Reproductive Success of Tricolored Blackbird Colonies in 2011 in the Central Valley of California

Final Report

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INTRODUCTION

The tricolored blackbird (*Agelaius tricolor*; hereafter tricolor) is a near-endemic California passerine that forms the largest breeding colonies of any North American songbird (Beedy and Hamilton 1999). Due to a variety of factors including habitat loss through conversion to agriculture and urbanization, market hunting, poisoning, shooting as an agricultural pest, and destruction of large breeding colonies through the harvest of their nesting substrates, the number of tricolors plummeted during the 20th Century (Neff 1937, Beedy and Hamilton 1999), leading to a petition by the Center for Biological Diversity to list the tricolor under the protections afforded by the State of California and Federal Endangered Species Acts (CBD 2004). These petitions were denied. The tricolor is currently a federal species of conservation concern (USFWS 2008) and a California Bird Species of Special Concern (Shuford and Gardali 2008).

I conducted field work between March 28 and July 19, 2011 to detect, monitor, and determine the fates of the largest tricolor breeding colonies in California's Central Valley. Where access permitted, I also estimated the reproductive success of successful colonies. I discuss the significance of this year's results, integrate this year's results into a seven-year perspective, and provide recommendations for actions that may help to stem the decline in the abundance of the species and lead to more positive conservation outcomes.

This is the seventh consecutive year that I have conducted field work with tricolors and the fifth year that I have banded tricolors. The results of this year's banding efforts are described in a separate report (Meese 2011). The field work I describe here and in my previous reports (Hamilton and Meese 2006, Meese 2006, 2007, 2008, 2009, 2010) emphasizes the Central Valley, although the tricolor has two distinct population segments: the Central Valley population and the southern California population (DeHaven and Neff 1973, Beedy and Hamilton 1999), and historically has nested in large numbers in coastal marshes in southern California (Baird 1870, Neff 1937, Unitt 2004). Workers in southern California have documented severe population declines in the southern California population segment (Neff 1937, Beedy and Hamilton 1997, Unitt 2004, Kelsey 2008, Western Riverside County MSHCP 2010, Kyle and Kelsey 2011). Small numbers of tricolors are also found in northern Baja California, western Nevada, southern Oregon, and, since 1998, southern Washington (Beedy and Hamilton 1999, Seattle Audubon Society Birdweb website, accessed August 2011), and as is the case in southern California, the Baja California population is in serious jeopardy (Erickson et al. 2007, Erickson and de la Cueva 2008).

This report summarizes field work in 2011 that sought to detect and determine the fates of settlements and colonies, and estimate the productivity of the largest colonies in the Central Valley tricolor population segment, where ca. 98% of all tricolors occur (Kyle and Kelsey 2011). I also summarize the observations of volunteers of two breeding colonies in northern Los Angeles County and one breeding colony in Riverside County as these were well known to me and, together, form a significant component of conservation efforts for the southern California population segment of the species. I integrate this and the past six years of field work and provide suggestions for conservation actions that may benefit the species.

METHODS

The methods I used in 2011 were identical to those used in previous field seasons and thus are only briefly reviewed here. See Meese (2010) for a more thorough description of the methods used to detect, monitor, and estimate the productivities of successful colonies.

Colony Detection

I began to survey for colonies on March 28, 2011 in the San Joaquin Valley. I searched for tricolor colonies by driving on public roads to examine previously-documented colony locations and supplemented these searches by surveying appropriate regions consisting of silage fields adjacent to dairies in the region from Kern County in the south to Merced County in the north.

Sacramento Valley colony surveys began in mid-May and consisted of targeted searches of previously-documented colony locations supplemented by searches of sites that have been reported by numerous collaborators (state and federal agency personnel, non-governmental organization staff, readers of the Central Valley Birds Yahoo Group, birders) or entered into the Tricolored Blackbird Portal (http://tricolor.ice.ucdavis.edu).

Monitoring

With one exception, I monitored all accessible at-risk sites until a colony failed or fledged its young. I surveyed the West Poso colony in Kern County only once as this site was already being monitored by at least two other field researchers and the owner had expressed to both a desire to harvest his triticale crop as soon as it matured (i.e. before the young tricolors had fledged and left their nests).

In most cases, colonies were monitored by observing from the closest public road if located on private property where permission to access had not been obtained, or by observing from immediately adjacent roads if located on public property or on private property where permission to access had been obtained. I observed colonies approximately twice-weekly to assess current conditions as well as to best assess colony chronology to estimate optimal times for conducting reproductive success and breeding population size estimates.

Estimating Area Occupied

I estimated the dimensions of the occupied areas of nesting substrates by one of two methods: visually estimating the area occupied or directly measuring the occupied area with a hand-held global positioning system (GPS) receiver. Both visual estimates and coordinates directly measured by GPS were placed into Google Earth to measure the dimensions of the occupied area. In addition, areas believed to be unoccupied were searched after birds had finished breeding to confirm the absence of nests. An estimate of the area occupied is required to estimate the number of breeding birds via sampling after the breeding season (see below).

Estimating the Number of Breeding Birds

The number of breeding birds in a colony was estimated in either or both of two ways: visually and/or by nest sampling following the breeding season.

Visual estimates of the number of breeding birds were derived each time a colony was monitored by carefully observing a colony for from five-30 minutes per visit. When possible, colonies were observed from multiple vantage points to most precisely estimate the number of birds present.

For colonies where permission to access had been obtained, I re-entered colonies after the young had fledged and both young and adults had left the area and estimated nest densities by counting nests within six-foot wide line transects of variable lengths. I documented start and end points of transects by GPS and computed the transect lengths by GPS or by the length measurement tool in Google Earth.

I used the number of nests in the sampled areas to derive estimates of the number of nests per acre and computed the number of nests constructed at a colony by multiplying the number of nests per acre by the

number of acres occupied by breeding birds. I assumed that each male breeds, on average, with two females (Beedy and Hamilton 1999), and multiplied the number of nests by 1.5 to estimate the number of breeding birds at a colony. This quantity then provides an independent estimate of the number of breeding birds, as the number of breeding birds is also visually estimated during monitoring activities.

Estimating Reproductive Success

I estimated reproductive success (RS), defined as the average number of young produced per nest, in one of two ways: by visual estimates or by sampling.

I derived visual estimates of RS by visually estimating the number of breeding birds and the number of fledglings. As one male breeds, on average, with two females (Beedy and Hamilton 1999), each two nests have three birds associated with them, so the product of the number of breeding birds multiplied by 2/3 (0.67) provides an estimate of the number of nests constructed. The visual estimate of the number of young fledged divided by the estimate of the number of nests constructed yields an estimate of the number of young fledged per nest (RS).

For colonies where permission to access had been obtained, I derived an estimate of RS by counting the contents of a random sample of nests when the average age of nestlings was believed to be seven to nine days old. Entering colonies when nestlings are greater than nine days of age will cause the nestlings to jump from the nests prematurely, likely increasing nestling mortality.

Estimating the Number of Young Produced

I estimated the number of young produced at colonies by either or both of two methods: repeated observations of young in groups ("crèches") following fledging, and/or calculating the product of the number of nests constructed by reproductive success (see above).

For most colonies, the number of fledged birds may often be carefully counted, especially for colonies where access has been granted, as young tricolors spend a minimum of several days in groups perched and calling ("food begging") conspicuously from the tops of vegetation at the margins of colonies (Beedy and Hamilton 1999, pers. obs.). Typically, groups of fledglings will begin to leave the nesting substrate and fly up to perch high in nearby shrubs or trees within two to four days of fledging. However, crèches remain within the colony boundaries for up to two weeks or more if there are no nearby taller shrubs or trees, as is often the case in colonies in fields of triticale in the "silage belt" of the southern San Joaquin Valley.

In cases where I estimated RS and the number of nests built by sampling, I estimated the number of young produced by multiplying the estimate of the number of nests by the average number of young produced per nest (RS). This estimate of the number of young produced serves as an independent check on the visual estimate of the number of young produced (= number of fledglings observed).

After the young had fledged from colonies in the San Joaquin Valley, I repeated these activities, and responded to reports of aggregations of tricolors, in the Sacramento Valley.

I made one trip to southern California in April but corresponded with workers in southern California throughout the field season and summarize the results of their field work on three colonies.

I trapped and banded birds during the interval from late April to mid-July; the results of my banding activities are presented in a separate report (Meese 2011).

RESULTS

As has been documented each year since 2007, tricolor reproductive success was poor in 2011. The total number of fledglings produced was the smallest in my seven years of field work with the species and unlike in past years when relatively good reproductive success at a large colony tended to "rescue" the reproductive effort for the season, none of the largest colonies fledged relatively large numbers of birds.

Several factors are believed to be responsible for severely limiting the productivity of tricolor colonies in the Central Valley in 2011, including:

1) an unusually cool and wet spring that delayed the growth of preferred nesting substrates, especially milk thistle (*Silybum marianum*), and appeared to reduce the abundance of insect groups (Orthopterans, Lepidopterans) preferred by foraging tricolors;
2) the harvest of grain fields being used as nesting substrate by breeding tricolors;
3) impacts on insect groups preferred by tricolors via on-going conversions of native vegetation and agricultural lands, primarily alfalfa, that offer productive foraging substrates to perennial crops, primarily orchards (almonds, walnuts, and pistachios) and vineyards, that are insect-poor foraging substrates;
4) the destruction of breeding substrates primarily on private property; and,
5) predation by cattle egrets (*Bubulcus ibis*) in Tulare County.

Colonies Detected

Field work started on March 28 and ended on July 19, 2011. During this time I detected, or received reports of, a total of 37 occupied sites (Appendix 1). Of these 37 sites, I confirmed occupancy by breeding tricolors at 29 sites; the remaining sites were reported to me via email by agency staff and field personnel. I or the other field workers observed breeding activity to at least the nest-building stage at all of these sites; aggregations of birds that were not believed to be breeding are not included in this total.

Colonies Monitored

I surveyed for colonies throughout the San Joaquin Valley beginning in late March, made a one-day trip to northern Los Angeles County on April 5, and began to survey Sacramento Valley locations in mid-May. I monitored 16 colonies in 2011 (Table 1). I determined the fates of all colonies monitored and estimated the reproductive success (RS) of five colonies (Table 1).

Table 1. Colonies Monitored in 2011.

Colony Name	County	Substrate	No. of Breeding Birds	Fate
Costa's	Kern	triticale	20,000	5 different fields occupied; young at 4 of these fledged, fate of 5th uncertain
ECLA Ponds	Kern	cattails	300-3,000	multiple breeding attempts; first attempt modestly productive
West Poso	Kern	triticale	30,000	destroyed by harvest; ca. 800 young produced
Deer Creek Dairy	Tulare	triticale	20,000	no young fledged - intense cattle egret predation
Holiday Lake	L.A.	cattails/bulrush	250, 600	relatively productive due to burn in April, subsequent nesting in June
Hulen Levee	Merced	Himalayan blackberry	50	ca. 20 nests produced 15 young; plants almost dead due to herbicide application
Rosa Road	Merced	Himalayan blackberry	2,000	abandoned
Producer's Dairy	Fresno	triticale	20,000	destroyed by harvest
Owens Creek	Merced	milk thistle	20,000	destroyed by cutting
South of Childs	Merced	milk thistle	10,000	destroyed by cutting
Sandy Mush and 99	Merced	fava beans	50,000	50-60% destroyed by harvest; 50,000 bird colony reduced to 10-15,000 breeding birds

Merced NWR Duck Slough	Merced	milk thistle	25,000	relatively unproductive
Merced NWR West Farmfield 3	Merced	milk thistle, mustard	40,000	relatively unproductive
Crane Ranch	Merced	Himalayan blackberry	300	settlement of 25,000 birds formed 300-bird colony
Duck Slough No. 3	Merced	Himalayan blackberry	3,000	medium-sized colony in previously unknown site; fledglings present when colony found
Delevan T45.1	Colusa	bulrush	10,000	unproductive
Delevan T17.1	Colusa	cattails	2,500	unproductive

Unoccupied Sites

Unique to the 2011 breeding season was the number of unoccupied sites that have typically been occupied by large breeding colonies. This pattern was especially pronounced in the Sacramento Valley, where formerly occupied sites from Yolo to Colusa County were unoccupied (Table 2).

Table 2. Recently occupied sites that were unoccupied in 2011.

Site Name	County	Comments
Riverview	Tulare	occupied in 2008 & 2009
Conaway Ranch	Yolo	occupied for 4 of past 6 years
Delevan T43	Colusa	occupied for 5 of past 6 years, unoccupied when basin drained for maintenance
Yolo Bypass Wildlife Area	Yolo	occupied in 2009, 2010
Plumas Arboga	Yuba	occupied annually 2007-2010

Productivity

Overall, 2011 was the fifth straight year of limited productivity, even worse than the drought-induced statewide reproductive failure of 2007 (Figure 1, Meese 2007). The number of young produced by the colonies monitored in the southern San Joaquin Valley (Kern and Tulare counties) is summarized in Figure 1. Note that the total reported in Figure 1 does not include any young produced subsequent to the first nesting at ECLA Ponds in Kern County. Multiple-nesting at ECLA Ponds was reported to me by U.S. Fish & Wildlife Service staff at Sacramento National Wildlife Refuge but when I inquired of staff at Kern National Wildlife Refuge and Kelly Weintraub, a Humboldt State University master's student conducting research on the site, I was told that there was no information to share. However, given the number of breeding birds present at ECLA Ponds (3,000), the number of young produced even with relatively high reproductive success would not change the conclusion that 2011 was the least productive year since I began working with tricolors in 2005.

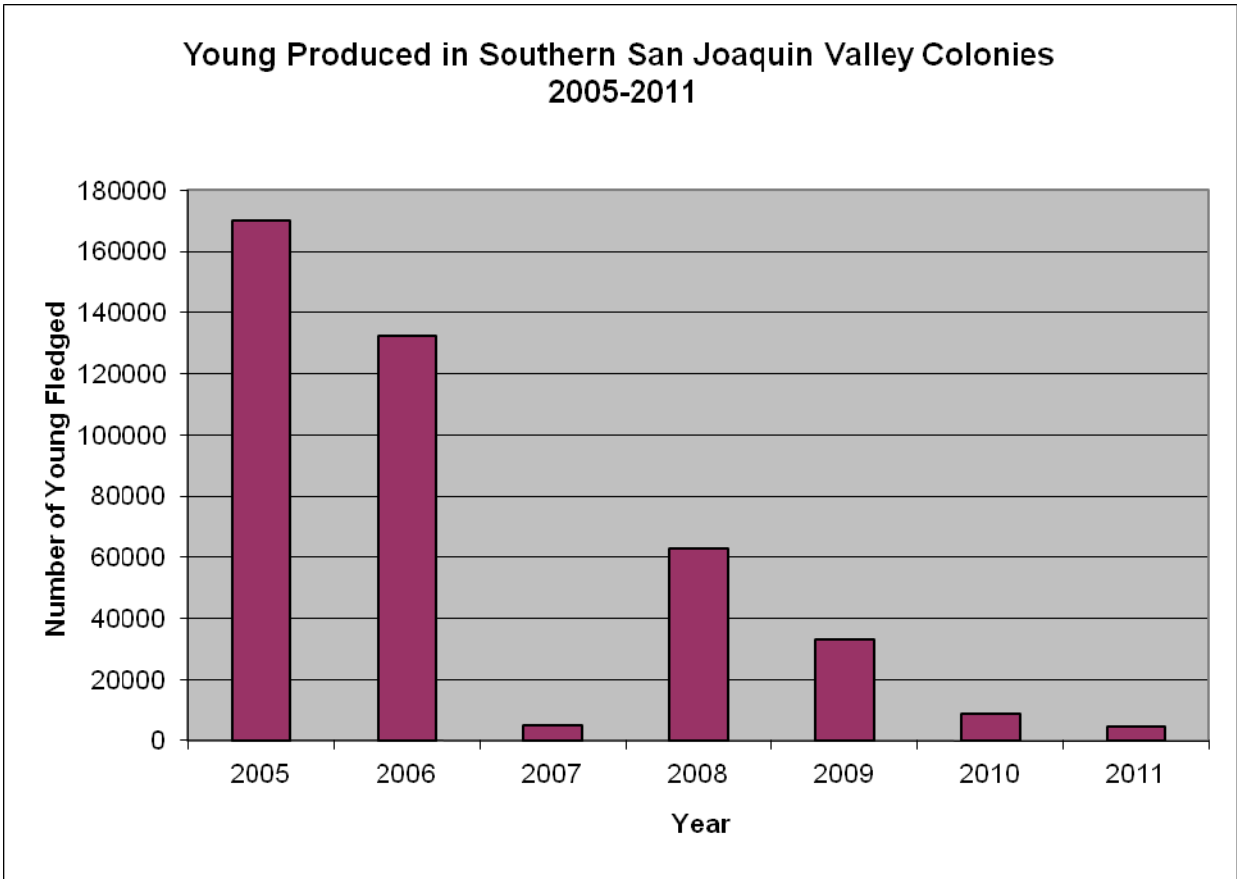

Figure 1. Number of young produced in Southern San Joaquin Valley colonies from 2005-2011. Only the first of a reported, but undocumented, multiple breedings at one site included.

Reproductive Success

Reproductive success (RS) was estimated by sampling at one of the five occupied fields at Costa's Dairy in Kern County, at both Merced N.W.R. sites, and at both Delevan N.W.R. sites. (Table 3). Overall, the estimated reproductive success for all colonies for which estimates of RS were obtained was 25,500 birds fledged from 65,325 nests, or an RS of 0.39.

A reproductive success estimate was attempted at another of the Costa's Dairy sites, but was inconclusive because the young in the nests were much younger than the average of 7-9 days that is required to accurately assess RS (Hamilton and Meese 2006).

Table 3. Reproductive Success.

Site	County	No. Breeding Birds	RS Estimate
Costa's Dairy	Kern	20,000	0.62
Merced NWR West Farmfield	Merced	40,000	0.34
Merced NWR Duck Slough	Merced	25,000	0.44
Delevan NWR T45.1	Colusa	10,000	0.09
Delevan NWR T17.1	Colusa	2,500	0.00

Cattle Egret Predation

Cattle egrets (*Bubulcus ibis*) were again responsible for reducing to zero the productivity of an entire colony in Tulare County. The 30,000 breeding bird Deer Creek Dairy colony in Tulare County had no known young fledged as a result of intense cattle egret predation. On March 29, I observed approximately 30,000 birds in the triticale fields adjacent to Deer Creek Dairy, which have consistently been used by breeding tricolors for nearly a decade (Hamilton and Meese 2006), but the site held fewer than 2,000 adults and no fledglings on April 25. I observed up to 120 cattle egrets in the field occupied by the breeding tricolors while monitoring this site during this interval.

This marks the sixth straight year that cattle egrets have preyed upon eggs and nestlings of breeding tricolored blackbirds in Tulare County and the fifth straight year when at least one Tulare County colony suffered complete reproductive failure due to cattle egret predation.

Colony Abandonment

Four monitored sites were settled but subsequently abandoned: Rosa Road, Crane Ranch and South Cackler in Merced County and Delevan T45.1 in Colusa County. I observed an estimated 2,000 birds with many females carrying nest materials on April 7 but the site had been abandoned by April 13. I observed an estimated 25,000 birds at Crane Ranch on May 3, 2011 but only approximately 300 birds remained on May 17. South Cackler, on the Merced National Wildlife Refuge, was settled (females had been seen carrying in nest materials) by May 26, 2011 but subsequently abandoned several days later, prior to egg-laying. Delevan T45.1 was settled by a visually estimated 10,000 birds by May 27 but more than 75% of the birds had abandoned the site by June 14. Both the Merced National Wildlife Refuge West Farmfield and Delevan T45.1 colonies appeared to have been abandoned by a large majority (> 75%) of the breeding birds but not until the adults appeared to be feeding nestlings.

Condition of Nests

Since the discovery in 2007 that female tricolors may build nests but fail to lay eggs and subsequently abandon a nesting effort (Meese 2007), I have attempted to characterize nests and to place each nest inspected into one of four categories: 1) immaculate nests are those lacking eggshell fragments, fecal sacks, dried yolk or other signs of use (i.e. those lacking evidence of a clutch of eggs or any other signs of use), 2) used nests are those containing eggshell fragments, fecal sacks, dried yolk or other evidence of a clutch of eggs or use, 3) ambiguous nests are those where feathers or other evidence of use was observed but lacking eggshell fragments, fecal sacks, or dried yolk, and 4) nests that had been pulled down, suggesting predation by raccoons (*Procyon lotor*) or other nest predators. Table 4 summarizes the results of efforts to characterize the condition of nests.

Table 4. Condition of Nests in 2011.

Site Name	Number of Nests Inspected	Number of Immaculate Nests	Number of Used Nests	Number of Ambiguous Nests	Number Pulled Down
Delevan T45.1	79	47	29*	1	2
Delevan T17.1	56	23	4	16	13

*includes nests with contents (eggs, young); 16 of these 29 were empty

New Colony Locations

As in my previous six years of field work with tricolors, colonies in new locations were detected this year. In 2011, 14 colonies were detected by or reported to me in previously unknown locations:

1. Main Canal Blackberries, Merced County
2. McNamara Road, Merced County
3. Keaton and 4th, Merced County
4. Rosa Road, Merced County
5. Sandy Mush and Highway 99, Merced County
6. River Road, Madera County
7. Madera Canal Cattails No. 1, Madera County
8. Madera Canal Thistles No. 1, Madera County
9. Madera Canal Tules No. 1, Madera County
10. Madera Canal Tules No. 2, Madera County
11. Bates Station Road, Madera County
12. Iron Point Road, Sacramento County
13. East of Madison, Yolo County
14. Sites Lodoga Road, Colusa County

The Main Canal Blackberries site is along a canal that has been surveyed annually since 2005 so is confirmed to have been previously unoccupied during this interval. The colony formed in California blackberries (*Rubus ursinus*) on private property to which I had no access. The McNamara Road site has been surveyed annually since 2006 and has not previously been occupied. The Keaton and 4th and Rosa Road sites consist of isolated Himalayan blackberry (*Rubus discolor*) copses surrounded by open rangeland. Numerous other such blackberry copses occur in this region and the specific copses occupied likely change among years. They sit in a matrix of several other documented colony locations one to two miles south-southwest of the town of Stevinson in Merced County. This site is on a route that has been surveyed annually since 2006 and confirmed to have been unoccupied until this year. The Sandy Mush and Highway 99 colony formed in a field of fava beans (*Vicia fava*), the first time fava beans have been documented to be used as a nesting substrate by tricolors. I discovered the River Road, Madera County site while en route to survey a site that had been reported to me via email by a biological consultant. The consultant had been conducting a biological survey in Madera County when he came upon a tricolored blackbird colony. He photographed several of the birds nesting at this site and upon reviewing his photographs discovered that one of the birds that he'd photographed was color-banded. He inquired of his colleagues whether any of them knew who was color-banding tricolors, one of them provided my email address to him, and he sent an email to me. Subsequently, he and a colleague sent me detailed descriptions of five additional colony locations in Madera County: four along the Madera Canal and one just off Bates Station Road. The Iron Point Road, Sacramento County site was reported via email by Lyann Comrack, nongame wildlife biologist with the California Department of Fish and Game.

The East of Madison site is an aberrant location near a busy interstate freeway and on the shoulder of a county road. This location is on an established Yolo County survey route and is believed to have been previously unoccupied since before 2005. The Sites Lodoga Road site was reported to me by Geoff Geupel, an ornithologist with PRBO Conservation Science and is another aberrant location: willow (*Salix* spp.) trees overhanging a well-traveled county road.

Colonies Destroyed by Harvest

Colonies from Kern County to Merced County were destroyed by harvest or the cutting of the nesting substrate in 2011. The West Poso colony in Kern County was destroyed by harvest just as the young had begun to fledge from their nests. The Producer's Dairy colony in Fresno County was destroyed a week after it was discovered. The owner had preferentially harvested the portion of his triticale field that was occupied by the breeding tricolors as only this portion of this field had been harvested when the site was observed on April 12. The Owens Creek and South of Childs colonies in Merced County were destroyed when the weedy fields in which they were situated were cut. The Sandy Mush and Highway 99 colony, also in Merced County, was cut in half despite on-going conversations with the farmer that sought to conserve the colony through a harvest delay whereby the farmer was to be compensated for his lost revenue that would have resulted from the delay in the harvest of his field of fava beans. Only 10-15,000 birds out of an original colony of 50,000 birds remained after half of the field was harvested.

Nesting Substrates Destroyed by Herbicides

At least four sites, all Himalayan blackberry substrates on private property, appeared to have been sprayed with herbicides since 2010: Hulen Levee in Merced County, Central American 1 in Stanislaus County, Openshaw Road in Butte County, and Ostrom Road in Yuba County. A fifth site, Bear Creek in Merced County, would have had its milk thistle substrate destroyed by herbicide if not for the heroic efforts of Steve Simmons (see Discussion, below).

DISCUSSION

Statewide Survey Results Show Rapid Population Decline

The remarkable results of the 2011 statewide survey, which showed a 35% reduction in abundance statewide since 2008 (Kelsey 2008, Kyle and Kelsey 2011), indicate that recent conservation efforts have been insufficient to stabilize, let alone increase, the number of tricolors and that the number of tricolors in California is rapidly declining. Although the decline in abundance was anticipated based upon the chronic low productivity since 2007 (Meese 2010, page 14, this report), the severity of the decline was unexpected and suggests that the species is now finding it difficult to reproduce successfully throughout its range.

Habitat Losses, Insect Availability, and Productivity

Habitat losses have accumulated for decades and are thought to be primarily responsible for the tricolor's severe population decline during the 20th Century (Beedy and Hamilton 1999), a decline that is continuing into the 21st Century. Losses to agriculture and urbanization have affected both nesting and foraging habitats by reducing both the amount of high quality nesting substrates, primarily freshwater wetlands (Neff 1937), as well as the amount of nearby foraging substrates that provide the insects required for breeding (DeHaven 2000). The tricolor's patterns of abundance are believed to have changed in response to the landscape changes by becoming more numerous in the San Joaquin Valley early in the breeding season (to take advantage of stored grains associated with the development of the dairy

industry in the 1980's) and then shifting north to the Sacramento Valley where the species is more numerous later in the breeding season (and where rice provides an alternative food source; DeHaven 1971, Hamilton 1998).

The losses of breeding and foraging habitats continue and have resulted in a distribution where a few very large colonies are predictably located in at-risk substrates in the San Joaquin Valley early in the breeding season, and an even smaller number of large (> 10,000 breeding birds) colonies more often in secure nesting substrates occur in the Sacramento Valley later in the breeding season. Although the nesting substrates of the largest colonies in the two regions are different, with triticale on private property dominating in the San Joaquin Valley and cattails and bulrushes on public property dominating in the Sacramento Valley, the surrounding foraging substrates are similar: both are dominated by agriculture and are chronically insect-poor. The San Joaquin Valley is a mosaic of orchards, vineyards, and grain fields while the Sacramento Valley is dominated by orchards and rice. None of these anthropogenic landscapes provides insects of the types and in the quantity required by colonially-breeding tricolors, as farmers employ a variety of measures to minimize insect-related damage to their crops. Further, the on-going conversions of agricultural crops utilized by foraging tricolors (e.g., alfalfa, sunflowers) to perennial crops shunned by foraging tricolors (vineyards, orchards) and the conversions of formerly natural or semi-natural habitats (grasslands, shrublands) to agricultural crops is reducing even further what remains of the area of productive foraging substrates.

The pressure exerted by an insectivorous, colonial passerine on food resources in the landscapes surrounding its largest breeding colonies is intense, and the combination of secure nesting substrate, a source of water, and surrounding secure, productive foraging substrate is now rarely found anywhere in the tricolor's distribution. This is likely the reason why so few tricolor breeding colonies are found between southern Tulare and Merced counties. This entire region is relatively inhospitable to breeding tricolors and lacks the resources required by breeding birds. The inability to find sufficient food also explains the other observations (colony abandonment, empty immaculate nests, desiccated nestlings) that have become part of the annual cycle of the species.

The dependence upon foraging substrates containing large numbers of the preferred groups of insects in the landscapes surrounding nesting substrates is likely why so few colonies have been productive since 2006. Preferred insect groups include species in the orders Orthoptera (grasshoppers and crickets), Lepidoptera (butterflies and moths), and Odonata (dragonflies), although other insect groups are consumed (Crase and DeHaven 1977, Skorupa et al. 1980). In most cases, an outbreak of insects of preferred insect groups has been associated with relatively high reproductive success in large colonies. Examples include the Painted Lady (Lepidoptera: *Vanessa cardui*) "invasion" of 2005 that supported the breeding by 122,000 birds in the adjacent Poso Creek and West Poso colonies, where 140,600 fledglings were produced (RS=1.72; Hamilton and Meese 2006), and the 83,000-bird Bear Creek colony in 2010, where 79,834 fledglings were produced during a peak in grasshopper abundance (grasshoppers not reliably identified to species, but likely *Melanoplus sanguinipes*; RS=1.44; Meese 2010). The association between a super-abundant supply of insects of groups preferred by tricolors and reproductive success is strong and not only suggests that insects play a dominant role in determining tricolor reproductive success, but that tricolor population biology may be controlled by infrequent "big bang" reproductive events that appear to be decreasing in frequency. This association suggests that, from a conservation perspective, efforts to create conditions suitable for a relatively larger number of relatively smaller colonies may be a more effective strategy than efforts to create "mega-colonies" that have a lower annual probability of being successful due to their greater demands on surrounding foraging landscapes.

Any strategy that seeks to increase the number of tricolors must consider all three breeding requirements: nesting substrate, water, and productive foraging substrate, and place these into a spatial arrangement

accessible to breeding birds. All evidence suggests that the absence of productive (insect-rich) foraging substrates is limiting tricolor productivity.

Age Distribution

The chronic reproductive failures that began in 2007 are believed to be responsible for the steep population decline and have also likely affected the age distribution of the species, with older age groups now likely dominant over younger age groups as the most recent year with relatively high reproductive output was 2006. As older age classes of most passerines are known to have lower fertility rates and higher death rates than do younger age classes (e.g., Martin 1995, Newton 1989), the rate of the decline in abundance may be expected to increase and, as 2011 was the first of three breeding seasons prior to the 2014 statewide survey, it is likely that the 2014 statewide survey will show a continued rapid reduction in abundance. The young born in the relatively high reproductive success years of 2005 and 2006 (Hamilton and Meese 2006, Meese 2006, Figure 1) are now five and six years old, and if the life expectancy of tricolors is similar to that of the closely-related red-winged blackbird (seven to eight years, Fankhauser 1967, 1971), the population is now more dependent upon reproduction by older birds, which are likely to be less productive, and thus less able to rebound from population declines.

Need for Intensive Annual Monitoring

The combination of an intensive annual effort coupled with the extensive statewide survey is an effective strategy to provide the information required to conserve the species. The intensive annual effort is needed to detect, monitor, determine the fates of and estimate the productivity of successful colonies. The annual effort typically accounts for the breeding efforts of 70% or more of the population and is required to identify and assist in conservation efforts of at-risk colonies. The triennial statewide survey is required to provide an estimate of the total number of tricolors in California and provides an every three year status update, informing working group members of the current population trend. It is the annual effort that provides insights into causative factors that are responsible for observed population trends (Kelsey 2008, Kyle and Kelsey 2011). That the intensive, annual effort is required to detect new colonies was illustrated by the fact that the largest colonies in both 2010 and 2011 were detected in previously unknown locations (Meese 2010, this report).

Spring Weather

The spring of 2011 was unusually cool and wet throughout the Central Valley (e.g., Modesto Bee 6/3/11) and apparent weather-related effects were observed in both primary and secondary productivity. Impacts on primary productivity were especially evident in the growth of milk thistle, a common nesting substrate. For example, the milk thistle nesting substrate utilized by the largest colony (50,000 birds) of breeding tricolors in 2010 at Bear Creek, Merced County was no more than half the previous year's height in 2011 (ca. eight feet+ vs. four to five feet). A biological consultant who had reported a colony in milk thistle from San Benito County last year reported that the site was unoccupied this year and cited the much lower height of the milk thistle as the likely cause for the absence of tricolors at this site in 2011. Also, the grasshoppers that were so conspicuous and abundant in foothill locations last year, from Bear Creek in Merced County to Openshaw Road in Butte County (Meese 2010), were far less conspicuous and appeared to be much less abundant this year. Although the relationship between weather, especially precipitation, and insect abundance is complex (e.g., Belovsky and Slade 1995), the unusually cool, wet weather appears to have played a role in reducing tricolor productivity in 2011.

Colony Abandonment

Four sites: Crane Ranch, Rosa Road, and South Cackler in Merced County and Delevan T45.1 in Colusa County, were mostly or entirely abandoned in 2011. Females were observed to carry nest materials in all four of these sites and birds remained at Delevan T45.1 for over two weeks (May 27 – June 14) before suddenly abandoning. The reasons why these sites were abandoned were not determined, but the most likely cause was a severe food shortage - the lack of insects required for breeding (Ramsay and Houston 1998, Skorupa et al. 1980). Colony abandonment has been observed in tricolors for decades (Beedy and Hamilton 1999) and appears to be a symptom of insufficient food (Hamilton et al. 1995). The nesting success of the closely-related red-winged blackbird (*Agelaius phoeniceus*) has been shown to respond positively to super-abundant food resources (Strehl and White 1986), and other colonial bird species are known to abandon nesting attempts *en masse* in response to severe food shortages (e.g., Sydeman et al. 2006).

Condition of Nests

I inspected a sample of nests to estimate reproductive success and again to estimate the number of adults in a breeding colony. Nest inspections of Delevan T45.1, Colusa County on June 16 revealed that the majority of nests (47/79) were immaculate; that is, there was no evidence (eggshell fragments, dried yolk, fecal sacs) that would indicate that eggs had been laid. Subsequently, nest inspections on July 19 at Delevan T17.1 showed that 23 of 56 nests were immaculate. I have documented the occurrence of empty, immaculate nests each year since 2007 (Meese 2007). These observations suggest that many female tricolors may, in most years and across much of the species range, be unable to form eggs. The inability to form eggs and to feed nestlings is consistent with, and may help to explain, the chronic reproductive failures observed and be a major cause of the population decline observed since 2008.

Reoccupation of Chronically Low Productivity Sites

Tricolor colonies appear to persist in areas for years even when breeding efforts in those sites are unsuccessful. This is especially true in the “silage belt” of the southern San Joaquin Valley and at Delevan National Wildlife Refuge and nearby duck clubs in Colusa County, where despite several consecutive years of poor reproductive success, locations with suitable nesting substrates are reoccupied. The reoccupation of these sites despite multiple years of poor reproductive success suggests that high-quality nesting substrate is in short supply. An insufficient supply of suitable nesting substrate further complicates efforts to stem the decline in the abundance of the species. A component of a strategy to enhance productivity ought to be the provision and maintenance of secure preferred nesting substrates: cattails (*Typha* spp.) and bulrushes (*Schoenoplectus* spp.), stinging nettle (*Urtica dioica*), or Himalayan blackberry in areas where sufficient water is available and milk thistle in drier upland areas.

Predation by Cattle Egrets

Predation by cattle egrets on the eggs and nestlings of tricolors was unknown prior to 2006, when it apparently arose spontaneously on a single colony in Tulare County (Meese 2006). In the four years since, it has become a chronic problem that is capable of reducing to zero the production of colonies consisting of tens of thousands of breeding birds. The Deer Creek Colony in Tulare County, where cattle egrets were originally observed to prey upon tricolor eggs and nestlings, has annually suffered severe predation by cattle egrets and in 2011 the productivity of this colony of 30,000 breeding birds was again reduced to zero.

Unless steps are taken to eliminate the cattle egrets or to reduce their impacts on nesting tricolors, there appears to be little chance for successful tricolored blackbird reproduction in a portion of Tulare County formerly occupied by tens of thousands of breeding birds. Should the incidence of predation by cattle egrets on nesting tricolors spread beyond Tulare County and affect additional San Joaquin or Sacramento Valley regions, it would be difficult to imagine a scenario in which the numbers of tricolors could be increased. Therefore, it would be wise to try to eliminate the threat posed by cattle egrets now, while severe predation by cattle egrets is confined to a relatively small geographical area.

New Colony Locations

The documentation of 14 new colony locations in 2011, with 11 of these in the adjacent Madera and Merced counties, suggests that new colonies will occur even in areas that are annually intensively surveyed, and that the northern San Joaquin Valley has historically been relatively under-surveyed. Additional, focused survey work in the northern San Joaquin Valley as well as additional outreach to field workers in this region may be warranted. With these additional 14 locations, there have now been 84 new colony locations documented by or reported to me since 2005 (Meese 2010, this report).

The largest colony detected in 2011, at Sandy Mush and Hwy. 99 in Merced County, occurred in a location that has been surveyed annually since 2006 and suggests that annual surveys in appropriate habitats are required to most thoroughly document colony locations. The Sandy Mush and Hwy. 99 location is also unique because the birds were nesting in a substrate of fava beans, a nesting substrate that had not previously been reported.

Banding and Colony Detection

Five of the Madera County sites were documented as a result of my previous work color-banding tricolors: I received an email on April 28, 2011 from a biological consultant working in Madera County. Attached to his email was a photograph that he had taken earlier in the week of a color-banded female tricolor and he asked whether I recognized the bands and, if so, if I could provide any more information about the bird. I replied to him, telling him what the two colors indicated (year [2009] and location [Delevan N.W.R., Colusa County]) and asked him if this bird had been photographed near a breeding colony and, if so, if he could provide me with the geographic location of this and any other tricolor colony with which he might be familiar. He and a colleague subsequently informed me of five tricolor breeding colony locations in Madera County. Thus, the color-banding of tricolors in 2007 – 2009 directly led to the documentation of five new breeding locations in 2011.

Southern California Colonies

In addition to my field work in the Central Valley, I made one trip to Los Angeles County in April, 2011. On this trip I monitored a site that had recently been burned to “refresh” the nesting substrate and consulted with private landowners to provide advice on how best to manage their properties to support breeding by tricolors. I also communicated extensively with Rose Cook, a biologist with the Riverside County Multiple-Species Habitat Conservation Plan and advised her on how to estimate the productivity of a colony on a dairy that was conserved through the efforts of Cook and Tom Paulek, State Wildlife Area Manager, retired.

As a core element of tricolor conservation efforts is work on private lands, I met, at the invitation of a local collaborator, with landowners in the Leona Valley of Los Angeles County to explain to them what conditions are necessary for tricolors to reproduce and what support might be available to assist them in creating and maintaining these conditions on their properties. The tricolor’s persistence is especially

precarious in southern California (Western Riverside County MSHCP 2010) and, as in the Central Valley, the contributions of sympathetic landowners will be essential if tricolors are to persist.

RECOMMENDATIONS FOR CONSERVATION

1. There is an immediate need for secure *nesting* substrates surrounded by secure *foraging* substrates, as called for in the 2007 Conservation Plan (Tricolored Blackbird Working Group 2007). The vast majority of breeding tricolors continue to nest on at-risk substrates and many of these nesting attempts are annually destroyed through the harvest, cutting, or treatment with herbicide of the nesting substrates. The need for secure nesting substrates surrounded by secure, productive foraging substrates has increased as the conversion of native habitats and formerly productive agricultural lands to perennial crops has proceeded. That tricolor reproduction may be food-limited has been known for decades (DeHaven et al. 1975, DeHaven 2000) but my seven years of work suggests that making a living is now extremely difficult for a colonial insectivorous passerine living in the Central Valley. Tricolors require primarily terrestrial insects for the females to form eggs and for nestlings through the first nine days of life (Crase and DeHaven 1977). As a component of this effort, we need funding and a process that identifies willing landowners with suitable properties who are willing to set aside land within an appropriate habitat mosaic containing nesting substrate, water, and productive foraging habitat.

2. We need a formal process that actively involves water agencies in tricolor conservation efforts. This process ought to consist of 1) inventories by experienced field workers of properties managed by water agencies, 2) monitoring of colonies, 3) reproductive success estimates of successful colonies, and 4) management actions specifically tailored to the needs of tricolors. Far too little is known about the occurrence and ecology of tricolors on water agency properties although sites in Los Angeles and San Diego counties managed by water agencies are known to have supported tricolor colonies as recently as this year (e.g., Fairmont Reservoir and Holiday Lake in Los Angeles County). Water agency properties could likely play a far larger role in tricolor conservation efforts, especially in southern California. A Memorandum of Understanding or other formal mechanism ought to be established between water agencies and the California Department of Fish and Game and the U.S. Fish and Wildlife Service that allows agency staff, University of California, Davis, and other qualified researchers access to water agency properties. Qualified researchers ought to consult with water agency staff on how to best manage water agency properties for the benefit of tricolors where they formerly, currently, or may potentially exist.

3. We need to protect all or at least a much larger proportion of the at-risk colonies through all available mechanisms. The exclusive reliance upon voluntary compliance with existing federal law and chronic, annual destruction of colonies through harvest, despite offers to fully compensate farmers for the reduction in value for their crops, is at least partially responsible for the decline in tricolor abundance and directly contradicts Working Group efforts to increase the number of tricolors. The cutting of half of the substrate on the largest breeding colony in 2011 (the new location at Sandy Mush and Highway 99) serves as a current case in point.

4. Continued annual intensive, range-wide -or-Central Valley-wide efforts to detect, monitor, and determine the fates of colonies is essential if we are to locate and protect at-risk colonies and understand the causes for the observed severe population decline. The triennial statewide survey is essential to provide a snapshot of the status of the tricolor in California but is silent on explaining the reasons for observed trends.

5. Develop a plan to control or eliminate cattle egrets from around tricolored blackbird breeding sites in Tulare County. It is likely only a matter of time before young cattle egrets that have been taught to prey upon tricolor eggs and nestlings and the devastating effects documented in Tulare County spread to other areas. Should this occur, it would greatly compound our current difficulties in even maintaining tricolor numbers at a level far below the historical average.

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APPENDIX 1. Characteristics and Fates of Tricolored Blackbird Settlements and Colonies Detected in 2011.

Colony Name	County	Substrate	Date Detected	Detected By	Area Occupied (Ac)	Number of Breeding Birds	Comme
Costa's	Kern	triticale	unknown	Frazer	40	30,000	5 separ
ECLA Ponds	Kern	cattails	unknown	Frazer	8	3,000	multiple but resu shared
West Poso	Kern	triticale	unknown	Frazer	30	30,000	weedy f
Spanish Spring	Kern	stinging nettle	4/6/2011	Stockton, Meese	2	1,300	on Bitte estimat
Deer Creek	Tulare	triticale	unknown	Frazer	30	30,000	destroy
Bear Creek	Merced	milk thistle	5/4/2011	Simmons	10	15,000	RS unk colony s due to h nesting
Duck Slough No. 3	Merced	Himalayan blackberry	5/17/2011	Meese	1	3,000	RS unk when co
Hulen Levee	Merced	Himalayan blackberry	4/7/2011	Meese	1	100	nearly d last yea
Rosa Road	Merced	Himalayan blackberry	4/7/2011	Meese	.5	2,000	settleme eggs lai
Owens Creek	Merced	milk thistle, weeds	4/13/2011	Meese	15	20,000	destroy substrat
South of Childs	Merced	milk thistle	4/13/2011	Meese	5	10,000	destroy prior to
Sandy Mush and 99	Merced	fava beans	4/15/2011	Woolington, Meese, Simmons	40	50,000	half of s 4/22/20 birds re
McNamara Road	Merced	milk thistle	3/30/2011	Meese	1	500	new loc feeding
Keaton and 4th	Merced	Himalayan blackberry	4/13/2011	Meese	.5	3,000	new loc
Rosa Road	Merced	Himalayan blackberry	4/7/2011	Meese	.5	2,000	new loc building
Merced NWR Duck Slough	Merced	milk thistle, mustard	4/12/2011	Woolington, Meese	30	24,400	modestl
Merced NWR West Farmfield	Merced	milk thistle, mustard	4/12/2011	Woolington	30	20,425	visually settleme abando = 0.34
Main Canal Blackberries	Merced	California blackberry	3/30/2011	Meese	.5	2,500	new col access;
Crane Ranch	Merced	Himalayan blackberry	5/3/2011	Simmons, Meese	3	25,000 @ settlement, 300 breeders	settleme 300 bird
Duck Slough No. 3	Merced	Himalayan blackberry	5/17/2011	Meese, Simmons	1	3,000	discove begun t modera
Producer's Dairy	Fresno	triticale	4/6/2011	Meese	20	20,000	destroy

Colony Name	County	Substrate	Date Detected	Detected By	Area Occupied (Ac)	Number of Breeding Birds	Comme
River Road	Madera	milk thistle	5/18/2011	Meese	.5	500	new col en-route new col
Madera Canal Tule No. 1	Madera	bulrush		Gary Woods	.5	unknown	new col Gary W and wild
Madera Canal Cattails No. 1	Madera	cattails		Gary Woods	1	unknown	new col Gary W and wild
Madera Canal Thistles No. 1	Madera	milk thistle		Gary Woods	.3	unknown	new col Gary W and wild
Madera Canal Tule No. 2	Madera	bulrush		Gary Woods	.5	unknown	new col Gary W and wild
Bates Station Road	Madera		6/7/2011	Jeff Davis	.5	unknown	new col Davis, b
Hallwood Blvd.	Yuba	Himalayan blackberry	5/23/2011	Meese	2	2,500	colony a 2010
East of Madison	Yolo	Himalayan blackberry	5/24/2011	Meese	1	1,500	new, od busy hig on day epheme
South Cackler	Merced	cattails	5/26/2011	Meese	10	7,500	large se week, s
Delevan T45.1	Colusa	bulrush, cattails	5/27/2011	Pence, Carpenter	15	10,000	burned 2004
Iron Point Road	Sacramento	Himalayan blackberry	5/8/2011	Lyann Comrack	2	2,000	new col Lyann C
Delevan T17.1	Colusa	cattails	6/24/2011	Carpenter, Pence	5	2,500	burned estimate
Sites Lodoga Road	Colusa	willows	7/12/2011	Geupel	1.5	1,000	new loc Geupel, Science begun t
Holiday Lake	Los Angeles	bulrush, cattails	6/2011	Alice Wollman	2	600	burned early Ju
Fairmont Reservoir	Los Angeles	cattails, bulrush	6/2011	Alice Wollman	1	500	reported product
Oostam Dairy	Riverside	mallow, weeds	Paulek, Nash, Cook	Rose Cook	15	750	reported Cook; v young fl