past. The results of the past 3 statewide surveys (2008, 2011, and 2014) are most directly comparable due to similar methods and levels of effort, unlike previous statewide surveys that suffered from wide variations in methods and levels of effort (Hamilton 2000). And the development of the Tricolored Blackbird Portal in 2008 provided a previously unavailable public resource that has met the needs of concerned citizens and encouraged their participation in tricolored blackbird conservation efforts while greatly improving data quality and management.

The rate of decline in the number of tricolors is alarming and appears to be accelerating: a comparison of the results of the 2008 to 2011 interval shows that the number of tricolors declined by 34%, from 395,000 to 258,000 birds. But from 2011 to 2014 the number of birds declined by 44%, from 258,000 to 145,000 birds (Figure 1). Thus, conservation efforts to date have been insufficient to stem the decline in the number of tricolors and the rate of decline is increasing.

There are likely several reasons for the decline, but clearly the rate of mortality of adults far exceeds that of the recruitment of new breeding birds into the population, and chronically low reproductive success since 2007 appears to be a major factor causing the disparity between mortality and recruitment (Meese 2013). Many sources of mortality are of essentially unknown severity (e.g., disease, predation, starvation) but some sources of mortality are known and must be eliminated. The destruction of colonies through the harvest of nesting substrates continues as an annual event in colonies established in grain fields surrounding dairies: at least two colonies were destroyed during the harvest of the triticale nesting substrate in Merced County in 2014, with unconfirmed reports of a third. Also, an unknown number of adult tricolors is killed each autumn when red-winged blackbirds (*Agelaius phoniceus*) are shot while causing depredations to ripening rice in the Sacramento Valley. As the two

congeneric blackbird species are extremely similar in appearance and flock together in autumn, the tricolor may be inadvertently shot while the red-wing is legally shot to prevent damage to rice.

The number of tricolors is down steeply statewide, but the decline is not uniform across different regions in the state. The decline is most pronounced in the San Joaquin Valley and along the Central Coast. The number of birds in the San Joaquin Valley plummeted 78% in 6 years, from 340,700 to about 73,500 birds, and the decline in especially alarming in Kern and Merced counties (Table 3). Along the Central Coast, the number of birds is down 91% in 6 years, from 7,014 to 627 birds (Table 4).

It is possible that some of the decline along the Central Coast is due to the severe drought that began in 2013 and to the resulting temporary loss of nesting habitat, although additional, permanent landscape changes such as conversions of coastal scrub and grassland foraging areas to vineyards are reducing the area suitable for breeding by tricolors. The losses of native habitats have been widely cited as among the most important causes for the long-term population decline (Beedy and Hamilton 1999).

Unlike in the San Joaquin Valley and along the Central Coast, during the same 6 year interval the number of tricolors in the Sierra Nevada foothills and Sacramento County have increased by about 145%, from about 22,500 birds to about 54,000 birds (Table 5). These numbers suggest either that tricolors 1) are moving into the foothills from other regions or 2) are breeding relatively more successfully in the Sierra Nevada foothills than they are in the San Joaquin Valley or Central Coast.

Southern California presents unique challenges to tricolor conservation, as urbanization and the movement of the dairy industry into the San Joaquin Valley have reduced the account of habitat suitable for tricolor nesting and foraging (Unitt 2004). The number of birds seen in southern California was up during the same 6 year interval, from 5,487 birds in 2008 to over 12,000 in 2014. A large and rapid increase in the number of birds in southern California has previously been observed: in 1997 a visually estimated 35,000 birds bred at the Hemet/San Jacinto Constructed Wetlands, and in 2000 a visually estimated 10,000 birds bred at the same location. Rather than spectacular reproductive success *in situ*, it is likely that these rapid increases result from birds moving from the Central Valley into southern California. Although this movement had been suspected due to an absence of genetic differentiation between the southern California and Central Valley regions (Berg, Pollinger, and Smith 2010), the first confirmation of such movements came in April, 2014 when a biologist working at a DOD installation in San Bernardino County sent two photographs of female tricolors foraging on her property to me for species identification. In examining her photographs I noticed that one bird was banded on the left tarsus. As I am the only person banding tricolors on the left tarsus, this is a bird that I banded, and I have only banded in the Central Valley and in one coastal location. Thus, this photograph likely represents the first confirmation of birds moving into southern California from the Central Valley and suggests a mechanism by which bird numbers could rapidly increase in response to especially favorable nesting conditions. Despite the increase in the number of tricolors in southern California, the number of birds is not sustainable and the species remains conservation-dependent.

The causes for these regional differences in the trend in abundance are poorly known but the chronic poor reproductive success of Central Valley colonies is well documented and correlated with low insect abundance (Meese 2013). A recent study from Europe has shown that songbird populations are declining in regions with low insect abundances and high neonicotinoid insecticide concentrations (Hallmann et al. 2014). Neonicotinoid insecticides are widely used in California (Starner and Goh 2012) but their effects on songbird populations remain unstudied.

Sierra Nevada foothill locations are, in general, surrounded by rangelands, and it is possible that the rangeland colonies have a relatively greater or more consistent prey base of terrestrial insects and that these support relatively greater reproductive success. Also, the losses due to the harvest of the nesting substrates while eggs and/or young are still in the nest that occur annually in the San Joaquin Valley are not mirrored in foothill locations. Additional work in foothill locations is needed to better understand the factors responsible for the apparent increase in abundance of tricolors during the interval when their abundance is plummeting statewide. This work should focus on the fates and reproductive success of foothill colonies and the relative abundance of insects preferred by foraging birds.

Do these results suggest that California's Central Valley and Central Coast have lost their ability to support breeding by a native, near-endemic colonial insectivorous passerine? Has the carrying capacity of the Central Valley and Central Coast been permanently reduced? How many breeding birds can 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 500,000 to 750,000 individuals – numbers that have been used to define "recovery" of the species by members of the Tricolored Blackbird Working Group. In the immediate past, the San Joaquin Valley held the vast majority of birds during the statewide survey (e.g., Kelsey 2008, Kyle and Kelsey 2011), so if it is no longer able to do so and the birds must breed elsewhere, 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 that second nesting attempts in the Sacramento Valley are 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 is 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 the Central Valley and Central Coast.

These regional differences in population trends have potentially great significance for conservation efforts and suggest that research and monitoring efforts ought to be expanded to include foothill locations. If it is found that the time-averaged reproductive success of foothill colonies is relatively greater than that of Central Valley colonies, this may justify an increase in emphasis and investment in on-the-ground actions to increase the number of tricolors breeding in foothill locations. At the same time, an analysis of potential threats is warranted as landscape changes have already eliminated much of the tricolor's former habitat throughout its range, and if such changes reduce the amount of suitable habitat in the foothills, few options will exist to restore the number of tricolors to a sustainable level.

With the on-going and apparently increasing rate of decline in abundance (Figure 1), it may be appropriate to begin to consider whether the population status warrants a listing for protection under the California Endangered Species Act. Although a listing will be controversial and may lead to conflict, the volunteer, non-regulatory efforts of the Tricolored Blackbird Working Group over the past decade have failed to stem the decline and the persistent reproductive failures make the long-term prospects for the species, and its potential for recovery, less certain. If a listing would result in the elimination of the known sources of mortality (harvest of nesting substrates before the young have fledged and

shooting in autumn in rice paddies), that might increase the number of young produced while reducing the rate of adult mortality and stabilize the number of birds. If a listing would help to provide funding for on-the-ground actions that result in increased reproductive success, that may help to increase the number of tricolors produced, increase the rate of recruitment, and increase the population. A vigorous, long-term, well-funded, and strategic approach involving a wide variety of stakeholders, including industry, will be needed to stop the decline in the number of tricolors and begin to restore the population to a self-sustaining level. A failure to act will result in the continued decline in abundance in California's blackbird.

Recommendations

1. Eliminate all known sources of mortality, including the losses of eggs and young via harvest of their nesting substrate and adults in autumn when causing depredations in rice.
2. It is essential to develop a mechanism for conserving at-risk colonies. A mechanism is required that 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 cannot be shot and shooting stops in autumn in rice, this will also save the lives 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. In some situations, fledglings persist on the original nesting substrates until moments before the substrates are harvested. Study these colonies and document where the birds go when the harvester shows up and what do 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. Provide supplemental insect foods (meal worms, possibly others) to investigate whether supplemental feeding may increase RS.
9. Provide meal worms or other insects to settling birds at desired locations to see whether the supplemental foods may influence breeding site selection.
10. Focus efforts on regions with a recent history of successful reproduction (e.g., Sierra Nevada foothills) and, where appropriate, seek to create additional breeding sites.
11. Expand monitoring and research into regions which have historically been under-studied (central Sierra foothills, coastal locations) and suggest strategies to sustain or increase reproductive output in these regions. Perhaps fund a volunteer effort by reimbursing volunteers for food and mileage costs for monitoring efforts.
12. Encourage and/or provide monetary incentives to farmers to grow alfalfa, sunflowers, and rice within 3 miles of active tricolored blackbird colonies without insecticides or to delay their use until after the young have fledged and left the area.
13. Investigate the relative abundance of insects in rice paddies under organic culture to that in commercial rice paddies to document whether organic 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).
14. Provide additional funding and guidance for landowners to provide essential resources for nesting tricolors on private property.
15. Actively maintain all wetlands recently used by breeding tricolors, and especially those in coastal locations, to provide the youthful conditions preferred by nesting birds.
16. Develop and disseminate via the Portal handbooks that illustrate best practices for maintaining wetlands and other nesting substrates for breeding by tricolored blackbirds.
17. 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.
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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