Tricolored Blackbird Breeding Status in 2015 in the Foothill Grasslands of the Sierra Nevada, California

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ABSTRACT

In 2015, we continued studies of the Tricolored Blackbird (*Agelaius tricolor*) initiated in 2014 (Airola et al. 2015) in the grassland area on the east side of the Central Valley and lower foothills of the Sierra Nevada ("foothill grasslands"). We expanded studies from the "central foothills" (from Placer County south to Stanislaus County) to similar adjacent grassland areas

("northern and southern foothills") to describe the breeding biology of Tricolored Blackbirds throughout the Sierra foothill region. Through geographic information systems (GIS) analysis, we identified 1,269 km^2 of suitable Tricolored Blackbird habitat in the study region and estimated that we surveyed 28% of all suitable habitat and 34% of that in central foothill region. We found a total nesting population of 55,270 birds at 26 active colonies, all but one of which were in the central foothills. Compared to 2014, the number of breeding birds increased by 12,261 (29%) in 2015, which was mainly attributable to increased survey coverage. The low proportion of suitable habitat surveyed indicates that the total nesting population in the foothills may be substantially higher than the number we detected. More intensive surveys are needed throughout foothill areas, especially in areas lacking public access. All but one of 26 active colonies (i.e., those that progressed to or beyond nest-building) produced young. Low rainfall occurred during the 2013-14 and 2014-15 seasons (51% and 71% of annual average, respectively), and may have especially reduced nesting habitat and use in the southern foothills. Only 11 (42%) of 26 colonies active in 2015 were at sites occupied in 2014. As in 2014, Tricolored Blackbirds in this region nested primarily in non-native Himalayan blackberry (*Rubus armeniacus*). Two colony sites disturbed after the 2014 nesting season were not reoccupied in 2015. Half of a large 7,000-bird colony was destroyed when young were in nests, eliminating an estimated 1,386 to 2,345 nests and an equal number of potential fledglings. Habitat disturbance we observed shows a need for ongoing outreach and coordination with landowners whose lands support active colonies. More intensive surveys are needed, especially in the southern foothills if annual rainfall increases and nesting habitat conditions improve. Developing nesting habitat in the southern foothills also is a conservation priority. The annual dynamics of nesting colony locations poses challenges for traditional acquisition-based conservation strategies and reinforces the need to work actively and sensitively with private landowners in the region.

The Tricolored Blackbird (*Agelaius tricolor,* hereafter also "tricolor") has suffered a long-term population decline due to habitat losses resulting from expansion of orchards and vineyards, urban and suburban development, and destruction of breeding colonies during agricultural operations (Beedy and Hamilton 1999, Cook and Toft 2005, Meese 2014). Recent dramatic declines in the statewide population (Meese 2014, 2015) led to its advancement to candidate status under the California Endangered Species Act (CESA) in December 2015 and to a formal status review under the Federal Endangered Species Act in November 2015.

Intensive surveys to determine the current breeding status, habitat requirements, and breeding phenology of the Tricolored Blackbird in the

central portion of the grassland dominated area on the east side of the Central Valley and lower foothills of the Sierra Nevada ("foothill grasslands") were initiated in 2014. That study documented nearly 43,000 tricolors nesting at 29 colonies, representing 30% of the 2014 statewide population (Airola et al. 2015, Meese 2014). All of the 24 colonies that were monitored for reproduction in 2014 successfully fledged young. Nesting occurred primarily in patches of the non-native Himalayan blackberry (*Rubus armeniacus*) and to a lesser extent in cattail (*Typha latifolia*) and bulrush (also tule; *Schoenoplectus* acutus var. occidentalis). Airola et al. (2015) also identified potential threats to the areas supporting nearly half of the 2014 foothill grassland nesting population, based upon approved and requested plans for development and mining.

In this report, we expand upon the 2014 work by Airola et al. (2015) to more thoroughly evaluate Tricolored Blackbird habitat use patterns and reproductive success under conditions of the 2011- 2014 drought. We also evaluate the dynamics of nest site selection over the two years to contribute to conservation efforts for the species in this region.

We expanded the 2014 study area (Airola et al. 2014) to similar grassland areas to the north and south to more thoroughly describe the breeding biology of tricolors throughout the Sierra Foothill region.

Study objectives were to:

- estimate the 2015 breeding population within the central portion of the foothill grassland study area and to compare it with that of 2014,
- characterize the breeding status of tricolors to the north and south of the original (2014) central foothill region,
- estimate the extent of survey coverage (percent of suitable habitat surveyed) in the region,
- determine whether nesting colonies were successful in producing young,
- describe the dynamics of colony site occupancy (i.e., site reuse or establishment of colonies in new locations), and
- identify any land use impacts on tricolor habitat and colonies over the 2014-15 period.

STUDY AREA

The study area encompasses 9,223 km^2 (3,560 mi^2) in the lower foothills of the Sierra Nevada, and the adjacent eastern Central Valley, California, at 15 to 550 m elevation from Yuba County south to Mariposa and Merced counties (Figure 1). This area consists of the 5,762 km^2 area in the central portion of the Sierra foothills from Placer County to Stanislaus that was studied in 2014 ("central foothills", see Airola et al. 2015) and an additional 3,460 km^2 added

in 2015 in Yuba and Placer counties ("northern foothills") and Tuolumne, Merced, and Mariposa counties ("southern foothills"). Surveys in Mariposa, Merced, and Madera counties, however, covered a smaller proportion of the suitable tricolor habitat than in other counties (see RESULTS), and were not as intensively surveyed over the nesting season as were other counties. Individual locations are identified by name (in italics), as designated in the Tricolored Blackbird Portal (http://tricolor.ice.ucdavis.edu).

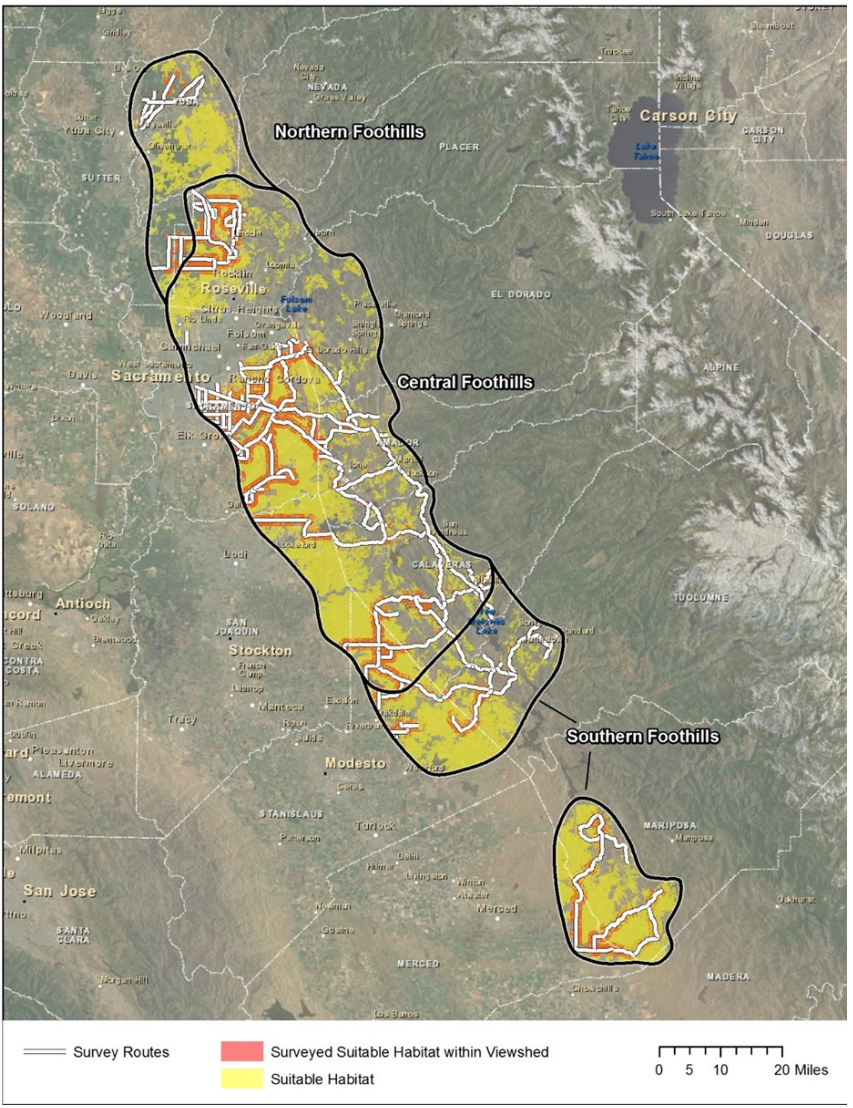


Figure 1. Suitable Tricolored Blackbird habitat and survey routes and survey areas within the 2015 Sierra Nevada foothill grassland study area.

METHODS

Surveys to Characterize the Nesting Population and Habitat

Survey participants had much prior experience conducting field surveys for Tricolored Blackbirds and nesting colonies. We conducted surveys for breeding birds from 10 April to 13 June in 2015. We surveyed all 29 sites that had been occupied in 2014 and many other sites that had previously been documented as colony locations, based on information in Airola et al. (2015) and in the Tricolored Blackbird Portal. We also surveyed for other colonies by conducting intensive road-based surveys across a large area of suitable habitat (i.e., open rangelands and areas with a low density of human dwellings with patches of Himalayan blackberry and stands of emergent cattails and bulrushes). Survey efforts in 2015, as in 2014 (Airola et al. 2015), were not quantified in detail, but coverage in 2015 was more organized and extensive than in 2014.

Survey routes were not selected randomly within the study area. Rather, routes consisted of roads driven to reach previous colony locations and other roads selected based on the presence of plant communities similar to those where colonies were known to occur. We determined whether sites were occupied by checking suitable habitat for the presence of breeding birds and by observing the flight paths of foraging birds (Beedy and Hamilton 1999). These methods enabled us to detect tricolor foraging flocks and colonies up to 1.6 km (1 mi) from roads. We generally checked sites on multiple occasions over the breeding season to detect colonies that were initiated both early and late in the nesting season and to document the fates of colonies and estimate reproductive success.

We visually estimated the numbers of breeding birds at colonies, determined nesting stage, and documented successful nesting at colonies using the methods described by Airola et al. (2015). We use the same terms as previously (Airola et al. 2015) to designate colonies as *occupied* (breeding groups present in suitable habitat), *active* (colony reached egg-laying stage), and *successful* (fledglings observed). We also recorded the nesting substrates used at each colony.

Precipitation

Airola et al. (2015) did not report on precipitation during the 2014 breeding season. We characterized rainfall in the study area for October-April in 2014 and 2015, to assess similarity between years and to the long term average. Data were taken from six gauging stations in and near the study area: Sacramento City, Folsom Dam, Auburn, Camp Pardee, Madera, and Merced (http://cdec.water.ca.gov/cgi-progs/reports/PRECIPOUT). The October to April period was used to characterize precipitation because most rainfall falls during this period in the study area and data were lacking for many

stations during May and June; also, nesting was mostly completed by early July.

Colony Location Dynamics

We compared colony locations in 2015 to those occupied in 2014 to determine the relative rate of colony location turnover. We also calculated the number of occupied sites in 2015 that had previously been surveyed and found to not be used.

Determining Survey Coverage of Suitable Habitat

To identify the proportion of suitable habitat surveyed within the study area, we first identified suitable habitat and then determined the proportion of this habitat that was visible from survey routes. Suitable habitat was defined broadly as areas of grassland and irrigated pasture, based upon previous study results of Airola et al. (2015), that were larger than 80 ha (200 ac). We mapped and estimated the area of suitable habitat from Calveg maps (as per Airola et al. 2015).

Notably, for mapping at this large scale, we did not assess the availability of nesting habitat. While we believe that nesting habitat is widely distributed within the central foothill portion of the study area, some areas within the central foothills and particularly in the southern foothills that appeared to support suitable foraging habitat may not have contained well-distributed nesting habitat. Therefore, some unknown amount of the area we designated as suitable based on foraging conditions may not have been close enough to be accessible to nesting birds.

To determine survey coverage of suitable habitat, we first mapped the roads traveled during surveys. We assumed that we could detect breeding Tricolored Blackbirds up to 1.6 km (1 mi) from survey routes within visible habitat due to their large numbers and flocking behavior when flying to forage. We then estimated the amount of suitable habitat that was visible within one mile of survey routes by excluding areas made “non-visible” by either topography or vegetation. Topographic constraints to visibility (i.e., hills, road cuts) were identified by applying a digital terrain model analysis with Esri’s ArcGIS 10.2 3D Analyst Viewshed tool. We also excluded suitable lands that would have not been visible from roads due to the obstruction by urban, orchard-vineyard, woodland, shrub, and forest CALVEG vegetation types. Suitable habitat within 1.6 km of roads that was not visually obstructed by topography and vegetation was considered surveyed. To assess completeness of survey coverage, we divided the acreage of visible suitable habitat by the total suitable Tricolored Blackbird habitat in the study area to calculate percent of suitable area surveyed.

Colony Disturbance and Losses of Nestlings and Young

We monitored all sites occupied during 2014 for signs of disturbance prior to the 2015 nesting season. We noted one active colony partially destroyed during the nesting season (See RESULTS); we used the following methods to estimate the number of nests, young, and potential fledglings destroyed. We estimated nestling losses using two methods: one based on the size of the estimated nesting population and the area of nesting habitat removed (*percent removal method*) and another based on the density of nests observed at the edge of the cleared area (*nest density method*).

Under the percent removal method, we multiplied the estimate of the colony population determined prior to disturbance by 0.67 nests per bird (since each male is assumed to breed with two females; Beedy and Hamilton 1997), and then multiplied this number by the proportion of the occupied nesting substrate that was destroyed. Under the nest density method, we counted the number of nests within a 0.5 m wide section of the remaining nesting habitat (along the entire edge of the clearing cut-face), then calculated nest density (number per longitudinal m), and multiplied nest density by the estimated width of nesting habitat removed (measured from Google Earth [earth.google.com).

We calculated estimated losses in productivity (i.e., the potential number of birds that would have fledged) at the partially destroyed colony based on an average fledging rate of 1.0 nestling per nest at successful colonies (Meese 2013, Airola et al. 2015).

RESULTS

Although 2014 results were published previously (Airola et al. 2015), a major purpose of this study was to compare 2014 and 2015 results. Therefore, we provide and compare results from the two years in this section.

Observed Nesting Population

We observed an estimated total nesting population of 55,270 birds nesting birds at 26 active colonies (Table 1). All active 2015 nesting colonies except one (*Hallwood,* Yuba County, with 200 birds) were in the central foothills, with the largest nesting populations in Placer and Sacramento counties (Table 1). Although several additional nesting attempts were initiated in the northern and southern foothills, none except *Hallwood* became active (i.e., proceeded beyond nest building).

Compared to 2014, the total number of colonies detected declined by 3 (10%), whereas the number of breeding birds detected increased by 12,261 (29%). Substantial declines occurred in both the number of colonies and nesting birds El Dorado County and in number of colonies only in Stanislaus County. Increases occurred in both number of colonies and nesting birds in Sacramento County and in nesting birds only in Placer County (Table 1).

Table 1. 2015 Tricolored Blackbird nesting population estimates by county in the lower Sierra Nevada foothill grassland region, California.

	Number of Active Colonies		Number of Nesting Birds		Suitable Area Surveyed	2015 Density
County	2014[1]	2015	2014[1]	2015	(km^2)	(#/km^2)[3]
Yuba	NS[2]	1	NS	200	30	7
Placer	6	5	12,473	19,200	183	105
El Dorado	4	1	5,800	2,900	20	145
Sacramento	9	12	11,000	19,300	424	46
Amador	3	4	6,375	6,320	63	100
San Joaquin	0	0	0	0	64	0
Calaveras	3	2	760	350	99	4
Stanislaus	4	1	6,500	7,000	169	41
Tuolumne	0	0	0	0	42	0
Mariposa	NS	0	NS	0	94	0
Merced	NS	0	NS	0	69	0
Total	29	26	43,009	55,270	1,269	

[1]Source: Airola et al. 2014
[2]NS=Not Surveyed
[3] Density calculated as # nesting birds/km^2 of suitable habitat

Survey Coverage and Resulting Nesting Density

Surveys covered a total of 776 km (466 mi) of roads in the total study area, many of which were surveyed multiple times over the nesting season. The GIS analysis identified 4,570 km^2 (1,764 mi^2) of suitable habitat in the entire study area, of which 60% was in the central foothills and 40% in the northern and southern foothills (Table 2, Figure 1). In each of the central and north-south study area subunits nearly half of the total area was suitable habitat (Table 2).

The analysis of visibility from roadways determined that we surveyed a total of 1,269 km^2 (490 mi^2; 28%) of suitable habitat in 2015 in the entire study area, with 74% of that area in the central Sierra foothills and 26% in the northern and southern foothills (Table 2). This surveyed area represents 34% of the suitable habitat in the central foothills and only 18% of suitable lands in the northern and southern foothills (Table 2).

Nesting density (# breeding birds at active colonies/km^2 surveyed) was highest in El Dorado, Placer, and Amador counties, intermediate in Sacramento and Stanislaus counties, and low in Yuba and Calaveras counties (Table 1).

Study Area Unit	Total Study Area (km^2)	Suitable Habitat (km^2)	% Total Area Suitable	Area Surveyed (km^2)	% Suitable Area Surveyed
Central Foothills	5,763	2,750	48%	936	34%
Northern and Southern Foothills	3,460	1,820	53%	333	18%
Total Study Area	9,223	4,570	50%	1,269	28%

Table 2. Amounts of suitable Tricolored Blackbird habitat available and surveyed within the Sierra Nevada foothill grassland study area in 2015.

Nesting Success

Only one active colony (*Hwy 16 between Excelsior and Eagles Nest*) failed to produce young after proceeding beyond the nest building stage (i.e., presumably to egg laying). All other active colonies that proceeded past nest-building fledged at least some young or were inferred to have done so, based on duration of occurrence (cf. Airola et al. 2015).

Precipitation

Rainfall in the study area averaged 71% of the long term average during October 2014-April 2015. The October 2013-April 2014 rainfall, which had not been previously reported (Airola et al. 2015), averaged 51% of average. Spring conditions for plant growth in annual grasslands appeared to be more similar between the years than rainfall totals suggest. Rainfall prior to and during the peak growing season of February-April was 100% of average in 2014 and 48% of average in 2015.

Nest Colony Dynamics

We identified groups of Tricolored Blackbirds at 37 different occupied sites. Of these, 26 (70%) became active (i.e., eggs laid), while 11 (30%) were abandoned either after the settling or nest building stages. Two successful colonies (*Carbondale Rd near RR tracks* and *Rancho Seco PAWS enclosure*) were initially settled by large numbers of birds, most of which abandoned after nest building, but smaller numbers proceeded to breed. Difficulty accessing and viewing the interiors of nesting substrates (especially Himalayan blackberries) precluded a complete determination at most sites of which colonies failed before or after nest building.

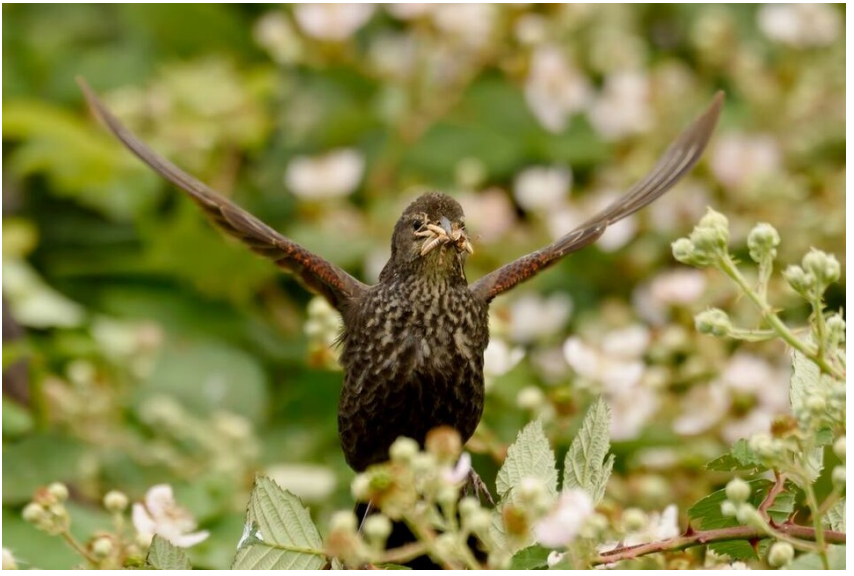
Only 11 (42%) of 26 active 2015 nesting colonies were known to have occurred at the same sites used in 2014. Eight colonies (32%) were at sites

known to be inactive in 2014, and seven (27%) were at sites not surveyed in 2014. Therefore, at the 19 colony sites active in 2015 where we also knew the nesting status in 2014, only 58% (i.e., 11 colonies) were active in both years, and 43% (8) were in locations not active in the previous year.

Numbers of colonies and nesting populations within each county varied somewhat in 2015 from the distribution in 2014. Numbers of nesting birds continued to be highest in Placer and Sacramento counties, intermediate in El Dorado, Amador, and Stanislaus, low in Calaveras and Yuba, and absent in San Joaquin (Table 1). Surveyed foothill grassland areas of Tuolumne and San Joaquin counties each had only one occupied colony that was abandoned early in the nesting season.

Nesting Habitat

Nesting substrates used at 2015 colonies were similar to those previously documented (Airola et al. 2014), with birds at 18 sites (69%) using solely Himalayan blackberry and at 2 sites (8%) using both blackberry and cattails or bulrush. Five colonies (19%) were in cattails, while one (4%) was in milk thistle (*Silybum marianum*). The largest proportion of the total breeding population used Himalayan blackberry solely for nesting (83%), while smaller proportions used mixed stands of blackberry and cattails (5%), pure cattail (12%), and milk thistle (1%).



Tricolored Blackbird (*Agelaius tricolor). 21 May 15.* Sacramento County, CA.
Photo © Dan Brown

Colony Site Disturbance

Disturbance Prior to the Nesting Season. Two of the 29 sites that supported active colonies in 2014 were made unsuitable prior to the 2015 nesting season. The *Aspen IV* colony, in Sacramento County was in a wash-water pond at an active aggregate mining site in 2014. The emergent wetlands were removed prior to the 2015 nesting season, presumably as a part of routine maintenance. At the *Bridge* colony in El Dorado County, development that began during the 2014 nesting season continued to intensify after the colony fledged that year. The blackberry patch used for nesting in 2014 became isolated within a riparian corridor preserved within the development. The tricolors did not return there to nest in 2015.

Active Colony Destruction. Part of one active colony, *Sonora Rd No. 3*, was destroyed during the 2015 nesting season. The colony was estimated to support 7,000 nesting birds on 28 April, and continued to support a large population on 9 May. When visited on 24 May, half of the colony had been destroyed by mechanical mastication. Blackberries were removed on one side of an overgrown fence line that laterally bisected the colony (Figure 2). We counted 154 partially destroyed and disturbed nests along the masticated face of the remaining blackberries (Figure 3) and 62 dead young and two adults, many of which were shredded (Figure 4). We estimated most young to be about 4 days old at the time of clearing.

Figure 2. East side of the Sonora Rd #3 Tricolored Blackbird colony after mastication to fence line, 24 May 2015. *Photo by Daniel Airola*

Figure 3. Cleared portion of the Sonora Rd #3 colony, with exposed nests evident. Close examination shows that approximately 37 disturbed nests are visible in this photo. *Photo by Daniel Airola*

Counts made of nests and dead young at *Sonora Rd #3* clearly were substantial underestimates of the actual effects of the mastication on the colony. We only counted nests that remained in a disturbed condition at the edge of the cut blackberry copse. Many additional nests were very likely to have been completely shredded and therefore were not detectable. The count of dead young also were likely substantial underestimates for several reasons: young were likely buried in the several inches of residue from the masticated vines, and the presence of substantial numbers of carcasses likely attracted scavengers that removed them (Erickson et al. 2005).

The percent removal method produced an estimated total loss of 2,345 nests. The estimate based on the nest density method and amount of habitat removed (i.e., 154 nests/0.5 m=308 nests per longitudinal meter multiplied by an estimated 4.5 m wide section of blackberry removed) yielded a loss of 1,386 nests. Therefore, somewhere in the range of 1,386 to 2,345 nests were destroyed. Based on average productivity of about 1 young per nest at successful colonies (Meese 2013, Airola et al. 2015), and the nest loss estimates described above, the habitat removal eliminated production of somewhere between 1,386 to 2,345 fledglings from the population.

Figure 4. Dead young (top, in middle foreground, left) and masticated adult male and young Tricolored Blackbirds on ground within masticated blackberry stems at Sonora Rd #3 Colony, 24 May 2015.

Photos by Daniel Airola

DISCUSSION

Recorded Nesting Population

The presence of an estimated 55,270 breeding Tricolored Blackbirds in the Sierra foothill grasslands region in 2015 further supports the previously noted importance of this region to the overall species' population (Airola et al. 2015). During 2015, the foothill grasslands area supported a known nesting population equal to at least 38% of the most recent statewide Tricolored Blackbird population estimate of 145,000 birds determined in 2014 through the statewide survey (Meese 2014).

Although the boundaries of the foothill grassland study area were expanded in 2015 from that surveyed in 2014, in 2015 all but one small colony was found in the central foothills region. The Tricolored Blackbird breeding population of 55,270 recorded in the entire Sierra foothill grasslands study area is 29% higher than the 43,009 estimated for 2014 (Airola et al. 2015). Given the overall declining status of the species (Meese 2014, 2015) it is important to consider whether this increase represents population trend or an artifact of the survey extent and procedure.

Obviously, population counts can be influenced by size of the survey area and search effort. Increasing the size of the survey area, however, did not contribute to an increased population estimate because only 200 birds (<1%) were found outside of the 2014 central foothills portion of the study area. Although survey effort was not quantified in detail in both 2014 and 2015, coverage in 2015 was more organized and extensive (in both survey days and areal coverage) than in 2014. A total of 8,820 birds was found breeding in 2015 at sites that were not surveyed in 2014. Therefore, it is possible some of these birds also bred at these sites in 2014 and were not detected. The 2015 population breeding at sites that were surveyed in both 2014 and 2015 was 42,250 (i.e., 55,270–(8,800+4,200). On the more consistent basis of considering only sites surveyed during both 2014 and 2015 years, population estimates differ only by 1.7%. This result supports the view that the foothill breeding population was stable, rather than it had increased, over this two-year period.

The near absence of active nesting tricolors in the northern and southern foothills (i.e., <1% of the total breeding population) in 2015, despite the fact that these areas supported one-fourth of the available suitable habitat, suggests that some differences exist that we did not consider in defining suitable habitat. Possible reasons why these areas supported few nesting pairs in 2015 include: lower availability of nesting habitat, lower rainfall (particularly in the south), or a different mix of land uses within these grassland-dominated areas. Tricolors nested in Mariposa County as recently as 2012 (http://ebird.org/ebird/view/checklist?subID=S10869324), which suggests some influence of the last several years' drought on the absence of

observed nesting there. We also have anecdotal information that grasshopper populations were high in some areas of Merced County (C. Swarth, pers. obs.), so food supply may have been adequate at least in some areas. Otherwise, we have no way to evaluate various possible explanations for the absence of nesting in the southern foothills. The status of the species in this region during more normal weather years deserves future attention because it could identify conservation management opportunities.

Implications of Survey Coverage

The analysis of survey coverage showed that only slightly over one-fourth (28%) of suitable foraging habitat within the entire study area was surveyed during our survey (Table 1). Due partly to access limitations, only about one-third (34%) of suitable lands were surveyed within the central foothill region, where >99% of nesting birds were found. We cannot, however, directly extrapolate to estimate a total population number based on the proportion of suitable habitat surveyed because survey routes were not selected randomly within the study area (see *METHODS*). It is likely that our nonrandom survey strategy, including focusing surveys on sites that supported nesting colonies in previous years, recorded more than 34% of the total nesting population in the foothill study area. Nonetheless, detection of 55,070 birds in the central Sierra grassland study area in a survey of only 34% of the available suitable habitat suggests that a substantially larger number of birds could have bred without being detected in this region.

Reported tricolor densities in the foothill grasslands (Table 1) should be considered only rough estimates because of non-random sampling. For example, high densities in El Dorado County reflect the focus of surveys on a small area of the county where tricolors had previously nested. Nonetheless, substantial differences in reported densities between counties likely reflects actual differences.

Implications of Precipitation

The persistent drought conditions of 2014 and 2015 provide results that characterize the Tricolored Blackbird's breeding biology in the foothill grasslands during periods of below-average precipitation. Absence of detection of nesting tricolors in the southern foothills, including within areas where tricolors bred in past wetter years, is associated with poor nesting habitat conditions in blackberry and milk thistle (*Silybum marianum*) in this region (Young and Conard, pers. obs.). Additional field work in 2016, which is predicted to be an intense El Niño year with far above average precipitation (http://www.elnino.noaa.gov/) would provide an opportunity to compare these results with those from a relatively wet year. We will be especially interested in documenting whether increased precipitation restores nesting habitat and encourages more tricolors to nest in the southern foothills, and whether it enhances reproductive success, as may be expected if insect prey resources increase under the influence of increased precipitation in 2016.

Nest Colony Dynamics

That only 61% of the occupied sites in 2015 were also occupied in 2014 provides the first estimate of location turnover in this region and is essentially identical to that reported by Holyoak et al. (2014) for a different set of tricolor colony locations in California. The annual changes in occupied sites do not reflect any obvious changes in nesting habitat conditions, as many nest sites that were occupied in only one year showed no changes between 2014 and 2015. This level of turnover may be associated with the spatial dynamics of prey abundance, and the tricolor's dependence upon relatively abundant prey populations for successful nesting (Meese 2013), but the variability in prey availability and its causes were beyond the scope of this study and require further investigation.

The dynamics of colony turnover pose a challenge for Tricolored Blackbird conservation in the foothill grasslands region (Airola et al. 2015, Airola and Young 2015). An effective conservation strategy cannot rely on acquisition-based strategies that protect nest sites and associated foraging areas used in one or a few years, but rather a dynamic system that works with private landowners to safeguard a network of suitable nesting areas that may be used only during certain years. A key element in crafting a conservation strategy for the species is to determine what factors influence nest site selection and especially to understand how relative insect abundance may affect site occupancy.

Nesting Habitat Loss and Colony Destruction

Our observations are generally consistent with the findings of Airola et al. (2015) that Tricolored Blackbird breeding locations are threatened by approved and proposed development. Three-fourths (75%) of the foothill nesting population occurred in Placer, Sacramento, and El Dorado counties, where development pressures are highest. More detailed assessment of threats is needed, that considers nesting colony locations that have been used in 2014 and 2015 and that may be used in the future. The pace of development appears to be increasing in the region, as the housing economy recovers (http://www.sacbee.com/news/business/real-estate-news/article 32382975.html). We also have not examined the mitigation measures incorporated into current development projects, but such an evaluation is needed to determine if effective measures have been incorporated, especially in light of the species' advancement to candidacy under CESA in December 2015.

Direct disturbance prior to the 2015 breeding season of the nesting substrates at two sites used by breeding birds in 2014 and the partial destruction of the vegetation occupied by one large colony in 2015 illustrates the effects of existing and changing land uses. The fact that the 2015 nesting population did not appear to decline from the 2014 level in the foothill

grassland study area suggests that nesting habitat removal during the non-nesting period, at least conducted at this scale (2 out of 29 nesting colony sites active in 2014), did not have any noticeable effect on the total nesting population. In contrast, the destruction of half of the *Sonora Rd #3* colony directly resulted in the loss of roughly 1,300-2,300 fledglings, which (at a productivity rate of 1 nestling per nest; Meese 2013) eliminated roughly 2% to 4% of the annual productivity of the known foothill grassland population. These results indicate that more outreach to landowners is needed to encourage and provide incentives to manage for Tricolored Blackbird conservation in the region.

ACKNOWELDGEMENTS

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Tricolored Blackbird (*Agelaius tricolor). 21 May 15.* Sacramento County, CA.
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