

Tricolored Blackbird Conservation Status and Opportunities in the Sierra Nevada Foothills of California

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ABSTRACT

The Tricolored Blackbird (*Agelaius tricolor*) has suffered a long-term decline in abundance in California, including a 63% loss from 2008 to 2014, which led the California Fish and Game Commission in December 2014 to list it as endangered under the California Endangered Species Act (CESA). We studied breeding colonies within a 5,665 km² area dominated by annual grasslands in the foothills of the Sierra Nevada, from Placer to Stanislaus counties, in spring 2014. Nearly 43,000 birds were documented or estimated to nest at 29 colonies, representing 30% of the statewide population. Nesting occurred primarily in non-native Himalayan blackberry (*Rubus armeniacus*; 63% of colonies), cattail-bulrush (16%), or mixtures of both (21%), in pastures irrigated for livestock forage, stock ponds, and along small creeks. Blackbirds foraged mostly in annual grasslands (70% of observations), with less use of pasture (20%) and cropland (harvested hayfields, 7%). Lands surrounding and within 5 km of colonies had more annual grassland (55%) and less woodland and shrubland (21%) than their overall abundances in the study area (45% and 31%, respectively). All 24 of the active colonies monitored for reproduction successfully fledged young. Minimum reproductive success at four colonies monitored intensively was estimated as 0.66-0.90 young per nest. Nearly half (47%) of the blackbirds nested on lands that are at risk of habitat loss to development or mining, including active development or mining (3%), zoned for development (29%), or proposed for rezoning to development (15%). The remaining 52% of nesting birds occurred on lands designated as open space, but only 1% were within protected conservation lands. Breeding birds on our study region depend upon ranching activities to create nesting habitat and maintain grassland foraging habitats. The recent listing of the species under

CESA raises concerns that landowners may alter management to discourage nesting habitat. We recommend the development of a foothill-specific conservation program to help ensure the long-term persistence of the species in this region, with key elements consisting of the relaxation of agency prohibitions on managing for Himalayan blackberry, education and outreach, incentivizing the conservation of habitats, and mitigating habitat loss to development.

INTRODUCTION

The Tricolored Blackbird (*Agelaius tricolor*, hereafter also “tricolor”) is a colonial bird species that is nearly endemic to California (Beedy and Hamilton 1999). The species has suffered a long-term population decline due to a variety of factors including range-wide habitat losses and the destruction of many of the largest breeding colonies during agricultural operations (Cook and Toft 2005, Meese 2014). The 2014 Tricolored Blackbird Statewide Survey showed a continued and dramatic decline in the statewide population, down 63% since 2008, from nearly 400,000 to 145,000 birds (Meese 2014). The recent acceleration in the rate of the decline appears to have resulted primarily from chronically low reproductive success since 2007 (Meese 2013), raising questions about the ability of the San Joaquin Valley to continue to support breeding by the species. As a result of concern over its steep and ongoing decline, the Tricolored Blackbird was listed as endangered under the emergency provisions of the California Endangered Species Act (CESA) in December 2014.

The numbers of Tricolored Blackbirds in California have been estimated at approximately three year intervals since the mid-1990s through a volunteer Tricolored Blackbird Statewide Survey (Meese 2015). The survey is conducted in the second half of April, when the total number of birds in the state may be most accurately counted (Hamilton 1998). Tricolored Blackbirds, however, are itinerant breeders, and most females are believed to nest twice, once in April in the San Joaquin and southern valleys and again in May and June in more northerly locations (Hamilton 1998, Meese unpub. data). As a result of its timing, the Statewide Survey yields limited information on the more northerly nesting colonies, breeding by birds in the later nesting season, and habitat selection by nesting birds in the northern foothills and Sacramento Valley.

Breeding by Tricolored Blackbirds in low elevation grasslands in the foothills surrounding California’s Central Valley (“foothill grasslands”) has been well documented (Beedy and Hamilton 1999, Cook and Toft 2005) but historically, little emphasis has been placed on monitoring the results of breeding efforts in this region. These grasslands are located mainly at 50-350m elevation in rolling terrain east of the lower and flatter Central Valley (see STUDY AREA) and in the Coast Ranges west of the Central Valley. The size and productivity of the nesting population in this region remain mostly

unknown. Effective conservation of the species will require additional information on the distribution and size of the nesting population, reproductive success, habitat characteristics, and potential threats to habitat in foothill grassland regions. It is of particular interest to compare the population trend in California's rangelands to other regions of the state.

Here we provide additional information on the breeding status of and habitats used by Tricolored Blackbirds in the lower elevation foothill grassland region of the central Sierra Nevada in 2014. Specifically, we:

- estimate a minimum nesting population in 2014,
- estimate relative nesting success of colonies,
- describe the seasonal dynamics of reproduction,
- describe the habitat characteristics at colonies,
- identify potential threats posed by existing and proposed land use conflicts, and
- provide conservation recommendations derived from the study

STUDY AREA

We studied Tricolored Blackbird breeding colonies within a 5,665 km² area in part of the Sierra Nevada foothills ecoregion (Sawyer et al. 2009). The area referred to here as Sierra foothill grasslands differs somewhat from the Central Sierra foothills bioregion identified by Meese (2015), by also including grassland donated regions of lower elevations in Placer, Sacramento, and Stanislaus counties. The area includes lands of generally rolling terrain above the valley floor of the Central Valley from 15-50 m elevation in the following counties: Stanislaus, Calaveras, Amador, San Joaquin, Sacramento, El Dorado, and Placer (Figure 1). The climate is extreme Mediterranean with cool wet winters and hot dry summers. Although 2014 was a drought year in California with greatly reduced winter precipitation, late-season storms in February and March appeared to provide good growing conditions for grasses in the study area (see RESULTS).

Lands in the study area are mostly privately owned. Vegetation consists primarily of annual grassland composed of non-native Mediterranean grasses and forbs (Sawyer et al. 2009). Intermixed agricultural lands include irrigated pasture, non-irrigated hayfields, and a variety of annual field crops, vineyards, and orchards (see RESULTS). Wetlands and riparian shrub and woodland vegetation occurs along rivers, small streams, natural depressions, and along man-made larger reservoirs and stock ponds. Suitable blackbird nesting habitat occurs in patches of the non-native Himalayan blackberry, which grow primarily in irrigated pastures and along stream-courses and pond edges, and emergent stands of bulrush (*Schoenoplectus californicus*) and cattail (*Typha latifolia*) in constructed ponds (Meese and Beedy 2015; also see RESULTS).

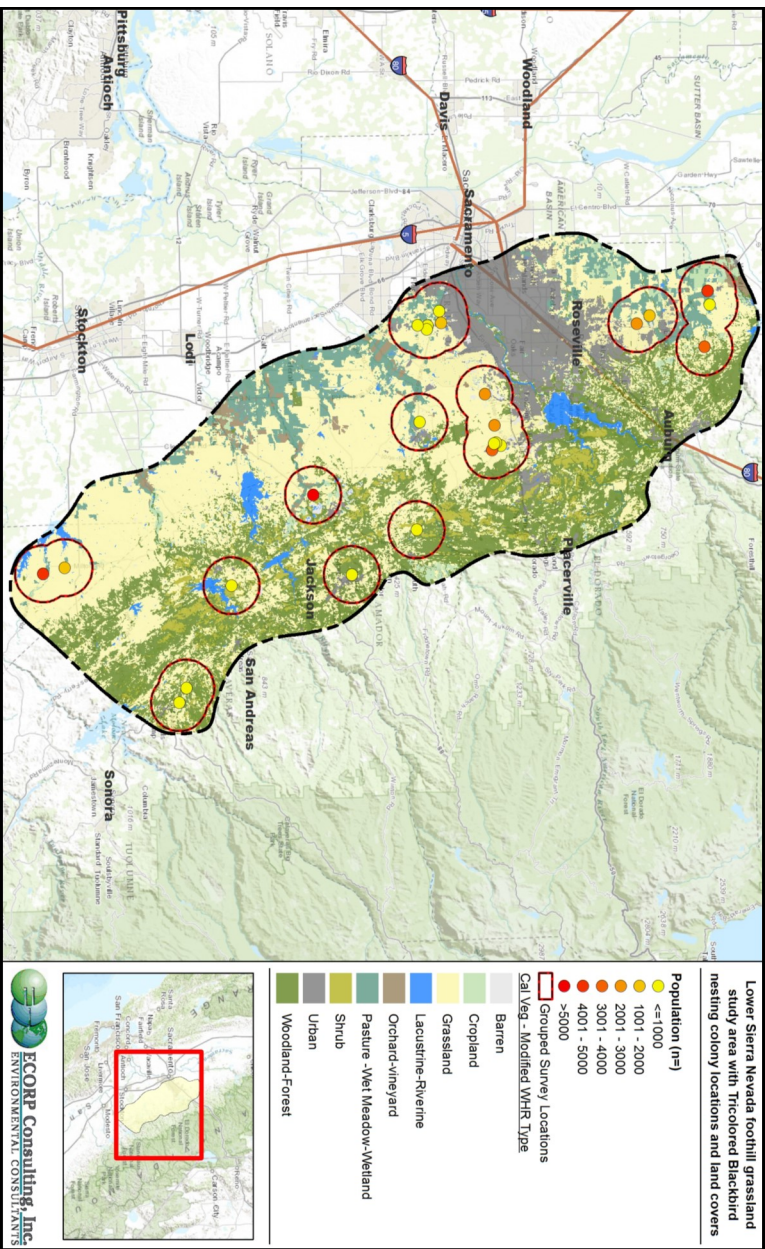


Figure 1. Lower Sierra Nevada foothill grassland study area with land covers and Tricolored Blackbird nesting colony locations and surrounding 5-km areas used in land cover analysis.

METHODS

We use the term *occupied* for sites where birds were present and sang or built nests in appropriate substrates. Colonies were *active* if they exhibited behavior indicating that egg laying had occurred (i.e., the colony went quiet and males remained out of sight), and *successful* if they fledged young. *Reproductive success* is the average number of young fledged per nest.

Field Survey

The results of the 18-20 April 2014 Tricolored Blackbird Statewide Survey (Meese 2014) identified a set of occupied sites which served as the baseline for evaluating later tricolor use. During 27 April to 20 June, we re-surveyed sites occupied during the Statewide Survey, and additional occupied sites we found during subsequent driving surveys. Colonies were located by checking apparently suitable nesting habitat (open rangelands with isolated blackberry patches and stands of emergent vegetation) and by observing birds returning from foraging bouts.

We estimated the number of birds present at each colony during each visit and documented occupancy and estimated the stage of the nesting cycle. Where possible, we determined whether colonies were successful and estimated reproductive success (see *Reproduction* below). Our surveys were not a complete census of the Tricolored Blackbird population in the study area because we lacked access to substantial areas of private property, and we surveyed only areas that could be observed from public roads. Thus, our sample represents an unknown subset of all the colonies that occur in the study area, but we believe that we located most of the colonies there, as we surveyed from most public roads and the species' considerable foraging distances and flight lines makes them conspicuous in the landscape (Beedy and Hamilton 1999).

Colony names follow those in the Tricolored Blackbird Portal hosted by the University of California, Davis (<http://tricolor.ice.ucdavis.edu>). Records of our observations were entered into the Portal.

Breeding Schedule and Population Size Estimation

The number of birds present at a colony may vary over the course of a breeding attempt due to several factors including nest site limitation, settlement of additional breeding birds, attraction of non-breeding birds, and nest failures. Therefore, we report our best estimate of the number of breeding birds (territorial males and breeding females) based on multiple visits. We monitored active nesting colonies at 1-2 week intervals to estimate the number of breeding birds, document colony chronology, and estimate reproductive success.

Precisely estimating the numbers of breeding adults was difficult due to limited access and the birds' habits of entering into dense nesting habitat and

foraging at long distances from colonies. We estimated nesting colony size by directly counting birds on the nesting substrate, in foraging areas, and flying to and from the colony, with care not to double-count the same birds. Despite our best efforts, we believed we were unable to observe all of the birds present at colonies due to limits on access and poor detectability of some roosting and foraging birds; therefore we increased our visual estimates by 25% to derive our estimates of the number of birds at each colony. All breeding population estimates at colonies were made by the authors, except at one site (E. Highway 65 Bypass Lincoln Highway) estimated by C. Conard.

We calculated a total known breeding population estimate for the study area by summing the numbers of birds at monitored sites plus estimates for five sites known to be occupied during the Statewide Survey but not monitored thereafter. The numbers of breeding birds at five unmonitored colonies were estimated by multiplying the number of birds recorded during the Statewide Survey by the average percentage of birds at fully monitored colonies that remained through the late breeding period (53%, see RESULTS).

We recorded the nesting stage during each colony visit based upon behaviors exhibited.

Reproduction

We estimated reproductive success for a subset of accessible colonies. We verified and quantified reproduction at various levels of precision depending on accessibility and the timing and frequency of visits.

Reproductive Success. We calculated reproductive success (average # young fledged/nest) for four sites where we had close access and were able to make numerous visits. Reproductive success was estimated by 1) counting the number of fledglings, 2) adding an adjusted number for proportion of the colony that could not be viewed due to access limitations and vegetation obstruction, and 3) dividing this by the number of nests (calculated as 67% of the number of breeding birds observed, as each male breeds, on average, with two females; Hamilton 1998, Beedy and Hamilton 1999, Meese 2013).

We counted fledglings at the four colonies at 3-8 day intervals (average = 5.9 days). Tricolored Blackbird fledglings often leave nesting colonies within 4-6 days after fledging (Beedy and Hamilton 1999). Therefore, our reproductive success estimates should be considered minimum numbers because some fledglings likely escaped detection due to movements away from the colony between our visits.

Reproduction Verified. We considered reproduction verified when at least one (generally more) fledgling was observed, but where an accurate count of the number of young could not be made due to incomplete access, vegetation obstruction, or lack of visits throughout the fledging period.

Reproduction Inferred. We were unable to visually verify reproduction at 14 colonies due to lack of access and distance to nesting substrates. We determined that, at other sites where access allowed detection of fledgling production, all colonies that hatched young (based on observation of food deliveries by adults) also produced fledglings. Therefore, we inferred that colonies were successful where prey delivery was observed.

We characterized colonies as reproductively successful if fledglings were observed or young were inferred to have fledged.

Nesting Substrates and Habitat Conditions near Colonies

We recorded the vegetation used for nest placement by Tricolored Blackbirds at each nesting colony. We also quantified habitat conditions within a 5 km (3 mi) radius of each of the 25 colonies, as a generalized characterization of potential foraging conditions in the surrounding landscape. The 5 km radius was selected as an approximation of the distance within which much of the colonies' foraging would occur, based on our observation of foraging locations and previous studies (Orians 1961, Meese 2014). Many of the potential foraging areas around colonies overlapped, which resulted in depiction of 11 separate polygons ranging in size from 7,850 -18,379 ha (30-71 mi²).

We compared vegetation characteristics of lands near nesting colonies to the study area as a whole, as a way to assess potential landscape factors that may influence colony location. We prepared a vegetation map for the study area using the 2009 CALVEG polygon GIS data. Data from two CALVEG zones (Zone 5, Central Valley and Zone, North Sierra) were merged to create a single data set with complete coverage for the study area.

We selected the California Wildlife Habitat Relationships (WHR) classification system (Mayer and Laudenslayer 1988) from the CALVEG data base as a basis for characterizing vegetation (http://frap.cdf.ca.gov/projects/frap_veg/classification.html). We aggregated the various WHR vegetation classes into groupings with similar vegetation structure (and thereby assumed to be perceived and used similarly by the blackbirds) to create the following land cover groupings: annual grassland, woodland/shrub, urban, pasture-wetlands, open water, cropland, orchard-vineyard, and barren.

We then quantified the area of each land cover type within the study area as a whole and within land polygons within 5 km ("vicinity") of a nesting colony. We compared the relative amounts of land cover types in the vicinities of nesting colonies to the study area as a whole to determine potential positive and negative resource selection ("selection and avoidance") by the blackbirds. We evaluated the magnitude and statistical significance of potential selection and avoidance of land covers based on Strauss's (1979) method of comparing bird use vs. availability.

Foraging Habitat

Due to access limitations, we were unable to describe prey species abundances in foraging areas (as per Meese 2013). We determined land cover types used for foraging Tricolored Blackbirds by directly observing areas where adults foraged around colonies and areas from which they carried prey to nests. We also inferred land covers used at locations out of sight from colonies by mapping travel directions of foraging birds and using aerial imagery (earth.google.com) to determine, where we could unambiguously, the land covers used by foraging birds.

Land Use Threats to Colonies

We evaluated potential threats of current and future land uses based on field examination of land conditions and uses and by reviewing planning documents for jurisdictions in which colonies occurred. Each colony was assigned to one of the following land use categories to assess potential future threats:

- *Active construction and mining*: active land clearing or construction of commercial or residential development or active aggregate mining and processing operations occurring during survey
- *Zoned for development or mining*: zoned for these uses in local jurisdictions' General Plans
- *Proposed for rezoning for development*: zoning changes have been proposed but not yet approved to allow development or mining
- *Designated open space*: designated as agricultural and open space uses in General Plans
- *Protected open space*: open space and natural areas protected through conservation easements.

RESULTS

Nesting Population and Colony Sizes

Of the approximately 65,000 Tricolored Blackbirds observed in the foothill grassland study area during the 18-20 April 2014 Statewide Survey (Meese 2014), approximately 38,644 (59%) of the birds were associated with sites that were or became active nest sites, and the remainder were observed at sites where we documented that nesting did not occur. We recorded a total of 16,200 birds at nine colony sites that were not occupied during the Statewide Survey. These individuals, however, are not assumed to have been missed by the Statewide Survey, but rather likely consisted mainly of birds that did not settle into colonies until after the survey period.

Numbers in the region as a whole and at individual nesting colonies decreased as the breeding season progressed, from the initial 65,334 to

38,770 observed breeding individuals during the late nesting period (when food-carrying or fledging was observed, from 23 May-20 June at 24 colonies). We estimated an additional nesting population totaling 4,239 birds at five colonies we did not monitor after the Statewide Survey, for a total regional nesting population of 43,009 (Table 1).

Individual colony sizes in the study area ranged from 75 to 12,000 breeding birds. Of the five colonies with >5,000 individuals at the time of the Statewide Survey, two declined by about half by the nestling period and three were abandoned before egg laying occurred.

Nesting Chronology

Nesting within the study area occurred over a period of almost three months, from 18 April (when the Statewide Survey began) through late June. Nesting activities were asynchronous among colonies, with the schedules of some adjacent colonies as much as 2.5 weeks apart. Birds in the earliest colonies were building nests on 18 April, and the latest birds were nest-building on 20 May.

The first fledglings were observed over a 36 day interval, from 15 May to 20 June. Timing of fledging was not related to elevation: the Dogtown Rd/Lakeview Dr., Calaveras County colony was at the highest elevation (525 m) but fledged young at the same time as many lower-elevation colonies.

Table 1. 2014 Tricolored Blackbird nesting population estimates by county in the foothill grassland region, California.

County	Number of colonies	Number of Nesting Birds		
		Colonies Monitored During Breeding Season	Colonies not Monitored after Statewide Survey ¹	Total
Placer	6	9,100	3,373	12,473
El Dorado	4	5,800	0	5,800
Sacramento	9	11,000	0	11,000
Amador	3	5,700	675	6,375
San Joaquin	0	0	0	0
Calaveras	3	670	90	760
Stanislaus	4	6,500	101	6,601
Total	29	38,770	4,239	43,009

¹Colonies identified during Statewide Survey, but not monitored thereafter. See Methods for approach used to estimate breeding populations at these sites.

Nesting Habitat

Tricolored Blackbirds in the foothill grassland region nested primarily in non-native Himalayan blackberry (Table 2). Blackberry was used at 20 (84%) of 24 reproductively active colony sites verified, which supported 87% of the total area nesting population. Blackberry was the sole nesting substrate at 15 of these sites, comprising 81% of the nesting population, and occurred in mixtures with bulrush or cattail at another five sites. Bulrush and cattail were both used at six and five site respectively (including mixtures with blackberry). Nesting occurred at only four sites (17%) where blackberry was absent and the birds used either cattail or bulrush alone or a mixture of the two species, comprising 13% of the nesting population. Activity was observed at one site in non-native milk thistle (*Silybum marianum*) and another in willow (*Salix* sp.) during the April Statewide Survey, but nesting did not proceed at either site.

Individual colony sizes in the study area ranged from 75 to 12,000 breeding birds. Of the five colonies with >5,000 individuals at the time of the Statewide Survey, two declined by about half by the nestling period and three were abandoned before nesting proceeded beyond initial stages.

Foraging Habitat

Breeding adults foraged primarily in annual grasslands (70% of 26 recorded colony foraging flock observations), with less frequent use of less abundant pasture (20%) and cropland (7%, all in harvested hayfields). Woodland, forest, and shrub lands were not used, although grasslands larger than 50 ha intermixed with woodlands received some foraging use. No orchards, vineyards, or urban areas were observed to be used. Tricolored Blackbirds in the study area did not make extensive use of stored grains at dairies or livestock corrals (4% of observations), which were uncommon in the region. Adult Tricolored Blackbirds were consistently seen returning to all nesting colonies from foraging bouts in annual grasslands with beaks full of many small yellowish grasshoppers (possibly *Oedaleonotus enigma* or *Melanophus devastor*).

Landscape Characteristics at Foothill Grassland Colonies

Colonies occurred at elevations from 15 to 525 m (average=121 m), but most sites were at lower elevations (median=93 m). The lower elevation limit of colonies resulted partly from our definition of the study area boundary, which was defined to exclude extensive areas of lower elevation cultivated and irrigated agriculture. The upper boundary coincided with elevations where woodland and shrubland predominated over annual grassland.

All active colonies occurred in areas with extensive annual grasslands. Grassland occupied 55% of lands within 5 km of colonies, significantly higher than the 45% of the total study area comprised by grassland (Figure 2). Area dominated by woodland, forest, and shrub occurred at lower proportions

Table 2. Nesting substrates used by Tricolored Blackbird at nesting colonies and by the nesting population as a whole in the Sierra foothill grassland region.

Nesting Substrate	Colonies		Nesting Population	
	#	%	#	%
Himalayan Blackberry only	15	62	30,755	81
Himalayan Blackberry and emergent marsh	5	21	2,270	6
Bulrush	2	8	2,500	7
Cattail	1	4	500	1
Cattail-bulrush	1	4	2,000	5

near colonies (21%) than their overall presence in the study area (31%). Urban areas also occurred at lower proportion near colonies than in the study area as a whole (8% vs 11%). The other five less common land covers (comprising <14% of total land area) were used at levels that did not differ from their availability in a biologically meaningful way.

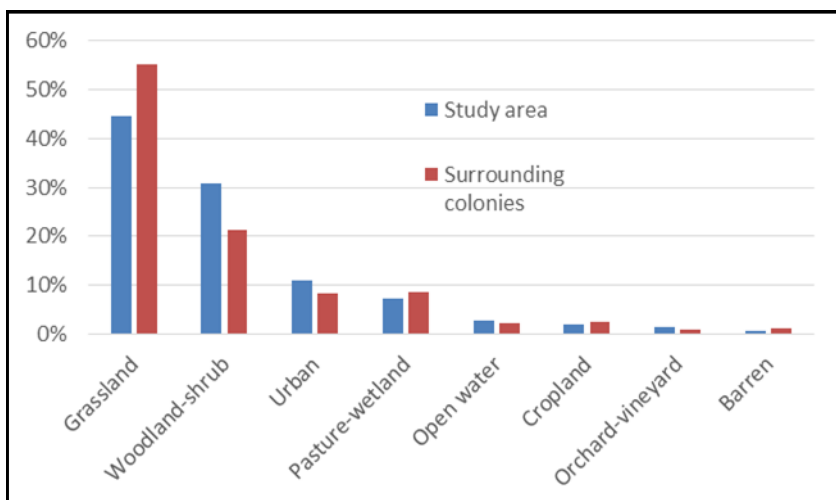


Figure 2. Comparison of percent of land areas occupied by land cover groups and lands within 5 km surrounding Tricolored Blackbird nesting colonies and in the study area as a whole.

Colony Success and Reproductive Success at Active Colonies

Due to access restrictions and limited staffing, we were able to directly observe if fledglings were produced at only 11 of the 24 active Tricolored Blackbird colonies. We could determine if adults fed nestlings or fledglings at the 13 other active colonies. We observed fledglings at all 11 of the monitored sites and inferred that reproduction was successful at all 13 other additional sites, based on food carrying. Therefore, we concluded that all 24 active colonies monitored for reproduction successfully produced some young.

We estimated reproductive success at four colonies (Table 3), representing 6,400 breeding adults, or 15% of the total studied. The minimal productivity estimates ranged from 0.66-0.90 and averaged 0.84 young per nest.

We observed no substantial effects of predation during direct field observations and no evidence of late season abandonment of colonies, which can be attributed to predation. The only instances of predation we observed at any colony were of a single Swainson's Hawk (*Buteo swainsoni*) preying on blackbirds of unknown age at one colony (Dave Brubeck Rd, Amador County) on two different dates. This predation did not result in colony abandonment. We flushed one Great Blue Heron (*Ardea herodias*) from a colony (Highway 16, 0.8 mi W Stonehouse Rd) where fledglings were present but predation was not observed.

Known and Potential Land Use Conflicts

Tricolored Blackbirds in the foothill grassland region bred within lands with a range of future threats to habitat suitability (Table 4). Active development occurred at one occupied site during the 2014 nesting season. Land was graded for commercial development within 30m of the Bridge colony in El Dorado County while adults were feeding nestlings and fledglings (Figure 3). The activity did not cause colony abandonment but eliminated a substantial amount of adjacent grassland. The successful Aspen IV colony was in an active aggregate mining wash pond.

Thirty-two percent of the colonies, including 44% of the breeding population, occurred within areas zoned for development or proposed for rezoning for development, including several actively planned projects. Sixty-one percent of colonies and the 53% of the total nesting population occurred in open space areas that are not formally protected, but are zoned for non-intensive uses (agriculture, open space). Only one site (Yankee Slough, Placer County) that supported <1% of the total breeding population occurred on lands protected as open space. Only one site, in open space (Milton Rd, 1.6 mi south of Hwy 4, Stanislaus County) had adjacent grassland recently converted to orchard.

Table 3. Minimum estimated fledgling productivity of four monitored Tricolored Blackbird colonies in the foothill grassland region.

Colony	No. Breeding Adults	No. Nests	No. Fledglings	Average No. Young/ Nest
Bridge Colony	700	467	374	0.80
Latrobe Rd, #3	4,000	2,667	2,372	0.90
Five Palm Trees	700	467	306	0.66
Elder Creek Rd #4	1,000	667	552	0.83
Total	6,400	4,268	3,604	0.84

Table 4. Levels of land vulnerability and protection afforded locations of 2014 Tricolored Blackbird colonies and the associated breeding population in the foothill grassland region.

Land Use	Colonies		Nesting Population	
	Number	%	Number	%
Active Construction	1	4	700	2
Active Mining	1	4	500	1
Zoned for Development	7	25	12,300	29
Proposed for Development Rezoning	2	7	6,500	15
Unprotected Open Space	16	57	22,615	53
Protected Open Space	1	4	400	1

Land use change poses the greatest threat to Tricolored Blackbird colonies in El Dorado County where all four 2014 colonies, supporting 5,800 breeding individuals, were located within or adjacent to proposed development south of El Dorado Hills. Placer, Sacramento, and Amador counties each show a range of land use threats, with six of 16 active colonies within areas proposed or zoned for development and others in open space zoning designations. All seven colonies in Calaveras and Stanislaus counties were in lands designated as open space.

Ranching and Farming Practices. Most grasslands surrounding nesting colonies were grazed by cattle. Tricolored Blackbirds regularly, but not exclusively, associated with cattle in open rangelands. We did not directly observe any rangeland management actions that detrimentally affected nesting habitat in occupied Tricolored Blackbird. One landowner, however, who did not provide land access after the Statewide Survey identified an estimated 6,500 Tricolored Blackbirds there, reported at the height of the nesting season (25 May) that she was controlling Himalayan blackberries where the birds nested and that “the birds were gone” (fide C. Conard, pers. comm.). We also observed other colony sites in the study area used in previous years but not active in 2014 that appeared to have been treated with herbicide or burned in previous years, presumably to reduce blackberry competition with livestock forage or to maintain ditches. Conditions in these areas were not optimal for nesting in 2014.



Figure 2. Land clearing in grasslands adjacent to the "Bridge" Tricolored Blackbird colony in Himalayan blackberry (in mid-ground), El Dorado County, 18 May 2014. Subsequent work also removed most of the grassland area including the area in foreground, leaving a 10 m buffer around the active colony. The colony successfully fledged young while land grading was occurring (see Table 3). Photo © Daniel A. Airola

DISCUSSION

Breeding Occurrence and Abundance Patterns

The Tricolored Blackbird numbers we recorded at colonies in the foothill grassland study area are a minimum estimate of the 2014 nesting population due to our restricted access to private property. All of the colonies we studied occurred on private property, and our access was limited almost entirely to public roads. Although breeding sites could be detected up to 2+km away based on observations of foraging blackbirds leaving and returning to colonies from in surrounding lands, not all suitable breeding areas were surveyed. Some of these inaccessible lands appear to provide suitable habitat, based on superficial examination of aerial imagery. We recommend a more thorough investigation of the foothill region and the development of a habitat suitability model to identify priority sites for additional investigation, if access can be acquired.

The estimate of over 43,000 breeding birds for the foothill grassland region comprises nearly 30% of the total statewide population estimate of 144,000 tricolors (Meese 2014). This number represents the first estimate of the minimum breeding population for this region of the state. Previous characterizations of Tricolored Blackbird use within this region have been based on the April Statewide Survey, which is conducted at a time when many birds appear to be migrating north through the region to other breeding areas and before nesting begins in many areas. Therefore, our information shows the foothill grassland region has substantial importance to the statewide breeding Tricolored Blackbird population.

Colony asynchrony has been previously noted in the Sierra Nevada foothills (Beedy 2008). The greater detail we provide for this region may assist in understanding relationships between the species' itinerant breeding populations across the state and should inform scheduling of future breeding season surveys.

Reproductive Success

All indicators of Tricolored Blackbird reproductive success, including minimum levels of fledgling productivity at closely monitored colonies, presence of fledglings at others, and low rates of colony abandonment after colony initiation, all indicate that at least moderate levels of reproduction occurred in 2014 at foothill grassland colonies. This apparently healthy rate of reproductive success contrasts with low productivity in San Joaquin Valley agricultural habitats in 2014 and previous years (Meese 2013). Thus, beyond the simple numbers of breeders supported within the region, reproduction indicators suggest that this population segment may have contributed more to species recruitment than those in the San Joaquin Valley and perhaps other regions.

The consistent reproduction at Tricolored Blackbird colonies in foothill grasslands where upland Himalayan blackberry was the predominant nesting substrate is consistent with observations by Cook and Toft (2005), who reported higher nesting success in upland than wetland nesting habitats, and Holyoak et al. (2014), who reported higher production in Himalayan blackberry than in other nesting substrates. In addition to low predation rates at colonies, higher reproductive success may also have resulted from abundant insect prey, as reported by Meese (2013). Although prey could not be quantified due to restrictions on access, our observations of adults returning from foraging flights with multiple prey items in their bills suggests that the foraging habitats surrounding these foothill colonies provided adequate prey.

Nesting and Foraging Habitats

Tricolored Blackbirds in the foothill grassland region in 2014 used a different suite of vegetation types for nesting and foraging than do those on the Central Valley floor. Although we have not measured the availability of suitable blackberry and emergent marsh nesting habitat to assess resource selection, the birds we studied made extensive use of Himalayan blackberry coves as a nesting substrate. The importance of grasslands is indicated by the extensive use of grasslands by foraging tricolors and by the birds' selective location of nesting colonies in areas with high proportions of grasslands. Grain crops used by tricolors in the San Joaquin Valley (Meese 2013) are absent from the Sierra foothills. In contrast to the agricultural conflicts in the San Joaquin Valley, and tricolor breeding and ranching appear to be compatible land uses in the foothills. Indeed, due to the large number of grasshoppers consumed by breeding birds and the dependence upon grasses for cattle, tricolors and cattle ranching appear to be mutually beneficial, with tricolor consumption of grasshoppers increasing the amount of available cattle forage by removing large numbers of insect herbivores.

Conservation Implications and Needs

The relatively large number of birds that bred successfully in the foothill grassland study area in a year of historic drought when no breeding was documented in all of Colusa County (Meese, unpub. data) and the number of birds breeding in the San Joaquin Valley was 78% lower than it was in 2008 (Meese 2014), suggests that the region may play a previously unappreciated role in Tricolored Blackbird conservation. Tricolored Blackbirds are known to respond strongly to insect prey populations, especially grasshoppers (Payne 1969, Meese 2013), and our observations and results from this exceptionally dry year suggest that, unlike in other portions of the species range, the birds found favorable breeding conditions in the Sierra foothills. Our results suggest that additional work is needed to better assess the long-term conservation value of this region and California's rangelands more generally.

Tricolored Blackbirds breeding in the Sierra foothill rangelands face threats associated with changing land uses. Existing and proposed developments may impact a substantial portion of the birds' habitats, with nearly half of the colony locations occurring in sites that were being actively developed or mined, approved for development, or proposed for future development and mining. Land use planners and Tricolored Blackbird managers should consider individual and cumulative impacts on the birds' required habitats when evaluating development proposals. All impacts on required resources should be adequately mitigated and planning in the region should maximize opportunities to conserve and enhance resources required by breeding birds. Mitigation efforts to date tend to favor protection of riparian and oak woodland habitats and less so annual grasslands required by Tricolored Blackbirds for foraging.

Although livestock grazing and Tricolored Blackbird conservation appear to be mutually compatible land uses in the Sierra foothills, a potential conflict exists with the control of blackberries. Blackberry copses are the dominant nesting substrate in this region, but blackberries are typically controlled at intervals to maintain access to livestock forage and to maintain irrigation ditches. Although we observed one possible disruption of an active tricolor breeding colony by blackberry control, most control efforts over the foothill grassland region are localized and occur at multi-year intervals at individual sites. In addition, much of the blackberry that may be subject to control is not highly suitable as nesting habitat due to patch size, density, and height. (see Meese and Beedy 2015). As tricolors frequently move between different nesting sites in alternate years (Holyoak et al. 2014), periodic blackberry control, if it occurs during the non-breeding season, is largely compatible with Tricolored Blackbird conservation.

The recent listing of the Tricolored Blackbird as Endangered by the State of California has the potential to cause landowners to remove nesting habitat, as a means to avoid perceived land use restrictions that could result from hosting a colony, as noted in the comment letter on the listing decision jointly submitted by the California Cattleman's Association, Farm Bureau Federation, Building Industry Association, and other entities (http://www.fgc.ca.gov/meetings/2014/dec/Exhibits/6_3_LTR_Tricolor_Coalition112014.pdf). Such removal, if focused on recently used nesting habitat in sufficient amounts, has the potential to reduce populations in foothill grasslands. We believe that except for legal prohibitions on removal of active nests during the 2-month nesting period, the potential for conflicts between the Endangered Species Act requirements and the ranching industry is minimal. Nonetheless, a program to pay landowners to protect Tricolored Blackbird nesting colonies may be a valuable way to both protect the species and to show good faith and incentivize the livestock industry (Airola and Young 2015).

Extensive use of Himalayan blackberry for nesting by Tricolored Blackbirds creates a potential conflict with other ecosystem management goals. Because it is an exotic, invasive species, the Himalayan blackberry is widely considered to be a pest species that degrades native ecosystems (Bossard et al. 2000) and may not be planted as part of federally-funded habitat restoration programs. Many of the areas where it is used by Tricolored Blackbirds, however, are in heavily grazed irrigated pastures and at the edges of stock ponds or small creeks in grassland habitat. In many such areas, few other woody native plants can grow due to high grazing pressure and because they lack the heavy armoring that protects Himalayan blackberry from grazing. In addition, in many of the areas that it grows, the blackberry outcompetes only other non-native herbaceous species that grow in heavily grazed annual grasslands or irrigated pastures. Therefore, across a wide area of the foothills, localized clumps of dense, tall Himalayan blackberry provide the only viable nesting substrate for Tricolored Blackbirds, without degrading native ecosystems. Conservation agencies and organizations need to show more management flexibility to maintain and even encourage the strategic and localized development of Himalayan blackberry nesting habitat for Tricolored blackbirds in this and similar regions.

Effects of grazing on availability of grasshoppers and other arthropod prey eaten by Tricolored Blackbirds are unknown. Although both livestock and grasshoppers are herbivorous, and thus might be considered to be in competition for forage, reduction in grass height and density by livestock also may allow foraging blackbirds increased access to prey. Improved access to prey could offset the possible detrimental effects of reduction in prey numbers. Grazing also provides the incentives to irrigate pasture, and many of the blackberry patches used by Tricolored Blackbirds occur in irrigated fields and along ditches and reservoirs constructed and operated for irrigation.

Enhancing the image of Tricolored Blackbirds as consumers of large numbers of grasshoppers (Payne 1969, Skorupa et al. 1980), which compete for forage with livestock, may provide incentive for ranchers to maintain some blackberry patches for blackbird nesting. If economic incentives are required to get ranchers to maintain or even encourage blackberries, the cost should be substantially lower than the conservation expenditures that have been made to date to delay crop harvest in more intensively managed agricultural lands of the San Joaquin Valley (Airola and Young 2015).

Conservation efforts for the Tricolored Blackbird in foothill grassland regions should be combined with conservation efforts for other grassland and vernal pool species to optimize overall effectiveness. Several other bird species of conservation concern, including wintering raptors (Pandolfino et al. 2011, Pandolfino and Smith 2011), Loggerhead Shrike (*Lanius ludovicianus*; Humple 2008), and Grasshopper Sparrow (*Ammodramus savannarum*; Unitt

2008), as well as other sensitive plants and animals (Hunter et al. 2011) occur in similar large grassland areas.

Previous recommendations for Tricolored Blackbird conservation on private lands were limited, consisting primarily of protecting active colonies; encouraging consideration of nesting and foraging needs in created mitigation wetlands; and incorporating the species needs in Habitat Conservation Plans (HCPs), other multispecies plans, and ongoing private habitat conservation programs (Beedy and Hamilton 1997). Our study results and implications have been incorporated into updated management recommendations and recovery recommendations for the species (Meese and Beedy 2015, Meese et al. 2015).

This study provides an estimate of the contribution of the Sierra foothill rangelands to Tricolored Blackbird conservation; however, existing benefits to the species may be reduced due to significant threats associated with landscape changes including urbanization, conversion to orchards and vineyards, and mining. We suggest that California's rangelands be more thoroughly studied as Tricolored Blackbird conservation areas to better assess their potential to aid in recovering the species. We specifically need to know whether the birds that breed here are breeding first elsewhere, and we need further study to estimate the annual variation in reproductive success. California's rangelands are providing many previously underappreciated conservation benefits and likely numerous additional opportunities exist to enhance these contributions as part of an integrated, pragmatic, and cost-effective conservation strategy.

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Tricolored Blackbird (*Agelaius tricolor*). 15 Feb 2015. Folsom, Sacramento County, California. Photo © Ray Rozema