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Special Issue on the Status, Ecology, and Conservation of the Tricolored Blackbird

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The *Central Valley Bird Club Bulletin* welcomes the contribution of articles, notes, and news of research and publications on the avifauna of California's Central Valley. Of particular interest is original information that addresses bird status, distribution, ecology, and conservation. Contribution of high quality photographs and artwork are also welcomed. Potential contributors are encouraged to contact the editor.

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Special Issue on the Status, Management, and Conservation of the Tricolored Blackbird

The Tricolored Blackbird is a near-endemic of the Central Valley and a symbol for the Central Valley Bird Club (see cover). It truly is "California's Blackbird". The species is in trouble for a variety of reasons, and the solutions are not obvious or easy to achieve. In December 2014, the California Fish and Game Commission listed the Tricolor as Endangered under its emergency protection procedure, and the species has been petitioned for listing under the federal Endangered Species Act. These actions, however, are not a solution. Rather, they are the start of a new chapter in conservation efforts.

We must continue to work on many levels cooperatively to safeguard the species. A hallmark of the Central Valley Bird Club has been its cooperative work with the agricultural and ranching communities on a variety of projects, including management of rice lands for waterbirds and assessing and protecting private grasslands for wintering and breeding raptors. Success in conserving the Tricolored Blackbird will require an unprecedented level of cooperation and collaboration with these and many other entities. Conservation will require both encouraging practices that benefit the species and mitigating those activities that are harmful. The responsibilities however, must be assigned in a manner that doesn't unfairly burden private entities upon whose land the blackbird depends, but rather as a commitment shared by all.

This special issue of the Bulletin provides important information documenting the precarious status and declining trend of the Tricolored Blackbird both on a statewide and regional basis. It identifies a new approach to population assessment that can give a more frequent assessment of the species status and the effectiveness of conservation actions. It also provides new information on the ecology of the species in the lower foothills of the Sierra Nevada and a program to provide incentives for private ranchers to protect and enhance Tricolored Blackbird nesting habitat.

The issue also includes key information on recovery actions and management practices needed for Tricolored Blackbird habitats, and information on a large scale cooperative program to address the difficult issue of nesting loss during harvest of silage crops at dairy farms. Finally we include a case study of the formation of an impressive ad-hoc group representing Audubon Chapters, Audubon California, and the Central Valley Bird Club that has rapidly undertaken a leadership role in conducting on the ground actions to reverse the species' decline.

The Central Valley Bird Club is proud to provide so much critical information in a timely manner to support Tricolored Blackbird conservation

efforts. To that end, we are more broadly marketing this issue to a wider audience with interest in conserving this species.

We hope you enjoy this issue, but more importantly, we hope it spurs you to action on behalf of the Tricolored Blackbird. Your support of the Central Valley Bird Club has helped prepare this issue of the Bulletin. There are many other meaningful contributions that you can make: assisting with ongoing species surveys, financially supporting ongoing conservation efforts, advocating on behalf of the species, publicizing the plight of the species and gaining public support, joining action groups that are identifying and implementing conservation projects… the list goes on. Find a way to help.

Chris Conard (CVBC President) and Daniel A. Airola (CVBC Editor)

Flock of Tricolored Blackbirds. *Photo © Andrew Engilis, Jr.*

Note from Editor:

This issue was made possible through the dedication and hard work by many people. I particularly thank species experts Drs. Robert (Bob) Meese and Edward C. (Ted) Beedy who authored many papers and reviewed others. I also offer thanks to Lowell Young for his encouragement in preparing this volume and his dedication to Tricolored Blackbird conservation. Finally a huge thanks to Layout Editor, Frances Oliver; Photo Editor, Dan Brown; and proof-reader Dan Kopp for their substantial and critical efforts in bring this issue to press.

Daniel A. Airola

Efforts to Assess the Status of the Tricolored Blackbird from 1931 to 2014

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The Tricolored Blackbird (*Agelaius tricolor;* hereafter, also "tricolor"), is unique to California. Among its many salient traits, the tricolor is colonial, and often nests in large groups that place heavy demands upon the local biota. Globally, colonial species are believed to be highly vulnerable (Terborgh 1974), and many have become conservation priorities. The tricolor is among these, as it has over the past century suffered a steep population decline due to reductions in its native breeding and foraging habitats and several other factors (Beedy and Hamilton 1997). More recently, elevated rates of mortality of eggs and chicks have resulted from the destruction of breeding colonies during the harvest of their grain field nesting substrates (Meese 2009), and an unknown number of adults is shot in autumn when in mixed flocks foraging in ripening rice with red-winged and other blackbird species (USDA 2013, Meese unpub. data).

In December 2014 the tricolor was given emergency protection under the California Endangered Species Act as a result of its steep and accelerating population decline (Meese 2014). A petition for listing under the federal Endangered Species Act also has been submitted recently.

It is inherently difficult to assemble enough information on rare species to enable robust evidence-based recovery efforts. In some ways, tricolors pose particular problems in that they breed in a rather small number of large, somewhat ephemeral colonies that, over time, blink on and off across the landscape (Holyoak et al. 2014). As a result, classic random sampling is likely to miss even larger colonies, or to produce population estimates of unknown reliability. On the other hand, the future of the species may rest on the success or failure of a fairly small number of large and conspicuous colonies which are intensively monitored. Thus, the species' unusual biology makes it a unique study subject, but at the same time provides special opportunities to demonstrate that science can greatly improve conservation outcomes.

In order to address these biology-induced sampling problems and to monitor the status of the species, since the 1990's the primary means to estimate the number of tricolors in California has been the triennial Tricolored Blackbird Statewide Survey (Hamilton 2000; Holyoak et al. 2014). The purpose

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of this report is to review and evaluate efforts to document the status of the species, to contrast prior efforts to those of the past three Tricolored Blackbird Statewide Surveys, and to examine the most recent trends in abundance and distribution. It excludes consideration of synthetic works (e.g., Graves et al. 2013, Holyoak et al. 2014).

METHODS

I reviewed the scientific literature and other published and unpublished reports beginning with Neff (1937) until mid-2014 to summarize and characterize efforts to determine the status and estimate the size of the Tricolored Blackbird population in California. I used the comprehensive reports of the 2008, 2011, and 2014 Tricolored Blackbird Statewide Surveys, along with the standardized methods and data management support provided by the Tricolored Blackbird Portal (http://tricolor.ice.ucdavis.edu), to compare the results of these three Statewide Surveys and to contrast these with prior efforts to assess the conservation status of the species.

I also present results by "bioregions"—large parts of the state that are relatively ecologically homogeneous and distinct, to assess regional differences (Figure 1). Previous reports (Kelsey 2008, Kyle and Kelsey 2011) have also recognized bioregions, but their boundaries were somewhat different than those recognized here. I divided the state into five bioregions that include the majority of the breeding distribution of the Tricolored Blackbird:

1. Southern California: the entire region south of the Transverse Range; includes southern Kern County, and all of Ventura, Los Angeles, San Bernardino, Orange, Riverside, San Diego, and Imperial counties.
2. San Joaquin Valley: the portions of northern Kern, Tulare, Fresno, Madera, and Stanislaus counties below 100 m elevation and all of Kings, Merced, and San Joaquin counties.
3. Central Coast: Alameda, Santa Clara, Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara counties.
4. Central Sierra Foothills: portions of Placer, El Dorado, Amador, Calaveras, and Stanislaus counties between 100-500 m elevation.
5. Sacramento Valley: Sacramento, Yolo, Sutter, Yuba, Colusa, Glenn, and portions of Butte and Tehama counties below 100 m elevation.

The Sacramento Valley is included in the analysis of bioregions although tricolors are itinerant breeders and most birds arrive to breed in this portion of their range only after having first bred in the San Joaquin Valley (Hamilton 1998, Meese unpub. data). Thus, the Statewide Survey, which occurs in the second half of April, provides an estimate of the number of tricolors in the Sacramento Valley at this time but does not provide an estimate of the total number of birds that breed there. Similarly, the Modoc Plateau is not included in this analysis because birds breed in this part of California after April, so are

not recorded during the Statewide Survey, the results of which form the data sets upon which this analysis is based.

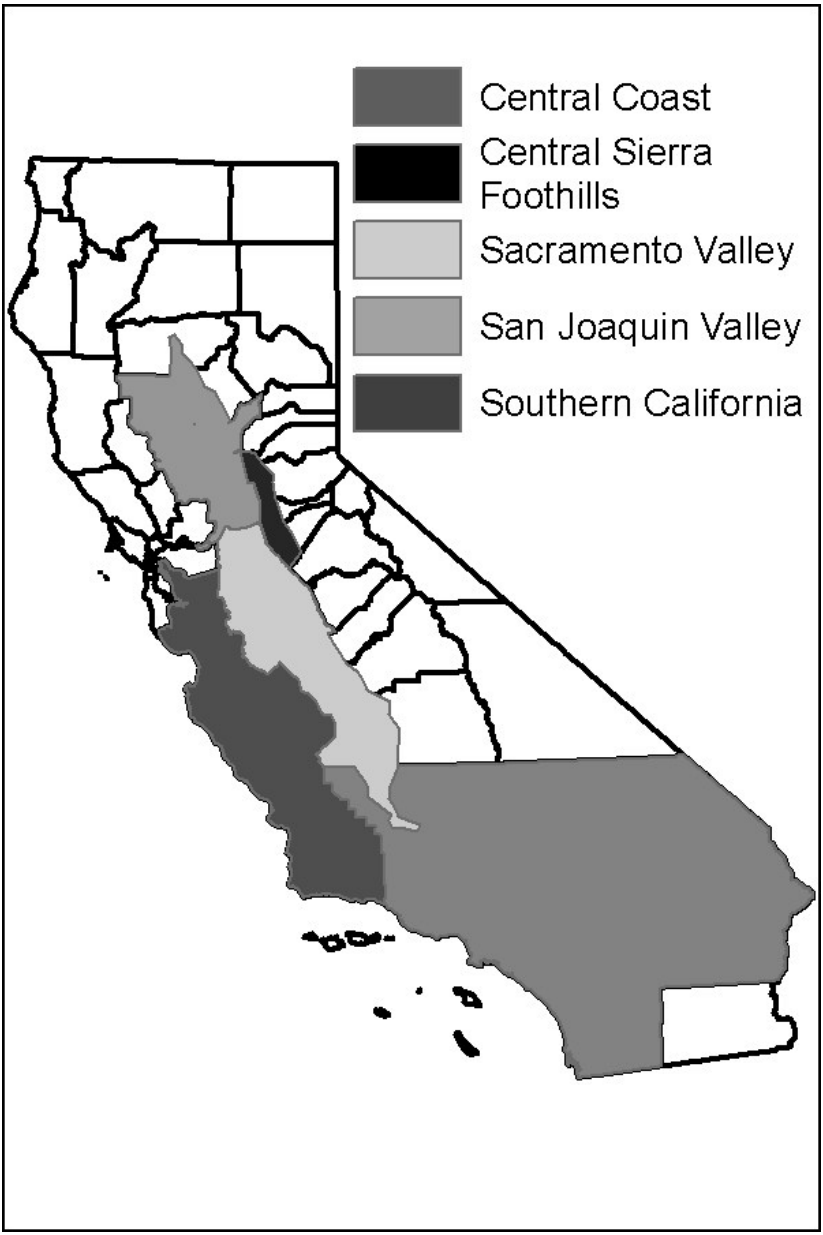

Figure 1. Bioregions used in this paper to discuss Tricolored Blackbird Status in California.

RESULTS

Neff (1937) was the first to attempt to assess the status of the Tricolored Blackbird in California. Neff's work was stimulated by anecdotal observations of absences of tricolors from locations where they had previously been common and focused on nest counts in primarily very large colonies during the breeding season and on visual counts of roosting birds at a few locations in the non-breeding season. Neff's (1937) work, conducted from 1931 until 1936, did not attempt to provide a comprehensive survey of the entire range of the species because "such a survey was humanly impossible", and he did not attempt to estimate the number of birds in a brief interval of time. He concluded that the species had likely undergone a serious population decline in response to widespread habitat losses associated with the drainage and filling-in of marshes in the early 20th century. This, he believed, was followed by a population increase due to the development of irrigated agriculture and he found that the species was still quite common in many areas. Although Neff (1937) did not attempt to estimate the total number of birds in California, he provided what he described as a conservative estimate of 491,000 nests within 46 colonies in only eight counties in 1934, which would be about 736,500 birds (assuming that each male breeds, on average, with two females; Beedy and Hamilton 1999).

DeHaven et al. (1975) were the next to attempt to survey a large portion of the tricolor's breeding range. They surveyed much the same region as did Neff and his collaborators over three decades earlier. Their work, conducted from 1969 to 1972, emphasized the Central Valley, although in 1971 they attempted to survey the entire breeding range. Although they, too, studied colonies throughout the breeding season, they concluded that the number of tricolors had declined by at least 50% in the 35 years since Neff's work.

The concept of a Statewide Survey, an effort to estimate the total number of breeding birds in the entire state, was developed by Edward C. (Ted) Beedy and William J. Hamilton III in 1993 (Beedy, pers. comm., Beedy and Hamilton 1997) in response to previous, more limited surveys that suggested an on-going decline in abundance. The Statewide Survey was proposed as a voluntary effort with numerous participants that was centrally coordinated, and conducted within a 3-day interval every three years beginning in 1994. Statewide Surveys were conducted in 1994, 1997, 2000, and 2005, but due to differences in methodology, duration, level of effort, geographic completeness, inadequate data management, and incomplete documentation, the results of these surveys are not directly comparable (Hamilton 2000).

Table 1. Comparison of the first four statewide surveys. Sources: Beedy and Hamilton 1997, Hamilton 2000, EDAW 2005.

Sources: Beedy and Hamilton 1997, Hamilton 2000, EDAW 2005.

Year	Duration	Participants	Counties Surveyed	Sites Surveyed	Occupied Sites Identified	Birds Observed	Comments
1994	Not reported (3 days?)	68	32	Not reported	28	369,359	follow-up survey results included
1997	Not reported (3 days?)	55	34	Not reported	71	237,928	follow-up survey results included
2000	4 days	81	33	Not reported	71	162,000	pre-survey workshop held
2005	3 days	65	24	Not reported	121	257,802	No report submitted

The Statewide Survey methodology was revised in 2008 by: 1) adding county coordinators to transfer the coordination of the participants from the statewide to the county level, 2) providing training sessions for survey participants, and 3) developing and deploying a web-based Tricolored Blackbird Portal. A level of survey coordination at the county level was added to improve colony detection and geographic completeness by taking greater advantage of local knowledge (Hamilton 2000), and to share the burden of the coordination of a statewide effort among several individuals. In many cases, county coordinators were environmental consultants with extensive local experience with the species and a large pool of qualified persons from which to draw to serve as survey participants.

The Tricolored Blackbird Portal was developed to:

- enhance the management of existing data on colony locations and observations of birds at breeding colonies and in non-breeding aggregations,
- improve communication by providing controlled vocabularies that enabled Portal users to standardize on colony location and nesting substrate names,
- enhance citizen participation by providing online data entry capabilities for records of colony locations and observations of birds (including support for the Statewide Surveys),
- provide reliable natural history information,
- provide access to numerous reports and publications, and
- provide news and links to news reports.

The Portal was developed as a secure, public resource and is password-protected: a user account is required to enter records so as to reduce spam and unwanted spurious records. A small staff of content managers with extensive Tricolored Blackbird and data management experience edits records and assures quality control.

All of the Statewide Surveys since 2008 (i.e. 2008, 2011, and 2014) have used the three levels of coordination (statewide coordinator, county coordinator, participant), are more thoroughly standardized by data entry via the Portal, and are more completely documented by comprehensive reports, so the results of these three surveys are more directly comparable than are those from previous surveys. Table 2 provides a comparison of the results of the three most recent Statewide Surveys.

The results of the three most recent Statewide Surveys showed a rapid decline in abundance, from just under 395,000 birds to 145,000 birds in 6 years, a decline of 63% (Meese 2014). The rate of decline appears to be increasing: from 2008 to 2011 the number of tricolors dropped by 35%, from

395,000 to 258,000 birds (Kyle and Kelsey 2011), but from 2011 to 2014 the number of birds dropped by 44%, from 258,000 to 145,000 birds (Figure 2).

Table 2. Comparison of 2008, 2011, and 2014 Statewide Surveys. Sources: Kelsey 2008, Kyle and Kelsey 2011, Meese 2014.

Year	Duration (days)	Participants	Counties Surveyed	Sites Surveyed	Occupied Sites Identified	Statewide Population Estimate
2008	3	155	38	361	155	394,858
2011	3	100	29	608	138	258,000
2014	3	143	41	802	143	145,000

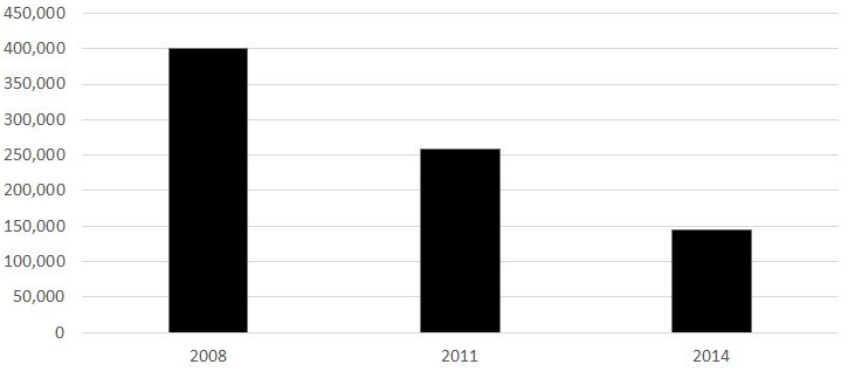

Figure 2. Estimates of the number of Tricolored Blackbirds in California in 2008, 2011, and 2014.

The decline in the statewide estimate of the number of birds occurred despite a rapid increase in knowledge of where the birds breed, as data entry via the Tricolored Blackbird Portal has allowed 77 different Portal users to enter 249 new colony location records since 2008 (Figure 3).

The 2014 Statewide Survey was the most comprehensive: 802 known locations were surveyed versus only 361 locations surveyed in 2008 (Table 2). Hence, the recorded decline cannot be attributed to a decline in the thoroughness of the surveys.

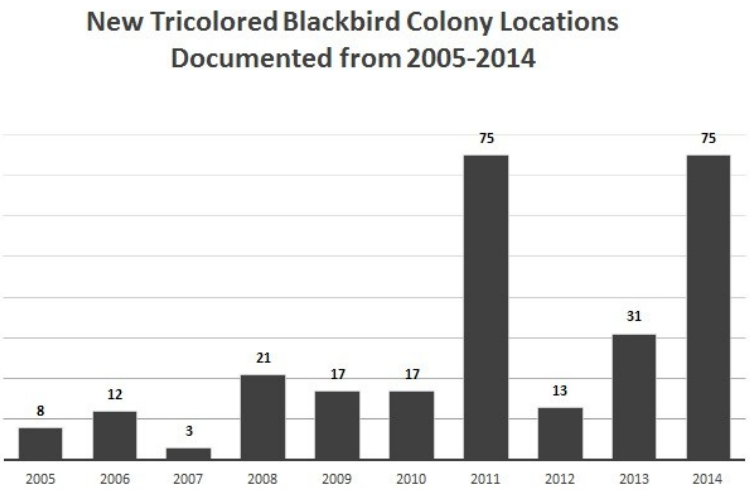

Figure 3. Number of previously unreported Tricolored Blackbird colony locations reported each year from 2005-2014.

Associated with the decline in the number of birds was a dramatic decline in the sizes of the largest colonies (Figure 4).

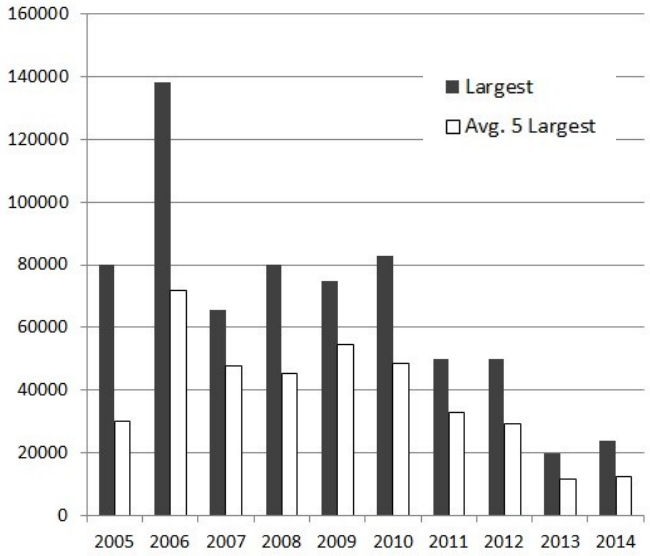

Figure 4. Ten year trend in the sizes of the largest Tricolored Blackbird colonies and averages of the five largest colonies.

The rate and intensity of the decline between 2008 and 2014 varied among bioregions. The Central Coast had the greatest proportionate decline, dropping 91%, from 7,014 birds in 2008 to 652 birds in 2014. The San Joaquin Valley had the second highest proportionate decline, dropping 78% from 340,703 birds in 2008 to 73,482 birds in 2014. The number of birds in southern California increased by 126%, from 5,487 birds in 2008 to 12,386 birds in 2014, due primarily to a single large colony of 5,000 breeding birds in Los Angeles County (Meese 2014). The number of birds in the Central Sierra Foothills also increased, from 22,586 birds in 2008 to 28,281 birds in 2014. Figure 5 summarizes the results for the three most recent Statewide Surveys by bioregion.

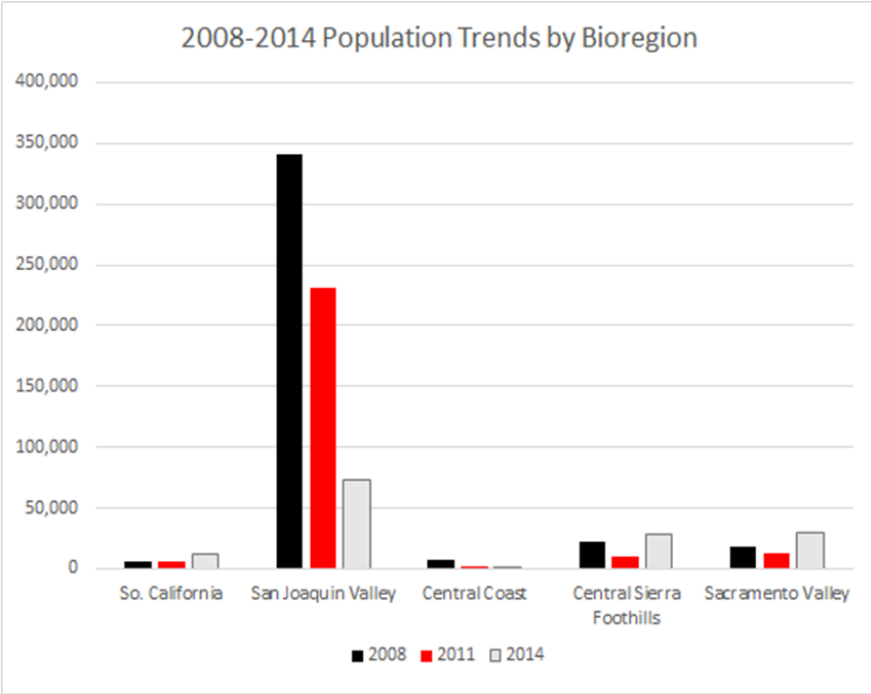

Figure 5. Results of 2008, 2011, and 2014 Statewide Surveys by Bioregion.

DISCUSSION

Early efforts to determine the status of the Tricolored Blackbird depended upon the work of a small number of individuals who tried to survey an immense geographic area and, due to logistical and time constraints, had to focus on locations concentrated in the Sacramento Valley (Neff 1937,

DeHaven et al. 1975). Neither Neff (1937) nor DeHaven et al. (1975) attempted to estimate the statewide population of the species but rather attempted to survey breeding birds during the entire breeding season. DeHaven et al. (1975) surveyed the region studied by Neff (1937) to try to determine whether the species had changed in abundance in this portion of its range. They found far fewer colonies and far fewer birds at the largest colonies than did Neff (1937) and concluded that the number of tricolors in the Sacramento Valley had declined by more than 50% in about 35 years.

Efforts to estimate the statewide population of tricolors began in 1994 with work coordinated by Beedy and Hamilton (1997) and continue to this day. Unlike previous efforts to assess the status of the species, Statewide Surveys were conducted in 3-day intervals, from Friday to Sunday, in late April. Non-breeding birds tend to be highly mobile and difficult to find and thus to count, so the Statewide Survey was designed to be conducted in the second half of April, when the maximum number of birds are breeding (Beedy and Hamilton 1999), and are thus more reliably found and easier to count. Conducting a Statewide Survey during a 3-day interval minimizes the risk of double-counting birds that have moved following first breeding attempts (Hamilton 1998). Increasing the number of persons surveying allows a much larger geographical area to be covered and enables a statewide estimate of the number of birds.

Although the 1994 Statewide Survey included only 32 counties and found only 28 occupied sites, the estimate of the number of birds seen exceed 369,000 (Hamilton et al. 1995). The 2014 Statewide Survey covered 41 counties and found birds at 143 locations yet the estimate of the number of birds in California dropped to 145,000 (Meese 2014). Thus, despite substantial increases in geographical coverage and in knowledge of where the birds nest, the estimate of the number of birds seen dropped by 61%. In the 2008-2014 interval, when the Statewide Surveys were far more directly comparable due to more standardized methodology, the estimate of the number of tricolors dropped by 63%, from 395,000 to 145,000. Unfortunately, given the differences in methods, level of effort, data management, and data documentation, it is not possible to directly compare the results of the Statewide Surveys from 1994 to those of 2014, but the small number of colonies identified and the relatively large number of birds observed in 1994 compared to 2014 suggests a serious statewide reduction in abundance during this 20 year interval, and that the extent of the decline would be greater than that estimated if the 1994 survey had been as complete as was that of 2014.

The number of birds seen during the three most recent Statewide Surveys differed greatly by bioregion, with the largest number of birds seen in all three surveys concentrated in the San Joaquin Valley (Figure 5), where the

majority of breeding birds have been seen since the 1980s (Hamilton et al. 1995). A comparable survey of breeding birds in the Sacramento Valley would best occur in early June, when most of the birds have finished breeding in the San Joaquin Valley and moved north to breed again (Hamilton 1998, Beedy and Hamilton 1999, Meese unpub. data). As the tricolors that breed in the Sacramento Valley are in most cases the same birds that bred earlier in the San Joaquin Valley (Hamilton 1998, Meese unpub. data), any reduction in abundance documented in April in the San Joaquin Valley would be expected to be mirrored by a reduction in abundance of breeding birds in the Sacramento Valley the following June.

Because the vast majority of breeding birds occur in the San Joaquin Valley, the sharp drop in abundance documented there is of particular concern, as efforts to restore the species will depend disproportionately upon the results of breeding efforts at the largest colonies. Recent research has shown that reproductive success is positively correlated with both colony size and insect abundance (Meese 2013), and the results of the three most recent Statewide Surveys showed a sharp drop in total abundance and size of the largest colonies. This period coincided with a period of chronically low reproductive success (Meese 2013). A lack of insects along with the destruction of breeding colonies adjacent to dairies by the harvest of their nesting substrates (Meese 2009) are believed to be the two most important causes for the recent population decline.

There are several reasons why insect abundances may be insufficient to support breeding by the colonial and insectivorous Tricolored Blackbird. The widespread and on-going conversion of native habitats to dairies, orchards, vineyards, rice, and other forms of agriculture (Beedy and Hamilton 1997) and the use of effective and persistent insecticides (Hallmann et al. 2014) may have created unsuitable breeding conditions in much of the core area of the species' range. The relatively small number of birds that have recently bred outside of the San Joaquin Valley is insufficient to sustain a population of 700,000 birds, the suggested population target for the recovery of the species (Meese et.al. 2015a). The apparent unsuitability of much of the San Joaquin Valley to support breeding by the species suggests that future conservation actions will have to occur in strategically chosen areas of the Central Valley that have previously or may be managed to support breeding by relatively large numbers of birds. The conservation effort will require both secure, permanent nesting habitats surrounded by secure, productive, foraging habitats that may provide the insect abundance that is associated with relatively high reproductive success (Meese 2013, Meese et al. 2015a). The rapid decline in the sizes of the largest colonies (Figure 4) complicates conservation planning and reduces the options available to stem the decline because even effective conservation actions will be expected to benefit a smaller number of breeding birds.

The conservation of breeding colonies in grain fields adjacent to dairies may be ensured by the recent listing of the Tricolored Blackbird as endangered under the California Endangered Species Act (CESA). Any loss of Tricolored Blackbird eggs or nestlings would be considered "take" and is prohibited under CESA, except with explicit permit approval. Recent voluntary efforts to conserve Tricolored Blackbird breeding colonies adjacent to dairies, by compensating farmers for their costs associated with delaying the harvest of their occupied grain fields, have been only partially successful (e.g., Meese 2009, Meese 2014). Effectively conserving the efforts of all breeding birds, and especially the largest colonies, which are usually situated in grain fields (Beedy and Hamilton 1999, Kelsey 2008), will be essential if the species is to recover. A far more robust education and outreach component must be developed and implemented with industry participation (see Arthur 2015), and intensive surveys and monitoring of "silage colonies" must occur annually. These silage colony conservation measures, however, are temporary emergency reactions to an on-going conflict, and a permanent solution will require the provision of alternative nesting substrates in the San Joaquin Valley and southern California that create safe, secure breeding conditions.

The triennial Tricolored Blackbird Statewide Survey has for 20 years played a prominent role in efforts to monitor the health of tricolors in California. Recent improvements in methodology and the addition of the Tricolored Blackbird Portal have rapidly increased our knowledge of where the birds breed by providing a mechanism for concerned citizens to become actively engaged in research and monitoring efforts. The resulting increase in the number of persons looking for and reporting breeding colony locations and observations of (occupied and unoccupied) breeding colony locations has aided efforts to monitor the health of the species.

The Tricolored Blackbird is increasingly conservation-dependent, and future monitoring efforts should expand beyond a triennial statewide population estimate to include the: 1) annual monitoring of the results of breeding efforts in a variety of habitats and bioregions, 2) effects of relative insect abundance on reproductive success, and 3) results of specific conservation actions. A useful addition to the triennial Statewide Survey would be an annual effort to estimate the population size through a statistically valid sample (see Meese et al. 2015b). This monitoring tool would provide an annual population estimate with a much smaller number of volunteers and require surveys of only a sample of the total number of colony locations each year. An annual sample survey would provide an additional means to monitor the health of the population and supplement more intensive efforts to monitor the results of tricolor breeding, thereby helping to more thoroughly document the status of California's blackbird.

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Sampling to Estimate Population Size and Detect Trends in Tricolored Blackbirds

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The Tricolored Blackbird (*Agelaius tricolor*) is a medium-sized passerine that nests in the largest colonies of any North American landbird since the extinction of the passenger pigeon (*Ectopistes migratorius*) over 100 years ago (Beedy and Hamilton 1999). The species has a restricted range that occurs almost exclusively within California, with only a few hundred birds scattered in small groups in Oregon, Washington, Nevada, and northwestern Baja California, Mexico (Beedy and Hamilton 1999). Tricolored Blackbirds are itinerant breeders (i.e., breed more than once per year in different locations) and use a wide variety of nesting substrates (Hamilton 1998), many of which are ephemeral. They are also insect dependent during the breeding season, and reproductive success is strongly correlated with relative insect abundance (Meese 2013). Researchers have noted for decades that Tricolored Blackbird's insect prey are highly variable in space and time; Payne (1969), for example, described the species as a grasshopper follower because they are preferred food items, and high grasshopper abundance is often associated with high reproductive success (Payne 1969, Meese 2013). Thus, the species' basic reproductive strategy is tied to rather infrequent periods of relatively high insect abundance in some locations followed by much longer periods of range-wide relatively low insect abundance and poor reproductive success. Of course, anthropogenic factors such as habitat loss and insecticide use may be at least partly responsible for these patterns (Hallman et al. 2014, Airola et al. 2014).

The Tricolored Blackbird was formerly considered to be one of the most abundant land birds in California (Beedy and Hamilton 1999), and it is likely that 2-3 million birds remained into the 1930s (estimated by extrapolation of Neff 1937, see Meese 2015). The alarming decline in abundance, especially in the past decade, to only 145,000 birds in 2014 (Meese 2014) led to an emergency listing of the species as endangered under the California Endangered Species Act (CESA) in December 2014 (State of California 2014).

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It is inherently difficult to assemble enough information on rare species to enable robust evidence-based recovery efforts. In some ways, Tricolored Blackbirds pose particular problems in that they breed in rather small numbers of large, somewhat ephemeral colonies that, over time, come and go across the landscape (Holyoak et al. 2014). As a result, classic random sampling is likely to miss large colonies, or to produce unreliable estimates of total population size. On the other hand, the future of the species may rest on the success or failure of a fairly small number of large and conspicuous colonies which are intensively monitored and that may have the greatest reproductive success (Meese 2013). Thus, the species' unusual biology makes it a challenging study subject, and as a consequence, creates a special need for science to inform conservation efforts.

Here we describe the problems inherent in estimating total population size and temporal trends in population size for Tricolored Blackbirds. In order to reliably survey the birds and to estimate their numbers, it is of strategic importance to locate their breeding colonies and to count them during the breeding season. While at their breeding colonies, the birds are relatively fixed in space and their behaviors make them conspicuous and relatively easy to locate and count (Beedy and Hamilton 1999). To introduce the problems of sampling total population size and trends, we review previous efforts both in the form of early surveys of limited geographic extent as well as Statewide Surveys, and then describe an approach for estimating the statewide population from a statistical sample of sites.

EARLY SURVEYS

From the 1930s until the mid-1990s, the status of the Tricolored Blackbird was assessed by intensive surveys undertaken during the entire breeding season in a portion of the species' range that emphasized the Sacramento Valley (Neff 1937, DeHaven et al. 1975). Early workers conducted fieldwork alone or in small teams and intensively surveyed appropriate habitats from public roads. Most knowledge of the birds' distribution and colony locations relied on a few experts. As Meese (2015) described, inconsistencies in methodology and survey effort difficult it hard to compare the early surveys and to know how reliable they were at indicating total population size of the species.

STATEWIDE SURVEYS

Since 1994, the size of the statewide population has been estimated by the Tricolored Blackbird Statewide Survey (Beedy and Hamilton 1997, Meese 2015), a mostly triennial volunteer effort that occurs over a 3-day interval. The Statewide Survey differs from previous efforts to determine the status of the species in the following ways.

- It occurs during a 3-day period rather than the entire breeding season in an attempt to minimize the potential for double-counting the same birds in more than one location.
- It attempts to count birds throughout their range in California.
- It relies upon numerous volunteers, rather than a few experts.
- Participants survey all known breeding colony locations.

Early Statewide Surveys conducted in 1994, 1997, 2000, 2001, and 2005 utilized volunteers and a single statewide coordinator to provide extensive geographical coverage that sought to estimate of the entire California population. More recent Statewide Surveys conducted in 2008, 2011, and 2014 utilized both a statewide coordinator and individual county coordinators to take better advantage of local knowledge and to reduce the burden of coordinating an effort that included over 35 counties and over 100 volunteer participants (Meese 2015).

The Tricolored Blackbird Statewide Survey provides an estimate of the number of birds in the entire state; however it is not without limitations (Meese 2015):

- It is extremely labor intensive and consequently occurs only every third year.
- There is a risk of participant fatigue, which over time may limit the size of the participant pool. This fatigue can negatively affect the effort if the most experienced persons cease to participate.
- It utilizes volunteers with diverse levels of experience in Tricolored Blackbird biology and in estimating the numbers of birds at breeding colonies.
- Despite best efforts to provide a complete census of the species in California, it is at best an estimate because it is impossible to cover all areas of suitable habitat and precisely count every individual.
- Prior to 2008, the Statewide Survey made no attempt to measure or quantify potential sources of counting error, such as variations in survey coverage and imperfect and variable rates of colony detection.

As a result, these early surveys lack error estimates or confidence intervals around the population size estimates. Beginning in 2008, the survey methods improved to report results for all sites surveyed (whether occupied or not). Also, a small number of sites was surveyed by more than one observer to provide a means to quantify error.

ESTIMATES FROM A STATISTICAL SAMPLE

With the emergency listing of the Tricolored Blackbird under CESA in December 2014, and petition for federal listing under consideration, the conservation of the species should receive far greater attention by State and

Federal agencies. An increase in the frequency and statistical rigor of the population estimate will help agencies to monitor the status of the population and its responses to conservation actions. Three developments have provided an opportunity to more rigorously examine Tricolored Blackbird population trends.

- Knowledge of sampling designs and understanding of statistical considerations in general have increased.
- The size of the data set of tricolor numbers and locations provided by scientists and concerned citizens is rapidly increasing.
- Data management capabilities have recently improved.

Increases in both data quantity and quality have resulted from the development of the Tricolored Blackbird Portal in 2008 and its web-based data entry and data standardization capabilities. These improvements provide a new opportunity to apply statistical considerations to a population estimate derived from a sample of breeding colony locations.

Key desirable attributes of the new sample-based scheme for estimating populations include:

- the feasibility to conduct surveys annually;
- random selection of sampling sites that are stratified by important factors (habitat type, bioregion, etc.);
- quantifiable sources of variability, including the detectability of colonies and variability of observer estimates of number of birds at occupied sites;
- the ability to generate estimates of population size, population change, and breeding colony size;
- the ability to calculate confidence limits of estimates; and
- the ability to estimate the probability of colony detection.

We emphasize that the subset sampling approach will produce less information than does the census approach and the population size estimate will not be better than that produced by a more complete census, but the sampling approach aims to improve existing population information by:

- improving information collection during the years between the triennial Statewide Surveys;
- producing estimates that can be compared to the full triennial Statewide survey estimates, without the intense effort that is required for the full Survey;
- providing more complete information on temporal changes, including trends and inter-annual variation; and
- increasing opportunities for conducting double-observer surveys, which will enhance the reliability of error estimates and confidence intervals.

The application of statistical considerations to an annual sampling effort will allow biologists to rigorously estimate the number of birds in California with a far smaller number of field workers. The sample-based scheme will provide determinations of the amount of uncertainty in the estimates of the total number of birds and in the numbers at individual colonies. Although there has been a recent, dramatic downward trend in the sizes of the largest colonies (Meese 2015), the largest errors in the estimates of the numbers of breeding birds may be expected to be associated with the largest colonies. Therefore, a sample survey at a subset of known sites selected according to a carefully designed scheme should try to include those sites having the highest measurable expectation of supporting large colonies.

Surveying a sample of colonies will help to alleviate participant fatigue and allow an annual, rather than a triennial, population estimate and thus allow an annual estimate of the trend in the number of birds while providing confidence intervals of the estimates. Annual estimates would allow rapid assessments of any continued population declines and help biologists to assess the results of conservation actions.

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Tricolored Blackbird (*Agelaius tricolor*). 14 April 2014. Sacramento County, California. *Photo © Phil Robertson.*

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 km^2 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

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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 on-going 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 km^2 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).

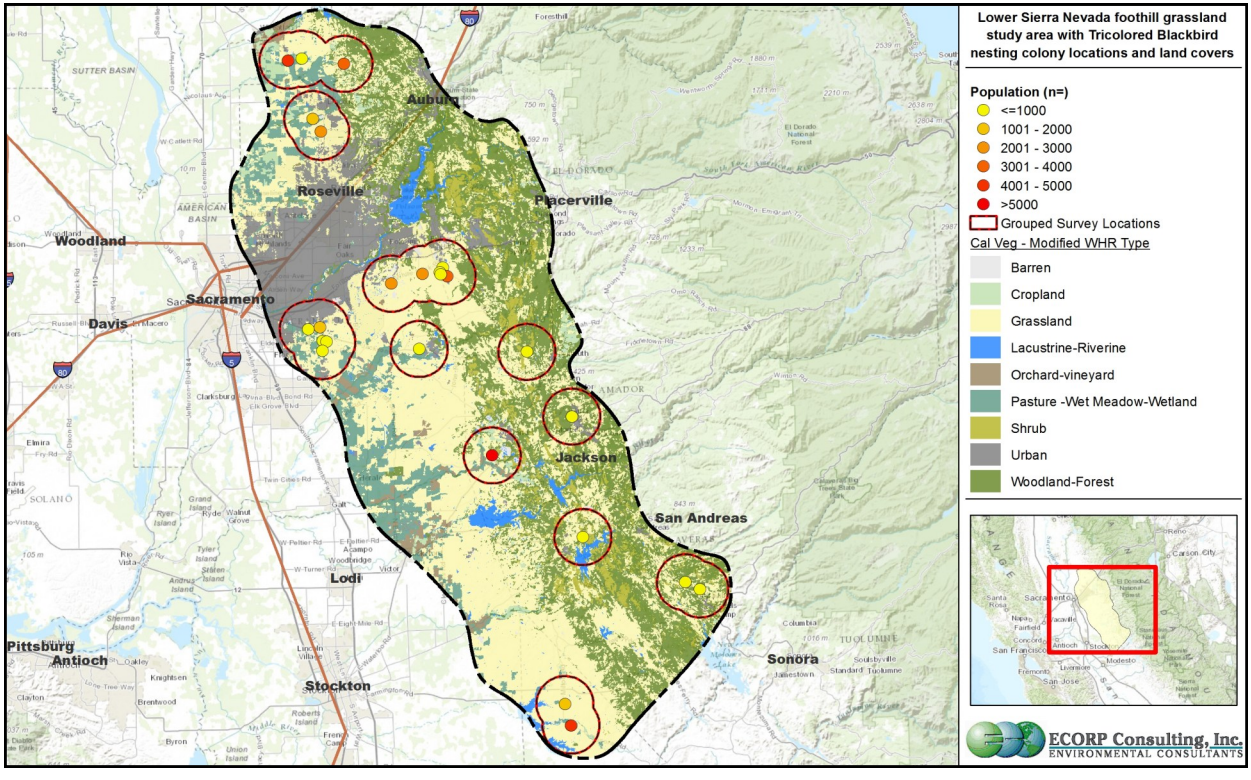

Figure 1. Lower Sierra Nevada foothill grassland study area with land covers and Tricolored Blackbird nesting colony locations and surrounding 5-km areas used in land cover analysis.

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 mi^2).

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.

		Number of Nesting Birds		
County	Number of colonies	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

[1]Colonies 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.

	Colonies		Nesting Population	
Nesting Substrate	#	%	#	%
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.

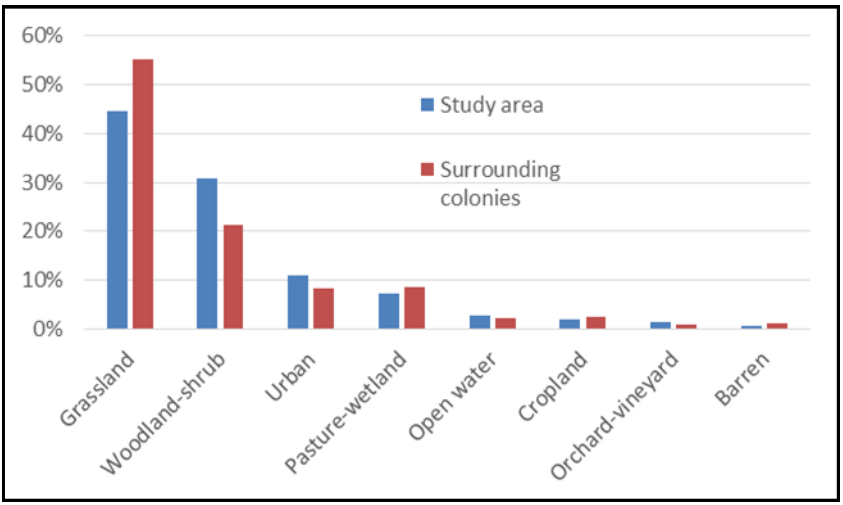

Figure 2. Comparison of percent of land areas occupied by land cover groups and lands within 5 km surrounding Tricolored Blackbird nesting colonies and in the study area as a whole.

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.

	Colonies		Nesting Population	
Land Use	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 copses 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.*

Managing Nesting and Foraging Habitats to Benefit Breeding Tricolored Blackbirds

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The Tricolored Blackbird (*Agelaius tricolor*) is a near-endemic California passerine that now forms the largest breeding colonies of any North American land bird, since the extinction of Passenger Pigeon (*Ectopistes migratorius*) in 1914 (Beedy and Hamilton 1999, Cook and Toft 2005).

Unlike their close relative, the widespread and territorial Red-winged Blackbird (*Agelaius phoeniceus*), the Tricolored Blackbird has a very limited geographic range and is nearly restricted to California. The number of Tricolored Blackbirds plummeted during the 20th Century due to a variety of factors, and the number of tricolors continues to decline due to on-going habitat losses through widespread conversion of natural habitats to agriculture and urbanization (Figure 1), chronic destruction of breeding colonies by the harvest of their nesting substrates, and shooting in autumn when causing depredation to ripening rice while in mixed-species foraging flocks.

This paper provides guidance to private landowners and public land managers to conserve and enhance breeding and foraging habitats to promote the recovery and long-term conservation of the species. We first summarize what is known of the Tricolored Blackbird's current range, its habitat requirements, and the causes and extent of its current population decline. We focus on the breeding season, as habitat management to create and manage wetland and upland breeding habitat with nearby foraging habitat is critical to enhance breeding by the species. We assume that Tricolored Blackbirds will continue to use agricultural and weedy fallow fields for nesting, so we also provide guidance on managing these agricultural habitats to maximize their value for "California's Blackbird."

CURRENT RANGE

Historical surveys did not include large portions of the species' currently known breeding range and consequently did not document its full extent. Tricolored Blackbirds are now known to occur at low elevation sites throughout the entire length of California. For more than seven decades, the largest number

of breeding birds has occurred in the Central Valley (Neff 1937, Beedy and Hamilton 1999, Beedy 2008, Kyle and Kelsey 2011). However, the proportion and absolute number of birds breeding in the Central Valley has recently declined precipitously (Meese 2014).

Figure 1. Before and after photographs of a Tricolored Blackbird breeding colony location in eastern Merced County that was planted to almonds. *Before* photograph taken in May 2006; *after* photograph taken February 2015. Almond trees planted autumn 2012.

Tricolored Blackbirds are fairly common but localized breeders in the western Sierra Nevada foothills up to about 500m (1,500ft) (Beedy and Pandolfino 2013; Airola, et al. 2015). Smaller numbers breed in coastal locations from Santa Barbara County north to Mendocino County and on the Modoc Plateau in northeastern California (Beedy 2008). Small numbers also breed at scattered locations in Oregon, one valley in Washington, a single site in western Nevada, and at several locations in northern Baja California, Mexico (Beedy and Hamilton 1999). Tricolored Blackbirds often exhibit "itinerant breeding," in which individuals move north after first nesting efforts (early March to late April) in the San Joaquin Valley to new breeding locations in the Sacramento Valley, low Sierra foothills, and northeastern California (Hamilton 1998).

Following the breeding season, Tricolored Blackbirds flock with other blackbird species and are primarily found in the Sacramento Valley. During winter, most Tricolored Blackbirds are found in the Sacramento-San Joaquin Delta, the southern Sacramento Valley, and widely dispersed in the San Joaquin Valley. The southern California population segment south of the Transverse Ranges is relatively sedentary, with movements mostly confined to southern California, although apparently some birds rarely move out of the Central Valley into southern California (Beedy and Hamilton 1999, Beedy 2008, Meese 2014).

HABITAT REQUIREMENTS

The Tricolored Blackbird's basic requirements for selecting breeding sites are: 1) a protected nesting substrate in flooded, thorny, or spiny vegetation; 2) an open accessible source of water for drinking and bathing; and, 3) a suitable foraging space providing insect prey (Beedy and Hamilton 1999, Beedy 2008, Cook and Toft 2005, Meese 2014).

Breeding colonies are found in a variety of nesting substrates, including freshwater marshes dominated by cattails (*Typha latifolia*) or bulrushes (*Schoenoplectus californicus*) in the Central Valley and in coastal locations, introduced Himalayan blackberry (*Rubus armeniacus*) surrounded by grazed annual grasslands and oak savannas in the foothills of the Sierra Nevada, and grain fields adjacent to dairies in the San Joaquin Valley and southern California. Ideal breeding habitats consist of a suitable nesting substrate surrounded by foraging habitats in annual grasslands, shrublands, or agricultural fields that produce large numbers of grasshoppers, dragonflies, and other large insects, with a source of surface water nearby (Beedy and Hamilton 1999, Meese 2014).

Wintering Tricolored Blackbirds often congregate in large, mixed-species flocks that forage in grasslands and agricultural fields with low-growing vegetation and at dairies and feedlots. Wintering birds are especially attracted to agricultural fields that are under active cultivation. They occur in large flocks with several other blackbird species and follow closely behind tractors and related farm machinery to feed on unearthed invertebrates and seeds (Beedy and Hamilton 1999, Beedy 2008). In early February, however, they segregate into pure Tricolored

Blackbird flocks, which may subdivide further into age-and sex-specific flocks. At this time, flocks roam across the landscape until they find a suitable nesting substrate.

CAUSES AND EXTENT OF CURRENT POPULATION DECLINE

Among the Tricolored Blackbird's numerous conservation challenges, the most insidious and widespread are the losses of breeding and foraging habitats. In most of the species' range, these habitat losses are due to conversion of native habitats to agriculture and urbanization, primarily of native habitats to perennial nut orchards, vineyards, and rice.

Rice cultivation produces an additional conservation challenge: in autumn, mixed flocks of Tricolored Blackbirds, Red-winged Blackbirds, other blackbirds, and European Starlings (*Sturnus vulgaris*) and are commonly found in rice paddies in the Sacramento Valley. Although Tricolored Blackbirds are listed as endangered under the California Endangered Species Act and may not be legally killed, the other blackbird species are exempted from protection under any state or federal law and are often shot in large numbers when causing depredations to ripening rice (DeHaven 1971, USDA 2012, Meese pers. obs.). Thus, an unknown number of Tricolored Blackbirds is shot each fall when they flock together with other blackbird species while foraging on ripening rice.

In addition to landscape conversions and losses in autumn, for several decades there have been widespread and sustained losses of eggs and nestlings due to normal agricultural activities. Since the 1980's, large numbers of Tricolored Blackbirds have nested in grain fields adjacent to dairies in the San Joaquin Valley and in southern California (DeHaven 2000). Most dairies are surrounded by large grain fields, primarily of triticale, a high-yield wheat (*Triticum*) X rye (*Secale*) hybrid grain grown to feed dairy cows. Due to their vigor and stiff stems, triticale plants, unlike other grains, are able to support Tricolored Blackbird nests.

Until recently, a vast majority of breeding Tricolored Blackbirds nested in triticale fields (Kelsey 2008). The number of birds nesting in these fields, however, has declined dramatically due to reproductive failures that resulted from the harvesting of their nesting substrates before young fledged from nests and to poor reproductive success in those grain-field colonies that were conserved (Meese 2009). Despite recent efforts to conserve these "silage colonies" by paying farmers to delay the harvest of their fields, this voluntary program has been only partially successful, and the breeding efforts of many hundreds of thousands of birds over several decades have been lost—a likely contributor to the species' overall decline (Meese 2009).

Due to their colonial nesting behavior, where hundreds or thousands of nests occur in close proximity to each other, mammalian and avian predators can take a large toll by consuming eggs and nestlings, especially from

freshwater marsh colonies. Raccoons (*Procyon lotor*) are the most serious mammalian predator of nesting Tricolored Blackbirds in wetlands but river otters (*Lutra canadensis*) may also cause widespread losses. Avian predators often seen around freshwater marshes include Northern Harriers (*Circus cyaneus*), Cooper's Hawks (*Accipiter cooperii*), Red-tailed Hawks (*Buteo jamaicensis*), Black-crowned Night-Herons (*Nycticorax nycticorax*), Cattle Egrets (*Bubulcus ibis*), White-faced Ibis (*Plegadis chihi*), and Common Ravens (*Corvus corax*). Marsh Wrens (*Cistothorus palustris*) cause additional losses by poking holes in blackbird eggs (Beedy and Hamilton 1999).

As a result of these and other factors, the number of Tricolored Blackbirds has been reduced by more than 90% in the past 80 years, and future conservation of the species will depend on active protection and management efforts. The non-regulatory efforts of many public agencies and private organizations 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, uncertain. In response to the decline, the Center for Biological Diversity filed a petition to list the Tricolored Blackbird as "Endangered with Emergency Regulations" with the California Fish and Game Commission on 8 October 2014 (Center for Biological Diversity 2014), and the species was given emergency protection as endangered under the California Endangered Species Act in December 2014. If the listing eliminates the known sources of mortality (e.g., harvest of nesting substrates before young have fledged and autumn shooting in rice fields), this could increase the number of young produced while reducing the rate of adult mortality, and thereby stem the decline and help to increase the number of birds.

GUIDELINES FOR MANAGING WETLAND NESTING HABITATS

One critical component of the effort to recover the Tricolored Blackbird is to provide optimal nesting conditions by managing nesting substrates. The quality of many of the most common nesting substrates varies through time and it is hoped that active management will more consistently provide optimal nesting conditions and increase the number of young produced. The following management guidelines are intended to benefit Tricolored Blackbirds by describing the nesting habitat characteristics required by breeding birds and providing guidance to landowners and managers. While our emphasis is on nesting habitats, we also describe actions that may enhance foraging habitats, as both are required for successful reproduction.

Freshwater Marshes

Freshwater marshes are believed to have been the Tricolored Blackbird's primary nesting habitat throughout its evolutionary history (Orians 1961), and the first studies of the species found that over 80% of nests were constructed in freshwater marshes (Neff 1937). Nesting female Tricolored Blackbirds strongly

prefer large, continuous blocks of young, lush cattails and bulrushes that are in their first or second year of growth (Figure 2). Optimal marsh habitat conditions include emergent vegetation at least 1.3 m (4 ft.) high and submerged in shallow water 15-45 cm (6-18 in) deep. Cattail stands must be at least 50ft (15m) wide to support successful nesting by Tricolored Blackbirds.

Figure 2. Tricolored Blackbird colony in freshwater marsh, Los Angeles County.
Photo © Alice Wollman.

Although birds will nest in both cattails and bulrushes, they appear to prefer cattails due to their multiple, closely-spaced stems. Bulrush stands are less frequently occupied likely due to the relatively wider spacing of stems, and those that are occupied are, like cattails, typically in their first or second year of growth. Young, dense growth provides the multiple closely-spaced stems preferred by females both because they provide multiple supports for their woven grass nests and perhaps also because they help to hide their nests from mammalian predators. Of great importance is the condition of the cattails and bulrushes, as they must be maintained in a young and vigorous state to be attractive to nesting birds. When old, senescent stems begin to accumulate, these must be removed. Older stems are both less dense and are more likely to fall over, and when fallen stems accumulate, they provide less cover and may provide easy access to the nests for mammalian predators (Meese pers. obs.).

Creating and maintaining the conditions preferred by Tricolored Blackbirds nesting in wetlands may also provide significant benefits for many other special status wetland-dependent species, including: Yellow-headed Blackbirds

(*Xanthocephalus xanthocephalus*), White-faced Ibis, Least Bitterns (*Ixobrychus exilis*), Northern Harriers, California Red-legged Frogs (*Rana draytonii*), and Giant Garter Snakes (*Thamnophis gigas*). Thus, providing optimal nesting habitat for Tricolored Blackbirds may also enhance the habitats of several other sensitive or endangered species.

Freshwater marshes require relatively high levels of maintenance to maintain the vegetation conditions preferred by nesting Tricolored Blackbirds. Ideal management involves "refreshing" the marsh vegetation to return it to a youthful state of dense, rapidly-growing stems through effective water management plus regular removal of dead stems through burning, cutting, grazing, discing, or masticating.

Water Management. An easily accessible source of surface water is essential for both drinking and bathing, and for nest-building as females use mud to line and provide shape and structure to the nest bowls. In many cases, females will gather long grasses for their nests but wet the grasses prior to weaving them around the stems and leaves of the nest substrate. Water is also used to wet insects captured by adults prior to feeding them to the nestlings (Meese, pers. obs).

Tricolored Blackbirds use water provided in a variety of forms, including streams, ponds, farm canals or ditches, and in many agricultural areas water is provided when crops are flood-irrigated. In most cases, birds prefer to nest over or immediately adjacent to water, but in drier upland situations, they will nest hundreds of yards from water sources. If water is under the control of the landowner, it should be provided throughout the breeding season.

A water regime consisting of perennial flooding is preferred to produce and maintain optimal vegetation conditions that may last for 4 or 5 years. Seasonally-flooded wetlands must be actively maintained in an annual or biennial cycle if they are to provide the young, lush cattails preferred by nesting birds. The season of flooding should be timed so that: 1) the cattails are a minimum of 4 ft. tall by 1 April in southern California and the San Joaquin Valley and 1 May in the Sacramento Valley and coastal areas, and 2) the cattails remain flooded during the entire time that tricolors are present.

Thus, winter through spring flooding is required in southern California and the San Joaquin Valley and recommended in the Sacramento Valley. Standing water 6 to 12 inches (15-30 cm) deep should be maintained throughout the breeding season to minimize mammalian predation and to maintain a cooler microclimate around nests. Tricolors typically abandon breeding attempts if water is drawn off of wetlands before the young fledge. In addition to the flooding regime, a perimeter "moat" of deeper water, up to 1 m (3 ft.) deep and 10 m (30 ft.) wide is desirable, to discourage raccoons and other mammalian predators from entering the portion of the wetland occupied by breeding birds.

Waterfowl Brood Ponds. Waterfowl brood ponds (ponds with spring and summer water for the young produced by waterfowl) may provide Tricolored Blackbird breeding habitat and take best advantage of the costs of providing spring and summer water. A waterfowl brood pond may be managed as a summer water pond (flooded October–July), a reverse cycle wetland (flooded February–July), a seasonal wetland–summer water combination (flooded all year), or an upland–summer water combination (flooded February–July). The ideal flooding regimes for Tricolored Blackbirds are either a reverse cycle wetland or a large summer water pond, if the water is provided early enough to support cattail growth to the height preferred by nesting birds by the time of their arrival. We also stress that the recommended configuration of cattail patches for optimal Tricolored Blackbird breeding habitat differs from that for a typical waterfowl brood pond. Waterfowl brood ponds usually have small islands interspersed throughout the pond to maximize surface area of the cattail patches. Tricolored Blackbirds do not use small patches of cattails and so it is important to manage cattail patches to be large and continuous (see above), maximizing the internal area of patches, and to keep water on the site long enough into the summer for the Tricolored Blackbirds to finish nesting.

Burning. Burning is the preferred method to maintain wetland vegetation as it mimics natural conditions and rapidly and completely removes old, senescent stems while releasing nutrients that support the growth of new stems. Burning is best done in late autumn when the maximum number of senescent stems has accumulated, and preferably over water or well-saturated soil to protect the rhizomes and any young plants from being scorch-killed. Burning may be done as late as early February, but when wetlands are burned this late the cattail growth by the Tricolored Blackbird's breeding season is usually insufficient to be suitable for settling birds. Experience has shown that Tricolored Blackbirds will arrive at a wetland and remain in the area before settling if the cattails are shorter than the height preferred by nesting birds but are rapidly growing and reach the preferred height within 2-3 weeks following their arrival (Meese pers. obs.). Landowners may burn cattails, assuming any necessary air resource board permits are obtained, or they may be able to schedule a burn by federal, state, or county fire crews as part of their fire management training. Landowners are encouraged to consult with wetland managers at a local National Wildlife Refuge, a local Natural Resource Conservation Service (NRCS) office, or a California Department of Fish and Wildlife office for additional information and to discuss options for using fire to maintain wetland vegetation.

Cutting Cattails. This method is a more labor-intensive means of removing dead stems and may be suitable only for very small stands where fire is inappropriate due to nearby trees or other woody vegetation, air quality regulations, or where other concerns preclude its use. There are several different types of cutters, from tractor-mounted types (e.g., pak-flail mowers)

Figure 3. Freshwater marsh burning in autumn, Colusa County. *USFWS photo.*

to hand-held hedge trimmers. The use of hedge trimmers will result in the accumulation of cut stems which must then be removed by burning or mechanical harvest and disposal, whereas cutters typically produce a mulch of small stem fragments which may be left to degrade in the marsh and to slowly release their nutrients.

Grazing. Livestock grazing is an appropriate and effective means of removal of dead cattail stems if the water level of the wetland can be controlled and cattle can be allowed into the wetland for a brief interval of 1-4 weeks. Cattle will typically graze the stems down to the soil level (Figure 4). As with burning, grazing is best scheduled in late autumn following the annual period of growth and all cattle should be removed prior to growth resuming in late winter.

Discing. This is an appropriate management method to delay the re-growth of new cattails, to prevent their expansion, or when it is difficult to obtain a permit to burn. Discing is not recommended if the rapid re-growth of the wetland vegetation is desired and care is required so that discing does not result in mortality to cattail rhizomes (Figure 5). As with burning, discing is recommended in late autumn, as it requires dry soil and the cattails need three or more months of growth post-treatment to attain the characteristics preferred by nesting Tricolored Blackbirds.

Figure 4. Cattail marsh recently grazed by cattle. *Photo © Lee Metcalf, USFWS.*

Figure 5. Cattails recently disced. Kern County. *Photo © Bob Meese.*

Mastication. This method involves the use of a specialized piece of equipment, the vegetation masticator, which is typically a tractor-mounted drum with large claws or teeth that shreds vegetation into small pieces (Figure 6). It may be useful in some instances where cattail and bulrush growth is especially thick and not easily maintained by other mechanical methods and/or in areas where burning is impractical or inappropriate. Vegetation masticators that are mounted on the end of a large mechanical arm may allow the maintenance of vegetation within 10-20' of the perimeter of a pond and not require that the pond be drained prior to use, whereas a tractor-mounted vegetation masticator would require that the water be drawn off and the soil in the basin be nearly dry. Care must be taken with this method as there is a risk that the vegetation masticator may dig too deeply into the soil and thereby destroy or pull out the underground rhizomes. Marsh management with vegetation masticators is typically done by vegetation management specialists.

Figure 6. Vegetation masticator, Monterey County. *Photo © Christy Wyckoff.*

Stinging Nettles

Stinging nettles (*Urtica dioica*) are native plants confined to wet canyon bottoms, reservoir margins, and other saturated soils surrounded by uplands. Nettles provide well-protected nesting substrates due to the presence of sharp hollow spines on the stems and leaves that contain histamines and other

chemicals that produce a stinging sensation when contacted. Tricolored Blackbird colonies in stinging nettles are often found in regions of high topographic relief on the sides of the Central Valley but may occur in the Central Valley if the required saturated soils are present. Stinging nettles are annuals and require little maintenance, but in some instances it may be necessary to maintain a water supply to provide the required saturated soil.

Stinging nettles may occur naturally due to appropriate edaphic and hydrographic conditions, but both seeds and plants are widely available from commercial sources if it is desired to begin a stand in a new location. Stands of stinging nettles occupied by nesting birds are often small, only a few feet wide and tens to hundreds of feet long, and small 30'x30' blocks of stinging nettles grown successfully by gravel mine operators during land reclamation activities have been used by breeding Tricolored Blackbirds.

GUIDELINES FOR MANAGING UPLAND NESTING HABITATS

The upland breeding substrates most often used by nesting Tricolored Blackbirds are the non-native Himalayan blackberry and milk thistle (*Silybum marianum*). Less often they use a wide variety of other wild and cultivated plant species including: cheeseweed mallow (*Malva parviflora*), mustard (*Brassica spp.*), California blackberry (*Rubus ursinus*), giant cane (*Arundo donax*), bull thistle (*Circium vulgare*), prickly lettuce (*Lactuca serriola*), sandbar willow (*Salix exigua*), and cultivated fields of triticale and fava beans (*Vicia fava*; Beedy and Hamilton 1999, Meese 2011). Several of these species may occur together, as well as with cattails and bulrushes, and Tricolored Blackbirds colonies may occur in weedy fields with nests built in several different plant species in close proximity.

Upland habitats are easier to maintain than wetland habitats, as most plants used by nesting birds are perennials that require little if any maintenance or annuals that require little management but whose growth is often strongly influenced by the timing and quantity of annual precipitation or irrigation.

Himalayan Blackberry

Himalayan blackberry is a large and vigorous plant that is native to Eurasia and has become naturalized throughout North America where it was first introduced as a cultivated crop in 1885. By 1945 it had become well-established along the West Coast, including in California where it is now considered an invasive weed and may not be planted as any part of a federally-funded conservation project (California Invasive Plant Council 2014).

Himalayan blackberry is the predominant nesting substrate used by Tricolored Blackbirds in the lower elevation foothill grassland region between the Central Valley floor and the Sierra Nevada (Airola et al. 2015) and is widely used in the upper San Joaquin Valley and much of the Sacramento Valley.

Figure 7. Tricolored Blackbird colony in Himalayan blackberry, Yuba County. *Photo © Ted Beedy.*

Nesting Tricolored Blackbirds use stands of Himalayan blackberry varying in size from a fraction of an acre to several acres, and from 1.6-3.3 m (5-10 ft.) tall (Figure 7). In most cases, Himalayan blackberry grows in long, narrow stands but its stature is highly variable and dependent upon local conditions. The plants have long canes that are protected by large, sharp thorns that provide a degree of protection to nesting birds that may be unmatched by any other nesting substrate. In most cases, the plants occur interspersed in open annual grasslands often in association with water sources such as leaking drainage ditches and canals and in irrigated pastures in the Central Valley floor, annual grasslands, and open blue oak (*Quercus douglasii*) savanna in the Sierra Nevada foothills. Tricolored Blackbirds seem to prefer the tallest Himalayan blackberry stands, especially those that are supported by barbed-wire fences and grow along fence-rows, but regularly occupy stands that are not associated with fences especially when these are near a reliable source of water. During severe, prolonged drought, such as that from 2011-2014, Himalayan blackberries may lose large amounts of foliage and thus be unattractive and largely unsuited to nesting Tricolored Blackbirds (Meese pers. obs.).

Himalayan blackberries may spread across pastures to such an extent that they reduce livestock forage production, thus some ranchers regularly control blackberries through mechanical pruning or mastication, burning, crushing, or spraying with herbicide and then burning. However, because many of the blackberry stands that conflict with grazing are not attractive to nesting Tricolored Blackbirds, they can be controlled while the most suitable stands for nesting are retained. Landowners with small stands of Himalayan blackberry who wish to attract nesting Tricolored Blackbirds should encourage their vertical growth while restricting their horizontal spread.

Weedy Fields

In many cases, a field occupied by nesting Tricolored Blackbirds is not dominated by a single species but may be composed of several weed species,

usually including milk thistle, mustard, and mallow, and nests may be constructed in all three (and perhaps other) species. To encourage the growth of such fields, either burn the field or cultivate the soil in autumn and rely upon winter and early spring precipitation to provide the water necessary to germinate seeds and sustain the weedy growth.

Figure 8. Tricolored Blackbird colony in triticale, Kern County. *Photo © Bob Meese.*

Triticale

Since the 1980s the largest Tricolored Blackbird breeding colonies have been located in fields of triticale (Beedy and Hamilton 1999; Figure 8). Triticale fields are not considered a desirable nesting habitat, as birds that settle to nest present farmers with a dilemma: typically, the triticale field is ready for harvest while eggs or young are in the nests, but delaying the harvest reduces nutritional value of the crop. Any farmer with Tricolored Blackbirds settling in to nest in a grain field is urged to contact the local Agricultural Extension Specialist, Fish and Wildlife officer, or nearby National Wildlife Refuge.

GUIDELINES FOR MANAGING FORAGING HABITATS

Foraging Requirements

Breeding female Tricolored Blackbirds require insects to provide the essential fatty acids and essential amino acids needed to form eggs, and nestlings require insects for their first nine days of life. Recent research has shown a strong correlation between insect abundance and reproductive success (Meese 2013). Tricolored Blackbirds eat a wide variety of insects and feed many kinds of insects to their young (Crase and DeHaven 1977). They appear to take advantage of many insect groups that may become locally abundant, but are known to prefer large insects that are locally super-abundant, including grasshoppers during "outbreak" years, caterpillars in years and locations where they are especially abundant (Payne 1969, Meese pers. obs.), and dragonflies, especially late in the season (July and August) when large numbers of dragonflies hatch (Meese and Beedy pers. obs.).

Breeding Tricolored Blackbirds forage in a wide variety of habitats, including dry and irrigated pastures, open rangeland, shrublands, grasslands, and rice paddies. Birds along the coast are often arboreal foragers, and take caterpillars (often called oakworms) of the California oak moth (*Phryganidia californica*) primarily from the boughs of coast live oak (*Quercus agrifolia*) trees (Meese pers. obs.). Breeding birds in the San Joaquin Valley and at some sites in Riverside County also forage on stored grains in dairy commodity barns, although too-great dependency on the stored grains is often associated with poor reproductive success and colony failure (Meese unpub. data).

Due to their wide-ranging foraging habits (i.e., regularly travelling up to 5 km [3 mi]) from active breeding colonies), Tricolored Blackbird foraging habitats are typically not under the direct control of landowners or managers. Where possible, however, in an agricultural landscape, the organic or pesticide-free culture of crops known to support large insect populations (including alfalfa [*Medicago sativa*], sunflowers [*Helianthus spp.*], and rice [*Oryza sativa*] can sustain nearby Tricolored Blackbird colonies, and birds have been observed to travel up to 5 km between their nests and suitable foraging substrates even in highly urbanized environments (e.g., a colony in Riverside County in 2014). Thus, any action that would decrease insect mortality and result in increased insect abundance within 5 km would benefit nearby breeding tricolors, and the breeding birds themselves may be an effective and inexpensive "ecosystem service" that removes the insects that insecticides would be applied to control. Similarly, breeding Tricolored Blackbirds may be beneficial in rangeland areas where grasshoppers compete for livestock forage, but where grasshopper control through application of insecticides is not economical.

Tricolored Blackbirds and Ranching

In most agricultural settings, Tricolored Blackbird conservation and agriculture are alternative and conflicting land uses; however, in California's rangelands, cattle ranching and Tricolored Blackbird conservation are mutually beneficial activities. Ranchers provide water that may encourage the growth of Himalayan blackberries that are used as nesting substrate and also create stock ponds that produce emergent marsh nesting habitat and the water required for drinking and bathing. Ranchers also provide hay and alfalfa that may provide seeds and insects (alfalfa may support relatively high insect abundances, especially if left unsprayed; Meese 2006). Ranchers benefit from nesting Tricolored Blackbirds when the birds eat grasshoppers and other herbivorous insects that consume the grasses and forbs eaten by livestock, since the cattle disturb insects while grazing and make them more available to foraging birds. Grazing also maintains the grasses to the shorter stature, below 40 cm (15"), which is preferred by foraging Tricolored Blackbirds.

CONCLUSIONS

On-going losses of breeding and foraging habitats, which may contribute to chronic low reproductive success, complete breeding failures in harvested agricultural fields, and mortality from autumnal shooting of birds in rice paddies, are believed to be the major causes of recent Tricolored Blackbird population declines. The recovery of this species will require the active and thoughtful management of breeding and foraging habitats in strategically located portions of the species' range and the participation of local landowners.

The management of nesting habitats for breeding Tricolored Blackbirds may in some cases present possible conflicts in conservation policy because birds often nest in invasive non-native plants (e.g., Himalayan blackberries, milk thistle [*Arundo donax*]) that are widely viewed as undesirable. Tricolor conservation efforts, however, must eliminate known sources of mortality while maximizing reproductive success, which requires management for non-native nesting substrates. Conservation actions must emphasize collaborative approaches and strategic land management of high priority sites. Agriculture and Tricolored Blackbird conservation may be mutually compatible land uses in cases where breeding habitats are near foraging habitats that may consist of crops (primarily alfalfa, sunflowers, and rice) that are raised organically or without the use of pesticides while the breeding birds are present. Ranching and Tricolored Blackbird conservation are mutually compatible land uses and the active management of freshwater marshes may benefit several conservation-dependent species.

Tricolored Blackbird populations may recover if they are provided sufficient habitat and these habitats are properly managed. We have seen many instances where the active and collaborative habitat management for

"California's Blackbird" creates a win-win situation for both birds and landowners.

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Recovering the Tricolored Blackbird in California

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The Tricolored Blackbird (hereafter, also "tricolor") is a near-endemic California passerine that forms the largest colonies of any North American landbird since the extinction of the passenger pigeon (*Ectopistes migratorius*) over 100 years ago (Beedy and Hamilton 1999). Tricolor numbers have plummeted recently, from an estimated 395,000 birds in 2008 (Kelsey 2008) to 145,000 in 2014 (Meese 2014) due to a variety of factors including widespread nesting and foraging habitat losses to agriculture and urbanization, destruction of nesting colonies during the routine harvest of their grain field nesting substrates, and shooting in autumn in paddies of ripening rice. This decline in abundance coincided with a period of chronically low reproductive success (Meese 2013), and led, in December 2014, to an emergency listing as an endangered species under the California Endangered Species Act (CESA).

POPULATION TARGET

A population target for the Tricolored Blackbird is essential to define "recovery", guide recovery planning, and evaluate the results of recovery efforts. Members of the Tricolored Blackbird Working Group proposed a population target of a breeding population of 700,000 birds averaged over several years, although this target was never formally adopted (Tricolored Blackbird Working Group 2007, 2009).

We agree with the Working Group members and recommend that a population target of an average of 700,000 breeding birds, calculated over five annual monitoring efforts, be adopted as the recovery target. The 700,000 bird target represents a prudent population level that likely existed in the last decade of the 20th Century and is justified by:

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- knowledge of the historical population (Meese 2015),
- the recent concentration of the majority of birds in a small number of colonies (Kelsey 2008, Kyle and Kelsey 2011),
- insufficiently documented but well-known fluctuations in annual population sizes and productivity (Neff 1937, DeHaven et al. 1975, Meese 2013, 2015), and
- on-going threats to the species' survival, including undetected (although now illegal) human-caused mortality during harvest of active colonies in grain fields adjacent to dairies, incidental shooting while in multi-species foraging flocks in autumn in fields of ripening rice, additional losses of breeding and foraging habitats due to development and conversion to nut orchards and other perennial crops, and the as-yet unstudied effects of insecticides in suppressing insect populations, which are required for breeding (Payne 1969, Meese 2013).

We further recommend a more definitive population modeling effort that incorporates existing bioregional information and an examination of banding data to evaluate the connectedness of the regional populations, estimation of adult and juvenile survival rates and the annual variance in regional and statewide population numbers, and a formal population viability analysis. Results of these analyses (i.e., effective population size, population size variance, annual productivity, annual survival rates) would provide additional metrics to incorporate into recovery goals.

Reaching this recovery goal will take an "all hands on deck" approach and require the efforts of many sympathetic landowners, agency staff, tricolor experts, and California citizens to create conditions throughout the range of the species that support, in perpetuity, breeding by this unique colonial passerine.

STRATEGY

The first element of an integrated recovery effort is to have a coherent strategy that has been developed by experts to address known anthropogenic sources of mortality, conflicts between Tricolored Blackbird conservation and other land uses, factors responsible for the recent chronic low reproductive success, and existing and potential land use changes. Widespread and on-going habitat losses have eliminated large parts of the tricolors' native nesting and foraging habitats in California's Central Valley and in southern California. These two regions are where the species was formerly the most abundant, as a year-round resident in southern California and during the breeding season in the San Joaquin Valley (Baird 1870, Neff 1937, Beedy and Hamilton 1999, Unitt 2004). Thus, it is essential that any recovery strategy address the needs of the birds in these two parts of its range. The options for tricolor conservation may be few in southern California due to likely irreversible

habitat losses. Given the 78% reduction in abundance from 2008-2014 in the San Joaquin Valley (Meese 2014), the door may be closing for conservation opportunities there, as well. Thus, time is of the essence in developing and implementing an integrated and effective recovery strategy.

IDENTIFYING PRIORITY SITES

Given the extraordinary natural diversity of California and the wide geographic range of the tricolor at lower elevations within the state, it is essential to take a bioregional or even county-by-county approach in reviewing the decline in abundance and identifying potential actions in specific locations that could benefit the species. The results of the recent Statewide Surveys and other studies suggest that the problems facing the species are not uniform across its range but rather regionally specific, although nowhere except possibly in the Sierra Nevada foothills does the species appear to be holding its own (Airola et al. 2015, Meese 2015, Meese et. al. 2015). The Southern California, Central California Coast, and San Joaquin Valley bioregions all support far fewer birds now than they did in the recent past, and analyses of potential actions to benefit the species should consider bioregional differences in the causes for and responses to the decline.

All analyses of suitable actions should consider:

- history of use of location;
- current and future suitability;
- history of productivity;
- suitable nearby foraging habitats;
- surrounding land uses; and
- known, proposed, or potential threats to nesting and foraging habitats.

It is essential to establish site priorities based upon an expectation of their use, and perhaps the best indicator of the potential for use of a site is its recent history. Where possible, it is important to consider both how many birds nested and how many young were fledged, because low reproductive success has been a chronic problem for at least several years (Cook and Toft 2005, Meese 2013). All else being equal, locations with relatively higher average reproductive success should be preferred targets for conservation investments (Holyoak et. al 2014). Land cover and uses within a 5 km radius of the nesting substrates, the distance within which the vast majority of foraging typically occurs (Beedy and Hamilton 1999), should be considered as equally important as nesting vegetation. This is especially important where past reproductive success is unknown, as tricolors are insectivorous during the breeding season and reproductive success is correlated with insect abundance (Meese 2013). High quality nesting habitat surrounded by low quality foraging habitats may create ecological traps where birds form colonies but breeding efforts are relatively unsuccessful (Meese 2013), and

such situations will likely do little to reverse the species' decline in abundance. Any changes to both nesting and foraging habitats that may have made the site less suitable since previous use also should be considered, and known, proposed, or potential threats assessed.

The Tricolored Blackbird Conservation Plan, signed by over 30 agencies and organizations in 2007 (Tricolored Blackbird Working Group 2007) and updated in 2009 (Tricolored Blackbird Working Group 2009), was intended to provide planning guidance for conservation. It did not, however, provide the kind of site-by-site or county-by-county recommendations that are needed, and many of its recommendations were not adopted and others were implemented inconsistently. The number of birds has decreased alarmingly since the Plan was adopted (Meese 2014).

IMPLEMENTATION: ON-THE-GROUND ACTIONS

The recovery of the Tricolored Blackbird will require site-specific actions in strategic locations to stem the decline in abundance and increase the number of birds. In all cases, implementing actions appropriate for local conditions will be needed to provide for the long-term needs of the species. What follows is a bioregional assessment of needed actions, with the bioregions defined according to Meese (2015).

Southern California

Southern California may be the most threatened of the bioregions, as the greatest obstacle to tricolor conservation in this portion of the species' range is the ongoing habitat loss due to urbanization (Unitt 2004, Cook 2010). This area, along with the Central Coast, is possibly where the greatest percentage of the historic population has been lost. Although no complete estimate of the number of birds in southern California was provided by early investigators, knowledgeable ornithologists considered the tricolor to be the most abundant land bird in southern California around the end of the 19th Century (Baird 1870, Unitt 2004). During the 2014 Statewide Survey, however, only about 12,000 birds were observed from the Tehachapis south to the Mexican border (Meese 2014).

Due to the intense and ongoing urbanization in southern California, the conservation of tricolors there will likely depend disproportionately upon protected areas including state wildlife areas and remnant or anthropogenic "natural areas" including flood retention basins and constructed wetlands associated with water treatment facilities. In a few strategic locations (e.g., the region around Palomar Mountain in northern San Diego County), active collaborations with private landowners may help to conserve remnant colony locations with adjacent foraging habitats.

Southern California also has a remnant dairy industry, and in Riverside County, in particular, there recently have been wholesale losses of breeding efforts when grain fields occupied by breeding birds were harvested during normal agricultural operations (Cook, unpub. data). It is imperative that all known anthropogenic sources of egg, nestling, and adult mortality be eliminated and all breeding colonies in southern California be preserved. Specific efforts to identify and conserve at-risk colonies that establish in grain fields adjacent to dairies, with compensation to affected landowners, are essential components of recovery efforts.

In southern California, it may be especially important to emphasize the review of all development proposals to include possible detrimental effects, including cumulative impacts, on required tricolor nesting and foraging habitats. An excellent, current example of cumulative impacts are the threats posed by alternative energy developments such as those in the Antelope Valley in northern Los Angeles County and southeastern Kern County, where the installation of photovoltaic panels has eliminated large portions of potential foraging habitats east of Holiday Lake, a site that was utilized by 5,000 breeding birds in 2014 (Meese 2014, unpub. data).

San Joaquin Valley

The San Joaquin Valley is California's "Dairy Belt," and for decades tricolors have been most abundant during the breeding season in this portion of their range (Beedy and Hamilton 1999, Kelsey 2008). This abundance apparently has resulted from the rise in the dairy industry during the 1980s and the attraction of the breeding birds to the essentially *ad libitum* amounts of stored grains there. As recently as 2006, a colony established in triticale (a wheat x rye hybrid grain grown as forage for dairy cows) adjacent to a dairy consisted of an estimated 138,000 breeding birds (Meese 2006). The number of tricolors in this region, however, has declined by an estimated 78% from 2008 to 2014 (Meese 2014).

Although tricolors are believed to subsist largely on grains during the non-breeding season (Beedy and Hamilton 1999), grains alone apparently do not support successful breeding (e.g., Meese 2009a, 2013), and this is also the region where for decades, a conflict between so-called "silage colonies" and normal agricultural operations has resulted in the mortality of tens of thousands of eggs and nestlings when their triticale nesting substrate is harvested during the breeding season (Meese 2009a).

Conservation actions in this region must focus on the resolution of the "harvest conflict" by providing secure nesting habitats surrounded by or close to productive foraging habitats so that breeding birds have an alternative to silage nesting. In the interim, while permanent nesting and foraging habitats are being provided, a policy of zero loss of silage colonies with compensation to the few affected landowners must be adopted to ensure that all silage

colonies are conserved and fledge their young before the harvest of the triticale nesting substrate occurs.

Examples of possible conservation scenarios in this region include a private duck club, which could provide cattail (*Typha latifolia*) nesting habitat and water, adjacent to or within 3 miles of 80-160 acres of unsprayed alfalfa. Alfalfa can support large insect populations, and tricolor reproductive success is highly correlated with insect abundance (Meese 2013). Another potential conservation scenario may be a National Wildlife Refuge or sympathetic landowner with appropriate nesting substrate and open water (See Meese and Brady 2015) that is adjacent to open rangeland or similar foraging habitats. In some cases, the National Wildlife Refuges themselves may be managed to provide insect-rich foraging habitats such as appropriate native plants or unsprayed alfalfa. Lands in permanent conservation easements or other forms of permanent protection should be evaluated for their potential to contribute to tricolor conservation and recovery.

Coastal Locations

Tricolors have been nearly extirpated from the Central California Coast region. In the April 2014 Statewide Survey, only 627 birds were seen in six counties from Alameda to San Luis Obispo, a reduction of 91% since 2008 (Kelsey 2008, Meese 2014). In this region, the birds nest primarily in marshes on private property; thus, conservation actions involve working with property owners to restore or properly manage nesting substrates (Meese et al. 2015) at sites with adjacent or nearby secure, potentially productive foraging habitats. Colony locations and surrounding foraging habitats must be provided long-term protection from land use changes including the planting of additional vineyards and residential developments, so all potential conservation investments should include assessments of susceptibility to habitat loss through reviews of County and City General Plans and other environmental planning documents.

Sacramento Valley

Most birds that breed first in the San Joaquin Valley are believed to move north in May and breed again in the Sacramento Valley (Hamilton 1998, Meese unpub. data). The Tricolored Blackbird Statewide Survey is conducted in mid-to-late April, and does not estimate the number of breeding birds in the Sacramento Valley. However, the severity of losses of breeding tricolors in the Sacramento Valley is indicated by the fact that there were no colonies known in all of Colusa County in 2014 (Meese pers. obs.), where in the very recent past, colonies of 80,000 breeding birds had formed (e.g., Meese 2009b).

The Sacramento Valley is dominated by agriculture, and major portions of the floor of the Sacramento Valley are covered by rice and nut orchards.

Conservation efforts here should focus on providing high quality foraging habitats rather than nesting habitats (see Meese and Beedy 2015), as many National Wildlife Refuges, State Wildlife Areas, and private duck clubs in this region provide excellent potential nesting habitat. The area has a well-documented history of use by large numbers of breeding birds, but with very low reproductive success due to the extremely limited nearby foraging habitats. For example, the 75,000 birds that bred at Delevan National Wildlife Refuge in 2009 produced only 13,000 young, or only 0.26 young per nest (Meese 2009b). Options to provide additional foraging opportunities include providing insect-attracting plants on state and federal refuges and other protected areas to increase insect prey populations near nesting birds, and growing more organic or insecticide-free rice, as organic rice cultivation is believed to provide sufficient insect abundance to support relatively high reproductive success (Meese unpub. data).

Central Sierra Foothills

The number of birds seen in this region over the past three Statewide Surveys increased by about 25%, from 22,586 birds in 2008 to 28,281 birds in 2014. This increase and a recent breeding season survey in the region (Airola et al. 2015), suggest that conditions in this bioregion may continue to support successful breeding by tricolors. The dominant land-use in areas occupied by tricolors is ranching, and birds breed primarily in isolated stands of Himalayan blackberries (*Rubus armeniacus*) and small cattail (*Typha latifolia*) and bulrush (*Schoenoplectus maritimus*) marshes in stock ponds (Airola et al. 2015). Most of the ground cover near colonies is open rangeland dominated by introduced Eurasian grasses, with lesser amounts of irrigated pasture, dryland hayfields, other agriculture, oak savanna and woodland, shrublands, and urban development. However, nearly 37% of colony locations studied by Airola et al. (2015) in this bioregion are threatened by approved or proposed development, so all proposed conservation investments should include assessments of susceptibility to habitat loss through reviews of general plans and other environmental planning documents.

Ranching appears to be beneficial to breeding tricolors (Airola et al. 2015), but many private landowners may be wary of maintaining habitat for an endangered species. Therefore, conservation actions here must include vigorous education and outreach efforts to explain to landowners the importance of the resources that they are providing to breeding birds and the benefits that the breeding tricolors provide by consuming large numbers of grasshoppers (Payne 1969, Meese 2013, Airola et al. 2015) that would otherwise compete with cattle for forage. Voluntary programs such as conservation easements may protect rangeland resources and benefit both birds and ranchers.

plight. These education and outreach efforts should engage the widest possible audience, including:

- direct contacts with representatives in those industries likely to be most affected by Tricolored Blackbird recovery efforts, including developers and agriculture, especially the dairy industry, nut orchard owners, vineyard owners, ranchers, and rice farmers;
- targeted presentations to industry groups, local Resource Conservation District staff, local Audubon chapters, County Agricultural Commissioners, state and federal agencies, NGO staff, and others interested in or affected by recovery efforts;
- responses to requests for assistance from industry groups, local Audubon chapters, non-governmental organizations, biological consultants, and others to inform experts of settlements, colonies, and aggregations of birds, especially in new or at-risk locations, as well as habitat management techniques.

MONITORING

For over 20 years, Tricolored Blackbird conservation efforts have included an annual monitoring effort to gauge the breeding status of the species; however, these efforts have been conducted mostly by a few individuals working primarily in southern California and the Central Valley. Annual monitoring efforts should be expanded to include Sierra Nevada foothill and coastal locations and should emphasize use of the Tricolored Blackbird Portal as both a data entry tool and a device to coordinate and encourage "citizen science" efforts to engage motivated citizens to generate knowledge of breeding status and numbers across a wider geographical area.

Monitoring efforts should be especially focused on documenting the results of conservation actions, including harvest delays, establishment or enhancement of nesting substrates, experimental manipulations of nesting or foraging habitats, and other recovery efforts. Potential detrimental effects of species listing on habitat conditions on private lands also should be monitored.

Since 1994, the status of the statewide population has been assessed by the triennial Tricolored Blackbird Statewide Survey. However, this effort relies upon a large number of volunteers and risks losing some of the most experienced participants due to "participant fatigue" (Meese et al. 2015) and the increasingly precarious status of the species requires the development and implementation of an annual survey based on a statistically valid subset of locations to provide more current information (Meese et al. 2015).

RESEARCH

The recovery of the Tricolored Blackbird in California will take many efforts from many individuals throughout the range of the species and a

commitment to research that annually provides information on key parameters, including:

- site occupancy,
- estimates of numbers of birds at a sample of occupied sites,
- relative rates of reproductive success at a sample of colonies,
- relative insect abundances in foraging habitats near occupied sites, and
- results of site-specific conservation actions.

Some effort has been made to investigate these parameters, but a greater and more consistent effort is required if the species is to recover to the target of 700,000 birds. In addition to these areas of investigation, additional research is needed to evaluate the:

- possible roles of insecticides in the decline and reproductive success,
- factors that contribute to colony site selection,
- factors that contribute to relatively high reproductive success,
- foraging ecology of tricolors,
- resources and patterns of resource utilization around a sample of colonies in a diversity of areas, and
- use and reproductive consequences of conventional vs. organic culture in crops, especially alfalfa and rice, including estimates of the relative rates of foraging and reproductive success.

FUNDING

None of the work described above is possible without a significant and stable funding source. A part of the overall recovery strategy should be to estimate the funding needed to implement various conservation actions and to determine the funding sources available for those actions. Potential funding sources include agency appropriations; state and federal agency conservation programs, including the Wildlife Conservation Board's conservation programs; mitigation payments; crop insurance programs; and private individuals, organizations, and foundations. We stress that funding stability is paramount, as we believe the recovery of the tricolor will take a sustained effort spanning many years across numerous locations and inadequate or irregular funding jeopardizes the entire recovery effort.

We believe that a timely, vigorous, strategic, and effective recovery program can increase the number of tricolors and provide a bright and secure future for California's blackbird. Anything less than this will hasten the species' current rapid decline toward extinction.

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Additional conservation actions include encouraging or financially rewarding ranchers to continue to maintain and enhance existing nesting substrates, and creating new, additional nesting substrates in suitable areas that currently lack them (Airola and Young 2015). Efforts should incentivize practices that benefit breeding and foraging birds, and indemnify ranchers who provide essential resources. The absence of any potential for "take" (or mortality to breeding birds) from routine ranching activities should be emphasized, as should the ability of landowners to control blackberry patches during the non-breeding season.

ADMINISTRATIVE AND LEGISLATIVE ACTIONS

In addition to on-the-ground actions to benefit the birds and to help restore their populations, additional legal and administrative actions are needed. The recent CESA listing should serve to eliminate the destruction of "silage colonies" in southern California and the San Joaquin Valley as long as an effective mechanism is put in place that will conserve at-risk colonies. A mechanism is required to provide:

- field workers to detect settlements of birds in ephemeral nesting substrates (e.g., triticale fields);
- 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 for any losses incurred in delaying the harvest of occupied substrates;
- a cooperative extension specialist or other independent expert who estimates the loss in value of the crop as a result of the harvest delay; and
- 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, and 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 post-harvest behavior of the fledglings).

Implementing these steps would ensure that nearly all silage colonies are conserved while landowners are compensated for any costs incurred due to the delay in the harvest of their grain fields, and eliminate the need for enforcement actions.

Additional legislative or administrative actions may be needed to eliminate incidental mortality of adults in autumn while they are foraging in paddies of ripening rice in the Sacramento Valley with Red-winged (*Agelaius phoeniceus*) and Brewer's (*Euphagus cyanocephalus*) Blackbirds, European Starlings (*Sturnus vulgaris*), and other species for which depredation killing is

authorized under the federal Depredation Order for Blackbirds, Cowbirds, Grackles, Crows, and Magpies (50 CFR 21.43). Tricolors have been shot incidentally when in multi-species foraging flocks with other blackbird species and starlings to prevent depredation to ripening rice (e.g., USDA 2013, Meese unpub. data). The tricolors that use Sacramento Valley ricefields are largely comprised of post-breeding adults (Meese, unpub. data). The loss of post-breeding adults in autumn is especially detrimental since these adults contribute experienced breeders to the breeding population the following spring.

The incidental killing of Tricolored Blackbirds under the depredation order appears to be a violation of take prohibitions of CESA and is contrary to the species' overall recovery goals. The U.S. Fish and Wildlife Service is evaluating options for addressing Tricolored Blackbird take under the depredation order, particularly in light of a petition to list the species under the federal Endangered Species Act (R. Doster pers. comm.). The depredation order should be modified to prevent take of tricolors (e.g., by excluding California from the order or excluding take of all blackbirds and similar species within California) to eliminate adult mortality due to incidental shooting until species recovery is achieved.

LAND USE PLANNING

It is essential that the tricolor recovery effort anticipate land use changes, as many of the threats faced by the species are on-going and accelerating. At a minimum, all existing colony locations should be evaluated for known or anticipated development threats, including land use changes that would negatively impact both nesting and foraging habitats. Consultations with Resource Conservation District personnel in areas of potential conservation investments should consider City and County General Plans, regional Habitat Conservation Plans (HCPs), California Environmental Quality Act (CEQA) compliance documents (e.g., EIRs), and similar documents to identify land use changes that may negatively affect the species. The listing of the species also should result in more thorough re-evaluation of adopted and in-progress open space and conservation elements in General Plans and HCPs to ensure that they conserve tricolor habitat.

Region-specific mitigation guidelines should be developed for General Plans and project-specific plans to conserve, provide, or enhance high quality nesting and/or foraging habitats. Mitigation banks, conservation easements, and other mechanisms need to be developed to encourage conservation of large blocks of habitat containing nesting and foraging habitat.

EDUCATION AND OUTREACH

A very important element of tricolor conservation efforts is the education of a much larger number of Californians to its native blackbird species and its

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The Genesis and Program of Audubon Chapter Tricolored Blackbird Action Team

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It is fascinating how every now and then all of the pieces of a big puzzle fall into place. In this instance, I refer to the genesis of Audubon Chapter Tricolored Blackbird Action Team. I offer this story to inform people of our program to take action to protect and enhance the population of the Tricolored Blackbird (*Agelaius tricolor*), enlist others in the effort, and encourage others to adopt similar active and practical approaches to assist other imperiled species.

This project began improbably in 2005 when I was asked to participate in the triennial statewide Tricolored Blackbird survey. I had no idea what was involved but signed up anyway out of curiosity. I talked three friends, Len McKenzie, Joe Frank, and Paul Oldale, into attending a training seminar with me. After the seminar, we were excited and enlisted the help of the Yosemite Area Audubon Society (YAAS).

We had a great, yet frustrating time doing the survey. We drove virtually every road in Merced County checking every site where tricolors were known to have nested in the past, checking out every dairy that we could find, and looking for potential nesting habitat. We didn't see a single Tricolored Blackbird. We had the same results in 2008, but in 2011 we hit pay dirt—a 60,000-bird nesting colony in an agricultural field near the intersection of Childs and Cunningham roads in Merced County. We immediately called Keiller Kyle of Audubon California. The next day, Keiller began negotiating with the property owner to delay the crop's harvest until after all the nestlings had fledged. But the efforts were to no avail, the field was harvested before the birds had fledged. The killing of all those nestlings irritated me. I wanted to do something about it, but what? I didn't have the foggiest idea of what to do or how to do it.

In 2008, I learned that Ed Pandolfino and Zach Smith were putting together the first-ever survey of winter raptors in California's Central Valley (Pandolfino et al. 2011). I established a route that began in the grasslands of Merced County and ended in the foothills of Mariposa County. The survey was done in December, January, and February and ran for three years. We had the time of our lives doing the raptor surveys, we call them Raptor Runs, and didn't want to stop doing them at the end of the three years. I called Ed and Zack and told them that we wanted to continue doing our survey, do it all year

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and keep sending the data to them if they wanted. Their response was an enthusiastic, “go for it!”

In May 2011, during a Raptor Run survey, Bill Ralph, and I found small numbers of Tricolored Blackbirds in five different locations along a two-mile stretch of Preston Road in the Mariposa County foothills. About then, the Sierra Nevada Conservancy asked YAAS to sign a letter of support for a grant proposal to restore meadows in the High Sierra. They proposed to fence and restore creeks and provide watering troughs outside the creek zone for the cows. Those two events got me to thinking, why couldn't we do the same thing in the foothills and provide nesting habitat for tricolors that would be out of harm’s way? I talked to many people about the idea, and nearly everyone I shared it with dismissed it as unworkable or unrealistic. The exceptions were Ed Pandolfino, and Mike Sutton and Garry George of Audubon California. I was not dissuaded.

At the October 2011 YAAS meeting. Steve Simmons talked about his extensive and impressive local nest box program for Barn Owls (*Tyto alba*) and American Kestrels (*Falco sparverius*). Steve accompanied us on one of our Raptor Runs and banded most of the American Kestrels that we saw. It wasn't long before Bill Ralph had YAAS involved in developing a nest-box program for kestrels.

Another piece of the puzzle was about to fall into place. Several months later on another Raptor Run, we were stopped while looking at a distant raptor trying to identify it. A pickup truck pulled up alongside ours and asked what we were doing. I told him about the survey and added, “We’re also looking for places to put kestrel nest boxes.”

I quickly told the rancher about the benefits of us putting up nest boxes on his property. I hardly had the words, “They eat grasshoppers” out of my mouth when he said, “How many and how soon can you get them on my place?” We now knew a rancher who wanted to work with us. He also introduced us to other ranchers, all of whom have placed nest boxes on their property. We now have over 400 nest boxes for kestrels, owls, and other cavity-nesting birds in areas where there are few if any trees for them to nest.

All of the pieces of the puzzle were coming together. We now had property owners who wanted to work with us and put up kestrel nest boxes. I was confident that they would also work with us with tricolors. Then on September 3, 2014 as we were starting a Raptor Run, a rancher pulled up and asked, “Are you the guys who are putting up the nest boxes?” Len McKenzie told him with great enthusiasm, “We sure are, why?” “Well, my brother and I would like some on our place.” he replied. While we were talking, I happened to mention what we were doing with Tricolored Blackbirds and about our plans to enhance and create safe nesting and foraging habitat for them. He looked at me intently for a moment and said, “What do they look like?” After I had described the species to him he smiled and said, “We have them nesting

on our place and we'll work with you with them too." I was thrilled. Another piece of the puzzle had fallen into place. I now knew that many property owners would work with us once they understood the benefits they would derive from being bird friendly, and one had just volunteered to do so. Now, there were just two critical pieces of the puzzle that I hadn't found. Where would we get the money and the help that would be needed?

In October 2013, Mike Sutton, Vice President of the Pacific Flyway for National Audubon, was YAAS's guest speaker. Len McKenzie and I told Mike about my idea for Tricolored Blackbirds. He agreed it had merit and said he had access to money for these types of projects. Now all I needed was people to help find willing property owners and to get the projects going.

I begin a campaign to get other Audubon Chapters involved to collaborate with YAAS to work with the owners of property in the Sierra foothills to protect, enhance, and restore Tricolored Blackbird nesting habitat in the Sierra foothills. Garry George, was able to find money for three grants for Tricolored projects. As a result of his efforts, Kern Audubon & Kerncrest Audubon are working together to restore three wetland sites in the Kern River Valley where tricolors previously nested. They are digging a well and installing a solar pump in one wetland and enhancing the existing habitat at the other two. San Bernardino Valley Audubon also is restoring a wetland site on Riverside Conservancy property adjacent to the San Jacinto Wildlife Area in Riverside County.

In early 2014, I learned that Dr. Robert "Bob" Meese, wildlife professor at UC Davis, was leading the 2014 Tricolored Blackbird Statewide Surveys. Due to time limitations, I only surveyed Mariposa County. When I went through the well-organized survey preparation materials that Bob sent out, I was surprised there wasn't a single previous tricolored sighting shown for Mariposa County, because I knew that there had been some sightings. By going through various listserves and eBird, I found more than 30 locations where tricolors had been seen by credible birders in Mariposa County. All of these locations are now entered into the Tricolored Blackbird Portal, a centralized database maintained by Bob at UC Davis (tricolor.ice.ucdavis.edu).

Jim Ticer, Len McKenzie, and I surveyed each of the sites twice in mid-April 2014. Due to the drought conditions, the nesting habitat conditions at all but one site were horrible. At the one suitable site on Mt Gains Rd., we saw Tricolored Blackbirds carrying full bills of insects into what was obviously a small nesting colony.

I then called Bob Meese to report our results and to discuss my ideas about and desire to enhance, restore, and create nesting habitat in the foothills. Bob said that he thought it would be worth looking into doing so. He then informed me that the Statewide Survey results had shown that breeding populations in the state had declined by 64% over the last six years, and that nesting populations had nearly disappeared from a number of southern San

Joaquin Valley and Central Coast areas, but had increased in the Sierra foothills.

A short time later, Bob sent me a copy of *Results of the 2014 Tricolored Blackbird Statewide Survey* (Meese 2014). I had known the numbers were not good, but I had no idea of how bad they actually were. According to the report, the number of tricolors was down steeply statewide, but the decline was not uniform across different regions of the state. The decline was most pronounced in the San Joaquin Valley and along the Central Coast. The numbers in the San Joaquin Valley plummeted 78% in six years, from 340,700 to 73,500 birds, and the decline was especially alarming in Kern and Merced Counties. Along the Central Coast, the number of birds was down 91% in six years, from 7,014 to 627 birds. The report noted that unlike the San Joaquin Valley and along the Central Coast, during the same six-year interval the number of tricolors in the Sierra Nevada foothills and Sacramento County increased by about 145%, from about 22,500 birds to about 54,000 birds. These numbers suggest either that tricolors were either moving into the foothills from other regions or were breeding more successfully in the Sierra Nevada foothills than they were in the San Joaquin Valley or the Central Coast, or perhaps both.

After reading the report, I called Bob and reiterated my belief that restoring and creating habitat in the foothills was going to be a major part of saving our tricolors. He agreed that the idea was worthwhile, and suggested I talk to Dan Airola, who was working on tricolors in the central Sierra foothills.

Dan told me that he was conducting nesting surveys in seven counties in 2014 and was finding large numbers of nesting tricolors. Ultimately, he estimated the minimum nesting population for the foothill region between Placer and Stanislaus county to be nearly 43,000 nesting birds, or 30% of the statewide nesting population recorded in the 2014 Statewide Survey (Airola et al. 2015). As we discussed the vast population differences between the central and southern Sierra foothill Tricolored Blackbird populations, it appeared that there were two key habitat differences. First, overall the central region is wetter, and has more irrigated pasture lands and stream flow that can support nesting habitat in Himalayan blackberries (*Rubus armeniacus),* cattails (*Typha latifolia*), and tules (*Bolboschoenus californicus*). Second, despite the continuing drought, the central foothills had good spring rains in 2014 (120% of monthly average during Feb-Apr) that resulted in good growth of grasses, which may have resulted in good grasshopper production (Airola et.al. 2015) Grasshoppers, when present in abundance, serve as the key food item for tricolor nestlings.

Bob, Dan, and I talked over the next few days, and now I had the final pieces of the puzzle. They knew about tricolors and were also concerned, anxious, and motivated to get something done. And they had ties in the worlds of ornithological science and environmental regulation. They were

frustrated that there had been a long history of talk about saving our Tricolored Blackbirds, but little action to do so. So we agreed to organize a group dedicated to implementing actions to help the tricolors. We set a date for an organization meeting to develop a program to enhance the status of the Tricolored Blackbird. On 20 August 2014, 27 people attended, including concerned individuals representing seven Audubon Chapters from the foothills and Central Valley and the Central Valley Bird Club. Audubon California's Conservation Project Manager, Samantha Arthur, and their Chapter Network Director, Garry George also attended the meeting, as did Tricolored experts Bob Meese and Ted Beedy.

Audubon California is a strong supporter of our program, working closely with us to develop and complete a number of the 16 projects we identified at the workshop. They are assisting to get the projects ready for funding, and they have helped us identify sources of funding and write the grants to obtain funds for the projects. Several Audubon chapters have also stepped forward with other projects and funding. Audubon California also set up and is sponsoring our Tricolor Action Team list-serve, which makes it a lot easier to communicate with each other and keep everyone informed.

We ranked the priorities for the 16 identified projects based on several factors, which helped us determine which had the greatest possibility of being ready as soon as possible, including the 2015 nesting session. The highest priority projects are:

- *Yosemite Lake, Merced County.* Chris Swarth of YAAS is responsible for this project. Here four different property owners and a rancher, who leases some of the property, are cooperating to make this project possible. Bob Meese brought in Reyn Akiona of the USFWS to help develop a scope of work. We will excavate lands along the lake shoreline, and thereby expand and enhance the growth of emergent vegetation for nesting habitat. We will also fence potential nesting habitat in the north arm of Yosemite Lake to exclude livestock.
- *Merced National Wildlife Refuge*. Jane Manning, of Fresno Audubon Society, initiated this project, which involved three options to create a total of 175 acres of nesting habitat and 90 acres of foraging habitat at a cost of $57,000. We were hoping to get just one of the options funded, but Samantha Arthur and Meghan Hertel of Audubon California stepped up and all three projects should be ready for the 2015 nesting season.
- *Mendota Wildlife Area/Producer's Dairy*. Robert Snow and Jane Manning of Fresno Audubon developed this project, a cooperative partnership between these two entities. Once again, Audubon California is assisting us in bringing this project to fruition by building on what Jane and Robert proposed. The project will develop nesting and foraging habitat at both locations to give the partners the flexibility they need to protect any nesting birds and also provide the silage the dairies needs. This project

could be a model for future cooperative arrangements between governmental and private interests to protect tricolor habitats, meet other environment needs, and provide benefits to public and private economic interests.

- *San Joaquin River Parkway*. Robert Snow asked me to present a program on the Audubon Chapter Tricolored Blackbird Action Team to Fresno Audubon at their general meeting. After the program, George Folsom, President of the Board of Directors for the San Joaquin River Parkway and Conservation Trust, Inc., invited me to tour the Parkway. There are opportunities to develop multiple nesting sites using several different substrates. Jeff Davis of Colibri Ecological Consulting and Fresno Audubon are doing the scoping work for this project.
- *Sierra Foothill Nesting Habitat Protection Program*. Dan Airola and I have developed a program to enter into short-term contracts to pay landowners to protect existing and recent nesting colonies on private ranch lands (see Airola and Young 2015).

Thanks to Garry George of Audubon California, we have also obtained some funding to pay for a scope of work for several projects that will give us the information we need to acquire funding to make them happen.

We are not an exclusive group. Anyone who is concerned about the plight of Tricolored Blackbirds and all the other species that share their nesting and foraging habitats, is welcome to join and participate in our team. If you know of a potential project, let us know. If you want to help in any way, we welcome the opportunity to work with you. For more information, contact me (see contact information above). I will do my best to answer your questions or direct you to those who can. If you want to join our conversations, you can do so by joining our listserv at: www.yosemiteaudubon.org/.

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Protecting Nesting Habitat for the Tricolored Blackbird on Private Rangelands in the Foothill Grassland Region of the Sierra Nevada

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The recent statewide Tricolored Blackbird (*Agelaius tricolor*) survey (Meese 2014, 2015) documented a dramatic decline in the population of this near-endemic California species. In response, on 3 December 2014, the California State Fish and Game Commission listed the species as Endangered under its emergency listing provisions for a minimum period of six months, with eventual full listing expected. A petition for listing under the Federal Endangered Species Act also is under evaluation.

As a follow-up to the April 2014 Statewide Tricolored Blackbird Survey (Meese 2014), Airola et al. (2015) surveyed for and monitored nesting colonies in the grassland-dominated lower foothills of the Sierra Nevada and eastern edge of the Central Valley. This area, east of predominantly cultivated lands, included lands within Placer, Ed Dorado, Sacramento, Amador, San Joaquin, Calaveras, and Stanislaus counties.

The 2014 foothill grassland surveys showed that a minimum of 43,000 Tricolored Blackbirds nested within the study area, representing 30% of the remaining statewide population. Unlike other areas where the species nests, this foothill grassland area appears to support moderate to high reproductive success (Airola et al. 2015). All colonies occurred on private lands. The habitat at many colony sites depends on management practices employed for livestock production, including water impoundments and irrigation of pastures. One-third of the colonies in the foothill region, which support 44% of the nesting population in the area, is on lands approved or proposed for residential and industrial development.

As a result of the study, there is broad agreement that foothill grassland areas are important to the Tricolored Blackbird and offers substantial opportunities to provide productive habitat for long-term conservation (Airola et al. 2015, Meese and Beedy 201, Meese et al. 2015, Young 2015). The recent species listing, however, raises fears among landowners that they will face burdensome regulation if they have tricolors on their lands. As noted by the

California Cattlemen's Association and Farm Bureau Federation in their comment letter on the listing action, listing could cause landowners to remove nesting habitat to avoid potential regulation.

We believe that the real potential for regulatory burden on livestock operators is minimal, mostly consisting of a prohibition of direct take (i.e, killing or injuring) of adults, eggs, and young during the two month nesting season. After young are fledged from nests, the California Endangered Species Act (CESA) has no basis to prevent landowners from modifying or removing nesting habitat (e.g., removing Himalayan blackberry (Rubus *armeniacus*)} stands to enhance livestock forage or removing cattails (*Typha latifolia*) or bulrushes (*Schoenoplectus californicus*) to increase pond storage, repair dams, or improve livestock access to water. Nonetheless, we recognize that some owners may want to actively remove nesting habitat solely to avoid the perceived potential unknown risk of regulatory obstruction of management activities.

In response to these concerns, we have proposed a pilot program to reward landowners financially for protecting Tricolored Blackbird nesting habitat. This program would make cash payments to landowners who agree to provide short-term protection for lands that support, or have recently supported, active Tricolored Blackbird nesting colonies. A small annual payment would be made to landowners who agree to maintain the ongoing management practices that created the high quality habitat and prevent any potential detrimental actions to or the removal of the habitat. In essence, we want to pay ranchers to continue their current activities and to raise Tricolored Blackbirds in addition to livestock.

PROGRAM GOALS

Goals of the program are to:

- protect Tricolored Blackbird nesting colonies on private lands in the foothill grassland region;
- increase landowner awareness and provide incentives to manage positively for tricolors (i.e., to view them as the asset they can be, not as a liability, especially after listing);
- encourage the creation and enhancement of other highly suitable tricolor nesting habitat by private landowners;
- maintain program flexibility so that funds can go to where they can do the most good in any given year; and
- publicize the program with the ranching community to shift potential negative views toward the species to something positive and beneficial to land owners.

PROGRAM DESCRIPTION

The Tricolored Blackbird Nesting Habitat Protection Program would establish a fund from which individual private landowners could be paid to maintain and protect active and recently used Tricolored Blackbird nesting habitat (primarily emergent wetlands and Himalayan blackberry patches) in the foothill rangeland areas of the Sierra Nevada. The fund could provide a small payment to landowners who have high quality nesting habitat and who enter into an agreement to protect the nesting area from disturbance during or after the nesting season for a period of one to two years. The agreements would be short-term so that payments could be focused on active nesting colonies. The agreements could be renewed if conditions remain favorable and birds continue to nest. The program funds will be administered through the Yosemite Area Audubon Society.

Volunteers, and landowners (if they wish to) would identify locations of active and recently active Tricolored Blackbird colonies. Locations would be ranked for their incorporation into the protection program based on several criteria, including:

- how recently the site supported an active colony,
- colony size,
- distance to other active colonies and other suitable nesting habitat,
- quality of nesting and foraging habitat, and
- susceptibility to disturbance if not protected.

To date, foothill sites active during 2014 have been ranked for their protection priority.

Under the proposed program, landowners will be contacted to see if they are willing to enter into protection agreements in exchange for a modest annual payment (estimated at $300-500; the payment amount could vary based on landowner response, colony size and degree of threats). Volunteers would work with landowners to develop a customized agreement for use in protecting each colony. Volunteers would monitor sites where agreements are executed to verify compliance with agreement terms and evaluate effectiveness.

A standard agreement has been prepared that can be customized for individual landowners. Terms of the agreement would require continuation of ongoing management practices that created the habitat (i.e., irrigation) and would preclude measures that would detrimentally affect habitat conditions (removing emergent vegetation, or spraying, burning, or crushing blackberry patches). The fact that active colonies of birds can move from one nesting site to another on a yearly basis necessitates that the agreements be annual in nature. Over the long term, the program is intended to build appreciation for the species, provide incentives for beneficial management practices, and discourage habitat removal due to fears resulting from listing of the species.

The program will target landowners who are attempting to maintain a long-term ranching operation, rather than landowners who are intending to eventually develop their lands. However, there may be times in which protection of large, important colonies may warrant payment to owners whose lands are scheduled for developed.

An ancillary benefit of the program likely will be identification of opportunities to work with landowners to create or enhance Tricolored Blackbird habitat on their lands.

RATIONALE FOR THE CONSERVATON APPROACH

The approach proposed in this program is intended to address a potential short-term problem–the loss of Tricolored Blackbird breeding colonies due to unintentional, incidental management actions or purposeful removal of habitat to avoid risk of regulation. The program is unique, in that it relies on direct payment to landowners to incentivize short term management actions. There are many advantages of such a program that are specific to the Tricolored Blackbird. These include:

- *Effort is focused on active or recently active colony sites***.** This reduces cost compared to more expansive conservation approaches of acquiring lands in fee title or long-term conservation easements. Because Tricolored Blackbirds move nesting sites regularly, the program can efficiently follow the birds, rather than expect the birds to respond to on-paper land conservation.
- *Management activities are not substantially altered.* Ongoing management activities that have created suitable conditions for tricolors are encouraged to be maintained. Landowners do not have to accept or learn new ways to manage lands. No changes in management would occur that could create problems for adjacent landowners (increased fire risk, weed introduction, or regulatory reach).
- *Costs are expected to be low.* The program will offer to pay landowners to not change their existing management, so there is little or no cost to the landowners who participate in the program. This makes the cost needed to provide incentives for landowners low.

Notably, however, the program does not accomplish some needed long-term conservation needs. Specifically, it does not address impacts due to land use changes from ranching to more intensive uses (see Airola et al. 2015). Loss of nesting and foraging habitat to commercial development and mining is not likely to be effectively addressed by this program. These issues will have to be addressed through land use decision-making and project permitting, to avoid or mitigate habitat impacts. It also does not create new nesting habitat in areas where such habitat may be limiting (Young 2015), although the program could be readily adapted to encourage new habitat creation.

PROGRAM COST AND FUNDING

Cost of the program is somewhat uncertain, because the number of annual protection agreements and the cost of individual agreements are not known for certain. Currently, based on limited discussions with landowners, we believe a small payment of perhaps $300-500 will be adequate to encourage landowner enrollment for 1-2 breeding seasons. Such modest amount should be sufficient because the protection effort will, for the most part, only require that landowners continue managing lands as they have previously done, the results of which created the suitable conditions for Tricolored Blackbird nesting.

If our per-site cost estimates are correct, annual costs for the program will be low. Assuming protection of 3-5 sites during 2015, costs could vary from $900-2,500. If the program grows over time, costs could eventually reach $5,000 -7,500 per year, assuming that up to 15 sites may eventually be protected annually. At present, the contract and funding will be administered through Yosemite Area Audubon Society (YAAS) overseen by Lowell Young.

Sources of funding are also still somewhat uncertain. Audubon California has offered $2,000 to support the first year effort as a pilot project (G. George, pers. comm.). The YAAS has committed to make a small contribution. More traditional agency and other nonprofit groups have not yet come forward with funding. The program is innovative in ways that do not allow it to fit under many established agency and conservation group funding programs. We are considering raising funds through a "crowd-sourcing" website. We encourage organizations and individuals who are interested in supporting this conservation effort to contact us.

CONCLUSIONS

The dependence of a substantial component of the remaining depleted global population of the Tricolored Blackbird on privately owned rangelands in the lower Sierra Nevada foothills warrants action to maintain and enhance the species and its habitat there. Suitable conditions and apparently successful reproduction have been occurring under conditions created through incidental land management for livestock grazing (Airola et al. 2015). Also, a substantial component of the population in this area is threatened by changes in land use from grazing to development (Airola et al. 2015). The movement of Tricolored Blackbird colony locations between years also challenges existing conservation paradigms.

Effective conservation efforts in the foothill grassland region must be flexible and need to conform to the requirements and attitudes of the ranching community. We believe our proposed program to directly reimburse landowners whose management attracts active Tricolored Blackbird colonies has good potential to make Tricolored Blackbirds an asset to landowners,

rather than a liability. We hope to be able to implement the program to test its effectiveness as a cost-efficient approach to species conservation.

As described, however, the Tricolored Blackbird foothill nesting habitat protection program is a small scale pilot project intended to test key assumptions about landowner interest and program costs. Ultimately, to be successful on a larger scale, the program needs to be institutionalized with funding and administration by a government agency or a larger nonprofit organization.

ACKNOWLEDGEMENTS

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Protecting, Restoring, and Enhancing Tricolored Blackbird Habitat on Agricultural Lands through the Regional Conservation Partnership Program

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The 2014 Statewide Tricolored Blackbird Survey, a volunteer-based triennial survey to monitor Tricolored Blackbird population trends and habitat associations, documented a 44% decline in the species' population since 2011 (Meese 2014). The population decline demonstrates the need to reduce Tricolored Blackbird mortality and provide secure nesting habitat. The 2014 Statewide Survey found 38% of Tricolored Blackbirds nesting in triticale, a wheat-rye hybrid grown for forage on dairies (Meese 2014).

The timing of triticale harvest conflicts with Tricolored Blackbird nesting, putting colonies in these fields at risk of destruction. Because a high proportion of the Tricolored Blackbird's population nests in a small number of colonies within agricultural fields, protection of these colonies is critical to the continued existence of the species. Efforts to protect Tricolored Blackbird populations in dairy silage fields from 2005—2009 contributed significantly to Tricolored Blackbird productivity (Meese 2009). While short-term protection of colonies in silage fields is necessary, the long-term survival of Tricolored Blackbirds requires creation of safe nesting sites that do not conflict with dairy operations (Meese et al. 2015).

In January 2015, the Natural Resource Conservation Service (NRCS) announced its selection of projects under its new Regional Conservation Partnership Program (RCPP). NRCS awarded the conservation-dairy industry partnership between Audubon California, California Farm Bureau Federation, Dairy Cares, Sustainable Conservation, and Western United Dairymen $1.1 million over five years to protect, restore, and enhance Tricolored Blackbird habitat on agricultural lands. The Tricolored Blackbird RCPP grant seeks to contribute to the efforts to save the species by protecting colonies in silage fields and restoring or enhancing habitat that provides safe nesting sites on agricultural lands.

In addition to the $1.1 million RCPP grant award, project partners committed matching in-kind and cash contributions to lift the investment in Tricolored Blackbird conservation to nearly $2 million. With letters of support from eleven organizations and the NRCS State Conservationist, the Tricolored

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Blackbird RCPP project was one of two projects selected for funding by NRCS in the Bay Delta Critical Conservation Area (BDCCA) and one of six projects selected in California. While the needs of Tricolored Blackbirds are numerous and widespread, Audubon California and its partners see this effort as an important piece of the larger effort needed to recover the population.

REGIONAL CONSERVATION PARTNERSHIP PROGRAM

The RCPP was developed in the 2014 Farm Bill to promote coordination between the NRCS and its partners to deliver conservation assistance to agricultural producers and landowners. Roughly $1.4 billion in RCPP applications were received but only $370 million were awarded to projects that address water quality degradation, insufficient water supplies or inadequate habitat for fish and wildlife. National, state, and critical conservation area funding pools were designed by the United States Department of Agriculture to distribute RCPP funds. RCPP grants obligate up to five years of funding to be used in existing NRCS programs, with funding going directly to eligible landowners and producers. The Tricolored Blackbirds RCPP project utilizes the Environmental Quality Incentives Program and the Agricultural Conservation Easement Program to distribute $800,000 to $900,000 directly to landowners as part of cost-shares for Tricolored Blackbird protection, restoration, and enhancement, with the remainder to go to NRCS and partner staff to carry out the grant goals.

TRICOLORED BLACKBIRD RCPP PROJECT GOALS

The Tricolored Blackbird RCPP goals were developed directly from the 2007 Conservation Plan for the Tricolored Blackbird (Tricolored Blackbird Working Group 2007), which was signed by sixteen cooperating organizations or joint ventures that represented collections of organizations. The Conservation Plan identifies two conservation and management goals: 1) protect, create, restore, and manage habitats needed to support viable, self-sustaining populations of tricolors; and 2) protect silage-nesting tricolors until sufficient, permanent breeding habitat is available to maintain viable self-sustaining populations. The plan also includes additional research, data management, and general outreach goals that were outside the scope of the RCPP application.

The Tricolored Blackbird RCPP partners developed four project goals that align with objectives and tasks described in the Conservation Plan and reflect the strengths and capacities of the partner organizations.

- Implement habitat restoration and enhancement projects on NRCS Wetland Reserve Program properties or private agricultural lands to provide safe nesting sites for Tricolored Blackbirds. (USDA Farm Bill programs administered by NRCS are designed for agricultural producers and funds are restricted to use on current or former agricultural lands.)

- Partially compensate farmers in the Central Valley for lost crop value from harvest delays when Tricolored Blackbirds nest in their fields. This continues the already successfully launched NRCS program in California that was critical over the last three years to the survival and successful reproduction of large Tricolored Blackbird colonies on dairy farms and forage operations in the Central Valley of California.
- Develop long-term solutions that can substitute for federal harvest management practices when farmers have Tricolored Blackbird colonies on their fields and avoid situations leading to the destruction of colonies on forage fields (i.e., crop insurance programs or silage banks).
- Establish an industry-led campaign for outreach to farmers on the importance of the Tricolored Blackbird and their role in saving the species.

GEOGRAPHIC FOCUS

The Secretary of Agriculture defined geographic areas across the country where RCPP funding could be applied for and used, one of which is the BDCCA. The geographic focus of this project is Tricolored Blackbird nesting habitat in the San Joaquin Valley of the BDCCA. Stanislaus, Merced, Fresno, Kings, Tulare, and Kern counties are included in the project area to address the areas where concentrated, large Tricolored Blackbird colonies occur on dairy farms and associated forage operations. Madera and Mariposa counties are also included to capture recently documented large colonies or potential restoration opportunities.

The RCPP project designates funds to its project goals and geographic area, but existing NRCS programs will continue to be available outside of the project area. The same practices, such as habitat restoration, that will be utilized in the San Joaquin Valley are available statewide and we hope projects will be developed across the entire Tricolored Blackbird range.

CONCLUSION

A Statewide Survey conducted in 2014 documented approximately 145,000 Tricolored Blackbirds in California, down 44% from 258,000 birds in 2011 and down 64% from 395,000 birds in 2008 (Meese 2014). The steep decline in Tricolored Blackbirds calls for an all-hands-on-deck approach to its recovery. The RCPP project is one piece of a larger effort that is needed through the Tricolored Blackbird's range and life cycle. We hope to see additional efforts and investments that address the many challenges faced by this unique California bird.

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Large mixed blackbird flock composed mainly of Tricolored Blackbirds, taken 28 October 2007 by *Robert J. Meese* outside Birds Landing, Solano County. Flocks of this size have not been reported in recent years, likely reflecting the species 63% statewide population decline from 2008-2014.

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Front Cover:

Tricolored Blackbird (*Agelaius tricolor*).
14 Apr 2014. Sacramento County, California

Photo © Phil Robertson

Back Cover:

Female Tricolored Blackbird carrying food to nestlings,
28 Apr 2013. Sacramento County, California

Photo © Mike Bumgardner