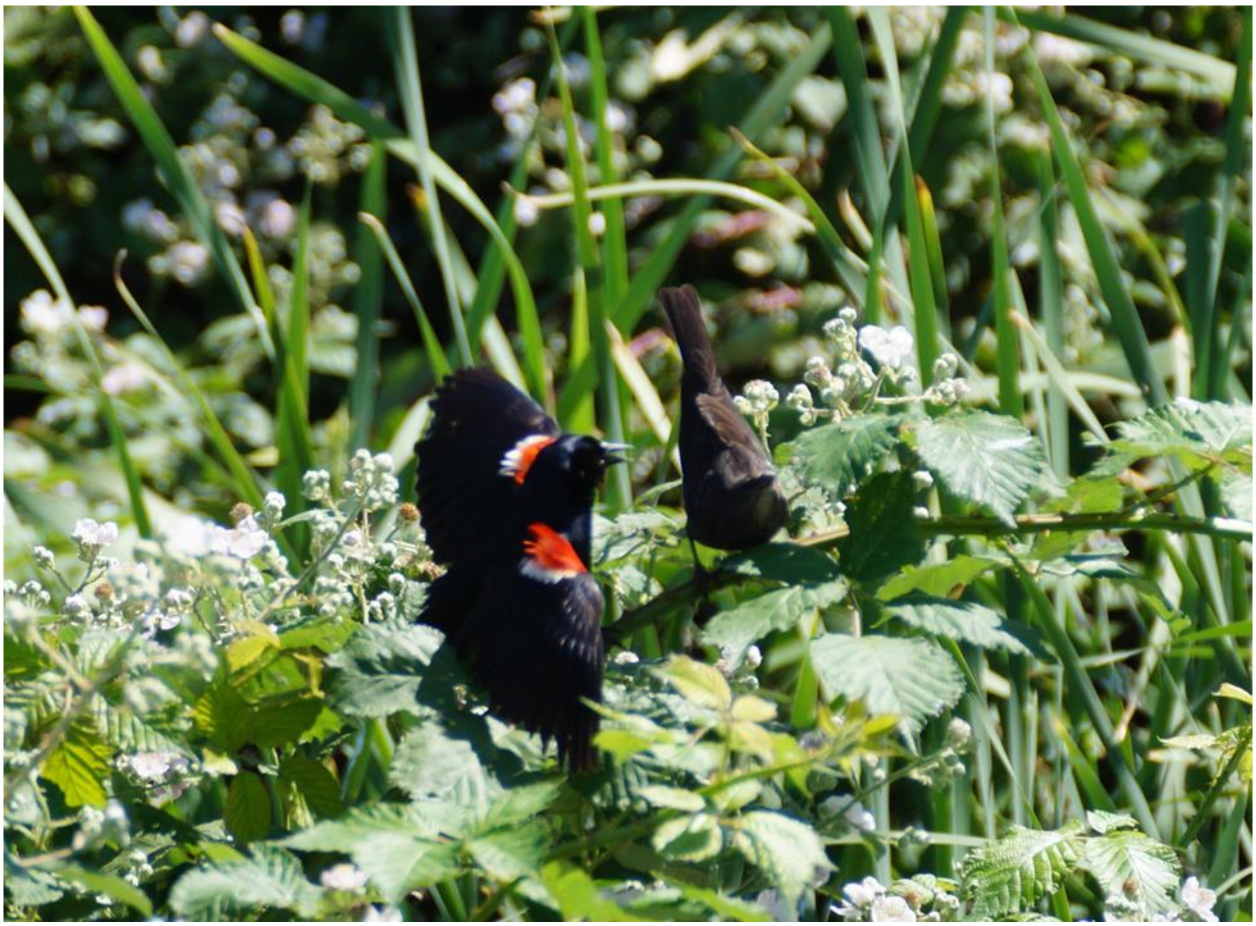
Species Status Assessment for the Tricolored Blackbird (*Agelaius tricolor*) Version 1.1



Male and female tricolored blackbird mating display. Photo credit USFWS.

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Suggested reference:
U.S. Fish and Wildlife Service. 2019. Species Status Assessment for the Tricolored Blackbird (*Agelaius tricolor*), Version 1.1. February 2019. Sacramento, California.

EXECUTIVE SUMMARY

On February 3, 2015, the U.S. Fish and Wildlife (Service) received a petition from the Center for Biological Diversity to list the tricolored blackbird (*Agelaius tricolor)* under the Act. On September 18, 2015, the Service published in the **Federal Register** a positive 90-day finding stating that the petition presented substantial scientific or commercial information indicating that listing the tricolored blackbird may be warranted (80 FR 56423). As a result, we are initiating a species status assessment (SSA) to determine if the tricolored blackbird is warranted for listing under the Act.

This report summarizes the results of the SSA completed for the tricolored blackbird. To assess the species' viability, we used the three conservation biology principles of resiliency, representation, and redundancy (together, the 3 Rs). These principles rely on assessing the species at an individual, population, and species level in order to determine whether the species can maintain its persistence into the future and avoid extinction by having multiple resilient populations distributed widely across its range. However, due to the tricolored blackbird's life history (itinerant, nomadic breeder) and the available genetic information which suggests the species as a whole is one interbreeding population (it is possible there are two or more distinct groups of interbreeding birds; however, additional genetic analysis needs to be completed for verification), it is not possible to distinguish discrete tricolored blackbird populations. Therefore, in order to evaluate the 3 Rs and assess the species' viability we need to define an analysis unit as a surrogate for population. So for the purposes of this SSA Report, we are defining a tricolored blackbird population as all nesting colonies that occur within a particular region over the breeding season. Regions are defined by state boundaries for colonies located outside of California (i.e., Oregon region, Washington region, etc.). Since the state of California contains the largest percentage (typically >99%) of the overall tricolored blackbird population, we sub-divided the state into regions by county boundaries, as described in Meese 2014, Meese 2017, and Graves *et al.* 2013. Several factors influence whether tricolored blackbird breeding colonies can maximize habitat occupancy within each region (both individual colony size and the number of colonies distributed throughout the region), which increases the resiliency of that region to stochastic events. These factors include specific demographic needs (i.e., reproduction, abundance, and survival) and habitat components (protected nesting substrate and foraging habitat) that influence those demographic needs at the individual, regional), and species levels.

The tricolored blackbird's current range is similar to its historical range; the species occurs throughout most of lower-elevation California with smaller nesting colonies in Oregon, Washington, Nevada, and Baja California, Mexico. Although the tricolored blackbird currently occurs throughout most of its historical range, the species has undergone a dramatic decline from historical estimates and the distribution of breeding colonies within its range has changed as the species' habitats throughout its range were lost to urban development and agricultural conversion.

Our analysis of the past, current, and future influences on what the tricolored blackbird needs for long term viability revealed that there are four influences that pose the largest risk to future viability of the species. These risks are primarily related to habitat changes: the loss of nesting and foraging habitats to development and conversion to unsuitable crops, which reduces the amount of available nesting vegetation and foraging habitat for the species; the destruction of breeding colonies during agricultural harvest, which results in the loss of a large proportion of the overall breeding population's reproductive effort; the threat of severe storms and drought, which can reduce reproductive success and the amount of available nesting vegetation and foraging habitat available for the species; and the application of pesticides throughout the species range, which can result in direct mortality or can reduce reproductive success by eliminating nesting vegetation, foraging vegetation, and insects. Furthermore, these influences may all be exacerbated by the projected effects of climate change. However, the species' inherent adaptability to varying habitat conditions and the implementation of beneficial management actions help mitigate some of the negative influences described above.

The influences described above play a large role in the future viability of the tricolored blackbird. If regions lose resiliency (i.e., the ability to support a large number of breeding birds and the ability to support multiple breeding colonies), they are more vulnerable to extirpation, with resulting losses in representation and redundancy. Given our uncertainty regarding the rates at which future stressors may act on specific regions and the uncertainty regarding funding for current beneficial actions continuing to occur in the future (i.e., silage delays and buy-outs), we forecasted how possible future conditions could impact the resiliency, redundancy, representation, and overall condition of the tricolored blackbird. In order to assess future condition, we have developed four future plausible scenarios. The following is a description of the four future scenarios, the status of the tricolored blackbird when analyzed under each scenario, and a summary of the assumptions we made under each scenario:

Scenario 1: Factors that are currently having an influence on tricolored blackbird regions continue at current rates for all of the influences but one. Under Scenario 1, we project the tricolored blackbird would have five regions at a moderate condition, six regions at a moderate to low condition, and one region at a low condition.

1. Climate change results in more arid conditions in some years throughout most of the range.
2. Pesticide application continues at the same rate.
3. Funding for silage delay/buy-out program is acquired.
    - Farmer participation is inconsistent.
4. Habitat destruction and conversion continues at the same rate.
    - The rate in which fields are fallowed or left barren will decrease.
    - Existing fallowed/barren fields may be re-planted with suitable foraging crops.
5. Some beneficial management actions are occurring on private land.
6. Wetlands currently managed to benefit the species are continued to be managed for the benefit of the tricolored blackbird.

Scenario 2: Scenario 2 is the best case scenario under which all regions retain or improve their current condition. Under Scenario 2, we project the tricolored blackbird would have one region in moderate to high condition and eleven regions in moderate condition.

1. Climate change results in more arid conditions in some years throughout most of the range.
2. Rate of pesticide use is reduced.
3. Silage delay/buy-out program funding is extended.
    - Full participation by dairy farmers.
4. Restoration and outreach efforts have been implemented and are successful.
5. Managed wetlands are managed to benefit tricolored blackbirds and not just waterfowl.
6. Habitat destruction and conversion continues, however:
    - The current rate of crop conversion stops and/or slightly reverses.
    - Some fallowed/ barren fields are planted with suitable foraging crops.

Scenario 3: Factors that are currently having an influence on tricolored blackbird regions continue at the rate seen over the last 10 years. Under Scenario 3, there would be one region in moderate condition, ten regions in moderate to low condition, and one region in low condition.

1. Climate change results in more arid conditions in some years throughout most of the range.
2. The rate of pesticide use in the Central Valley continues at the same rate.
3. Funding for silage colony protection is unreliable.
   - Farmer participation is inconsistent.
4. Habitat destruction and conversion continues.
   - Crop conversion continues at the same rate seen over the last 10 years.
   - Fallowed and barren fields are not planted with suitable foraging crops.
5. Wetlands currently managed to benefit the species are continued to be managed for the benefit of the tricolored blackbird.

Scenario 4: Scenario 4 is the worst case scenario in which factors that are currently having an influence on tricolored blackbird regions continue at the same or an increased rate seen over the last 10 years, and some of the management actions that are currently happening cease. Under Scenario 4, there would be three regions at a moderate to low resiliency, two of which are peripheral, and nine regions at a low resiliency.

1. Climate change results in more arid conditions in some years throughout most of the range.
2. Pesticide use increases throughout the range.
3. Silage colony protection funding ends.
4. Habitat destruction and conversion continues.
   - Crop conversion continues at an increased rate from what has been seen over the last 10 years.
   - Fallowed and barren fields are not planted with suitable foraging crops.
5. Wetlands that are managed to benefit the tricolored blackbird are no longer managed to benefit the species.

Over the next 50 years, we believe Scenario 1 or Scenario 3 are the most likely to occur. We believe these scenarios are the most likely since we expect that climate change is likely to continue (thereby increasing the likelihood of aridity), the use of pesticides is likely to continue at current levels throughout the range, the conversion to crops that are unsuitable for the species is likely to continue, and development is likely to continue. The difference between the two scenarios is the rate at which fields are fallowed or left barren, which may decrease or reverse from rates seen over the last 10 years (Scenario 1) or may continue at the same rate seen over the last 10 years (Scenario 3).

We believe Scenario 2 and Scenario 4 are unlikely to occur, but are important to consider as they represent the best and worst scenarios the species could experience. We believe Scenario 2 is unlikely since the rate at which pesticides are applied are unlikely to decline from current levels, the long-term funding to protect silage colonies is uncertain, and the conversion to crops that are unsuitable for the species is not likely to stop or reverse in the future. Likewise, we believe Scenario 4 is unlikely to occur since the protection of silage colonies via the silage buyout program has been successful and is supported by both conservation agencies and the dairy industry.

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CHAPTER 1: INTRODUCTION

The tricolored blackbird (*Agelaius tricolor*) (Audubon 1837) is a colonial passerine that is mostly endemic to California, primarily within the Central Valley (Sacramento and San Joaquin Valleys) and surrounding Sierra Nevada foothills, but also along the coast and in inland areas in southern and central California. Small, local populations are also known to occur in northeastern California, Oregon, western Nevada, and central Washington within the United States, and Baja California in Mexico. The U.S. Fish and Wildlife Service (Service) has been petitioned three times to list the tricolored blackbird under the authority of the Endangered Species Act (Act). The first petition was in 1991, but the petitioners withdrew their petition based on new research that showed the tricolored blackbird population was actually larger than what was previously thought when the Service was petitioned (71 FR 70483; Hamilton *et al.* 1995, p. 7; Clipperton 2017, pers. comm.; CDFW 2018, p. 7). The Service included the tricolored blackbird as a Category 2 candidate for Federal listing in the Service's 1991 and 1994 Candidate Notice of Review (CNOR) (56 FR 58810; 59 FR 58990); however, after the publication of the Service's 1996 CNOR, which revised the Service's candidate list to include only Category 1 species, the tricolored blackbird was no longer considered a candidate (61 FR 7595).

In the second petition, dated April 8, 2004, the petitioner requested the species be emergency listed. In a May 25, 2004, letter to the petitioner, the Service responded that the information contained in the petition did not indicate that an emergency listing was warranted. A 90-day finding was issued on December 5, 2006 (71 FR 70483), stating the petition did not present substantial information to indicate listing the tricolored blackbird was warranted. The third petition was dated February 3, 2015, and again the petitioner requested an emergency listing of the species. In a March 13, 2015, letter to the petitioner, the Service responded that the information contained in the petition did not indicate that an emergency listing was warranted. The Service issued a 90-day finding on September 18, 2015 (80 FR 56423), stating the petition presented substantial information to indicate listing the tricolored blackbird may be warranted.

The Species Status Assessment (SSA) framework (Service 2016, entire) and the SSA Report developed from the framework are intended to support an in-depth review of the species' biology and threats, an evaluation of its biological status, and an assessment of the resources and conditions needed to maintain long-term viability. The intent is for the SSA Report to be easily updated as new information becomes available and to support all functions of the Endangered Species Program from Candidate Assessment to Listing to Consultations to Recovery. As such, the SSA Report will be a living document upon which other documents, such as listing rules, recovery plans, and 5-year reviews, would be based if the species warrants listing under the Act.

This SSA Report for the tricolored blackbird is intended to provide the biological support for the decision on whether to propose to list the species as threatened or endangered and, if so, where to propose designating critical habitat. Importantly, the SSA Report does not result in a decision by the Service on whether the tricolored blackbird should be proposed for listing as a threatened or endangered species under the Act. Instead, this SSA Report provides a review of the available information strictly related to the biological status of the tricolored blackbird. The decision whether to list the species will be made by the Service after reviewing this document and all relevant laws, regulations, and policies. The results of our review of the best available scientific information will be announced in the *Federal Register* with appropriate opportunities for public input if listing is warranted and the proposed listing rule is published.

For the purpose of this assessment, we generally define viability as the ability of the tricolored blackbird to sustain colonies in natural ecosystems and anthropogenic habitats throughout each region in their range over time. Using the SSA framework (Figure 1.1), we consider what the species needs to maintain viability by characterizing the status of the species in terms of its resiliency, representation, and redundancy (Wolf *et al.* 2015, entire).

- **Resiliency** describes the ability of regions or populations to withstand stochastic events (arising from random factors). We can measure resiliency based on metrics of population health (or in the case of the tricolored blackbird, the average colony health within a region); for example, birth versus death rates and population size (or in the case of the tricolored blackbird, the size of individual colonies and the number of colonies distributed throughout the region). Highly resilient populations or regions are better able to withstand disturbances such as random fluctuations in reproductive rates (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

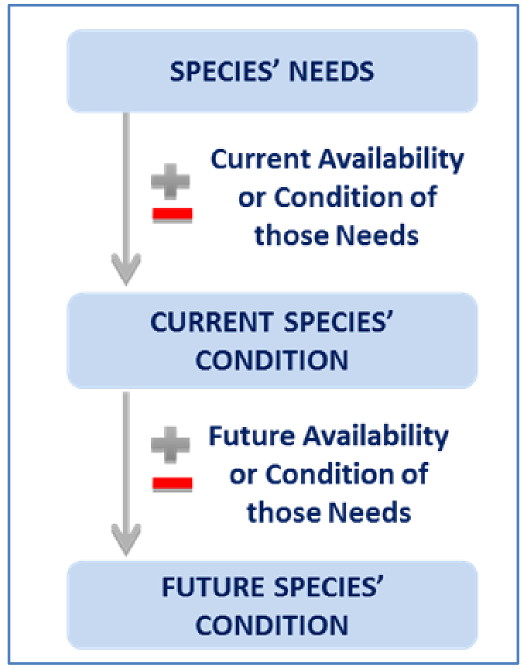

Figure 1.1 Species Status Assessment framework

- **Representation** describes the ability of a species to adapt to changing environmental conditions. Representation can be measured by the breadth of genetic or environmental diversity within and among populations or regions and gauges the probability that a species is capable of adapting to environmental changes. The more representation, or diversity, a species has, the more capable it is to adapting to changes (natural or human caused) in its environment. In the absence of species-specific genetic and ecological diversity information, we evaluate representation based on the extent and variability of habitat characteristics across the species' geographical range.

- **Redundancy** describes the ability of a species to withstand catastrophic events. Measured by the number of populations or regions containing colonies, as well as their resiliency, their distribution, and their connectivity, redundancy gauges the probability that the species has a margin of safety to withstand or the ability to bounce back from catastrophic events (such as a rare destructive natural event or episode involving many populations or regions).

To evaluate the biological status of the tricolored blackbird both currently and into the future, we assessed a range of conditions to allow us to consider the species' resiliency, representation, and redundancy (together, the 3 Rs). This SSA Report provides a thorough assessment of the tricolored blackbird's biology and natural history and assesses demographic risks, threats, and limiting factors in the context of determining the viability and risks of extinction for the species.

The format for this SSA Report includes: (1) a description of the tricolored blackbird, its life history, and the resource needs of individuals (Chapter 2); (2) the resource needs of tricolored blackbird colonies and the species overall, and a framework for determining the distribution of resilient regions containing breeding colonies across its range for species viability (Chapter 3); (3) a review of the likely causes of the current and future condition of the tricolored blackbird and an evaluation of which of these risk factors affect the species' viability and to what degree (Chapter 4); and (4) a conclusion that describes the viability of the species in terms of resiliency, representation, and redundancy (Chapter 5). This document is a compilation of the best available scientific and commercial information and a description of the past, present, and likely future risk factors to the tricolored blackbird.

CHAPTER 2: INDIVIDUAL NEEDS

In this chapter, we provide basic biological information about the tricolored blackbird, including its taxonomic history and relationships; genetics; morphology; physical environment; and known life history traits. We then outline the resource needs of individual tricolored blackbirds. Here, we report those aspects of the life history of the tricolored blackbird that are important to our analysis. For further information about the tricolored blackbird refer to Payne (1969), Beedy and Hamilton (1999) and Beedy *et al.* (2017; https://birdsna.org/Species-Account/bna/species/tribla/introduction).

2.1 Taxonomy

The tricolored blackbird was first collected by Thomas Nuttall near Santa Barbara in 1836 (Neff 1937, p. 62; Bent 1958, p. 179). Nuttall sent a male specimen to John James Audubon (Sitgreaves 1853, p. 80; Bent 1958, p. 179), who was the first to describe the species (Audubon 1839, pp. 1–5). Audubon first identified the species as *Icterus tricolor* (Audubon 1839, p. 1); however, in subsequent publications he referred to the species as *Agelaius tricolor*. The tricolored blackbird is classified in the blackbird family Icteridae and mitochondrial DNA sequencing suggests the nine *Agelaius* species form a polyphyletic group with other species in the Icterid family (Lanyon 1994, p. 689). The two North American *Agelaius* species, the tricolored blackbird and the red-winged blackbird (*A. phoeniceus*), are sister taxa (Lanyon 1994, p. 686). The tricolored blackbird is considered a valid species by the scientific community (ITIS 2017, Taxonomic Serial No.: 179060).

2.2 Genetic Diversity

Prior to the completion of genetic studies, potential behavioral differences observed between tricolored blackbird colonies in the Central Valley and colonies in southern California led researchers to believe there were two separate populations, and it was believed that the Tehachapi Mountains acted as a dispersal barrier between the two (DeHaven and Neff 1973, p. 10; Berg *et al.* 2010, p. 2). However, genetic studies completed by Berg *et al.* (2010) revealed there is no significant population structuring between the two populations and that there likely has been significant gene flow between them. These results suggest there is either ongoing dispersal between individuals in the Central Valley and southern California or that the isolation of the two populations happened fairly recently (Berg *et al.* 2010, p. 10). To further support the genetic studies completed by Berg *et al.* (2010), at least three birds banded north of the Tehachapi Mountains were later observed in San Bernardino County (Meese 2014, p. 13; Meese 2017, pers. comm.). However, it should be noted that Berg's study grouped birds south of the Transverse Mountain Ranges with birds from the Mojave Desert, which are both south of the Tehachapi Mountains, and that they considered both groups of birds to be part of the southern California population. In addition, the banded birds sighted in San Bernardino County were birds moving from the Central Valley into the desert, and there is no evidence that the birds found in the Mojave Desert are associated with the birds in southern California south of the Transverse Range. Therefore, until more genetic studies are completed with birds found south of the Transverse Ranges, it remains unknown whether the Central Valley birds are connected to the birds in southern California south of the Transverse Ranges (Clipperton 2017, pers. comm.; CDFW 2018, pp. 14–16). In addition, the rate and frequency of movements between the Central Valley and southern California remain unknown (Meese 2017, pers. comm.).

The genetic studies conducted by Berg *et al.* (2010) also showed no indication of significant reductions in genetic diversity, although there was an indication of moderate levels of inbreeding and mtDNA sequence variation was "extremely" low. Individuals found in the southern California region have a higher average number of microsatellite alleles per marker, suggesting the southern

California region is a reservoir for genetic variation. This is an important factor because the number of birds found in the southern California region has severely declined. Ongoing genetic studies will help inform our understanding of the genetic structuring of the individuals found within the various regions throughout the species range (Barr *et al.* 2017, entire). Genetic studies have currently not been completed for Washington, Oregon, Nevada, or Baja California.

2.3 Morphological Description

The overall morphology of the tricolored blackbird does not vary across its range (Beedy and Hamilton 1999, pp. 4, 7; Beedy *et al.* 2017, Systematics section). The species is a sexually dimorphic, medium-sized blackbird with a total length measuring 18–24 centimeters (7–9.5 inches) (Beedy and Hamilton 1999, p. 2). Typically, adult males weigh 66–69 grams (2.3–2.4 ounces) and adult females weigh 43–48 grams (1.5–1.7 ounces) (Beedy and Hamilton 1999, p. 2; Beedy *et al.* 2017, Appearance section). The molting strategy of the tricolored blackbird is best described by Howell (2010) as a Complex Basic Strategy. This molting strategy includes a near-complete pre-formative molt and complete pre-basic molts (Howell 2010, pp. 20–30). Tricolored blackbirds undergo a first pre-basic molt (also referred to as a pre-juvenile molt), which is followed by the pre-formative molt and then a cycle of pre-basic molts as an adult (Pyle 1997, p. 631). As shown in Figure 2.1a and 2.1b (bottom), adult male plumage is glossy black with a bright red shoulder patch and a pure to buffy white median covert; however, in intense sunlight the black plumage may look somewhat iridescent with a bluish, greenish, or even purplish hue (DeHaven 1975, p. 59; Meese 2017, pers. comm.). Adult females are mostly dark brown and are heavily streaked ventrally, with the ventral streaking merging to form a chocolate brown belly (Beedy *et al.* 2017, Appearance section). Females have a whitish chin and throat, and may have a reddish-orange shoulder patch with a buffy white border (Figure 2.1b (top) and 2.1c) (DeHaven 1975, entire; Pyle 1997, pp. 630–632; Beedy and Hamilton 1999, p. 2; Beedy *et al.* 2017, Appearance section). Juveniles of both sexes look similar to the adult female, only paler gray and buff (Pyle 1997, p. 631; Beedy and Hamilton 1999, p. 2).

Figure 2.1. a) Male tricolored blackbird; b) Female tricolored blackbird (top) approaching a male tricolored blackbird (bottom); and c) Female tricolored blackbird (Photo credit USFWS)

The plumage of tricolored blackbirds is so similar to red-winged blackbirds that museum specimens have been misidentified (Orians 1961a, p. 288). The primary difference between males of the two species is the color of the band on their median coverts; tricolored blackbirds have a distinctive white band whereas male red-winged blackbirds have more of a yellowish band or no band at all. In addition, the male tricolored blackbird's epaulette is a pure red while that of the red-winged blackbird male is orange-red. The most noticeable character difference between female red-winged blackbirds and female tricolored blackbirds is their ventral streaking. As described above, the ventral streaking in the tricolored blackbird merges at the belly so that the belly appears to be a uniform chocolate brown. In contrast, the ventral streaking in the female red-winged blackbird continues through the belly to the vent (Meese 2017, pers. comm.). Another difference between tricolored and red-winged blackbird females is less noticeable, but generally, female red-winged blackbirds are less sooty than tricolored blackbirds and red-winged blackbirds have a rusty tinge during the fall that the tricolored blackbird does not express (Orians 1961a, p. 288).

2.4 Range and Distribution

Historically, the tricolored blackbird's range was throughout most of lower-elevation California, but smaller nesting colonies were also known from Baja California, Nevada, and Oregon. Within California, the species' range is separated by the Transverse Ranges, so there may potentially be two separate groups of birds found north and south of the Transverse Ranges (see section 2.2 Genetic Diversity). Birds found north of the Transverse Ranges are primarily found in low-elevation areas west of the Sierra Nevada Mountains, extending through the Central Valley to the west and along the coast from Sonoma County in the north to Santa Barbara County in the south. Birds found south of the Transverse Ranges are primarily in low-elevation areas west of the southern California deserts and south into Baja California (Clipperton 2017, pers. comm.; CDFW 2018, p. 10–12)(Figure 2.2 and 2.3). The historical and current range of the species is very similar; however, since the 1990s, small colonies have also been observed in the state of Washington, which is considered an expansion northward of the species range (Beedy and Hamilton 1999, pp. 3–4). Historically, the California regions containing breeding colonies within the Central Valley, along the coast, in the Sierra Nevada foothills and in southern California (collectively referred to as the core regions; see Figure 3.1) contained the majority of the overall breeding population. However, more recently there has been a possible retraction from the southern portion of the species range (southern California and Baja California) and along the coast the number of birds found in breeding colonies has drastically declined (Clipperton 2017, pers. comm.; CDFW 2018, p. 37, 41–42; Robinson *et al.* 2018, pers. comm.).

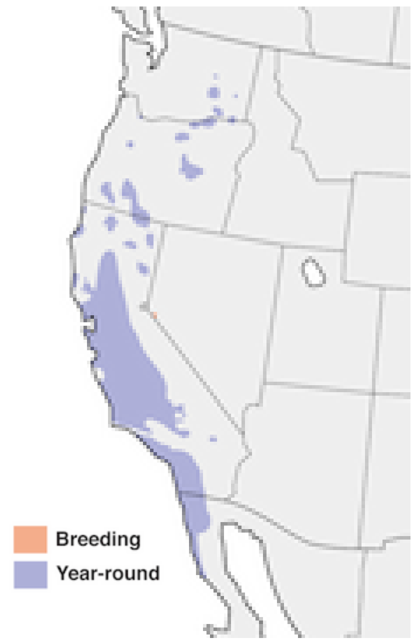

Figure 2.2 Distribution of the tricolored blackbird (Figure from Beedy *et al.* 2017 /Macaulay Library at the Cornell Lab of Ornithology)

The core regions currently contain breeding colonies with just a few individuals or colonies that can number anywhere from hundreds to sometimes as much as tens of thousands of individuals (eBird 2017; Tricolored Blackbird Portal). The regions containing breeding colonies in northeastern California, Oregon, Washington, Nevada, and Baja California (collectively referred to as the peripheral regions), comprise less than 1% of the overall breeding population and contain breeding colonies that are much smaller than the breeding colonies found in the core regions, rarely containing more than a couple hundred individuals (Beedy and Hamilton 1999, p. 1; eBird 2017). Although the peripheral regions contain breeding colonies that historically are much smaller than the colonies found within the core regions, have fewer individuals within the region, and altogether comprise around 1% of the overall population, the peripheral regions represent important ecological diversity (see section 3.2 Species Representation), and potentially genetic diversity, for the species. Within California, breeding colonies have been reported in 49 out of the 58 counties in the state (CNDDB 2017; Tricolored Blackbird Portal 2017), with the largest colonies in recent years found in the San Joaquin Valley, although twice in the past decade the largest breeding colonies were found in the Sacramento Valley (Meese 2017, pp. 9–10; Meese 2017, pers. comm.). Due to nesting habitat and prey base availability, the distribution of the species throughout California can vary annually. Both historically and currently, a majority of breeding occurs within the San Joaquin and Sacramento Valleys (Beedy and Hamilton 1997, p. 5; Beedy and Hamilton 1999, p. 3; see Figure 3.1). Non-breeding, over-wintering aggregations of tricolored blackbirds can be found throughout California, but most can be found within the San Francisco Bay Delta, along the California coast, and in the northern San Joaquin Valley (Orians 1961a, p. 289, 295; DeHaven *et al.* 1975b, pp. 224, 228; Hamilton 1998, p. 221; Beedy and Hamilton 1999, pp. 3, 4).

Within Oregon, the species primarily breeds in southern Klamath and Jackson Counties but has also been found in several small, isolated colonies scattered throughout the state (Beedy and Hamilton 1999, p. 3; Marshall *et al.* 2003, p. 579; Beedy *et al.* 2017, Distribution, Migration and Habitat section). Early accounts of the species are primarily from southern Oregon, so it is possible later accounts of the species in the northern portion of the state represent a range expansion north. The absence of, or inconsistency in, historical accounts in the northern portion of Oregon could also be due to a lack of survey coverage within that portion of the range (Clipperton 2017, pers. comm.; CDFW 2018, pp. 36–37). Some tricolored blackbirds within Oregon are year-round residents while others return to California during the winter (Beedy and Hamilton 1999, p. 3; Marshall *et al.* 2003, p. 579; Beedy *et al.* 2017, Distribution, Migration and Habitat section; Meese 2017, pers. comm.).

In 1998, the first breeding colony in Washington was recorded in Grant County. Since that first recorded occurrence, small colonies and individuals have been observed in southern and central Washington east of the Cascade Mountains (Beedy and Hamilton 1999, p. 3; Wahl *et al.* 2005, p. 345; eBird 2017; Beedy *et al.* 2017, Distribution, Migration, and Habitat section). Similar to northern Oregon, the absence of historical accounts in Washington could be due to a lack of survey coverage within that portion of the range and not a reflection of a northward expansion (Clipperton 2017, pers. comm.; CDFW 2018, pp. 36–37). There are few winter records of the species in Washington, although there have been some sightings of individuals during the non-breeding season (Wahl *et al.* 2005, p. 345; Mlodinow and Aanerud 2006, p. 49; Beedy *et al.* 2017, Distribution, Migration, and Habitat section).

In the state of Nevada, there is one small, regularly occurring colony near the town of Minden in Carson Valley, Douglas County (Floyd *et al.* 2007, p. 496; Ammon and Woods 2008, p. 65). This colony was first reported in 1996 but may have gone undetected for some time (Floyd *et al.* 2007, p. 496; Ammon and Woods 2008, p. 65). The species was considered a transient in the state prior to the discovery of this colony (Alcorn 1988, p. 365) and a limited but regular migrant in the spring (Ryser 1985, p. 511). Other small colonies have been periodically reported since 1996 in nearby wetlands in Carson Valley, and individuals have been observed at other locations in both western Douglas and Carson City Counties including an unconfirmed report of a colony in Carson City County in 1980 (Beedy and Hamilton 1999, p. 3; Ammon and Woods 2008, p. 65; Beedy *et al.* 2017, Distribution section; eBird 2017). Birds breeding in Nevada likely migrate back into California with other non-breeding tricolored blackbirds during the non-breeding season (Beedy and Hamilton 1999, p. 3; Beedy *et al.* 2017, Distribution, Migration, and Habitat section).

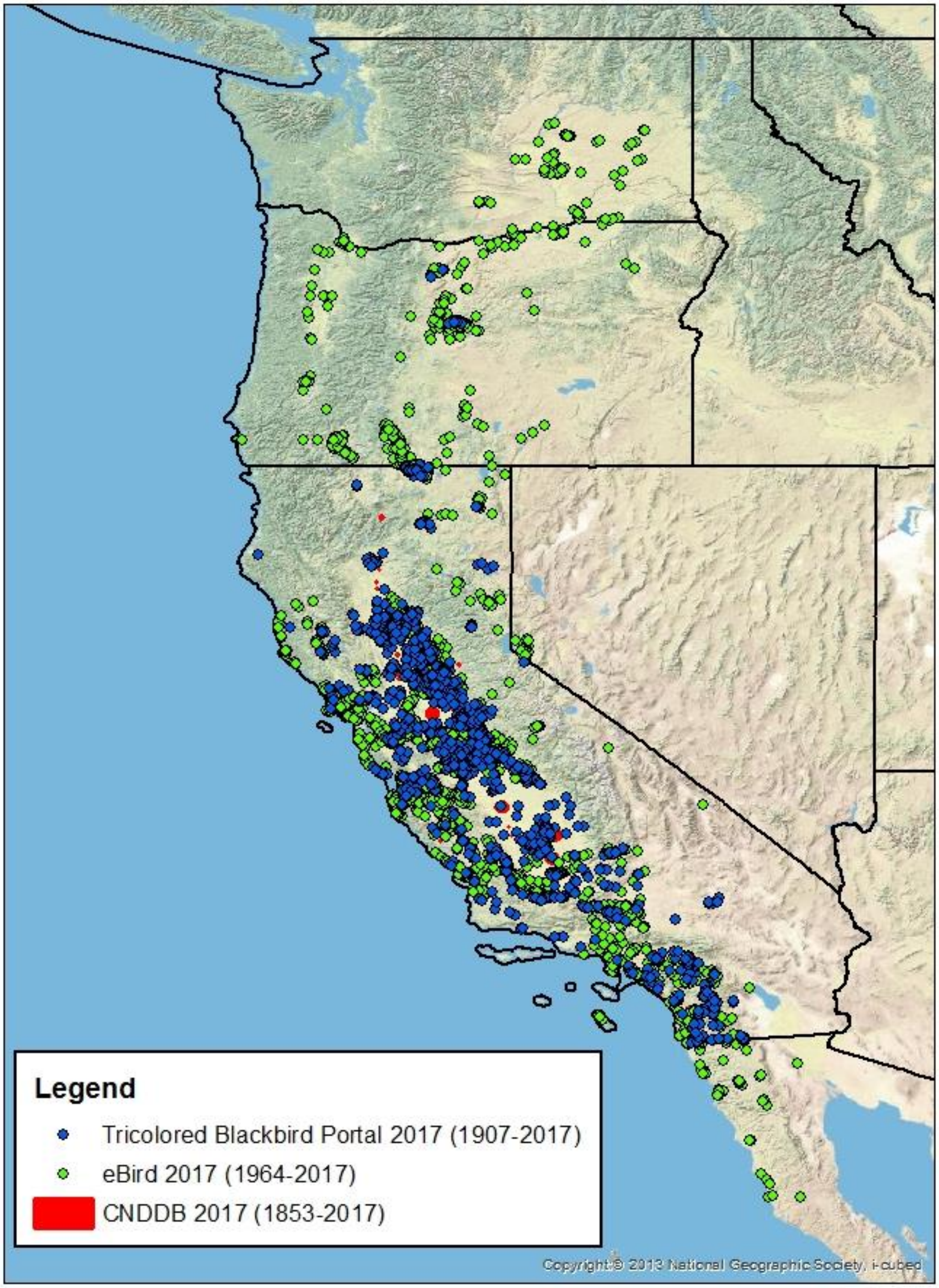

Figure 2.3 Recorded locations of tricolored blackbird colonies and individuals.
(Data retrieved from eBird 2017, Tricolored Blackbird Portal 2017, and CNDDB 2017)

There are historical records of breeding colonies in the central and western portions of northern Baja California, Mexico, to El Rosario since the 1800s. Although most of these historical records were of breeding colonies, tricolored blackbirds have more recently been observed in Baja California outside of the breeding season and are now considered resident (Howell and Webb 1995, p. 736; Beedy and Hamilton 1999, p. 3; Feenstra 2013; p. 1; Beedy *et al.* 2017, Distribution, Migration, and Habitat section; eBird 2017). Historical accounts of the species in Baja California described the species as common on the northwest coast of Baja California (Bryant 1889, p. 294), but there are no known historical colony or population estimates for the species within this region. More recent recorded observations and estimates of colonies in Baja California range from around 1,000 birds to as little as a couple of individuals but average between tens and a couple of hundred of individuals (Erickson *et al.* 2007, pp. 5–9; Erickson and de La Cueva 2008, p. 3; Feenstra 2013, pp. 8–10; Meese 2017, pp. 19–20; eBird 2017). Surveys conducted during the 2017 breeding season documented fewer than 350 individuals within Baja California at only three locations, and these more recent surveys have found a majority of the historical range within Baja California has been unoccupied (Meese 2017, pp. 19–20). These results suggest there is a continuing decline in the number of birds in the Baja California region and a possible range retraction within this portion of the species range (Meese 2017, p. 19; Clipperton 2017, pers. comm.; CDFW 2018, pp. 37, 42).

2.5 Life History

The basic life history of the tricolored blackbird appears to be similar to other blackbird species (Figure 2.4). However, the tricolored blackbird exhibits a unique breeding behavior that is a combination of colonial, nomadic, and itinerant, which is not seen in other blackbird species. Their colonial and generally highly synchronous nesting behavior is thought to be an adaptation to the temporary availability of unpredictable insect outbreaks and/or high rates of predation pressure (from coyotes, raccoons, black-crowned night herons). Their colonial and nomadic behavior also allows the species to exploit available nesting and foraging opportunities in a changing environment (Orians and Collier 1963, p. 451; Collier 1968, p. 355; Payne 1969, p. 28; Cook and Toft 2005, p. 74). Likewise, being able to breed itinerantly allows the species to exploit changing environmental conditions throughout their range by moving from an initial breeding location to another location with more favorable conditions where they breed again (Hamilton 1998, entire; Beedy and Hamilton 1999, p. 4; Airola et al. 2016, pp. 103–104). In the Central Valley of California, the typical pattern of itinerant breeding starts with initial nesting colonies from March until April in the San Joaquin Valley and in Sacramento County. The location of breeding colonies then shifts to the Sacramento Valley, the Sierra Nevada foothills, and more northern portions of the species range for a second nesting attempt (Beedy and Hamilton 1997, pp. 5–6; Hamilton 1998, p. 221; Beedy and Hamilton 1999, p. 5; Beedy *et al.* 2017, Distribution, Migration and Habitat section; Meese 2017, pers. comm.), although in some locations a second wave of nesting can occur after the first young have fledged (Beedy and Hamilton 1999, p. 16).

In the southern portion of the range, males can begin singing as early as February (Payne 1969, p. 6; Beedy and Hamilton 1999, p. 12) and typically initiate nesting from late March until early April in the San Joaquin Valley and in early March in southern California; however, recent surveys have documented the species initiating nesting as early as late February (Hamilton 1998, pp. 221–222; Meese 2017, pers. comm.; Cook 2017, pers. comm.). In the Sacramento Valley and Sierra Nevada foothills, nesting begins in May to June (Hamilton 1998, p. 222; Beedy and Hamilton 1999, pp. 4–5), although some nesting colonies in Sacramento County are known to be active as early as late March or April (Hamilton 1998, pp. 221, 223; Beedy *et al.* 2017, Distribution, Migration, and Habitat section; Meese 2017, pers. comm.). Both sexes can arrive at a colony site at the same time, but males are also known to arrive prior to the females (Beedy and Hamilton 1999, p. 12). Tricolored blackbirds exhibit a prospecting behavior when selecting nesting habitat. This behavior includes gathering in dense concentrations at one potential nesting site; collectively changing locations and moving to alternative sites; and finally returning to and settling at the selected nesting site (Beedy and Hamilton 1999, p. 9). While prospecting for a potential nesting site, tricolored blackbirds are looking for a location that contains protected nesting substrate, a nearby open water source, and an abundant insect prey source within 5 kilometers (km) (3.1 miles (mi)) of the site (Beedy and Hamilton 1999, p. 1; Beedy 2008, p. 439). Tricolored blackbirds require protected nesting substrate (a vegetative substrate that is sturdy enough for nest placement and is protected by being surrounded by water, has spines, and/or is dense) to provide shelter and protection to their young (Beedy *et al.* 1991, p. 24).

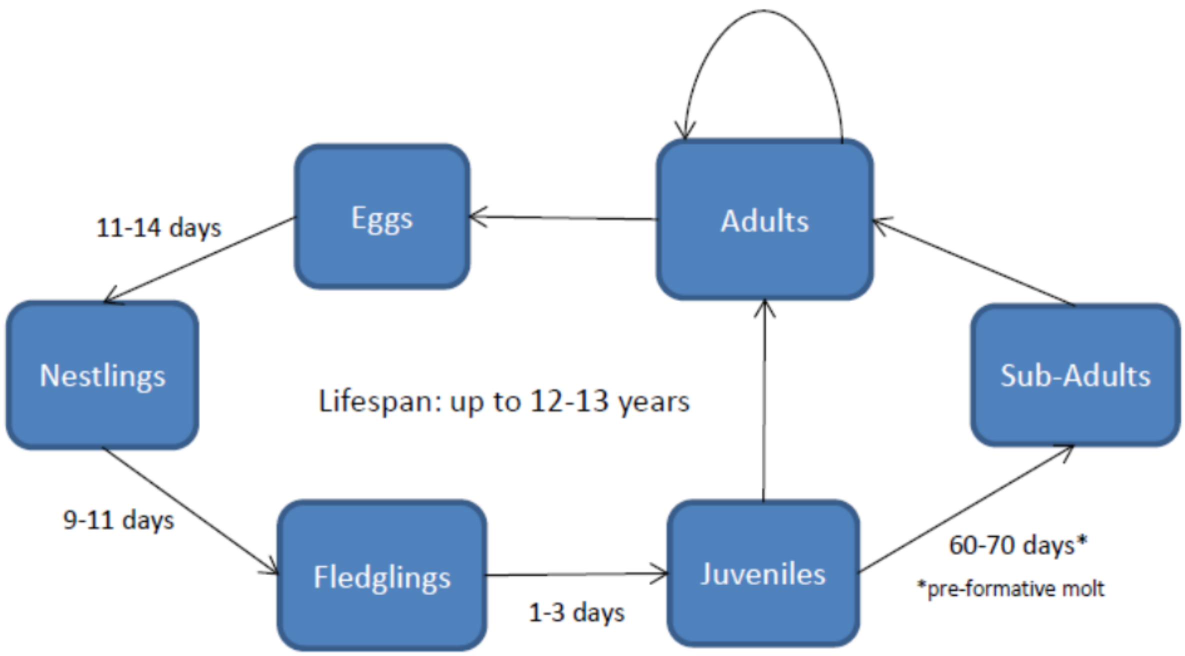

Figure 2.4 Tricolored blackbird basic life history model.

Most nesting begins within a week after prospecting begins and nests are constructed by the female within the small territory of the male (Beedy and Hamilton 1999, pp. 12, 13; Meese 2017, pers. comm.). Males may breed with one to four females at a time (Payne 1969, p. 10; Beedy and Hamilton 1999, p. 9), so up to four nests may be constructed within a male's territory; however, Orians (1961a) rarely saw more than two females to a male (Orians 1961a, p. 300) and Meese (2017) has never seen more than two (Meese 2017, pers. comm.). Nests are constructed of vegetation and sometimes mud, and are then lined with grasses (Payne 1969, p. 11; Airola 2017, pers. comm.). The time between completion of nest building and laying of the first egg can vary between 1 and 3 days, and a day passes between each egg laid in a clutch (Payne 1969, p. 12). Clutch sizes average three to four eggs, but nests with as few as one egg or as many as seven eggs have been observed (Mailliard 1914, pp. 205–206; Dawson and Brooks 1923, p. 110; Lack and Emlen 1939, p. 228; Payne 1969, p. 12). Females are the sole incubators and estimated incubation periods range from 11 to 14 days (Payne 1969, p. 13; Beedy and Hamilton 1999, pp. 13–14). During incubation, the colony may appear to be deserted because the males either leave the colony during the day or sit out of sight on their territories, presumably protecting their mates and offspring while the females incubate (Beedy and Hamilton 1999, p. 14; Meese 2017, pers. comm.). Although most colonies have such highly synchronous breeding that all of the eggs within a colony are laid within a week (Orians 1961a, pp. 296–297), some colonies are asynchronous and over a period of days or weeks additional nests are added to the periphery of the established colony (Beedy and Hamilton 1999, p. 12; Airola et al. 2016, pp. 90, 91–98, 101–102). The colonies that have been found to be quite asynchronous are primarily colonies formed in silage fields within the San Joaquin Valley and Riverside County, and colonies monitored within the Sierra Nevada foothills during the 2016 breeding season (Beedy *et al.* 2017, Breeding section; Airola et al. 2016, pp. 90, 98; Arthur 2017, pers. comm.).

In Oregon, birds begin to assemble near potential colony sites in February and March and reach peak concentration numbers in April. Nesting in Oregon, Washington, and Nevada primarily takes place from May through July, with tricolored blackbirds dispersing from their breeding site by mid-July (Marshall *et al.* 2003, p. 580; Wahl *et al.* 2005, p. 345; Ammon and Woods 2008, pp. 64–65). Active nesting colonies in Baja California are often observed from early May through June, with nesting activity likely beginning in April and ceasing by July (Erickson *et al.* 2007, pp. 5–9; Erickson and de la Cueva 2008, p. 3; Feenstra 2013, pp. 8–10).

In the laboratory, hatching takes approximately a half hour to complete. Once hatching is complete, the female removes the shell from the nest and deposits it away from the colony (Beedy and Hamilton 1999, pp.14–15). Nestlings are born blind, mostly naked, and uncoordinated, but have a powerful gaping response (a behavior to solicit food by opening their mouth widely) (Beedy and Hamilton 1999, p. 15). Females provide their young protection from the elements by standing on the nest and shading nestlings or by staying on nests during extreme precipitation events, which has been known to lead to mortality of both nestlings and the female (Beedy *et al.* 2017, Breeding section). During the nestling and hatchling stages, both males and females help with feeding their young a diet comprised almost entirely of insects, which can be found in a variety of habitats (Skorupa *et al.* 1980, entire; Beedy and Hamilton 1999, p. 15; Beedy *et al.* 2017, Diet section). Some tricolored blackbird nests can contain both well-fed nestlings and nestlings that are clearly starving (Payne 1969, p. 16). Disturbed nestlings will leave the nest 9–11 days after hatching; however, undisturbed nestlings typically fledge 12–14 days after hatching (Payne 1969, p. 16; Beedy and Hamilton 1999, p. 13). Fledglings remain at the colony location as their parents continue to provide them food. Fledgling dispersal from the colony location to water sources and foraging areas is directed by the parents and fledglings will form crèches, or nursery-like assemblages of fledglings, near foraging areas and on the peripheries of breeding colonies (Beedy and Hamilton 1999, p. 15).

Tricolored blackbird young are fully independent of their parents after approximately 25–32 days (Payne 1969, p. 16; Beedy and Hamilton 1999, p. 15). Juvenile tricolored blackbirds congregate with the adults after dispersing from their natal colony (Payne 1969, p. 16; Beedy and Hamilton 1999, p. 15). Within 80 days, nestlings banded at their natal colony in the San Joaquin Valley were captured almost 225 km (140 mi) north in the Sacramento Valley (DeHaven *et al.* 1975b, p. 223; Beedy and Hamilton 1999, p. 15). Since juvenile tricolored blackbirds have a strong incentive to stay with the adults when they disperse from their natal colony, it is likely that the juveniles arrive at a new location (likely a new breeding colony or the region around a new breeding colony) simultaneously or within days of the adults arriving at the new location. Female tricolored blackbirds are known to breed as one year olds, whereas males defer breeding until they are at least two years old (Orians 1961a, pg. 299; Orians 1963, p. 553; Payne 1969, pp. 44, 50; Beedy and Hamilton 1999, p. 16). Past banding efforts have shown the maximum lifespan for the species is 12 to 13 years (DeHaven and

Neff 1973, p. 10; Kennard 1975, p. 70) and average annual adult survival is about 60% (Beedy *et al.* 2017, Demography and Populations section).

Currently, the majority of the species' overall population is found in the Central Valley and surrounding Sierra Nevada foothill locations during the breeding season (March to July) (Beedy *et al.* 2017, Distribution, Migration and Habitat section). After the breeding season, large flocks of tricolored blackbirds congregate in the Sacramento Valley from August through the fall. Birds breeding in northern California, Nevada, and the migratory birds in Oregon concentrate primarily in the San Francisco Bay Delta, along the California coast, and in the northern San Joaquin Valley during the winter; however, tricolored blackbirds in Baja California, the majority of individuals in southern California and some of the non-migratory individuals in Oregon stay resident over the winter (Marshall *et al.* 2003, p. 579; Beedy *et al.* 2017, Distribution, Migration and Habitat section Clipperton 2017, pers. comm.). Winter observations of tricolored blackbirds in Washington suggest the species is resident within the state (Wahl *et al.* 2005, p. 345; Meese 2017, pers. comm.; eBird 2017).

Non-breeding congregations of tricolored blackbirds are often found in wetland habitats near abundant food sources such as rice fields, pastureland, recently cultivated cropland, and grain stores at dairies. Following the breeding season, tricolored blackbirds congregate into large, mixed-species flocks with other blackbird species, starlings, and brown-headed cowbirds. In the Central Valley, most congregations occur in the Sacramento Valley during the fall where abundant food sources such as rice, grains, weeds, and water grass occur (Orians 1961a, p. 289; Crase and DeHaven 1978, pp. 256–259; Beedy and Hamilton 1999, pp. 1, 4–5, 11; Beedy et al. 2017, Distribution, Migration and Habitat section).). During the winter, tricolored blackbirds in California retract from the Sacramento Valley and concentrate into the San Francisco Bay Delta, along the California coast, and in the northern San Joaquin Valley, but can occur throughout the species range. Formerly, wintering tricolored blackbirds were found in large numbers around dairies in Marin County and around feedlots in southern Solano and Merced Counties (Orians 1961a, pp. 289, 295; DeHaven *et al.* 1975b, pp. 224, 228; Hamilton 1998, p. 221; Beedy and Hamilton 1999, pp. 3, 4; Meese 2013, p. 110; Beedy et al. 2017, Distribution, Migration and Habitat section). Wetland habitats containing cattails (*Typha* spp.) and bulrushes (*Schoenoplectus* spp.) near suitable foraging sites are the preferred winter roost sites (Beedy *et al.* 2017, Distribution, Migration, and Habitat section). Beginning in February, tricolored blackbirds in California begin to disperse from their wintering grounds into the San Joaquin Valley, Sacramento County, and the Sierra Nevada foothills to breed (Hamilton 1998, p. 221; Beedy *et al.* 2017, Distribution, Migration, and Habitat section).

In the Central Valley and along the California coast, the tricolored blackbird has also been observed nesting in the fall (Orians 1960, entire; Orians 1963, entire; Hamilton 1998, p. 225; Beedy *et al.* 2017, Breeding section). Observations by Orians (1960, p. 381) revealed fall nesting is more protracted than the highly synchronous nesting during the spring nesting season. Fall nesting colonies seemed less dense and uniform compared to spring nesting colonies; however, clutch sizes in the fall were similar to sizes found in the spring (Orians 1960, p. 382). Nestling survival was low in fall nesting colonies, possibly due to the available insect prey base being primarily in adult form compared to the spring when the insects are primarily in larval form (Orians 1960, p. 383). Observations during the middle 20th century suggest fall breeding is associated with favorable environmental conditions that result in an increased insect prey base, early rainfall, and/or an abundance of rice in September and October (Beedy and Hamilton 1999, p. 5); however, fall breeding within the Central Valley has not been documented since 1964 and the only documented reports of fall breeding along the California coast were in the 1980s and 1990s (R. Stallcup, pers. comm. in Beedy *et al.* 2017, Breeding section).

2.6 Resource Needs for Individuals

The species needs at an individual level are best described when categorized by needs during each life stage (Table 2.1). For the tricolored blackbird, this section will describe what an **individual needs based on historical habitat conditions**. In contrast, section 2.7 Replacement and/or Supplemental Resources for Individuals will describe the needs of an individual tricolored blackbird based on existing habitat conditions. This separation between what the species needs based on historical conditions and what the species currently uses to replace or supplement those needs will continue throughout this SSA Report. For more detailed information on the loss and conversion of native habitats, see section 4.1 Habitat Loss, Degradation, and Modification.

A breeding adult needs protected nesting substrate (a vegetative substrate that is sturdy enough for nest placement and is protected by being surrounded by water, has spines, and/or is dense) in order to successfully reproduce (Beedy and Hamilton 1999, pp. 11, 13; Beedy 2008, p. 439). Prior to the conversion of wetland habitat to agricultural uses, an individual bird primarily used available emergent vegetation such as cattails and bulrushes growing in wetland habitats and in other vegetation such as willows, thistles, and nettles (Neff 1937, pp. 64, 67–79; Orians 1961a, p. 297; Collier 1968, p. 134; Beedy and Hamilton 1999, p. 5). Protection from terrestrial predators in wetlands habitats primarily consisted of water within which the nesting substrate grew, and/or deeper water that served as a moat to discourage entry into nest colonies. Adults also require a food source, and an individual adult needs both native insects and other plant material such as grains and seeds (Crase and DeHaven 1978, pp. 256–259; Beedy and Hamilton 1999, p. 4). Historically, foraging habitats that supported abundant insect populations and vegetative diet items were grasslands, shrublands, wetlands, riparian scrub, and other forested habitats (Beedy and Hamilton 1997, p. 5; Beedy 2008, p. 440; Meese 2017, pers. comm.).

During the breeding season, females appear to consume more insects than males, so it is likely breeding females require increased proteins and essential amino and fatty acids for egg formation (Beedy *et al.* 2017, Diet and Foraging section). In order to obtain food efficiently, adults require suitable foraging habitat(s) (e.g., with abundant prey) generally within 5 km (3.1 mi) of a colony site, although birds have been documented traveling as far as 13 km (8 mi) away to obtain food (Orians 1961a, p. 299; Beedy and Hamilton 1997, p. 5). Adults also require a water source to bathe and stay hydrated, and during the nesting season their water source needs to be near the nesting site (Beedy and Hamilton 1999, pp. 7, 13; Beedy *et al.* 2017, Behavior section). Historically, an individual adult would utilize the various wetland and natural waterway features found on the landscape to fulfill their water source requirement. During the non-breeding season, an adult requires cattails, bulrushes, and other wetland vegetation for sheltering. Non-breeding sites were typically adjacent to a food source, which during the non-breeding season is composed primarily of vegetative items, and to a lesser extent, insects (Beedy *et al.* 2017, Distribution, Migration and Habitat section).

Tricolored blackbird eggs require protected nesting substrate, a female for incubation (Beedy and Hamilton 1999, pp. 11, 13, 14; Orians 1961a, p. 300), and protein and essential amino and fatty acid sources for formation (see above). Therefore, during the egg life stage, individuals historically needed wetland habitats with emergent vegetation such as cattails and/or bulrushes, adequate foraging habitats that support abundant insect populations (i.e., grassland, wetland, shrubland, riparian scrub, and other forested habitats), and an adult female for incubation (i.e., birth mother)

(Neff 1937, pp. 64, 67–79; Orians 1961a, pp. 297, 300; Orians 1961b, pp. 331–332; Collier 1968, p. 134). Once hatched, tricolored blackbird nestlings require protected nesting substrate, some type of protection within the nest to shelter them from sunlight and extreme precipitation, and a strict insect diet for their first nine days of life, which must be provided to them by an adult (Payne 1969, p. 14; Beedy and Hamilton 1999, pp. 11, 13, 14; Beedy *et al.* 2017, Breeding section). Thus, individual tricolored blackbird nestlings historically needed wetland habitats with cattails and/or bulrushes, nearby grassland or other foraging habitat that supports insect populations, adults to bring the required insects to the nestlings, and either tall vegetation or an adult female (i.e., birth mother) to provide protection from the elements (Neff 1937, pp. 64, 67–79; Orians 1961a, pp. 297, 300; Orians 1961b, pp. 331–332; Collier 1968, p. 134; Payne 1969, p. 14; Beedy and Hamilton 1999, pp. 11, 13, 14; Beedy *et al.* 2017, Breeding section).

Fledglings historically required protected wetland habitat for shelter, tall vegetation to perch on, a food source near their nesting site, and a water source. Although the adults will continue to bring the fledglings food, the fledglings are able to acquire food for themselves after they are about 25 days old (Payne 1969, p. 16; Beedy *et al.* 2017, Breeding section); however, they do need an adult to show them how to find and obtain food (Payne 1969, p. 16; Beedy *et al.* 2017, Breeding section). Overall, a tricolored blackbird fledgling needs its initial nesting habitat, taller nearby vegetation to perch, nearby foraging habitat that supports the appropriate food items, an adult to provide insects and to learn how to obtain food, and a nearby water source for drinking and bathing (Neff 1937, pp. 64, 67–79; Orians 1961a, p. 297; Orians 1961b, pp. 331–332; Collier 1968, p. 134; Payne 1969, p. 16; Beedy and Hamilton 1999, pp. 11, 13, 14; Beedy *et al.* 2017, Breeding section). Juvenile tricolored blackbirds join the adults after fledging, so we assume they have similar needs to adults during the non-breeding season (see above).

2.7 Replacement and/or Supplemental Resource Needs for Individuals

The species needs at an individual level based on historical conditions are described above. Currently, however, the tricolored blackbird has replaced and/or supplemented its needs with what is currently available on the landscape throughout its range. Therefore, this section will describe tricolored blackbird **individual replacement and/or supplemental needs based on current habitat conditions**. As in the section above, the replacement and/or supplemental needs for an individual are best described when categorized by life stage, and are shown in **bold** in Table 2.1. For more information on the loss and conversion of native habitats, and the species' shift to utilizing novel habitats, see section 4.1 Habitat Loss, Degradation, and Modification.

The loss of 96% of wetlands in the Central Valley and 99% of perennial grasslands in the Central Valley and Sierra Nevada foothills to development and agricultural conversion greatly reduced the amount of available native nesting and foraging habitat for the tricolored blackbird (Kreissman 1991, pp. 62, 81). However, as the extent of agricultural and disturbed habitats increased within the range of the species, the tricolored blackbird shifted to utilizing these elements in these novel habitats to complete its life history requirements. Breeding adults, eggs, nestlings, and to a lesser extent, fledglings, still need protected nesting substrate in order to successfully reproduce and survive; however, with the loss of native habitats within their range, adults have also begun nesting in agricultural silage crops and other non-native vegetation to supplement their protected nesting substrate needs (Collier 1968, pp. 20–21; Kreissman 1991, pp. 62, 81; Cook 1996, entire; Beedy and Hamilton 1999, p. 5; Beedy 2008, p. 439; Meese and Beedy 2015, p. 81; Airola *et al.* 2015a, pp. 59, 66; Airola *et al.* 2015b, p. 105; Airola *et al.* 2016, pp. 99–101).

Table 2.1 Tricolored blackbird individual needs by life stage based on historical conditions and individual replacement and/or supplemental needs by life stage under existing conditions (**in bold**). The third column categorizes the individual needs into whether these needs effect breeding (B), feeding (F), sheltering (S), or migration (M).

Scale	**Needs**	**Life History Behavior**
Individuals		
Life Stage		
Adults	Food source (insects and seeds/grains found in grassland, wetland, shrubland, riparian scrub , forested, and **agricultural habitats**)	F
	Protected nesting substrate (wetland habitats, upland native vegetation, **silage fields, and other non-native vegetation**)	B/S/M
	Appropriate nesting material (vegetation, mud, grass)	
	Roosting habitat (wetland or marsh habitat) during the non-breeding season	S/M
	Water source for bathing/drinking (wetlands, **agricultural irrigation, stock ponds**)	F
	Mate for reproduction	B
	Material for nest construction (vegetation, grass, mud)	B/S
Eggs	Protein, essential amino acids, and essential fatty acids (insects) for formation (adequate grassland, shrubland, wetland, riparian scrub, forested, and **agricultural** foraging habitats within 5 km of the nest)	B
	Male for fertilization	B
	Female for incubation (11–14 days)	B/S
	Protected nesting substrate (wetland habitats, upland native vegetation, **silage fields, and other non-native vegetation**)	S
Nestlings	Insects (adequate grassland, shrubland, wetland, riparian scrub, forested, and **agricultural** foraging habitats within 5 km of the nest)	F
	Adults to bring them food	F
	Protection from the elements (a nestling's mother or tall vegetation)	S
	Protected nesting substrate (wetland habitats, upland native vegetation, **silage fields, and other non-native vegetation**)	S
Fledglings	Food source (insects and seeds/grains found in grassland, wetland, shrubland, riparian scrub, forested, and **agricultural habitats**)	F
	Parents to bring them food/help locate food	F
	Water source for bathing/drinking (wetlands, **agricultural irrigation, stock ponds**)	F
	Protected nesting substrate (wetland habitats, upland native vegetation, **silage fields, and other non-native vegetation**) and taller perching vegetation (wetland and riparian)	S
Juveniles	Food source (insects and seeds/grains found in grassland, wetland, shrubland, riparian scrub, forested, and **agricultural habitats**)	F
	Roosting habitat (wetland/marsh habitat) during the non-breeding season	S/M
	Water source for bathing/drinking (wetlands, **agricultural irrigation, stock ponds**)	F

In the San Joaquin Valley and in San Benito and Riverside Counties, large tricolored blackbird nesting colonies have shifted from using wetland vegetation to using agricultural fields where silage crops are grown for dairy cattle feed. The silage crops are often a wheat-rye hybrid called triticale and are more often than not infested with weeds, or are forage blends of wheat, rye, and oats, which provide a protective nesting substrate for large nesting colonies to utilize. Triticale in of itself is not an armored plant, but the weeds growing within the silage fields can contain some form of armor and since the silage fields are flood-irrigated, the fields may appear to be wetland-like to the species (Meese 2017, pers. comm.). It can vary by year, but it is estimated that more than 50% of nests constructed by tricolored blackbirds during their first nesting cycle of the year are in silage fields (Hamilton and Meese 2006, p. 4; Meese 2009b, p. 5) and the latest Tricolored Blackbird Statewide Survey (Statewide Survey) recorded around 33% of the overall breeding population in agricultural fields during the first nesting attempt (Meese 2017, p. 11).

The tricolored blackbird has also shifted to using non-native vegetation such as Himalayan blackberry (*Rubus armeniacus*) milk thistle, mallow, giant reed, and other Eurasian weeds in irrigated pastures, stock ponds, along drainages, and in upland habitats for nesting substrate. During the 2017 Statewide Survey, which only captures the species during their first breeding attempt and is not representative of the breeding colonies in the northern portion of the range, almost 15% of breeding colonies were found in Himalayan blackberry or thistle. Surveys completed in the foothill grassland region west of the Sierra Nevada Mountains (not the same boundary as the Sierra Nevada Foothill region as defined in this SSA report) found that Himalayan blackberry was used as a nesting substrate at 69–84% of active colony sites (Airola *et al.* 2015a, pp. 66–67; Airola *et al.* 2015b, p. 105; Airola *et al.* 2016, p. 99; Airola 2017, pers. comm.). The majority of colonies still occur in cattails and bulrushes found in existing wetland habitats and irrigation drainages, but nesting in these native habitats, especially outside of the Sacramento Valley, occurs at a lesser degree then historically (Meese 2017, p. 11).

All life stages require an insect and/or vegetative food source, and the species has shifted to utilizing agricultural-associated habitats to replace and/or supplement their foraging needs. Alfalfa, rice patties, open rangeland/cattle pasture, annual grassland, hay fields, and sunflower have all been documented as adequate foraging habitats for insects, and silage fields, stored grains, and rice provide vegetative diet items (Crase and DeHaven 1978, pp. 256–259; Meese 2013, pp. 104–107, 110; Airola *et al.* 2015a, pp. 66, 72). Fledglings and adults currently supplement their water needs with stock ponds, irrigation ditches, and other agricultural-associated water sources (Beedy *et al.* 2017, Diet and Foraging section, Behavior section).

CHAPTER 3: REGIONAL AND SPECIES NEEDS

In this chapter, we define the analysis unit we are using as a surrogate for a tricolored blackbird population since the available genetic information suggests the species as a whole is one interbreeding population (it is possible there are two or more distinct groups of interbreeding birds; however, additional genetic analysis needs to be completed for verification). In addition, this chapter will also describe what each analysis unit and the species overall, needs for viability. We also discuss the difficulty in estimating the size of the overall species population and review these estimates over time. As discussed in Chapter 1, for the purpose of this assessment, we define **viability** as the ability of the tricolored blackbird to sustain colonies in natural ecosystems and anthropogenic habitats throughout each region in their range over time. Using the SSA framework, we describe the species' viability by characterizing the status of the species in terms of its **resiliency**, **representation**, and **redundancy** (the 3 Rs).

3.1 Regional Resiliency

Populations of tricolored blackbirds are not easy to define or distinguish. During the non-breeding season, individual tricolored blackbirds form mixed species flocks and move around California, Oregon, Washington, and Baja California as different food items become available (the birds in the Nevada region are not resident). During the breeding season, individuals that may nest within a colony along the California coast or Mojave Desert one year could migrate into the Central Valley and nest within a colony at a different location the next year. Likewise, an individual that is part of a nesting colony in the San Joaquin Valley in early spring may then nest with different individuals comprising a new colony in the Sacramento Valley later in the season. To complicate things even further, a small number of individuals may also migrate outside of California to breed.

For these reasons, and for the purposes of this SSA Report, we are defining a tricolored blackbird population as all nesting colonies that occur within a particular region over the breeding season and will refer to these regions throughout the rest of this SSA Report as a surrogate for population. Regions outside of California are defined as follows: all of the counties in Oregon, Washington, and Nevada where potentially breeding birds have been recorded in eBird are considered the Oregon, Washington, and Nevada regions, respectively. Any birds breeding in Baja California, Mexico, are considered the Baja California region. Since the state of California contains the largest percentage (typically >99%) of the overall tricolored blackbird population, we sub-divided the state into regions by county based on the divisions described in Meese 2014, Meese 2017, and Graves *et al.* 2013 (Figure 3.1 and Table 3.1). As described above, the individuals within each region are actually interbreeding groupings of birds and should not be considered separate, discrete populations in a genetic or population biology sense. In addition, although some of the available literature sub-divides the species' range by these political boundaries (e.g., by county), these boundaries may not directly reflect the biological boundaries of the species. However, since Statewide Survey reports sub-divide the species' range in this way, we are also defining the species' regional boundaries in this way.

For the tricolored blackbird to maintain viability, its colonies within each region, or some portion thereof, must be resilient. Stochastic events that have the potential to affect tricolored blackbird colonies within a particular region include severe storms, drought, application of pesticides or other contaminants, and the removal of habitat via natural (i.e., fire, drought, disease, etc.) and anthropogenic means (i.e., conversion to agriculture, crop harvest, crop conversion, weed control). A number of factors influence the resiliency of colonies, including abundance, reproduction, survival, and connectivity. Influencing those factors are elements of tricolored blackbird habitat that determine the number of breeding colonies a region can support and whether those breeding colonies can increase reproductive success, and therefore overall abundance, thereby increasing the resiliency of the region. These regional needs and habitat elements are discussed below and are shown in Figure 3.2.

Figure 3.1 Tricolored blackbird regions in California, Nevada, Oregon, and Washington. Based off Meese 2014, Meese 2017, Graves *et al.* 2013, and eBird 2017.

Table 3.1 Counties contained within each region in the U.S. (the Baja California region is not shown).

Region	Counties
San Joaquin Valley:	San Joaquin, Stanislaus, Merced, Madera, Fresno, Tulare, Kings, Kern (North of the Transverse Range)
Sacramento Valley:	Butte, Colusa, Glenn, Sacramento, Sutter, Tehama, Yolo, Yuba
Sierra Nevada Foothills:	Amador, Calaveras, El Dorado, Placer, Mariposa, Tuolumne
North Coast:	Humboldt, Mendocino, Sonoma, Lake
San Francisco Bay/Delta:	Marin, Napa, Solano
Central Coast:	Alameda, Contra Costa, Monterey, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Santa Cruz
Southern California:	Los Angeles, San Bernardino, Orange, Riverside, San Diego, Kern (South of Transverse Range)
Northeast Interior:	Siskiyou, Modoc, Lassen, Shasta
Oregon:	Washington, Yamhill, Polk, Marion, Benton, Linn, Lane, Douglas, Curry, Josephine, Jackson, Klamath, Lake, Deschutes, Gilliam, Morrow, Umatilla, Union, Grant, Wheeler, Crook, Jefferson, Wasco, Multnomah, Sherman
Washington:	Adams, Lincoln, Grant, Yakima, Klickitat, Franklin, Walla Walla, Whitman
Nevada:	Douglas, Carson City

Regional Needs that Influence Resiliency

Reproduction and Recruitment

Resilient tricolored blackbird regions must have multiple breeding colonies that are successfully reproducing and adding new breeding individuals into the overall breeding population (i.e., recruitment). The distribution and size of each nesting colony throughout the species range may reflect the amount and productivity of available nesting and foraging habitats within any one region. The success of individual nesting colonies reflects environmental conditions, and the number of breeding individuals within a region reflects breeding population trends that may be stable, increasing, or decreasing. For example, some colonies in the San Joaquin Valley region concentrate a large proportion of the overall breeding population into fewer locations during the first breeding attempt than in the past. This concentration likely is a response to the loss of historical nesting and foraging habitat throughout the species range and the species utilization of agricultural habitats within that region to replace and/or supplement its needs. The success of each nesting colony throughout the breeding season, in addition to overall survival, is collectively reflected in the subsequent season's breeding population estimate since these individuals are now included in the overall population. However, until those new individuals are able to reproduce, they may not be actively recruiting new individuals into the breeding population.

Reproductive success is not easy to estimate for the tricolored blackbird, and to complicate matters further, the estimated reproductive success for an individual nest is actually only a portion of that individual's reproductive output since they likely breed twice a year on average. Some nesting substrates are impossible to enter to determine reproductive success (e.g., Himalayan blackberry) (Airola et al. 2015a, pp. 62–63; Airola 2017, pers. comm.), and entering colonies to assess reproductive success can cause nest failure and colony abandonment (Cook and Toft 2005, p. 76; Weintraub *et al.* 2016, p. 853; Beedy *et al.* 2017, Conservation and Management section). Counts of fledglings in the nest area are complicated by vegetation obstruction and dispersal of fledglings shortly after hatching, and individual nest success can vary widely both within and between colonies. For the tricolored blackbird, reproductive success is defined as the average number of young fledged per nest (Meese 2013, p. 102). During a 6 year study of 47 colonies, the average reproductive success found across all sites and years was 0.62, with a range between 0 and 1.44. Only 5 of the 47 colonies had an average of 1 or more young fledged per nest (Meese 2013, pp. 103–107). Airola *et al.* (2015a), however, reported four colonies in the Sierra Nevada foothills that averaged 0.84 young per nest (Airola *et al.* 2015a, pp. 68–69).

Because determining reproductive success is so difficult, especially in colonies where Himalayan blackberry is the nesting substrate, some researchers have reported colony success (i.e., the number of colonies that successfully fledge some young) as an indicator of reproduction (Airola *et al.* 2015b, p. 100; Airola *et al.* 2016, pp. 90–91). Although such a measure is crude, it is useful as many tricolored blackbird colonies may fail entirely, and thus the rate of colony failure can be a useful indicator of regional reproductive health. Using this metric, colonies in the grassland-dominated areas of the eastern Central Valley into the Sierra Nevada foothills have consistently demonstrated high colony success from 2014–2017 (Airola *et al.* 2015a, p. 68: Airola *et al.* 2015b, p. 104–105; Airola *et al.* 2016. pp. 97–98; Airola 2017, pers. comm.).

Although direct studies linking nearby insect abundance to reproductive success have not been conducted for colonies throughout the species range, it is likely that insect prey base availability is the limiting factor affecting reproductive success for the tricolored blackbird (Meese 2013, p. 110). Previous studies found that the type of nesting substrate affected reproductive success and that colonies nesting in non-native vegetation, particularly Himalayan blackberry, had the highest reproductive success (Cook and Toft 2005, pp. 80, 82; Holyoak et al. 2014, p. 6–7). The higher nesting success is thought to be attributable to the substrate providing a high level of protection from predators, the weather, and human disturbance (Beedy et al. 2017, Demography and Populations section). Prior to the protection of breeding colonies in silage fields and based on the current condition of wetland habitats throughout the species' primary range, both silage fields and native wetland vegetation were thought to be "critical population sinks" since colony-wide breeding failures were frequently associated with those nesting substrates. The reason these nesting substrates were associated with colony-wide breeding failures was because entire colonies were lost when silage crops were harvested and because the loss of over 96% of wetland habitats throughout the species' primary range likely concentrated predator populations, increasing the rate of predation within that habitat type (Cook and Toft 2005, p. 85). However, subsequent studies found that the type of nesting substrate has no effect on reproductive success and that increased reproductive success was likely associated with a greater abundance of the species' preferred insect prey base in surrounding foraging habitats (Meese 2013, p. 103). Early research suggested the tricolored blackbird's highly variable reproductive success and unpredictable breeding distribution is likely a response to food supply availability and the species' ability to readily exploit them (Orians and Collier 1963, p. 451). Under such variable conditions, suitable nesting habitat must be well distributed to allow colonies to establish near areas where prey outbreaks occur within a given year.

Itinerant Breeding

The tricolored blackbird is an itinerant breeder, moving from an initial breeding location to another location where they breed again (Hamilton 1998, entire; Beedy and Hamilton 1999, p. 4; Beedy *et al.* 2017, Distribution, Migration and Habitat section). In the Central Valley of California, initial nesting colonies are found in the San Joaquin Valley and Sacramento County, and then shift to the

Sacramento Valley and more northern portions of the species' range for a second nesting attempt (Beedy and Hamilton 1997, pp. 5–6; Beedy and Hamilton 1999, p. 5; Beedy *et al.* 2017, Distribution, Migration, and Habitat section). This movement from one breeding location to another is likely in response to changing habitat conditions (i.e., insect abundance and growth of suitable nesting habitat) throughout the species range. Once breeding is completed at the initial breeding site where the availability and/or quality of nesting and foraging habitat has begun to decline, tricolored blackbirds can then move to a new location where environmental conditions are better for a second nesting attempt.

Itinerant breeding in itself is not a habitat element; however, the ability to breed more than once during the breeding season at a different location requires the distribution of protected nesting substrate, foraging habitat, open water sources, and dispersal habitat throughout the species range. It also requires a temporal lag to the availability of these habitat elements at subsequent nesting locations so that required resources are available after initial nesting is completed. Because the ability of the species to breed itinerantly depends on the habitat elements described below, for the purposes of this SSA Report, itinerant breeding will no longer be considered.

<u>Abundance</u>
Historically, the core regions, which include all of the California regions other than the Northeast Interior, were the most resilient as these tricolored blackbird regions contained the largest breeding colonies. The concentration of numerous individuals into breeding colonies is thought to increase reproductive success by readily exploiting temporary foraging opportunities through social facilitation and/or to reduce the amount and extent of colony failure due to predation pressure through a density-dependent strategy known as predator saturation (Payne 1969, p. 28; Ward and Zahavi 1973, entire; Beauchamp 1999, pp. 675–677; Cook and Toft 2005, p. 74; CDFW 2018, pp. 21–23). Individuals that cluster in high densities may provide information to each other regarding abundant food sources and/or may reduce their individual probability of being eaten or of individual nest failure due to predation through predator saturation. Historically, breeding colonies within the core regions were known to contain thousands and up to hundreds of thousands of breeding individuals. Current breeding colonies throughout the core regions do not contain as many individuals as they did historically and the more recent Statewide Surveys have shown colonies have continued to decline by approximately 5% per year over the study period (2008–2017) (Meehan *et al.* 2018, pp. 1, 10, 12). However, colonies are still known to reach thousands and occasionally even up to tens of thousands of individuals at some locations (Kyle and Kelsey 2011, p. 15; Meese 2017, p. 18). It should be recognized that although the species may have nested in such large colonies to readily exploit temporary food resources through social facilitation or to reduce the amount of colony failure through density-dependent predator saturation within their core regions, successful breeding colonies with just tens to a couple of hundred of individuals have also been documented within the core regions.

In contrast, the peripheral regions (Northeast Interior, Oregon, Washington, Nevada, and Baja California) may have always contained small colonies compared to past colony sizes of the core regions, although it is possible the Baja California region supported more individuals than the region currently supports (Clipperton 2017, pers. comm.). The size of the breeding colonies within the peripheral regions typically range from several individuals to a couple of hundred of individuals. Because the peripheral regions support breeding colonies that are much smaller than the core region breeding colonies, it is unknown whether the colonies within these regions would experience a reproductive advantage if they were similar in size to the larger core region colonies. Whether the breeding colonies within the peripheral regions would experience increased reproductive success via predator saturation and/or would have available foraging opportunities to support large colonies within the region is unknown, and therefore, the regional need of Abundance, as defined for core regions within this SSA report as the ability to readily exploit temporary plentiful foraging opportunities through social facilitation and/or density-dependent avoidance of colony failure due to predation pressure, does not apply to the peripheral regions.

Due to annual variability in colony size at a particular location, we use regional abundance trend data as a surrogate for colony size throughout the core regions. Consistent with the methods of the Statewide Survey for all core regions except for the Sierra Nevada Foothills, we measure tricolored blackbird abundance by the total estimated number of breeding birds during the first breeding attempt across all colonies in any given year. For the Sierra Nevada Foothills, we measure tricolored blackbird abundance by the total estimated number of breeding birds within the region over the species' entire breeding season in any given year (Airola *et al.* 2016, p. 95). Therefore, in order for tricolored blackbird core regions to be resilient, they must have multiple breeding colonies within the region and each colony should be of sufficient size to increase reproductive success for that location. For the core regions, and potentially the peripheral regions, this requires breeding colonies to be large in order to increase reproductive success.

<u>Survival</u>
Adult tricolored blackbirds need to maintain a high survival rate in order to have resilient regions containing breeding colonies. Since the species' average reproductive success is fairly low and highly variable, tricolored blackbirds need a high survival rate so that they may attempt to reproduce two or three times annually and over several years. The estimated average annual adult survivorship based on banding data is around 60%, which is similar to other related bird species (Stewart 1978, pp. 93–94: Meese and Nicolai unpublished data *in* Beedy *et al.* 2017, Demography and Populations section). More recent analyses of banding and eBird data examined apparent survival, which is the probability that an individual remained alive within the population during the sample; in other words, this measure does not take dispersal into account. The analysis found that female adult apparent survival is around 60%, while male adult apparent survival is around 45%. However, the estimated survival rate for males is less certain as there are far fewer banded males than banded females (Robinson 2017, pers. comm.; Meese 2017, pers. comm.; Robinson *et al.* 2018, p. 361, 364 – 366).

<u>Connectivity</u>
During the breeding season, in order for individuals to move within the same region and from one region to another to breed again, we assume that some level of habitat connectivity is required. During the post-breeding season, individuals leave their breeding habitats and move into late summer/fall habitat found primarily in the Sacramento Valley (Beedy and Hamilton 1999, pp. 4, 5). During the winter, individuals will disperse into the San Francisco Bay Delta and the San Joaquin Valley. Individuals found in smaller colonies outside of the Central Valley and Sierra Nevada foothills may move back into the Central Valley or may stay resident within their region. Connectivity throughout the range likely increases regional resiliency by allowing the species to exploit favorable environmental conditions at different locations. There is no specific description in the literature about habitat connectivity; however, banding data has shown the species is able to move over large distances very quickly (within hours or days), even over large expanses of inappropriate habitats such as the Coast Range (Meese 2017, pers. comm.). Therefore, the connectivity of habitat does not seem to be a limiting factor for the species and will no longer be considered in this SSA Report.

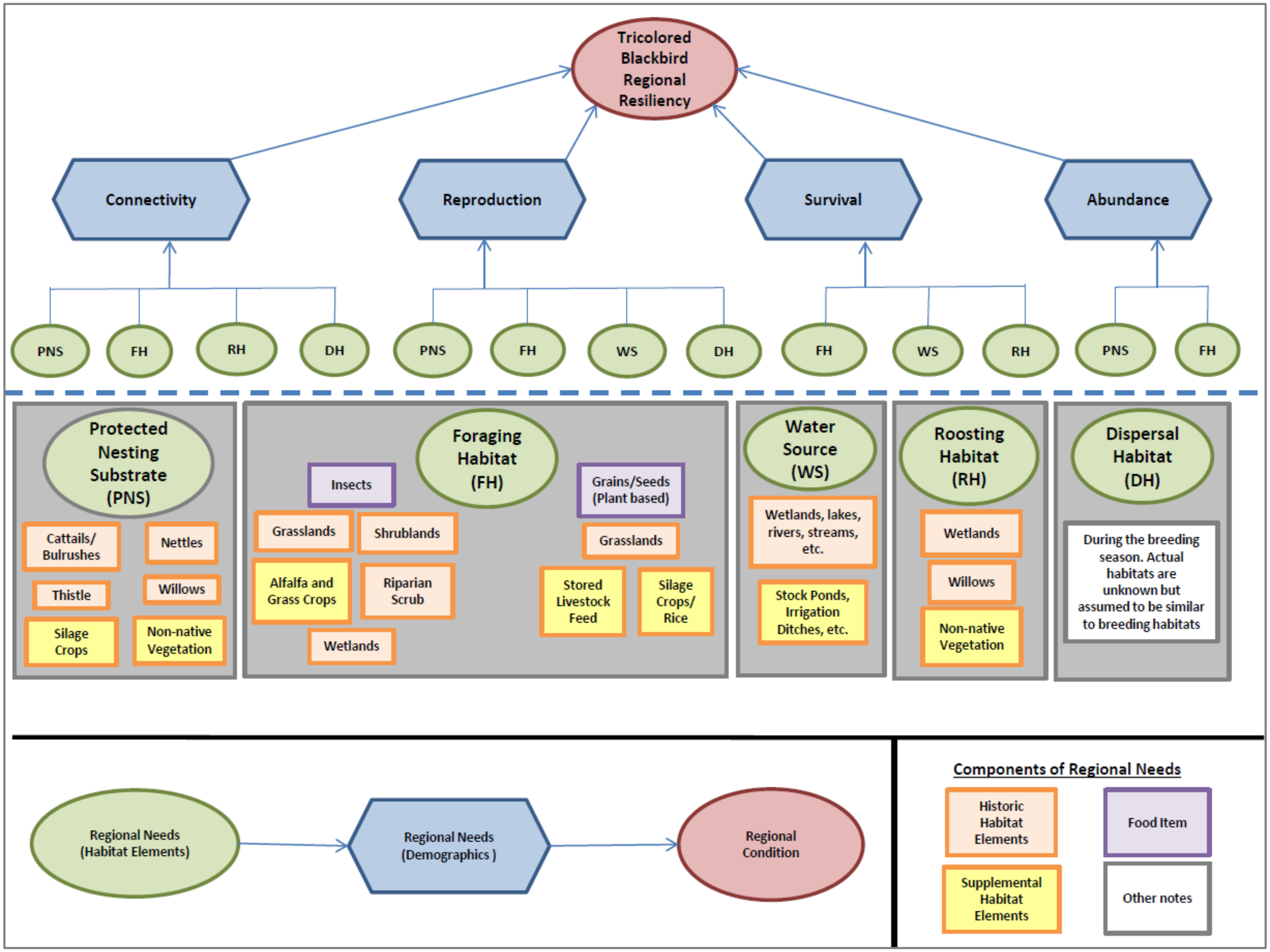

Figure 3.2 Tricolored blackbird regional ecology

Habitat Elements that Influence Resiliency

Protected Nesting Substrate
Tricolored blackbirds require sufficient amounts of protected nesting substrate to provide shelter and protection to their young (Beedy *et al.* 1991, p. 24). Appropriate protected nesting substrates include emergent vegetation that is surrounded by water in wetland habitats; stinging nettle in canyons and other relatively high-relief areas; dense silage crops found in agricultural habitats; and dense, spiny non-native vegetation (Beedy and Hamilton 1999, p. 5; Meese and Beedy 2015, p. 81; Meese 2017, p. 11; Meese 2017, pers. comm.).

Foraging Habitat
The tricolored blackbird diet consists of insects and other arthropods, as well as vegetative diet items such as grains and seeds. Foraging habitats that support abundant insect and other arthropod populations that the species can readily exploit include grasslands (defined here to include both grass species and forb species), wetlands, shrublands, riparian scrub, other forested habitats (i.e., oak woodlands), irrigated pastures, and agricultural crops such as hay, alfalfa, and sunflower. Vegetative items can be found in grasslands, disturbed habitats, and either actively growing or stored grain crops in agricultural habitats. During the breeding season, foraging habitats should be within 5 km (3.1 mi) of a colony site (Orians 1961a, p. 299; Beedy and Hamilton 1997, p. 5); however, individuals have been observed flying over 9.7 km (6 mi) from their breeding colony for insects (Arthur 2017, pers. comm.).

Water Source
Tricolored blackbird colonies need an open freshwater source for the birds to stay hydrated and to bathe. During the breeding season, an open water source needs to be within close proximity of the colony. Since a majority of suitable nesting and foraging habitat for the species is associated with artificial irrigation or other agricultural water sources (i.e., stock ponds), we assume sites containing protective nesting substrate and nearby foraging habitat also contain a nearby open water source. In addition, there is a lack of spatial data for water features within the species' range and there is nothing in the literature suggesting open water sources are a limiting factor for the species. Therefore, for the purposes of this SSA Report, we assume an open water source as a habitat factor has already been considered by the other two habitat factors above and will no longer be considered.

Non-Breeding Habitat
During the non-breeding season, flocks of tricolored blackbirds disperse into mixed blackbird flocks, which concentrate in the San Francisco Bay Delta, central California coast, San Joaquin Valley, and southern California to roost overnight. During the day, tricolored blackbirds will travel long distances from their roosting site in search for concentrated food sources (i.e., feed lots, dairies, active rice fields) and then return at night to their roosting site (Meese 2017, pers. comm.). In addition to roosting sites and foraging habitats during the non-breeding season, mixed blackbird flocks also require a water source (see above). Although non-breeding roosting habitat is likely an important habitat factor for the species, the available scientific literature does not thoroughly describe tricolored blackbird non-breeding habitat, and therefore, it will no longer be considered for the purposes of this SSA Report.

Dispersal Habitat
During the breeding season, tricolored blackbirds will move from one breeding location to another to breed again. In order to get from one breeding location to the next, the species may use some form of dispersal habitat; however, observations of the species traveling long distances within hours

or days suggests the species may not require dispersal habitat (Meese 2017, pers. comm.). The available scientific literature does not describe dispersal habitat for the tricolored blackbird and does not indicate it is currently a limiting factor for the species. Therefore, for the purposes of this SSA Report it will no longer be considered.

3.2 Species Representation

Maintaining representation in the form of genetic or ecological diversity is important to maintain the tricolored blackbird's capacity to adapt to future environmental changes. As discussed above, genetic studies indicate there is little population structuring between birds north of the Transverse Mountains and birds from the Mojave Desert. Additional genetic studies need to be completed on birds south of the Transverse Ranges in southern California to know whether they are connected to Central Valley birds; however, Berg *et al.* (2010) found birds south of the Tehachapi Mountains may be a reservoir for genetic variation (Berg *et al.* 2010, entire). The tricolored blackbird likely has maintained its genetic diversity since colonies are still found within each region (i.e., none of the regions have been extirpated) and regions are not thought to be isolated from each other. Further genetic testing needs to be completed for colonies found outside of California.

Throughout the species range, the tricolored blackbird is associated with wetland and anthropogenic habitats distributed throughout several different U.S. Environmental Protection Agency (EPA) Level III eco-regions. An EPA eco-region includes areas where environmental resources are similar and there are different hierarchical levels of EPA eco-regions, with Level I being more general and Level IV more detailed. The EPA eco-regions within the range of the tricolored blackbird are able to support the appropriate vegetation to enable the species to complete its nesting cycle, and grassland, agricultural, or other habitats which support abundant insect populations and vegetative diet items the species needs to complete its life cycle. The size and dominant vegetation of particular nesting and foraging habitats is known to vary across these eco-regions and, consequently, likely has an effect on the size and density of nesting colonies at any particular location. Therefore, we consider the tricolored blackbird to have representation in the form of ecological setting diversity as defined by the EPA Level III eco-regions.

A map of the EPA Level III eco-regions within the species' range is shown in Figure 3.3 and the EPA Level III eco-region(s) within each tricolored blackbird region is described in Table 3.2. Since each eco-region is represented with a number in Table 3.2 and Figure 3.3, the corresponding names are defined in Table 3.3. Assuming the species has always occupied each eco-region within Oregon as the species currently does (see Range and Distribution for a discussion of the species' range within Oregon), the species has always occupied fourteen EPA Level III eco-regions, despite the species' apparent range expansion into Washington in the 1990s. This is due to the fact that the Columbia Plateau eco-region, which is the only eco-region the birds in the Washington region occupy, also occurs within Oregon.

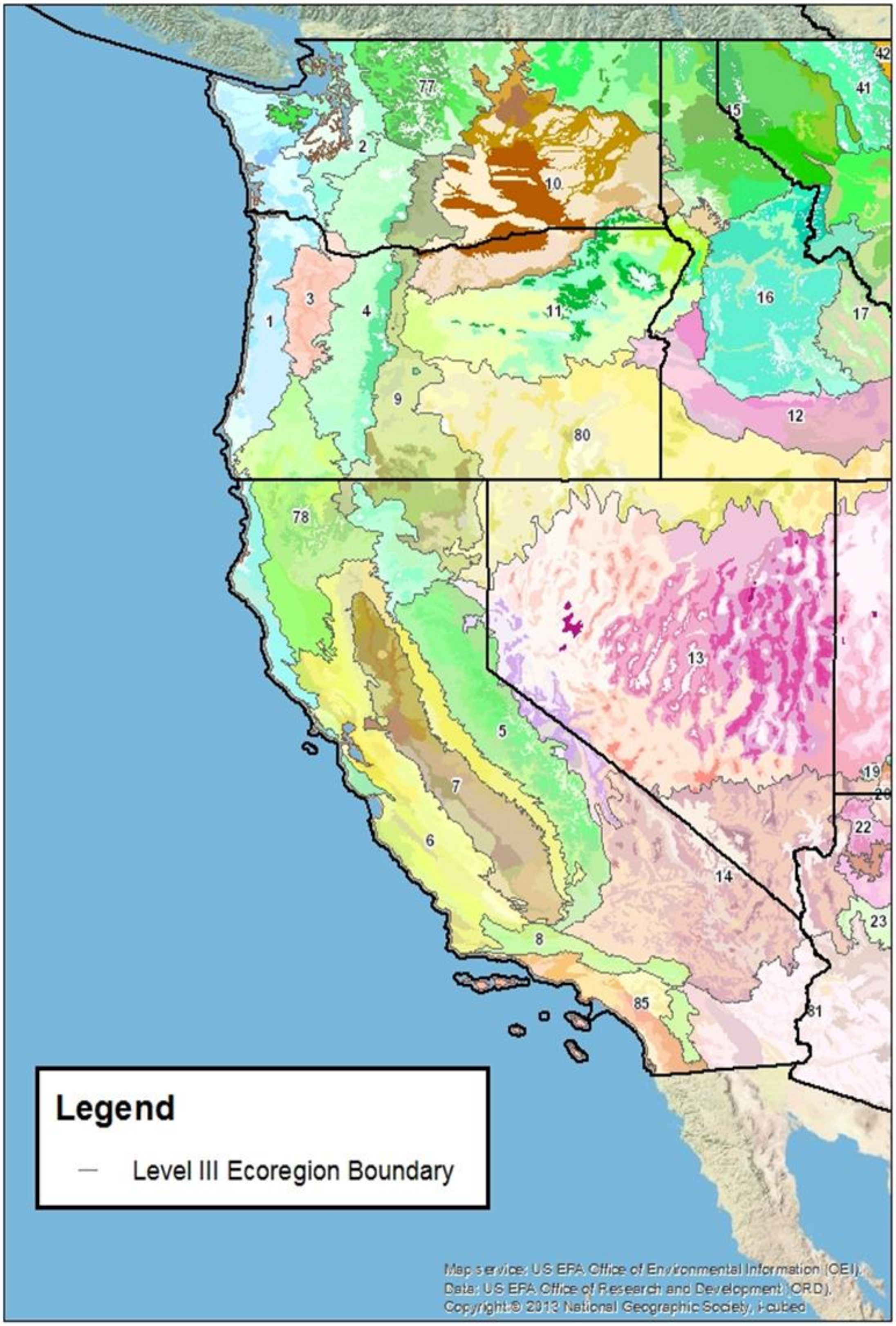

Figure 3.3 EPA Level III eco-regions throughout the tricolored blackbird range

Table 3.2 Primary EPA Level III eco-regions contained within each tricolored blackbird region

Tricolored Blackbird Region	EPA Level III Eco-Region
San Joaquin and Sacramento Valley:	6, 7
Sierra Nevada Foothills:	5, 6
North Coast:	1, 6, 78
San Francisco Bay/Delta:	1, 6
Central Coast:	6
Southern California:	8, 14, 85
Northeast Interior:	4, 9, 78
Washington:	10
Oregon:	3, 9, 10, 11, 78
Nevada:	13

Table 3.3 EPA Level III eco-region definitions

Eco-Region Number and Name
1. Coast Range
3. Willamette Valley
4. Cascades
5. Sierra Nevada
6. Central California Foothills and Coastal Mountains
7. Central California Valley
8. Southern California Mountains
9. Eastern Cascades Slopes and Foothills
10. Columbia Plateau
11. Blue Mountains
13. Central Basin and Range
14. Mojave Basin and Range
78. Klamath Mountains/California High North Coast Range
85. Southern California/Northern Baja Coast

3.3 Species Redundancy

The tricolored blackbird needs multiple resilient regions throughout its range to provide for redundancy. The more nesting colonies in a particular region and the wider the distribution of those colonies throughout that particular region, the more resilient that region will be. As increasingly resilient regions become more spread out throughout the species' range, the more redundancy the species will exhibit. Redundancy reduces the risk that a large portion of the species range will be negatively affected by a catastrophic natural or anthropogenic event at a given point in time. Species that are well-distributed across their historical range are considered less susceptible to extinction and more likely to be viable than species confined to a small portion of their range (Carroll *et al.* 2010, entire; Redford *et al.* 2011, entire). Historically, most tricolored blackbird regions, and the colonies within each region, were connected by the extensive wetland habitats found throughout the species' range. Currently, tricolored blackbird regions, and the colonies within each region, are still found throughout their historical range; however, due to the conversion of wetland and grassland habitats to agricultural uses, the tricolored blackbird regions are now primarily connected by the distribution of appropriate novel habitats throughout its range.

3.4 Historical and Current Population Estimates

Estimating the exact number of individuals within a tricolored blackbird breeding colony can be difficult due the activity of individual birds within the colony, which can vary depending on the stage(s) of the nesting cycle the colony is in. Individuals can be flying back and forth from foraging habitat gathering insects for nestlings or may stay hidden within the nesting substrate during incubation. In addition, since most colonies are located on private land, entire colonies can be missed or only partially estimated during surveys due to inaccessibly (Audubon 2017, p. 3). Furthermore, individual estimates are subjective to an individual surveyor's estimation ability and experience, and survey methodologies have differed overtime. Likewise, estimating the total population size in a particular year can also be challenging due to the extensive range of the species, the different habitats that the species can occupy, and complications from summarizing survey results from various portions of the species' range using differing methodologies and amounts of effort. In addition, since the tricolored blackbird is an itinerant and nomadic breeder, surveys to estimate the total breeding population need to occur at a specific time interval in order to avoid re-counting individuals that have moved to a different location to breed again. Surveys conducted over the entire breeding season (March through July) throughout the species range are likely to result in an overestimation of the species' overall population. Due to reasons described above, any overall population estimates for the tricolored blackbird should only be used to monitor trends and should not be used as a complete census of the species.

Evaluating abundance trends over time is difficult due to the above described challenges in estimating annual population size and due to inconsistent survey methods and differing levels of survey effort over time. Although statewide population estimates were conducted prior to the Statewide Survey in 2008, these estimates cannot be directly compared to Statewide Survey estimates from 2008 onward since survey methods were not standardized or as well documented (Meese 2015, entire). Survey methods for the Statewide Survey, which has been conducted triennially from 2008 to 2017, take into account the species' nomadic, itinerant behavior by limiting the time period the surveys are completed to the first nesting attempt in April. The Statewide Surveys conducted since 2008 allow us to compare overall population estimates since the survey efforts have been conducted in a well-documented and fairly consistent manner. In addition, data management has vastly improved with the development of the Tricolored Blackbird Portal by the Service and the University of California, Davis. However, even though the Statewide Survey is the best possible way to estimate the species' overall population, these estimates should not be used as a complete census of the species. The Statewide Survey results can be used to analyze overall population trends (i.e., increasing, declining, or stable) and to provide some insight into environmental conditions and habitat availability within each described region. Although conducting the survey at the beginning of the breeding season may be discounting any birds that have not yet joined the breeding population, the decided timeframe for the survey likely captures most of the overall population since a majority of individuals are fixed in place and can be most reliably counted during this time. In addition, since the Statewide Survey protocol was only made explicit from 2008 onward and is only conducted every three years, there are only four data points over a period that covers approximately 4–9 generations of the species (females breed in year 1 and males breed in year 2). Although this time period may allow for more recent history population trends, it is difficult to compare and analyze long-term population trends with the historical data available; however, the species experts agree the species has undergone a large population decline over the last several decades (Cook and Toft 2005, entire; Meese 2013, pp. 98, 110; Robinson *et al.* 2018, pp. 361, 364 – 365).

Historical accounts of the species were primarily just recorded observations at a particular location or of breeding colonies within a region and not estimates of the species' overall population size. A historical account of the tricolored blackbird in the Sacramento-San Joaquin Delta of California stated flocks numbered "…so many thousands as to darken the sky for some distance by their masses (Heermann 1859, p. 53)." Baird (1870) considered the tricolored blackbird as one of the most abundant species near the cities of Los Angeles and San Diego, and both Baird (1870) and Grinnell (1898) described seeing the species in considerable sized flocks throughout the year in southern California (Baird 1870, p. 266; Grinnell 1898, p. 33). Accounts from the 1920s described the species as gathering in flocks of hundreds, thousands, and even tens of thousands of individuals (Dawson and Brooks 1923, p. 107).

The first attempts at surveying colonies throughout the state of California was completed by Neff (1937, pp. 65–74). From 1931 until 1936, he used several methods to estimate the number of nests within a colony (Neff 1937, pp. 65–66). In 1931, surveys of colonies located in the Sacramento Valley and in Klamath, Oregon, found approximately 123,000 nests, or 185,000 breeding adults using a ratio of 1.5 adults for every nest estimated (average of 2 females for every breeding male). In 1932, Neff estimated 388,500 nests (583,000 breeding adults) from colonies found in 15 counties throughout California and in 1933 he estimated 367,000 nests (551,000 breeding adults) from colonies found in 10 California counties and Klamath, Oregon. The largest estimate over the 6-year study was in 1934 when Neff estimated 491,000 nests (737,000 breeding adults) from colonies found primarily within the Sacramento Valley. Estimates in 1935 totaled 67,200 nests (101,000 breeding adults) from 13 counties and an estimated 63,400 nests (95,100 breeding adults) from 20 counties in 1936 (Neff 1937, p. 66). Colony size estimates over the time period of the study varied from a low of six nests in 1932 in Solano County to a high of 200,000 nests within a colony in Glenn County in 1934 (Neff 1937, pp. 69, 71). It should be noted that since large portions of California were either not surveyed or sufficient survey time was not dedicated to locate breeding colonies in certain counties, these estimates are all underestimates of the overall breeding population in any given year. These estimates should also not be directly compared to each other due to the reasons stated above and because survey effort from year to year varied widely (Neff 1937, p. 68–74). In addition, since the species had not been recognized as an itinerant breeder prior to the 1990s and Neff's estimates included colonies formed over the entire breeding season, these annual estimates could have double-counted individuals by counting initial breeders at one location and second time breeders at another.

Wide-ranging surveys for the species were not conducted again until the late 1960s to early 1970s when DeHaven *et al.* (1975a) attempted to survey the entire range of the species to compare to Neff's earlier work. Surveys were completed from 1969 to 1972 by a few surveyors driving throughout portions of the species range (DeHaven *et al.* 1975a, p. 166; CDFW 2018, pp. 44–45). Surveys conducted in 1969 and 1970 were limited to the Central Valley, the survey in 1971 attempted to cover the entire range of the species from San Diego County north to southern Oregon, and the survey completed in 1972 was limited to the northern San Joaquin Valley to southern California. Not surveying the entire range of the species likely resulted in an underestimation of the overall population; however, since the surveys were conducted over the entire breeding season, it is likely individuals were counted more than once from subsequent breeding attempts at new locations (DeHaven *et al.* 1975a, p. 166). DeHaven *et al.* (1975a) found that the various measures to estimate abundance suggested the overall tricolored blackbird population had declined since Neff's work in the 1930s, even with increased survey effort. The results of the study revealed the number of colonies detected over the survey period declined from 256 over 6 years (average of 43 colonies per year) to 164 over 4 years (average of 41 colonies per year), and the number of non-breeding birds declined from more than 50,000 birds to around less than 15,000. In addition, the size of the largest colonies declined from more than hundreds of thousands of birds to tens of thousands and overall average annual estimates over the course of each study declined from about 375,000 individuals to 133,000 individuals (DeHaven *et al.* 1975a, pp.177–178; CDFW 2018, pp. 44–45). Hosea (1986) conducted surveys in four counties within the Sacramento Valley (Colusa, Glenn, Sacramento, and Yuba) over the entire breeding season to determine whether the population decline reported by DeHaven *et al.* (1975a) in the early 1970s was continuing. These surveys found a decrease in the number of colonies and overall number of birds compared to the surveys conducted by Neff (1937) and DeHaven *et al.* (1975a) (Hosea 1986, p. 34).

Observations from surveys conducted from 1992 to 1994 provided more insight into the species' itinerant breeding behavior; documented colony locations and sizes throughout the range of the species; and led to the discovery that a large proportion of the overall breeding population were nesting in large colonies in dairy silage or grain fields (Hamilton *et al.* 1995, pp. 5, 19–20, 26–27). The surveys conducted over this time period utilized a similar survey method as Neff (1937) and DeHaven *et al.* (1975a), but with a larger distribution throughout the species range and with considerably more effort (i.e., more people searching for colonies, more hours dedicated to searching). In 1994, the California Department of Fish and Wildlife (formerly the California Department of Fish and Game), the Service, and the National Audubon Society initiated an annual one-day volunteer effort to survey the entire range of the species (Beedy and Hamilton 1997, p. 12). The survey was conducted primarily on April 23 (some estimates were taken over the week) and the resulting estimation suggested the minimum number of birds during the initial breeding attempt was 369,400 adults (Hamilton *et al.* 1995, pp. 5, 14, 15, 35, 50; Beedy and Hamilton 1997, p. 13). These volunteer surveys were conducted again in 1995 and 1996, but did not have the same coverage or completeness as the 1994 survey. In 1997, CDFW coordinated another survey using the same methods, personnel, survey timing (i.e., limited to the first nesting attempt of the season), and coverage as the 1994 survey. A total of 237,900 birds were recorded during the 1997 survey effort (Beedy and Hamilton 1997, pp. 13–14 and Table 1; Hamilton *et al.* 1999, p. 2; Hamilton 2000, p. 26).

In 1999, another survey attempt resulted in an estimated breeding population of 104,756 individuals; however, the 1999 survey methods were not consistent with the methods used in 1994 and 1997, and therefore, are not comparable with those surveys (Hamilton *et al.* 1999, p. 2; Hamilton 2000, pp. 4, 15; Clipperton 2017, pers. comm.). The survey conducted in 2000, which estimated the overall population at 162,500 individuals, was most comparable to the surveys conducted in 1994 and 1997 (Hamilton 2000, p. 27; Clipperton 2017, pers. comm.). These three surveys (1994, 1997, and 2000) are considered the first set of triennial surveys conducted statewide for the tricolored blackbird. Although surveys were also conducted in 2001, 2004 and 2005, the survey methods during these years were inconsistent with the methods and coverage of the surveys conducted in 1994, 1997, and 2000, and therefore, are not directly comparable.

As mentioned above, data collected during the Statewide Survey, starting in 2008, is the most consistent set available to analyze changes in the overall tricolored blackbird population over time. Since the survey only occurs within California and does not include breeding colonies outside of the state, individuals may be missed. However, since the number of breeding birds outside of California is less than 1% of the overall breeding population (Beedy and Hamilton 1999, p. 1), these uncounted birds are negligible to the overall estimation. The Statewide Survey trend data revealed a 55% decline in the overall population from 2008 until 2017, with a 64% decline from 2008 to 2014 (Meese 2014, p. 7) and then a 22% increase from 2014 to 2017 (Meese 2017, p. 10) (Figure 3.4). The 2008 Statewide Survey, conducted between April 25th and 27th, and the 2011 Statewide Survey, conducted between April 15th and April 17th, resulted in an overall breeding population estimate of 350,000 and

259,000 individuals, respectively (Kelsey 2008, p. 6; Kyle and Kelsey 2011, pp. 4, 6). A total of 361 sites were surveyed during the 2008 Statewide Survey and colonies were identified in 32 out of 38 counties (Kelsey 2008, p. 6). During the 2011 Statewide Survey, 608 sites were surveyed and colonies were identified at 29 out of 38 counties surveyed (Kyle and Kelsey 2011, p. 6 and Table 1). The 2014 Statewide Survey, conducted from April 18th to April 20th, estimated the total number of birds at just over 145,000 from 37 out of 41 counties surveyed. A total of 802 sites were surveyed for tricolored blackbirds during the 2014 Statewide Survey (Meese 2014, p. 6). The most recent 2017 Statewide Survey covered 884 sites and resulted in an estimated 177,000 birds from 37 out of 41 counties surveyed (Meese 2017, p. 8–10). Therefore, although the amount of effort and locations surveyed has increased over time, the number of estimated individuals comprising the overall population from 2008 to 2017 has declined.

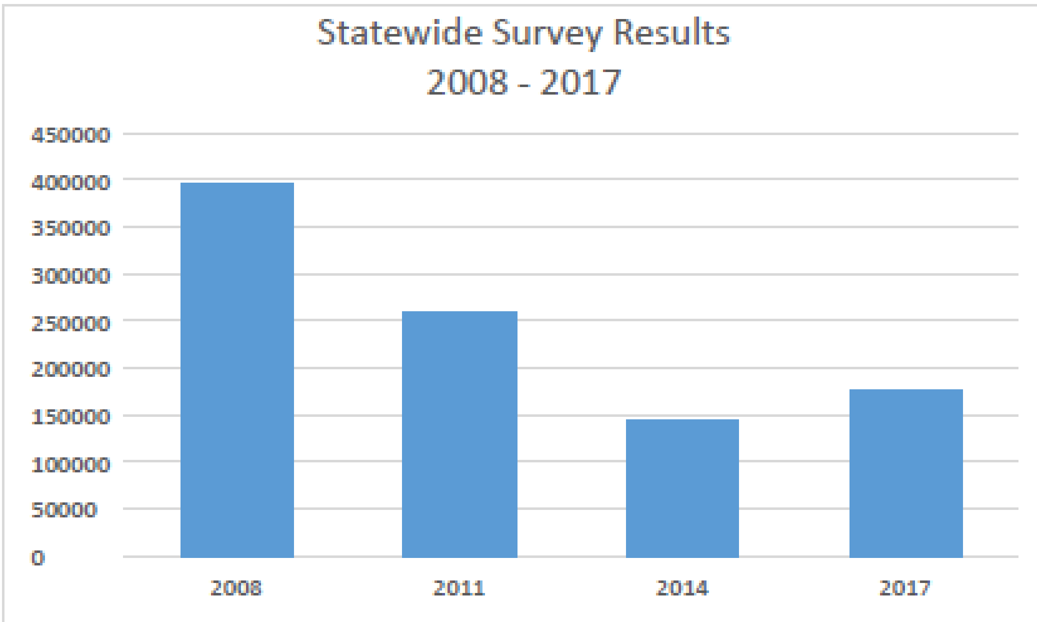

Figure 3.4 California overall population estimates from 2008-2017. Data collected from the Tricolored Blackbird Statewide Survey, conducted in 2008, 2011, 2014, and 2017 (Figure from Meese 2017, p. 10). Due to the difficulty in estimating the overall species population for the tricolored blackbird and the relatively short data set of the Statewide Survey, restraint should be used when using this data as a census.

The statewide population declines seen from 2008 until 2014 are thought to be attributable to the loss of suitable nesting and foraging habitat, the previous loss of entire or near-entire reproductive breeding efforts of colonies in silage fields due to the harvest of silage fields in the San Joaquin Valley, and to reproductive failures brought on by chronically low insect abundances throughout the Central Valley (Beedy and Hamilton 1997, pp. 20–21; Meese 2013, pp. 110–111). The increase of birds from 2014 to 2017 could be due to an underestimation of breeding birds in Kern County during the 2014 survey because surveyors did not locate all breeding colonies within that county. If the number of breeding birds in Kern County were underestimated during the 2014 season, it is possible the small increase in the number of breeding birds in 2017 is not really an increase and could actually be a reduction or stabilization of the population from 2014 to 2017. However, since the number of survey locations within Kern County increased from 2014 to 2017 and there is no apparent location or locations that would have been left un-surveyed during the 2014 season that could accommodate that number of breeding birds, it is unlikely this increase of individuals in Kern County was due to deficient survey coverage within the county. A more likely possibility is that the species did not nest in large numbers in Kern County during the initial breeding attempt in 2014 and instead nested in another portion of its range that was more suitable for breeding, or there was an increase in productivity within Kern County in 2017 that resulted in an increase of individuals within that region. If this is the case, then the increase in the number of birds in this region observed during the 2017 Statewide Survey may reflect an increase in the species overall population size (Meese 2017, pp. 20–21; Arthur 2017, pers. comm.; Airola 2017, pers. comm.).

The breakdown of the 2017 Statewide Survey data shows the number of birds varied widely by region and even by county within a region (Table 3.4). The Statewide Survey is conducted in the early spring during the species' first nesting attempt and the North Coast region, which is in the northern portion of California, typically contains the most breeding birds during subsequent breeding attempts later in the season, which is why the number of breeding birds in this region is so low over each of the survey years. The number of birds in the San Joaquin Valley region dropped dramatically from 2008 to 2014 but showed a small increase from 2014 to 2017; however, estimates in the San Joaquin Valley in 2017 were only 35% of what was observed in 2008 (Meese 2017, p. 14). The largest proportion of birds observed in the San Joaquin Valley region in 2017 was in Kern and Merced Counties, which both showed a noticeable increase from 2014 estimates. The number of birds in the Sacramento Valley region in 2017 is very similar to those observed in 2008, but the number of birds in the lower Sacramento Valley decreased by 33% when compared to 2014 estimates. This decline was due to a drop in birds seen in Sacramento County since all other counties in that region had an increase in birds (Meese 2017, p. 16).

The number of individuals within the Central Coast region increased markedly in 2017 compared to earlier Statewide Surveys. This increase was primarily due to a new 7,500 bird colony identified in San Benito County, an increase in birds observed in Alameda County, and a new colony location in Monterey County that was previously unknown. Although the new large colony identified in San Benito County may be included as part of the Central Coast region, this colony is located in the coast ranges directly adjacent to the Central Valley and it is likely it is more connected to the Central Valley than the Central Coast (Meese 2017, pp. 14–15; Clipperton 2017, pers. comm.). The population estimate for the Southern California region was almost equal to the estimate from 2014, although the distribution of the colonies differed throughout the region compared to 2014 (Meese 2017, p. 15).

Like the Sacramento Valley region, the Sierra Nevada Foothills regional estimate during the Statewide Survey has varied widely from 2008 to 2017. Numbers in 2017 for the Sierra Nevada Foothills region were similar to estimates in 2011, but compared to 2014, the number of individuals within this region declined by over 80% in 2017 (Meese 2017, p. 15). However, as described above, the Statewide Survey numbers reported for areas north of the San Joaquin Valley are not the best reflection of the total number of individuals that utilize this area since the Statewide Survey is conducted when birds are making their first nesting attempt of the season, which is typically in the southern portion of the species' range. The northern portion of the species' range typically contains breeding birds during their subsequent nesting attempt, which is well after the time period when the Statewide Survey is conducted.

There is another data set spanning breeding seasons 2014 to 2017 conducted in portions of the Sierra Nevada foothills that could be used in place of the Statewide Survey dataset (Airola *et al.* 2015a, entire; Airola *et al.* 2015b, entire; Airola *et al.* 2016, entire, Airola 2017, entire). Since these surveys are conducted over the species' entire breeding season and the foothill region typically contains the most breeding individuals during their second nesting attempt, this survey more accurately represents that particular region. The 2014 foothill survey was conducted from April 27th until June 20th and covered elevations between 15 and 525 meters (49 to 1,722 feet) from Placer County in the north to Stanislaus County in the south. Over 43,000 birds were observed at 29 colonies within the survey area, which was almost 30% of the 2014 Statewide Survey estimation of over 145,000 individuals (Airola *et al.* 2015a, pp. 59, 61, 64–65, 71). The 2015 survey covered a larger area of the foothills than the previous survey and went up to an elevation of 550 meters (1,804 feet). Survey coverage in 2015 stretched from Yuba County in the north down to Mariposa and Merced Counties in the south. A total of 55,270 birds were observed at 26 active colonies from April 10th until June 13th. Although survey effort was not quantified in detail, the 2015 survey was more extensive in areal coverage and days monitored and was more organized than the 2014 survey (Airola *et al.* 2015b, pp. 96–100, 102, 109).

Table 3.4 Early season regional estimates from the tricolored blackbird statewide surveys, conducted only within California in 2008, 2011, 2014, and 2017 (Figure adapted from Meese 2017, p. 12-13; Meese 2014, p.8; and Kyle and Kelsey 2011, Table 2). [1]North of the Transverse Range. [2]South of the Transverse Range. NS= Not Surveyed Note that these numbers do not accurately represent total breeding populations in each region over the entire nesting season in each year.

Region	Year			
County	2008	2011	2014	2017
San Joaquin Valley				
San Joaquin	0	0	515	1,000
Stanislaus	21,910	1,900	8,852	742
Merced	154,674	139,170	10,532	29,883
Madera	117	505	27,166	12,552
Fresno	1,000	400	6	5,750
Tulare	90,800	23,950	18,259	8,150
Kings	2,500	2,950	5,000	4,300
Kern[1]	69,702	61,825	3,477	60,453
Total	**340,703**	**230,700**	**73,807**	**122,830**
Sacramento Valley				
Butte	2,541	0	60	1,311
Colusa	301	923	0	247
Glenn	NS	500	300	405
Sacramento	3,551	6,105	29,272	12,455
Sutter	0	1	8	1,000
Tehama	NS	NS	300	515
Yolo	1,900	5,080	81	2,750
Yuba	10,405	500	268	820
Total	**18,698**	**13,109**	**30,289**	**19,503**
Sierra Nevada Foothills				
Amador	6,600	350	5,500	420
Calaveras	385	120	404	1,570
El Dorado	0	0	1,375	100
Placer	12,050	3,310	17,600	960
Tuolumne	645	170	825	850
Mariposa	NS	NS	13	0
Total	**19,680**	**3,950**	**25,717**	**3,900**

Table 3.4 continued. Early season regional estimates from the tricolored blackbird statewide surveys, conducted only within California in 2008, 2011, 2014, and 2017 (Figure adapted from Meese 2017, p. 12-13; Meese 2014, p.8; and Kyle and Kelsey 2011, Table 2). [1]North of the Transverse Range. [2]South of the Transverse Range. NS= Not Surveyed Note that these numbers do not accurately represent the total number of breeding individuals in each region over the entire nesting season each year.

Region	Year			
County	2008	2011	2014	2017
North Coast				
Humboldt	NS	NS	NS	0
Mendocino	835	315	100	213
Sonoma	0	0	0	0
Lake	711	421	150	3
Total	**1,546**	**736**	**250**	**216**
SF/Bay Delta				
Marin	0	0	NS	0
Napa	0	0	70	40
Solano	200	2,275	610	1,360
Total	**200**	**2,275**	**680**	**1,400**
Central Coast				
Alameda	28	2,200	50	3,000
Contra Costa	358	0	NS	30
Monterey	50	10	399	2,793
San Benito	66	NS	80	11,226
San Luis Obispo	6,242	197	98	3
Santa Barbara	500	NS	935	760
Santa Clara	50	0	0	344
Santa Cruz	220	0	0	0
Total	**7,514**	**2,407**	**1,562**	**18,156**
Southern California				
Kern[2]	see SJ Valley	see SJ Valley	500	400
Los Angeles	1,270	1,066	4,707	1,410
Orange	NS	NS	14	0
Riverside	2,150	4,132	4,368	8,180
San Diego	1,367	767	1,417	665
San Bernardino	700	0	1,380	466
Total	**5,487**	**5,965**	**12,386**	**11,121**
Northeast Interior				
Siskiyou	NS	NS	NS	NS
Modoc	NS	180	NS	530
Lassen	NS	NS	232	NS
Shasta	1,030	NS	250	0
Total	**1,030**	**180**	**482**	**530**
Grand Total	**394,858**	**259,322**	**145,173**	**177,656**

The 2016 survey further expanded the 2015 survey effort to include Tehama, Butte, and Sutter Counties in the north, and Madera and Fresno Counties in the south. The 2016 survey area was nearly 2 times the size and 1.5 times the size of the 2014 and 2015 surveys, respectively. During the 2016 survey, the number of breeding attempts were recorded and not the number of individuals like in previous years; however, the number of breeding attempts in 2016 were directly compared to the number of individuals recorded in previous years. There were 77,830 breeding attempts documented at 50 colonies from April 2nd to June 21st, 2016. During that survey year, the number of individuals found in the southern portion of the foothills increased, likely due to an increase in milk thistle growth which the species used for nesting substrate (Airola *et al.* 2016, pp. 82, 85, 94–96). The survey conducted in 2017 originally just focused on the southern portion of the Sierra Nevada foothills, but eventually expanded into the central portion of the foothills and into Yuba County. A total of 72,800 breeding attempts were documented during the 2017 season. Taking into account the more restricted survey area in 2017 compared to the previous year, these numbers are likely similar to the numbers estimated during the 2016 season (Airola 2017, entire). Although the amount of effort and total area surveyed changed from year to year, the authors of the study believe that the number of individuals utilizing this region, especially within the central foothills, has remained relatively stable over the 2014–17 breeding seasons (Airola 2017, pers. comm.).

The number of individuals within the North Coast region has steadily declined over each Statewide Survey; however, as explained above, the Statewide Survey is conducted in the early spring during the species' first nesting attempt and the North Coast region, which is in the northern portion of California, typically contains the most breeding birds during subsequent breeding attempts later in the season. Compared to 2008 estimates, the number of individuals within the North Coast region during the Statewide Survey period declined by over 85%, although the rate of decline decreased from 2014 to 2017 (Meese 2017, p. 12). The San Francisco Bay Delta regional estimate has varied considerably from survey year to survey year and the estimated number of individuals more than doubled from 2014 to 2017. This high variability could be due to the fact that this region is just north of the southern portion of the species' range where the majority of initial nesting attempts occur, so it is likely this area may contain initial nesters in one year and subsequent nesters in another, depending on environmental conditions. The estimated number of individuals comprising the Northeast Interior region, which is the northern-most portion of the species range in California and may not contain many birds during the early spring when the survey was conducted, increased in 2017 compared to 2014 (Meese 2017, pp. 12–13).

In April 2017, the northern portion of Baja California was also surveyed for the species. A total of 16 sites were surveyed over the course of the survey, but only three sites containing a total of 333 birds were observed. These results, in conjunction with past surveys and observational data, suggest that the number of individuals in the Baja California region is declining and the species may be experiencing a range retraction in the southern portion of its range (Meese 2017, pp. 19, 23; Clipperton 2017, pers. comm.; CDFW 2018, p. 37, 42; Robinson *et al.* 2018, pers. comm).

CHAPTER 4: INFLUENCES ON VIABILITY AND CURRENT CONDITION

In this chapter, we evaluate the past, current, and future influences that are affecting what the tricolored blackbird needs for long term viability (Figure 4.1). Current and potential future effects, along with current and expected distribution and abundance of the species throughout its range, determine present viability and, therefore, vulnerability to extinction. Finally, we consider the current condition of each tricolored blackbird region throughout its range.

4.1 Habitat Loss, Degradation, and Modification

The tricolored blackbird is largely endemic to California and evolved in the Central Valley where "a vast mosaic of seasonal wetlands, freshwater marshes, alkali flats, native grasslands, riparian forests, and oak savannas" occurred and upon which the species depended for nesting and foraging (Beedy 2008, p. 439). The species' colonial breeding system is thought to be an adaptation that allows the tricolored blackbird to exploit insect resources in a changing environment (Beedy 2008, p. 439; Orians 1961b, p. 333; Collier 1968, p. 358). As native habitats throughout the tricolored blackbird's range were lost to agricultural conversion and urban development, the species has begun replacing and/or supplementing their nesting and foraging needs with anthropogenic habitats, which are often associated with agriculture. This shift to utilizing new substrates for nesting and new habitats for foraging has resulted in new stressors to the species that were not apparent previously.

4.1.1 Destruction or Conversion of Native Breeding and Foraging Habitats

Historically, the tricolored blackbird's primary nesting substrate consisted of cattails and bulrushes located in freshwater wetland habitats (Neff 1937, pp. 64, 67–79). It has been estimated that the Central Valley contained more than 16,187.426 square kilometers (km^2) (4 million acres (ac)) of wetlands in the 1850s, but by 1939, 86% of wetlands were lost and only a little over 2,270.286 km^2 (561,000 ac) remained. By the 1990s, the loss of wetlands was estimated at 96% (Beedy *et al.* 1991, p. 22; Frayer *et al.* 1989, pp. 4, 18; Kreissman 1991, pp. 62, 81). During a 6-year study of tricolored blackbird nesting in the Central Valley, Neff (1937) found 93% of tricolored breeding colonies were found in freshwater wetlands containing cattails or bulrushes (Neff 1937, pp. 67–73; Beedy *et al.* 1991, p. 20). By the mid-1980s, the amount of freshwater emergent marsh habitat had declined by almost half when compared to 1939 levels, down from about 1,953.822 km^2 (482,800 ac) to around 983.791 km^2 (243,100 ac) (Frayer *et al.* 1989, p. 18). Likewise, during the 1970s and 1980s, the number of nesting colonies found in wetland habitats declined to just a little over 50% of reported nesting colonies (Beedy et al 1991, p. 22). Although there were wide-scale losses of wetland habitat within California until the late 20th century, more recently (late 1980s to early 1990s) the Central Valley Joint Venture (CVJV; formally known as the Central Valley Habitat Joint Venture) has sought to protect and/or enhance existing wetlands and to restore former wetlands within the Central Valley. By 2003, CVJV partners have protected almost 230.7 km^2 (57,000 ac), restored over 263 km^2 (65,000 ac), and enhanced between 202.3 and 303.5 km^2 (50,000 and 75,000 ac) of wetland habitat (Garone 2011, pp. 239–240).

A major factor in the selection of tricolored blackbird nesting sites, and likely a limiting factor for the number of individuals within a colony, is the nesting site's proximity to abundant insect resources (Orians 1961b, pp. 331–332; Payne 1969, p. 25; Beedy and Hamilton 1999, p. 1; Beedy 2008, p. 439). The nomadic and colonial behaviors of the tricolored blackbird may be strategies to exploit insect and vegetative resources in a quickly changing environment (Orians 1961b, p. 333; Payne 1969, p. 25; Shuford and Gardali 2008, p. 439). It is estimated that perennial grasslands in the Central Valley and Sierra Nevada foothills have declined by 99% or more due to agriculture or urban development, or were converted to annual grasslands dominated by non-native Mediterranean species (Beedy and Hamilton 1997, p. 11; Kreissman 1991, p. 81; Airola 2017, pers. comm.; Meese 2017, pers. comm.). Cameron *et al.* (2014) found 195,594 hectares (ha) (483,323 ac) of rangelands (which include grasslands, shrublands, and woodlands) were lost to urban development and high intensity agricultural conversion from 1985 until 2008. The top most common conversions were to urban development (96,389 ha (238,182 ac)) and intensive agricultural uses (78,793 ha (194,702 ac)), which includes production of vined and trellised olives, orchards, pasture/alfalfa, and bare plowed ground. The majority of development was seen in the grasslands and woodlands in the Sacramento Valley leading into the Sierra Nevada foothills east of Sacramento (Cameron *et al.* 2014, p. 7). Audubon 2017 also found a decline of grassland habitats near colony sites from 2008 to 2014 (Audubon 2017, pp. 3, 17–18).

The destruction of native habitats is still occurring, and the management of existing wetland habitats during the wrong time of year can negatively affect the species. Most wetlands within the Central Valley are managed for waterfowl and only contain flooded water during the fall/winter. These wetlands do not contain ponded water for the entirety of the tricolored blackbird breeding season, which can limit the amount of available nesting substrate for the species (Meese and Beedy 2015, p. 86; Clipperton 2017, pers. comm.). Spring burning, disking, or removal of wetland vegetation can reduce the amount of suitable nesting habitat available during the breeding season. However, wetland habitats burned in the fall or winter create conditions in the spring such that new, vigorous growth creates favorable nesting conditions during the spring, when the species begins breeding (Payne 1969, p. 23; Meese 2007, pp. 13, 20–23; Meese 2006, pp. 9–10, 34; Meese and Beedy 2015, pp. 84–89). Lack of such periodic disturbance can lead to unsuitable nesting conditions (Meese and Beedy 2015, pp. 84–85).

The impacts of wide-scale breeding and foraging habitat loss are primarily seen in the California regions, since California contains an overwhelming majority of the overall population. Although there has been loss of native nesting and foraging habitats outside of California, the magnitude of those losses is not anywhere near the scale as what occurred in California. The individuals found in the Oregon and Baja California regions are almost all associated with wetland vegetation that is growing primarily in artificially irrigated habitats associated with agriculture, and these regions did not contain the expansive wetland habitats that were seen throughout California. The one reliable colony in Nevada is in a small marsh associated with an agricultural return flow pond that is on private land (Ammon and Woods 2008, p. 64). Changes in the management of water and vegetation at this colony site has resulted in the loss of cattails and bulrush, so tricolored blackbirds breeding at this site now use grasses to nest in instead (NDOW 2017, p. 2; Averill-Murray 2017, pers. comm.). Individuals may not have occurred in the Washington region prior to the wide-scale loss of wetland habitats seen in the 1800s through the late 1990s, so this region likely was not impacted by the historical loss of native habitats, although loss of native foraging habitats could occur in the future.

Prior to the issuance of M-Opinion 37050, the interpretation of the Migratory Bird Treaty Act (MBTA) was that incidental take of birds, including active bird nests in native nesting substrates containing eggs or nestlings, would have been prohibited without a permit. Since the removal of native habitats that contain eggs and nestlings ultimately results in the destruction of those eggs and nestlings, the prior interpretation of the MBTA artificially extended a temporary protection to native habitats that were actively being used for nesting until the colony was independent of it. Once those individuals become independent of their nests the habitat could be destroyed without violating the MBTA, as there was no longer a risk of injuring or destroying an individual tricolored blackbird.

Again, it cannot be stressed enough that the habitat in of itself was not actually protected by the MBTA, it was the individuals dependent on that substrate (i.e., eggs or nestlings) that was extending a temporary protection to the habitat. Since the issuance of M-Opinion 37050 (DOI 2017, entire), the current interpretation of the MBTA only prohibits the purposeful take of birds without a permit and not the incidental take of birds. Therefore, if the removal of active native nesting habitat results in the destruction of eggs or nestlings, but the destruction of those eggs and nestlings is not the purpose of the action, then the removal of native nesting habitats resulting in the loss of nestlings or eggs is no longer considered a violation of the MBTA. For more information on the MBTA and M-Opinion 37050, see section 4.8 Management Actions.

The tricolored blackbird is listed as a threatened species under the California Endangered Species Act (CESA). As a threatened species under CESA, take of individuals without a permit is prohibited, including the take of eggs and nestlings found in breeding colonies within native habitats; however, the removal or alteration of habitat during the non-nesting period is not a violation of CESA's take provision. For more information on CESA, see section 4.8 Management Actions.

The implementation of approved Habitat Conservation Plans (HCPs) that include the tricolored blackbird as a covered species will help lessen the effects of development within the permit area of the HCP and will provide protection to areas that are known breeding sites and/or foraging areas for the species. For more information on HCPs that include the tricolored blackbird as a covered species, see section 4.8 Management Actions.

The loss of native habitats is affecting the tricolored blackbird at the individual, regional, and species level and is likely to continue into the future, although at a much smaller scale than was seen previously since the extent of native habitats has been dramatically reduced. The loss of these habitats has and will continue to reduce regional resiliency by reducing the size and/or number of sites where breeding colonies can establish within the region, which results in a reduction to the species overall representation and redundancy. However, due to continued agricultural practices throughout the range of the species, it is likely the species will continue to have access to native nesting substrates in novel habitats (e.g., cattails in irrigation ditches) and semi-native foraging habitats into the future. Wetland vegetation growing in artificially irrigated environments is likely to remain into the future, and the continued use of grassland habitats for cattle grazing will maintain native and non-native grasslands that the species uses for foraging; however, as described above, pasturelands throughout the range of the species are at risk of conversion, so any lands converted from cattle grazing to development or high intensity agriculture will no longer be of use to the species. Regulatory mechanisms and conservation actions are providing some protection to remaining native habitats, but some still remain at risk.

4.1.2 Destruction or Conversion of Other Suitable Breeding Substrates and Foraging Habitats

As the amount of wetland habitats declined throughout the primary portion of the species range, there has been an increasing trend of tricolored blackbirds using non-native, primarily upland vegetative species for nesting (Cook and Toft 2005, pp. 74–75; Holyoak et al 2014, p. 2; Airola et al 2015a, pp. 57, 66; Airola et al. 2015b, pp. 98, 105; Airola et al. 2016, p. 83–84, 99–100). Tricolored blackbirds have increasingly used Himalayan blackberry and thistles for protected nesting substrate, and colonies located in Himalayan blackberry seem to be densest and may have the greatest reproductive success (DeHaven *et al.* 1975a, pp. 172, 175; Hamilton *et al.* 1995, pp. 16, 21, 51, 57; Cook 1996, entire; Cook and Toft 2005, pp. 75, 78, 82, 84; Holyoak *et al.* 2014, pp. 6–8). Other non-native substrates the species has been observed using for nesting include silage (see section 4.1.3

Destruction of Breeding Colonies during Agricultural Harvest), barley, giant cane, safflower, alfalfa, tamarisk trees, and lemon orchards (Orians 1961a, pp. 290, 297; DeHaven *et al.* 1975a, p. 172; Beedy *et al.* 1991, p. 20).

Although Himalayan blackberry and other non-native vegetative species provide appropriate protection as a nesting substrate for the species, they are not natural to the area, and therefore, may not be managed in a way to benefit the species. Examples of private landowners destroying non-native nesting substrates during the breeding season include three colonies nesting in milk thistle and/or mustard that were destroyed by grazing livestock, two colonies in Merced County that were eliminated due to the cutting of their thistle nesting substrate, two active colonies nesting in Himalayan blackberry being masticated mechanically, and numerous colonies found nesting in Himalayan blackberry that were subsequently destroyed or reduced after being treated with herbicides (Meese 2010, pp. 10, 21; Meese 2011, pp. 7, 12; Airola *et al.* 2015a, p. 70; Airola *et al.* 2015b, p. 106; Meese 2015b, p. 9).

In addition to replacing and/or supplementing their nesting needs with non-native vegetation, tricolored blackbirds also replace and/or supplement their native foraging habitats with disturbed habitats (Beedy 2008, pp. 439–440). Alfalfa, rice, open rangeland, irrigated pasture, annual grassland, hay fields, and sunflower have all been documented as suitable foraging habitats that support abundant insect populations, and silage fields, stored grains, and growing rice provide adults with replacement and/or supplemental vegetative diet items (Meese 2013, pp. 104–107, 110; Crase and DeHaven 1978, pp. 256–259). Although the species has been able to utilize these novel habitats for foraging, there has been an increase in the conversion of suitable foraging crops to more profitable crops (i.e., orchards and vineyards) that do not support diet items for the tricolored blackbird. In addition, suitable crop fields have been fallowed or left barren in response to reductions in available irrigation water due to drought. Between 2007 and 2016, there was a loss of over 8,093.723 km^2 (2 million ac) of alfalfa and grassland in the southern portion of California from the Sacramento-San Joaquin Delta south to the Tehachapi Mountains and a loss of over 2,832.8 km^2 (700,000 ac) of alfalfa and grasslands north of the Sacramento-San Joaquin Delta. In contrast, there has been an increase of over 2751.862 km^2 (680,000 ac) of nut trees (almond, pistachio and walnut) planted throughout the state and over 4,046.856 km^2 (1 million ac) of fields that have been fallowed or left barren, none of which provide dietary items for the species. In addition, the northern portion of the state has lost over 271.139 km^2 (67,000 ac) of rice, an important diet item for the species post-breeding and during the fall. This is an overall loss of over 7,284.341 km^2 (1.8 million ac) of potential foraging habitat within California over the last 10 years to crops or barren habitats that do not support foraging opportunities for the species (USDA 2017).

The use of agricultural and disturbed habitats for nesting and foraging is seen throughout the species' range. The use of Himalayan blackberry for nesting has been well documented throughout the Sierra Nevada Foothills region and is seen in lesser amounts within the Sacramento Valley, San Joaquin Valley, and North Coast regions. The primary use of thistle for nesting has been documented in the San Francisco Bay Delta and Sierra Nevada Foothills regions, although some use of thistles as a nesting substrate has also been observed in the Southern California and Central Coast regions (Graves *et al.* 2013, pp. 2850–28528; Airola *et al.* 2016, pp. 99–101). The use of agricultural crops for foraging is likely seen throughout the species range where the appropriate crops are grown; however, since the intensity of farming in the Central Valley is greatest, and the largest proportion of the breeding population occurs in the Central Valley and surrounding foothills, it is likely the colonies breeding within the Central Valley regions are currently impacted the greatest when suitable crops are converted to unsuitable crops. The destruction and inappropriate management of non-native nesting substrates is likely to continue into the future and the conversion of suitable foraging crops to unsuitable crops is likely to continue, especially in the San Joaquin and Sacramento Valleys. The conversion of suitable foraging crops to fallowed or barren fields will likely vary based on environmental conditions. The increase of fallowed fields from 2007–2016 was likely in response to drought conditions throughout California beginning in 2012 and ending in 2017.

Prior to the issuance of M-Opinion 37050, the interpretation of the Migratory Bird Treaty Act (MBTA) was that incidental take of birds, including active bird nests in non-native nesting substrates containing eggs or nestlings, would have been prohibited without a permit. Since the removal of non-native habitats that contain eggs and nestlings ultimately results in the destruction of those eggs and nestlings, the prior interpretation of the MBTA artificially extended a temporary protection to non-native habitats that were actively being used for nesting until the colony was independent of it. Once those individuals become independent of their nests, the habitat could be destroyed without violating the MBTA, as there was no longer a risk of injuring or destroying an individual tricolored blackbird. Again, it cannot be stressed enough that the habitat in of itself was not actually protected by the MBTA, it was the individuals dependent on that substrate (i.e., eggs or nestlings) that was extending a temporary protection to the habitat. Since the issuance of M-Opinion 37050 (DOI 2017, entire), the current interpretation of the MBTA only prohibits the purposeful take of birds without a permit and not the incidental take of birds. Therefore, if the removal of active non-native nesting habitat results in the destruction of eggs or nestlings, but the destruction of those eggs and nestlings is not the purpose of the action, then the removal of non-native nesting habitats resulting in the loss of nestlings or eggs is no longer considered a violation of the MBTA. For more information on the MBTA and M-Opinion 37050, see section 4.8 Management Actions.

The tricolored blackbird is listed as a threatened species under CESA. As a threatened species under CESA, take of individuals without a permit is prohibited, including the take of eggs and nestlings found in breeding colonies within non-native nesting substrates; however, the removal or alteration of habitat during the non-nesting period is not a violation of CESA's take provision. For more information on CESA, see section 4.8 Management Actions.

The implementation of Habitat Conservation Plans (HCPs) that include the tricolored blackbird as a covered species will help lessen the effects of development within the permit area of the HCP and will provide protection to areas that are known breeding sites and/or foraging areas for the species. For more information on HCPs that include the tricolored blackbird as a covered species, see section 4.8 Management Actions.

Overall, the destruction or conversion of other, non-native suitable breeding and foraging habitat is affecting the tricolored blackbird at the individual, regional, and species level, and is likely to continue into the future. The loss of non-native suitable habitat results in decreases to regional resiliency by reducing the amount of available habitat on the landscape, effectively reducing the number of breeding colonies within a region and/or reducing the size of breeding colonies within region. This reduction in regional resiliency reduces the species' overall representation and redundancy since there are fewer breeding colonies representing each EPA eco-region and fewer colonies within each region. Regulatory mechanisms are providing some protection to non-native breeding habitat, but only when the species is actively using it. There are no regulatory mechanisms protecting non-native foraging habitat for the species.

4.1.3 Destruction of Breeding Colonies during Agricultural Harvest

Large tricolored blackbird nesting colonies in the San Joaquin Valley and in Riverside and San Benito Counties use silage crops and the weeds that infest the silage crop for nesting substrate. As discussed above, the silage crop is often a wheat-rye hybrid called triticale, or forage blends of wheat, rye, and oats. These crops provide a sturdy protective nesting substrate that large nesting colonies can utilize. It can vary by year, but it is estimated that more than 50% of nests constructed by tricolored blackbirds during the first breeding attempt of the season are in silage fields (Hamilton and Meese 2006, p. 4; Meese 2009b, p. 5). The latest Statewide Survey found approximately 33% of the overall breeding population was nesting in an agricultural field (Meese 2017, p. 11). The use of silage crops as a nesting substrate and the subsequent harvest of the crop during the breeding season have resulted in the near-entire or entire loss of breeding colonies since the timing of silage harvest is often prior to when the young have fledged (Meese 2009b, pp. 3–4). Although the harvest of silage colonies was considered a violation of the MBTA prior to the issuance of M-Opinion 37050 since it resulted in the incidental take of nests, eggs, and young, the harvest of silage colonies continued to occur (for more information about the MBTA and M-Opinion 37050, see section 4.8 Management Actions). Between 2005 and 2009, at least 21 silage colonies containing an estimated 420,000 breeding adults were harvested during the breeding season (Meese 2009b, pp. 8–10). In 2015, two newly identified silage colony locations in Merced County were destroyed by harvest. One colony contained approximately 1,000 breeding adults and the other colony was harvested before the number of breeding birds within the colony was estimated (Meese 2015b, p. 8, Table 2). During the 2017 breeding season, a silage colony in Madera County was also lost to harvest (Meese 2017, pers. comm.).

Prior to the issuance of M-Opinion 37050, the interpretation of the Migratory Bird Treaty Act (MBTA) was that incidental take of birds, including active bird nests in silage crops containing eggs or nestlings, would have been prohibited without a permit. Since the removal of silage crops that contain eggs and nestlings ultimately results in the destruction of those eggs and nestlings, the prior interpretation of the MBTA artificially extended a temporary protection to the silage crop that were actively being used for nesting until the colony was independent of it. Once those individuals become independent of their nests, the silage crop could be harvested without violating the MBTA, as there was no longer a risk of injuring or destroying an individual tricolored blackbird. Again, it cannot be stressed enough that the silage crop in of itself was not actually protected by the MBTA, it was the individuals dependent on that substrate (i.e., eggs or nestlings) that was extending a temporary protection to the crop. Since the issuance of M-Opinion 37050 (DOI 2017, entire), the current interpretation of the MBTA only prohibits the purposeful take of birds without a permit and not the incidental take of birds. Therefore, the harvest of silage that is actively being used for nesting and that results in the destruction of eggs or nestlings is no longer considered a violation of the MBTA since the destruction of those eggs and nestlings is incidental to the harvest of the crop and is not the purpose of the action. For more information on the MBTA and M-Opinion 37050, see section 4.8 Management Actions.

The tricolored blackbird is listed as a threatened species under CESA. As a threatened species under CESA, take of individuals without a permit is prohibited, including the take of eggs and nestlings during the harvest of silage. For more information on CESA, see section 4.8 Management Actions.

The harvest of silage colonies has occurred within the San Joaquin Valley region and in Riverside and San Benito Counties. The conflict between harvest timing and nesting completion is likely to continue into the future; however, successful programs have been implemented to encourage farmers to let the nestlings fledge prior to harvesting, which has helped reduce the impacts of this stressor (Meese 2009b, p. 2; Audubon 2015, entire; Audubon 2016, entire). Current management actions rely upon available public funding to incentivize farmer participation. Although funding was provided in 2015 by the Natural Resources Conservation Service (NRCS) to compensate farmers to delay harvest when silage colonies occur in their fields, the amount of funding remaining will only cover one half of the average annual costs. To continue to delay harvest when the species nests in grain fields, long-term funding must be obtained. For more information about the protection of silage colonies, see section 4.8 Management Actions.

The destruction of breeding colonies during agricultural harvest is affecting the tricolored blackbird at the individual and regional level within the San Joaquin Valley and Southern California regions; however, due to current management actions this stressor has been reduced, but will only continue to be reduced if funding is designated for or maintained at the current level. Otherwise, management actions to protect silage colonies cease. The harvest of silage crops while colonies are actively nesting can result in the reproductive failure of the entire silage colony, resulting in a decrease in the region's resiliency by reducing the number of successful breeding colonies within that region.

4.2 Disease

A variety of diseases that affect various bird species can impact the tricolored blackbird throughout its range. Known diseases include avian pox, which causes growths around their bill, eyes, and feet (Beedy *et al.* 2017, Demography and Populations section). In addition, the species has been known to be infected with West Nile virus; however, when tricolored blackbirds were infected in the lab with a strain of West Nile, they expressed increased viremia levels and had an antibody response but did not die (CDC 2012, p. 3; Reisen and Hahn 2007, entire). In addition, hundreds of birds caught in 2007 and 2008 were tested for West Nile virus and were found to be carriers; however, none of the individuals seemed to be affected (Meese 2017, pers. comm.). The tricolored blackbird is also susceptible to parasites such as mites (Beedy *et al.* 2017, Demography and Populations section). The effects of diseases and parasites will continue to act on the species into the future throughout its range. There are no accounts of disease causing mass mortality or extreme detrimental effects to the species. Therefore, disease only affects the tricolored blackbird at the individual level.

4.3 Predation

Tricolored blackbirds usually select nesting sites that provide some sort of protection from predators, including choosing spiny and/or dense vegetative substrate, or substrates that are found over water to deter terrestrial predators (Beedy *et al.* 1991, p. 24). Although breeding tricolored blackbirds selectively choose protected habitats and/or substrates for nesting, historical and recent observations have documented numerous examples of breeding colonies, specifically tricolored blackbird eggs and young, being preyed upon by a variety of predators. Observed predators include wolves, gray foxes, skunks, opossums, Swainson's hawks, Cooper's hawks, burrowing owls, American crows, raccoons, mink, feral cats, northern harriers, barn owls, short-eared owls, yellow-billed magpies, gopher snakes, king snakes, rattlesnakes, garter snakes, coyotes, rats, black-crowned night herons, great blue herons, cattle egrets, white-faced ibis, ravens, merlins, red-tailed hawks, peregrine falcons, American kestrels, and river otters (Heermann 1853, p 268; Mailliard 1914, p. 205; Evermann 1919, pp. 2–3; Neff 1937, pp. 77–78; Orians 1961a, p. 301; Payne 1969, pp. 25–26; Beedy *et al.* 1991, p. 24; Beedy and Hamilton 1997, pp. 16–17; Beedy and Hamilton 1999, pp. 11–12; Meese 2010, pp. 6, 9, 16; Meese 2013, p. 108; Meese 2016, p. 9; Meese 2017, pers. comm.).

Tricolored blackbirds do not respond to predators by attacking. Instead, tricolored blackbirds will respond with an anti-predation strategy that is specific to the species of predator. In the case of peregrine falcons and Cooper's hawks, all activity within the colony stops and the birds go silent (Beedy and Hamilton 1999, p. 12; Beedy *et al.* 2017, Behavior section; pers. obs.). When approached by a northern harrier, tricolored blackbirds will rise out of the vegetation and shriek constantly while whirling above the harrier (Meese 2017, pers. comm.; Beedy *et al.* 2017, Behavior section). Tricolored blackbirds are known to mob cattle egrets, snakes, ravens, burrowing owls, and humans, but do not strike. Tricolored blackbirds typically perch and watch any nearby American crows, red-tailed hawks, and Swainson's hawks (Beedy *et al.* 2017, Behavior section). Nests built on the periphery of nesting colonies are subject to increased predation rates and nests built on the periphery of an established colony are only added to the periphery after all of the interior portions of the colony are occupied (Beedy and Hamilton 1999, p. 11). Documented large-scale nesting failures have been attributed to predation, especially colonies that nest in wetland habitats and in dairy silage (Hamilton *et al.* 1995, pp. 12, 21; Hamilton 2000, p. 14; Meese 2012, entire; Meese 2016, p. 9, 12). At some nesting sites, colonies completely fail due to predation pressure (Cook and Toft 2005, p. 84). In particular, in Tulare Country both cattle egrets and white-faced ibis were observed preying upon eggs and/or nestlings, which caused large-scale reproductive failures of very large colonies (Meese 2012, entire; Meese 2013, p. 106; Meese 2016, pp. 9, 12).

Historically, the tricolored blackbird may have always experienced a high predation rate and it is likely the species' colonial, highly synchronous, and nomadic nesting behavior is an adaptation to high rates of predation pressure (Picman et. al. 1993, p. 93; Beauchamp 1999, pp. 676; Cook and Toft 2005, p. 74). The effects of predation will continue to act on the species into the future throughout its range, although the species of predator and level of impact that species of predator has on the tricolored blackbird (i.e., individual, entire colony abandonment, partial colony destruction, etc.) may vary by region. Predation by cattle egrets and white-faced ibis has only been documented in Tulare County (San Joaquin Valley region), but it is possible they prey on tricolored blackbird young in other areas where their ranges overlap. Tricolored blackbird colonies nesting in wetland habitats are among the most susceptible to predation when the water within the wetlands are drawn down at the wrong time of year or dry out during seasonal drought conditions, allowing increased access to the nests by terrestrial predators (Beedy 2008, p. 440).

Predation will continue to affect the species at the individual, regional, and species level into the future throughout its range. Predation pressure impacts the species at a regional and species level by reducing reproductive success, which results in reduced regional resiliency by decreasing the size and number of colonies within that region. The loss of regional resiliency reduces the species' overall representation and redundancy since there are fewer breeding colonies representing each EPA eco-region and fewer colonies within each region. In addition, as the number of individuals within a region decreases and the number of prey stay constant, the species is likely to feel increased levels of predation pressure. There are currently no regulatory mechanisms that address the threat of predation.

4.4 Severe Storms and Drought

Another documented cause of wide-scale reproductive failure of colonies is severe storms. There are two "types" of storms that impact the tricolored blackbird in different ways. Storms with heavy winds occur regularly every year, especially from late April until the second half of May, when tricolored blackbird young are ready to fledge from their nests. Neff (1937) noted that entire nesting colonies were deserted after egg laying because high winds damaged the wetland nesting vegetation

(Neff 1937, p. 77). Wind can also cause nesting substrate to blow down, expelling the contents of nests and causing major losses in all habitat types except for Himalayan blackberry, which is much sturdier than other substrate types. Meese (2010) observed strong winds shaking occupied nests resulting in eggs spilling to the ground, nestlings being ejected, or nestlings clinging "…precariously to horizontal nest cups" (Meese 2010, p. 11). A colony of 20,000 tricolored blackbirds nesting in cattails in Yuba County experienced large scale reproductive failure and produced fewer than 1,000 fledglings after a severe storm (Meese 2009a, pp. 9, 10). In Merced County, a 2,000 bird colony nesting in thistle only successfully produced 200 young after a severe storm left hundreds of dead young scattered on the ground beneath their nests (Meese 2010, pp. 10, 11, 15, 21). Another large colony nesting in mustard and thistle at the Merced National Wildlife Refuge was affected by a severe storm, and out of the estimated 15,000 birds nesting at this site, only 500 fledglings were produced (Meese 2010, pp. 9–10, 15, 21). Airola *et al.* (2016) reported losses of nests at several early season colonies in milk thistle in the southern Sierra Nevada foothills due to heavy winds (Airola *et al.* 2016, p. 98). The other "type" of storm is one with both rain and strong winds, which are less common than just wind storms. During severe storms of this type, females are known to shelter their nests from the rain. In Colusa County, a colony examined post-nesting effort had 17 nests with a dead female covering her chicks or eggs (Beedy *et al.* 2017, Demography and Populations section). A colony nesting in Himalayan blackberry in Sacramento County was completely lost after a severe rainstorm (Airola *et al.* 2016, p. 98). The localized nature of these storms and colony losses, both in time and space, as well as the tricolored blackbird's ability to rapidly re-nest, reduce the potential effects of such losses at the regional level.

In addition to severe storms, the effects of drought conditions may also impact nesting colonies of tricolored blackbirds. In his comments to support an emergency listing of the species by the California Department of Fish and Wildlife, Beedy (2014, p. 3) stated:

> "(t)he recent drought and effects of climate change have noticeably reduced the extent of suitable nesting and foraging habitat in the Central Valley compared to conditions when I first began my intensive studies of this species in the mid-1980s. The effects of the drought on the available wetlands and moist, insect-producing agricultural fields, was especially apparent during this year's Statewide Survey—in the third year of a severe drought."

Although drought can reduce that amount of wetland and foraging habitats, Neff (1937) made the observation that other upland vegetation (i.e., thistles and nettles) can reclaim these former wetland areas and those substrates that are suitable for nesting (Neff 1937, p. 78). Surveys conducted in the central Sierra Nevada foothills from 2014 to 2017 found the nesting population did not decline during drought conditions and did not substantially increase during a year with average precipitation. This may be due to fact that this area supports breeding birds during their subsequent nesting attempt, and the occurrence of spring rainfall and irrigation in this region may have buffered the population from drought effects (Airola 2017, pers. comm.). In addition, increased rainfall in the southern Sierra Nevada foothills after multiple drought years resulted in increased milk thistle growth, which allowed a substantial number of individuals to breed after many years of no or very little breeding in this area (Airola *et al.* 2016, p. 104; Airola 2017, pers. comm.).

The effects of severe storms and droughts will continue to act on the species into the future, although the intensity and geographical location of these stressors may vary year to year such that the stressor will have a colony level effect in some years (a portion of the region) and a regional level effect in others. Since the primary range of the species occurs within California, the regions that occur within the state are likely to be most affected. The effects of severe storms can impact any colony or region, despite substrate type; however, the effects of drought will impact colonies or regions throughout the range in different ways. Tricolored blackbird colonies nesting in wetland habitats can experience an increased risk of predation during drought periods when the wetlands do not contain enough water to deter terrestrial predators (Beedy 2008, p. 440). The growth of upland vegetation that the species uses for nesting substrate (e.g., thistle) may be reduced or may not grow at all in response to drought conditions, particularly impacting individuals in the San Francisco Bay Delta region and the southern portion of the Sierra Nevada Foothill region. However, it is also possible that some spring rainfall during periods of prolonged drought conditions can increase the amount of upland nesting substrate available for the species (Airola *et al.* 2016, p. 83, 105–106). Throughout the species' entire range, reduced rainfall likely results in reduced insect abundance. This affects the tricolored blackbird's reproductive success and results in the species not nesting at particular locations, although the presence of irrigated pasture appears to buffer drought effects in the central Sierra Nevada foothills (Airola et al. 2016, p. 104). In the case of the smaller peripheral regions, and specifically the Nevada region which has only one consistent nesting colony, drought conditions may result in that region having no breeding colonies at all.

Effects from severe storms and drought temporarily reduce regional resiliency due to the loss or reduction of suitable nesting substrate and insect abundance within that region. The loss or reduction of suitable nesting substrate and available insects will temporarily reduce the size and/or number of breeding colonies within a region, reducing the species' overall representation and redundancy by having fewer or smaller breeding colonies within one or more regions. There are currently no regulatory mechanisms that address the threat of severe storms and drought.

4.5 Pesticides and Other Contaminants

Throughout the range of the tricolored blackbird, a variety of pesticides and other contaminants are applied to crops and other vegetation. In agricultural settings, insecticides are applied to crops to control pest insect outbreaks and herbicides are applied to help control the growth of unwanted vegetative species. The application of pesticides can have direct effects on individuals via direct toxicity or can indirectly impact reproduction and growth by limiting the amount of suitable substrate for nesting and the abundance of insect prey. The mechanism by which pesticides impact the amount of suitable nesting substrate or abundance of the species' insect prey base is unknown, although it is intuitive that applying insecticides to crops that provide habitat to insect populations would reduce insect abundances and foraging opportunities for the species (Meese 2013, p. 111). The amount of pesticides and other contaminants used annually within the range of the tricolored blackbird is immense. Almost 60 million kilograms (kg) (132 million pounds (lbs)) of pesticide active ingredients were applied to agricultural lands in the Central Valley in 2007 (Luo and Zhang 2010, p. 1629). Figure 4.2 depicts the total pounds of pesticides applied per U.S. Geological Survey 7.5 minute quadrangle throughout California in 2014. Studies on other bird species found the pesticides used within the tricolored blackbird's range can be highly toxic. Using various sources of pesticide data and literature available, Mineau *et al.* (2001) calculated acute toxicity values that can be used as reference values when evaluating pesticide risk. These values do not address effects that reduce biological fitness or effects that result in mortality at a later point in time; they only address acute lethal toxicity. A total of 34 pesticides were found to have the highest toxicity to birds (Mineau *et al.* 2001, pp. 69–71), and a number of these pesticides are applied in large quantities throughout the species range (CALPIP 2017).

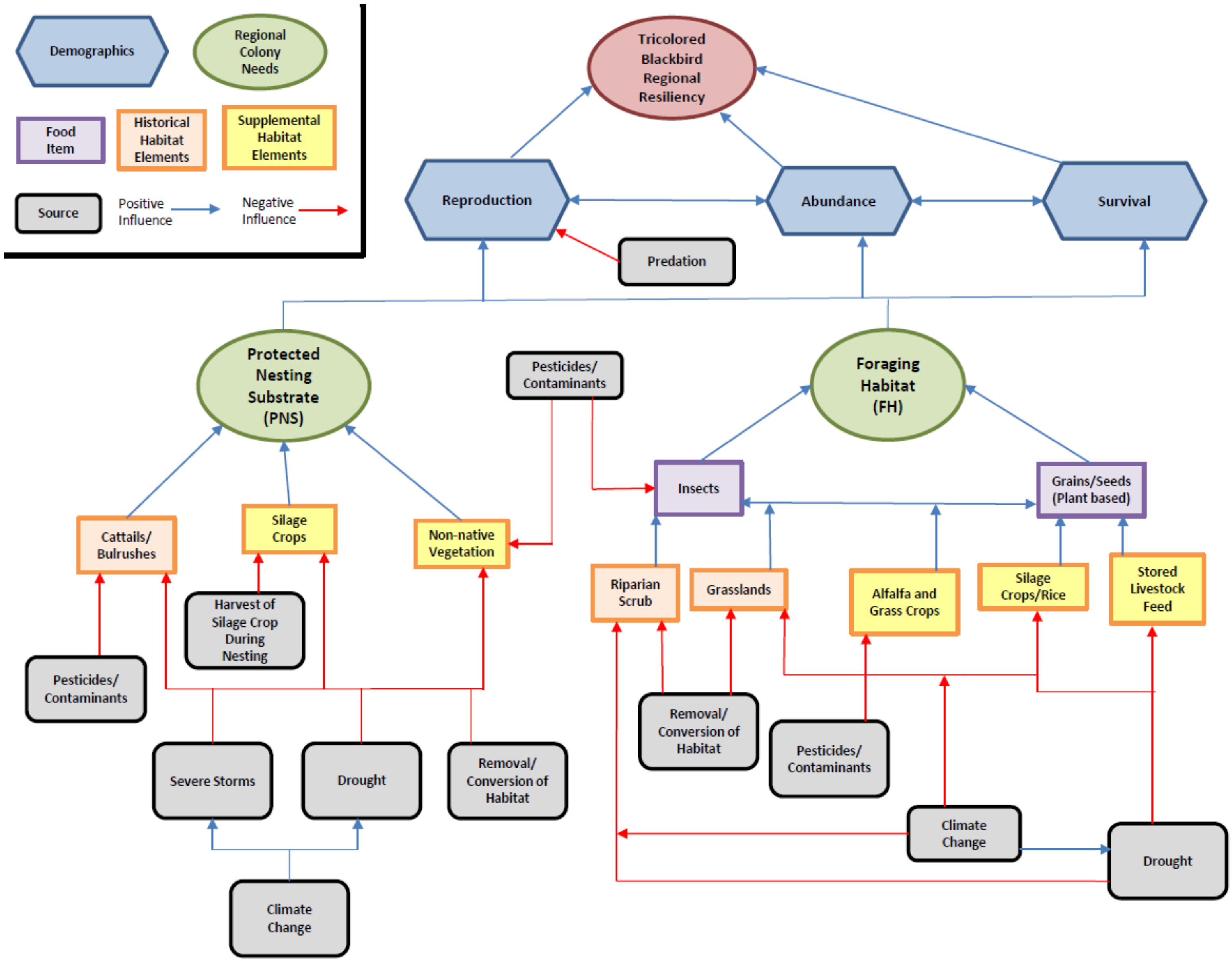

Figure 4.1 Tricolored blackbird regional resiliency influence diagram

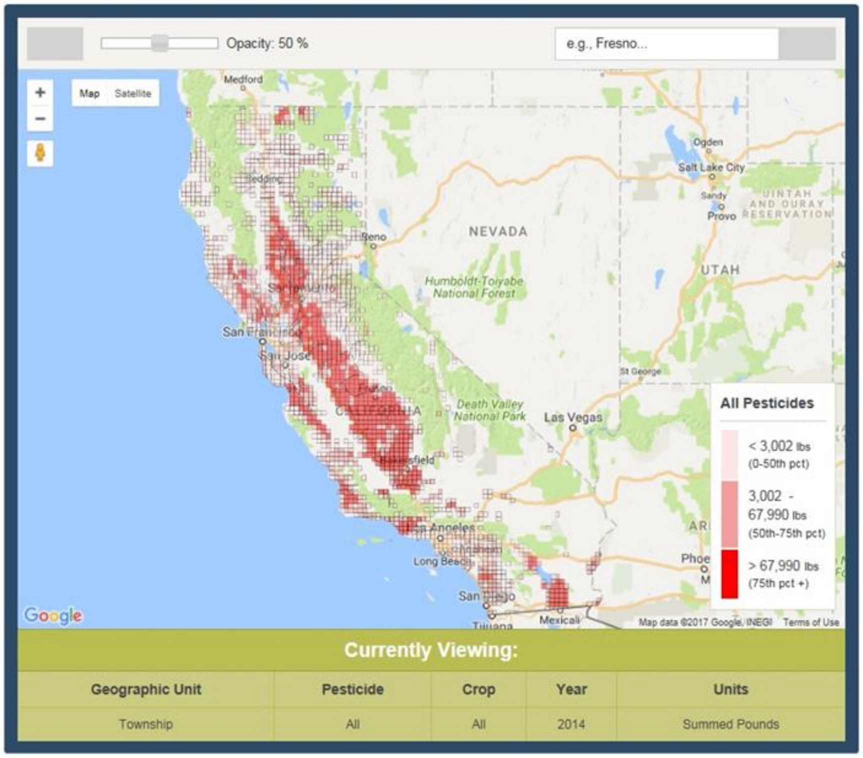

Figure 4.2 Total pounds of pesticides applied per quad throughout California (Figure from the California Environmental Health Tracking Program website: http://cehtp.org/page/pesticides/agricultural_pesticide_use_in_california). Note concentration of pesticide use in lowland areas supporting agriculture.

The total amount of pesticides used throughout California increased from 2014 to 2015. In Sacramento and Madera Counties, the two counties which contained the largest proportion of breeding birds during the 2014 Statewide Survey (Meese 2014, p.8), the amount of pesticides applied has increased from 1.8 million to 2.2 million kg (4,061,419 to 4,779,465 lbs) and 4.4 million to 5.1 million kg (9,588,770 to 11,294,779 lbs), respectively (CDPR 2017, Pesticide Use Reporting – 2015 Summary Data: http://www.cdpr.ca.gov/docs/pur/pur15rep/lbsby_co_15.pdf). From 2005 to 2010, the overall trend in pesticide use has increased (Figure 4.3), and in particular, the use of insecticides and herbicides has increased. As seen in Figure 4.2, the application of pesticides within the range of the tricolored blackbird is primarily seen within the Sacramento Valley, San Joaquin Valley, Central Coast, and Southern California regions.

While completing a population census of the tricolored blackbird in the Sacramento Valley, Hosea (1986) documented two almost complete colony failures due to the application of herbicides on adjacent rice fields. Since both of the nesting colonies were located on the edge of the rice fields, the aerial application of the herbicide onto each of the fields resulted in overspray, which subjected both of the nesting colonies to the herbicide application. The application of herbicides appeared to directly poison the nestlings at each colony site, resulting in the death of almost all the nestlings. In addition, at one of the colony sites the amount of herbicide overspray was so much that it killed all of the nesting vegetation within the slough where the tricolors were nesting, eliminating the possibility of the colony nesting there again during that season (Hosea 1986, p. 36).

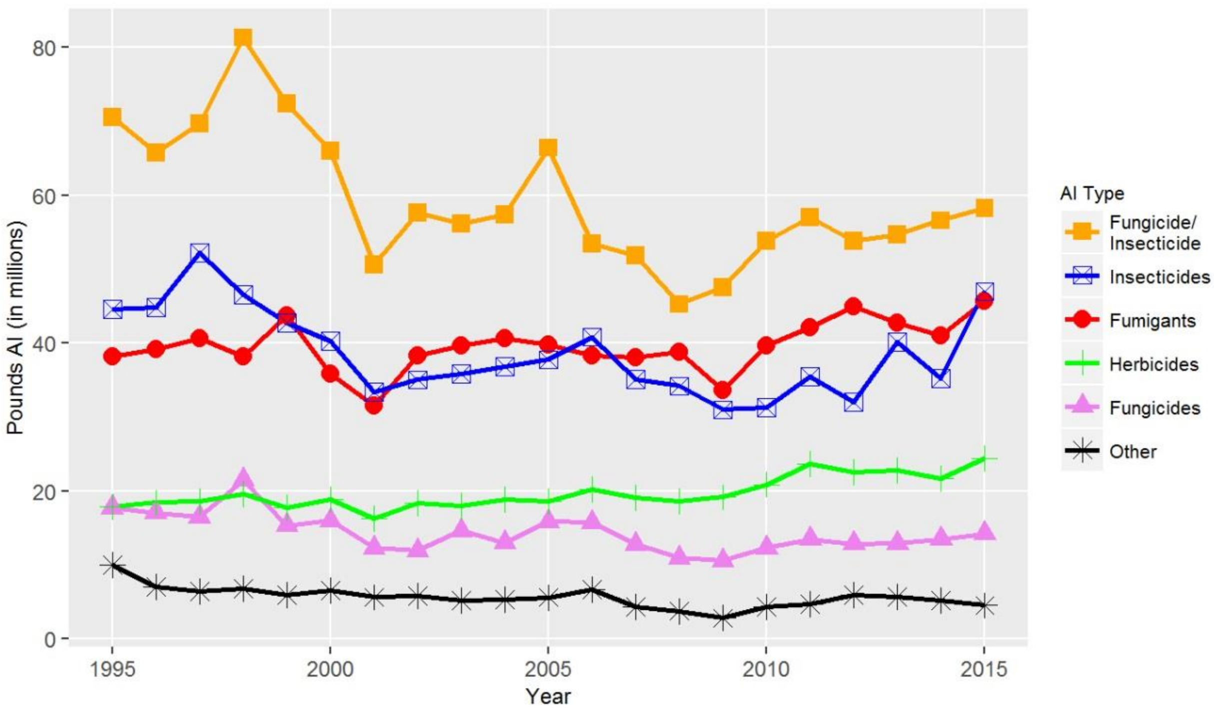

Figure 4.3 Trend in various pesticide uses from 1995 to 2015 in California. (Figure from the California Department of Pesticide Regulation, Summary of Pesticide Use Data - 2015)

Pesticide use in the regions outside of California is likely not as intense, especially compared to pesticide application in the Central Valley. In Oregon, the tricolored blackbird nests primarily in wetland habitats associated with irrigation and uses irrigated pasture lands to forage. In aquatic environments, only 94,000 kg (207,000 lbs) of pesticides were applied in 2008. However, a majority of pesticides used in aquatic environments within Oregon were herbicides, which could negatively impact the amount of available nesting habitat (Oregon Department of Agriculture 2008, p. 13). Over 680,000 kg (1.5 million lbs) of pesticides were applied to sites identified in Oregon as pasture/forage/hay land; however, the top 5 active ingredients used on those identified lands were herbicides and not insecticides, so it is likely the tricolored blackbird would still be able to use these habitats for foraging (Oregon Department of Agriculture 2008, pp. 15–16). Since the tricolored blackbird also uses agricultural crops such as alfalfa and sunflowers for foraging, the application of pesticides to these crops could impact the quality of those crops for foraging. Field crops in Oregon were treated with over 2.7 million kg (6 million lbs) of pesticides in 2008; however, the top five pesticides used were soil fumigant and herbicides, so it is likely these crops will continue to provide foraging opportunities for the species (Oregon Department of Agriculture 2008, p. 15). Specific information regarding the use and/or amount of pesticides applied in the state of Washington is not available; however, since the intensity of agricultural use is similar in Washington and Oregon, and the species in both states depend largely on agricultural associated habitats, it is likely that pesticide use within the portion of Washington that the species occurs is similar to Oregon. Likewise, pesticide information for Nevada is not available and there is nothing in the literature showing the one known colony has been negatively impacted by pesticides in the past.

Several studies have documented the relationship between tricolored blackbird mortality and contaminants. Beedy and Hamilton (1999) observed deformities and colony failure in association with selenium run-off at Kesterson Reservoir in Merced County. From 1981 to 1986, inflow into Kesterson Reservoir came from subsurface agricultural drainage water, which contained high concentrations of selenium. In 1986, there was a total nesting failure of a breeding colony at Kesterson containing 47,000 individuals. Hundreds of dead nestlings were found along levee roads, many with deformities such as club feet. The following year, the colonies at Kesterson were monitored and dead nestlings collected. Laboratory analysis of livers collected from the 1987 nestlings revealed high concentrations of selenium and pathological examinations revealed heart muscle degeneration (Beedy and Hayworth 1992, pp. 33, 35, 36, 41; Beedy *et al.* 1991, p. 25; Beedy and Hamilton 1997, p. 19). Furthermore, they found that the application of mosquito abatement oil on the eggs of a nesting colony in Kern County resulted in eggs failing to hatch and reduced the overall reproductive success of the breeding colony (Beedy and Hamilton 1999, p. 18).

The use of pesticides and other contaminants will continue to act as a stressor on the species throughout its range into the future, but effects are likely to be variable due to the various rates of application within different portions of the species' range. In particular, colonies nesting in the Central Valley are much more likely to be affected by the application of pesticides than areas that do not have the same level of pesticides applied.

The application of pesticides within the range of the tricolored blackbird can have various effects. Herbicide application can reduce the number of available locations for the species to breed within a region, reducing the resiliency of that region if there are no additional nesting locations for the species to use within that region. Herbicide application to nesting substrates that are being actively used can result in the reproductive failure of entire nesting colonies due to the direct poisoning of nestlings or by eliminating the sturdy nesting substrate needed to support the active nests. The application of insecticides, in particular, likely has the most detrimental effects to the species of all of the applied pesticides since it reduces the species' required insect prey. The low reproductive success seen throughout the species range in California is thought to be due to the conversion or loss of available foraging habitats and potentially reduced insect abundances from the application of insecticides. The loss or reduction of suitable nesting substrate from herbicide application and the reduction of available insects due to insecticide application may temporarily reduce the size and/or number of breeding colonies within a region. This reduction will result in a loss of overall representation and redundancy by having fewer and/or smaller breeding colonies within each affected region.

4.6 Targeted Take via Trapping, Shooting, or Direct Poisoning

Direct take of tricolored blackbirds via trapping, shooting, and/or direct poisoning primarily occurred in the past. Individuals were killed for sale, killed to protect crops, or used for target practice. During the late 19^{th} and early 20^{th} centuries, different species of blackbirds, including tricolored blackbirds, were shot and sold in large numbers (Neff 1942, pp. 46–47; Heermann 1853, p. 268). This historical practice continued until at least the 1930s and it is estimated that more than 300,000 tricolored and red-winged blackbirds were killed and sold from the Sacramento Valley during a 5-year period (Neff 1937, p. 78). Prior to the 1960s, tricolored and other blackbirds were deliberately exterminated to control damage to rice and other crops in the Central Valley. Direct poisoning of tricolored blackbird colonies has been documented infrequently, but the few published examples illustrate that toxic substances have the potential to destroy entire colonies. As an agricultural experiment to develop an effective method to get rid of crop-destroying blackbirds, 30,000 breeding tricolored blackbirds were deliberately poisoned using grains laced with strychnine (McCabe 1932, entire; Beedy *et al.* 1991, p. 25).

Although the direct killing of blackbirds to protect crops has been largely eliminated due to declining tricolored populations and improved harvesting methods (Beedy *et al*. 1991, p. 24), there are more recent accounts of rice farmers killing individual tricolored blackbirds. In 2008, at least two tricolored blackbirds were shot by a rice farmer in Butte County and another rice farmer in Yuba County admitted to knowing rice farmers that annually herd the birds to shoot. In 2006, representatives of Colusa County admitted flocks of blackbirds were shot in their county (Meese 2009a, p. 16). The Service has a depredation order issued under the MBTA that allows for the control (including via lethal means) of depredating blackbirds, cowbirds, grackles, crows, and magpies (50 CFR 21.43). Although the tricolored blackbird was removed from the depredation order in 1989 (54 FR 47524), red-winged blackbirds are still included in the depredation order. Since tricolored and red-winged blackbirds are difficult to distinguish from each other (especially females), it is likely lethal methods to control other blackbird species are also resulting in the death of tricolored blackbirds (Meese and Beedy 2015, p. 82). The U.S. Department of Agriculture's Wildlife Services program, which provides management solutions to solve conflicts between wildlife and humans, publishes annual reports on the number and species of animals dispersed, killed, euthanized, or freed through their program. In 2016, over 8,000 red-winged blackbirds were reported as lethally taken by various means and it is possible, due to the difficulty in distinguishing the two species, some of the birds lethally taken may have actually been tricolored blackbirds (https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_reports/sa_pdrs/ct_pdr_home_2016). The impact of targeted take of tricolored blackbirds is likely low and is confined to portions of the Central Valley, and mostly the Sacramento Valley, where grain and rice crops are grown.

The MBTA provides regulatory protection to individuals that could be targeted via trapping, shooting, or direct poisoning. For more information on the MBTA, see section 4.8 Management Actions.

The tricolored blackbird is listed as a threatened species under CESA. As a threatened species under CESA, take of individuals without a permit is prohibited, including the take of individuals via trapping, shooting, or direct poisoning. For more information on CESA, see section 4.8 Management Actions.

The targeted take of tricolored blackbirds is likely to continue acting on the species at the individual level into the future. Although take via trapping, shooting, or poisoning could be occurring throughout the range, all of the documented accounts of targeted take by those methods have been within the Sacramento Valley region, so it is likely this stressor will be confined to this region. The California Rice Commission has implemented a new initiative that seeks to address the shooting of tricolored blackbirds in rice fields. This initiative uses education and outreach materials to inform rice farmers of the relationship between rice and tricolored blackbirds, the regulations in place to protect the species (i.e. MBTA) and provides alternative methods to deter the species from eating their crop. While the MBTA is providing some protection to individuals that may be purposefully killed via trapping, shooting, or direct poisoning, some individuals still remain at risk.

4.7 Allee Effect

The tricolored blackbird is a highly social (colonial) breeder with historical accounts documenting breeding colonies within California that numbered in the tens to hundreds of thousands of birds (Neff 1937, p. 66). Species which require such socially facilitated breeding may experience reduced reproduction or survival at low population densities (Stephens and Sutherland 1999, p. 403; Cook and Toft 2005, p. 73). This phenomenon, known as the Allee effect, is a positive relationship between population density and survival and reproduction (inverse density dependence) (Cook and Toft 2005, p. 73). Possible mechanisms of the Allee effect include predator saturation (occur in high densities so the probability of an individual being eaten is reduced), social thermoregulation (group regulation of body temperature), reduction of genetic complications (inbreeding, genetic drift, hybridization, etc.), and social facilitation of reproduction (Stephens and Sutherland 1999, p. 402). The colonial breeding behavior of the tricolored blackbird likely facilitates successful reproduction by reducing predation pressure (predator saturation) and by taking advantage of locally abundant, temporary food resources.

It is possible the Allee effect is influencing a source-sink dynamic between the regions found within the Central Valley and the smaller regions found outside of the Central Valley. Stephens and Sutherland (1999, p. 402) described how the Allee effect can influence species range dynamics. Some species subject to the Allee effect can show a decline in density as they get closer to the edge of their range. This observed decline in density could be due to the fact that the available habitat at the edge of the range is less suitable and may only be able to support small local populations or populations with lower densities. If these small populations are near a critical threshold of local abundance, it is possible they are at a greater risk of extirpation. If the species also happens to disperse readily, as the tricolored blackbird does, these source-sink dynamics can come into play. The smaller populations can act as sinks by recruiting individuals from the source population that is within the more productive center portion of the range (Stephens and Sutherland 1999, p. 402). Although it is possible this dynamic is occurring, in the case of the tricolored blackbird the more productive portion of the range has the most intense stressors acting on the species while the smaller peripheral regions do not experience the same amount of impacts. In addition, some individuals found in these smaller regions are not resident and may return to the core regions to breed in subsequent years or within the same year, and there is no evidence that the migratory individuals breeding in the smaller regions return to breed at that same location year after year. It is possible that when environmental conditions are not favorable to support breeding in these smaller regions, those individual birds may disperse throughout portions of California to breed or possibly wait to breed until conditions are favorable.

There are concerns that if the tricolored blackbird is subject to the Allee effect it may be vulnerable to extinction since the overall tricolored blackbird population has vastly declined compared to historical abundances. In addition, current conditions have resulted in the concentration of large portions of the overall nesting population at a few select nesting locations during the first breeding attempt of the season. This overall decrease in abundance and the concentration of large portions of the breeding population can make the species more susceptible to random events, as was the case for the now extinct passenger pigeon (*Ectopistes migratorius)*. Cook and Toft (2005) described and compared the tricolored blackbird's current situation to the chain of events that ultimately led to the extinction of the passenger pigeon. Both species are similar in that they are highly social, nomadic breeders. Factors such as fragmentation of habitat, harvest, and the large variability in population size caused the passenger pigeon to decline to such a small population size that foraging efficiency was decreased and eventually it was driven to extinction. Similar to the passenger pigeon, habitat for the tricolored blackbird has become fragmented throughout its range and the species' overall population size can vary widely depending on environmental conditions (Stephens and Sutherland 1999, p. 402; Cook and Toft 2005, pp. 85–86). However, unlike the passenger pigeon, the tricolored blackbird has adapted to the wide-scale loss of wetland habitat by using novel habitats for breeding and the species is no longer harvested to sell at market, unlike the situation with the passenger pigeon which continued to be harvested as their population declined.

Since species-specific detailed studies on survivorship and fledgling rates have either resulted in highly variable results or have not been completed for colonies of varying size throughout the species range, we have not been able to identify impacts associated with Allee effect acting on the species. It is likely the species does experience inverse density dependence in certain portions of its range and/or in certain habitats, but successful breeding colonies with just a few individuals have been documented, especially within the peripheral regions. Therefore, although we have no evidence at this time that impacts associated with the Allee effect is currently acting on the species, we cannot entirely discount that some type of impact may be occurring.

4.8 Management Actions

Migratory Bird Treaty Act (MBTA)

The tricolored blackbird is currently protected under the Migratory Bird Treaty Act (MBTA). These protections make it "illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations." The MBTA provides regulatory protection to individuals that could be targeted via trapping, shooting, or direct poisoning, and prior to December 22, 2017, the incidental take of any individual eggs and nestlings destroyed during the removal of active nesting habitat. Incidental take is when take occurs that is a result of an action, but is not the purpose of the action.

The U.S. Department of the Interior's Office of the Solicitor (solicitor) issued a memorandum opinion (M-Opinion 37041) to the Director of the Service on January 10, 2017, providing clarification on whether incidental take is prohibited under the MBTA (DOI 2017, entire). M-Opinion 37041 provided a legal analysis for the Service's long-standing interpretation of the MBTA to include incidental take. Based on that analysis, M-Opinion 37041 concluded that MBTA's prohibitions on the taking and killing of migratory birds include the direct incidental take of individuals. Under M-Opinion 37041, the harvest of silage and the removal of nesting substrates containing active tricolored blackbird colonies were a violation of the MBTA since those actions resulted in the incidental take of eggs and nestlings. On February 6, 2017, M-Opinion 37041 was suspended pending review and on December 22, 2017, the solicitor issued another memorandum opinion (M-Opinion 37050) which permanently withdrew and replaced M-Opinion 37041. M-Opinion 37050 provided a legal analysis for the interpretation of the MBTA to only include purposeful take and not incidental take. Based on this analysis, M-Opinion 37050 concluded that the MBTA's prohibition on take "applies only to direct and affirmative purposeful actions that reduce migratory birds, their eggs, or their nests, by killing or capturing, to human control (DOI 2017, pg. 41)." Therefore, the harvest of silage colonies and/or the destruction of active colonies while managing vegetation (i.e., routine removal of blackberry or thistles) under the new interpretation of the MBTA, as described in M-Opinion 37050, are no longer a violation of the MBTA since the take of eggs and nestlings are not the purpose of the action. It should be noted that when prohibitions under the MBTA were interpreted to include incidental take (i.e., prior to the issuance of M-Opinion 37050) the harvest of silage colonies still frequently occurred and the violations were not heavily enforced. Once the species was emergency listed under CESA, the harvest of silage colonies was greatly reduced (additional information on CESA is below).

The Fish and Wildlife Service also considers the species a Bird of Conservation Concern and a Bird of Management Concern; however, neither of these designations offers regulatory protection. Inclusion as a Bird of Conservation Concern is "intended to stimulate coordinated and collaborative conservation actions among Federal, State, Tribal, and private partners…" for the species and "…to prevent or remove the need for additional…bird listings…" under the Endangered Species Act. Birds of Management Concern are species which are protected under the MBTA and "warrant management or conservation attention…" The tricolored blackbird is also included as a Focal Species, which is a small subset of Birds of Management Concern that the Migratory Bird Program believes "need additional investment of resources to address pertinent conservation or management issues." The Migratory Bird Program focuses conservation actions that benefit the tricolored blackbird and other Focal Species.

California Endangered Species Act (CESA)

The California Fish and Game Commission was petitioned by the Center for Biological Diversity to list the tricolored blackbird under the California Endangered Species Act (CESA) in 2014. While the California Department of Fish and Wildlife was reviewing the species status to determine if listing was warranted, the species was considered a candidate under CESA until the status review was completed and the final listing determination was made. While considered a candidate under CESA, the take of individuals was prohibited unless the take was authorized by a permit. It should be noted that the state's definition of take is not the same as the Service's definition of take under the Federal ESA. CESA regulations only apply to the take of individuals and not habitat; however, removal of habitat occupied by an active breeding colony can result in the loss of eggs and nestlings and would therefore be a violation of CESA. During the 2016 and 2017 breeding seasons, the California Department of Fish and Wildlife extended a regulation to allow a small amount of take for landowners participating in the NRCS silage grant program (additional information on NRCS' silage grant program is below). On April 19, 2018, the California Fish and Game Commission determined the tricolored blackbird warrants listing under CESA as a threatened species. This finding will be adopted at a later commission meeting. As a threatened species under CESA, the take of individuals will continue to be prohibited unless authorized by a permit.

Habitat Conservation Plans

There are 19 Habitat Conservation Plans (HCPs) that include the tricolored blackbird as a covered species. Being included as a covered species means that habitat will be set aside and managed for the species as compensation for covered activities, such as planned urban development, within the area the HCP covers, as agreed upon and permitted by the Service under section 10(a)(1)(B) of the Endangered Species Act. In addition, within the permitted area, avoidance, minimization, and other conservation measures such as monitoring, seasonal work windows, habitat management, protection of habitat, and habitat creation and/or enhancement will be put into place. Table 4.1 is a list of the permitted HCPs that cover the tricolored blackbird, the year the section 10(a)(1)(B) permit was issued, and the permit term. Table 4.2 is a summary of the common conservation measures described in the 19 HCPs and the impact each conservation measure has on the species if implemented.

Tricolored Blackbird Working Group

The Tricolored Blackbird Working Group (Working Group) was formed to respond to concerns about the status of the tricolored blackbird in California and to help coordinate conservation efforts for the species. A working group existed prior to the current Working Group, but stopped meeting in the mid-1990s after limited progress was made in developing conservation measures for the species. However, the group reconvened in 2000 and expanded to include the members of the current Working Group. The Working Group is a voluntary assemblage of Federal and state agency biologists, non-governmental organizations, industry representatives (primarily the dairy and rice industries), and academics that meet biannually, triennially since 2014, to "discuss both long-term, strategic efforts as well as short-term immediate actions necessary to conserve the tricolored blackbird." The biannual meetings are typically held in the spring and the fall. The spring meeting generally focuses on any needs for the upcoming breeding season, including the organization of breeding season survey efforts, and the fall meeting is a review of breeding season efforts and to identify any next steps that need to be taken to conserve the species and its habitat. In addition to their biannual meetings, the Working Group has various committees that meet numerous times a year, and the Working Group communicates informally to coordinate conservation efforts and to keep updated on the status of the species and its habitat (Tricolored Blackbird Portal; http://tricolor.ice.ucdavis.edu/tbwg). The Working Group is comprised of Audubon California, California Association of Resource Conservation Districts, California Farm Bureau Association, California Cattlemen's Association, California Department of Fish and Wildlife (formerly known as the California Department of Fish and Game), California Department of Food and Agriculture, California Rice Commission, Central Valley Bird Club, Central Valley Joint Venture, Dairy Cares, Natural Resources Conservation Service, Pacific Gas and Electric, Point Blue (formerly known as Point Reyes Bird Observatory Conservation Science), Santa Lucia Conservancy, Sonoran Joint Venture, Sustainable Conservation, University of California, the Service, U.S. Geological Survey, Western Riverside Regional Conservation Authority, and Western United Dairymen.

Table 4.1 HCPs that include the tricolored blackbird as a covered species.
* Natural Community Conservation Plan with the State of California

Plan Name	Permit Issued	Permit Term (Years)
East Contra Costa County HCP/NCCP*	2007	30
Fieldstone/La Costa & City of Carlsbad	1995	30
Kern Water Bank	1997	75
Lake Mathews	1995	50
Multiple Habitat Conservation Plan (MHCP) - City of Carlsbad Habitat Management Plan	2004	50
MSCP - City of Chula Vista Subarea Plan	2005	50
MSCP - City of La Mesa Subarea Plan	2000	50
MSCP - City of Poway Subarea Plan	1996	50
MSCP - City of San Diego Subarea Plan	1997	50
MSCP - County of San Diego Subarea Plan	1998	50
Natomas Basin Revised HCP	2003	50
Natomas Basin, Metro Air Park	2002	50
North Peak Development Project	1999	30
Orange County Southern Subregion NCCP/HCP	2007	75
PG&E San Joaquin Valley O&M HCP	2007	30
San Diego Gas & Electric	1995	55
San Joaquin County Multi-Species Habitat Conservation and Open Space Plan	2001	50
Santa Clara Valley HCP/NCCP*	2013	50
Western Riverside Multi-Species Habitat Conservation Plan (MSHCP)	2004	75

Table 4.2 Summary of common conservation measures described in the HCPs that include the tricolored blackbird and the impact each measure has on the species. Not all measures are included in every plan.

Measure	**Description**	**Impact**
Preserve System	Creation of a preserve/reserve system within the plan area that will be protected and managed for the species	Protection of suitable habitats that will be available for use in the future
Maintenance of Habitat	Preservation of historic and active breeding sites	Protection of suitable breeding and foraging habitat that will be available for use in the future
	Maintain a minimum amount of habitat for the species within the plan area. The amount will vary depending on the size of the HCP's permit area and how much existing habitat is within the area	
Acquisition of Habitat	Acquire land that is suitable for enhancement, restoration, and/or creation	Protection of potential habitat that will be available for use once enhancement, restoration, and/or creation activities are complete. Increase in survival and reproductive success
Habitat Enhancement	Habitat enhancement for those areas that contain potential breeding and foraging habitats	Increase the quantity and/or quality of breeding and foraging habitats available for the species. Increase in survival and reproductive success
Habitat Restoration	Habitat restoration for those areas that historically contained breeding and foraging habitats	
Habitat creation	Habitat creation for those areas that currently do not contain suitable breeding and/or foraging habitats	
Monitoring	Regular monitoring of the species within the plan area	Ensure habitat protections are continuing to benefit the species
	Monitor habitat use within the permit area and document successful reproduction	
Avoidance and Minimization	Relocate impacts away from potential nesting habitat	Reduce disturbance and increase reproductive success
	Implementation of pre-construction surveys immediately prior to construction	
	Implementation of work windows to minimize and/or avoid disturbance to breeding colonies	
	Establishing buffer zones around known breeding sites to avoid and/or minimize the amount of disturbance	
	Avoid impacting foraging habitat in the vicinity of currently or historically active nests	
Miscellaneous Measures	Provide incentives to private land-owners within plan area to ensure farming and ranching practices support foraging habitat	Increase in survival and reproductive success
	Management of predators (i.e., feral cats)	
	Manage contaminants by minimizing pesticide use adjacent to suitable habitats	
Compensation	Compensate the loss of suitable habitat at specific ratios	Protection of suitable habitat that will be available for use in the future

Conservation Plan for the Tricolored Blackbird

In September 2007, the Working Group published the *Conservation Plan for the Tricolored Blackbird* (*Agelaius tricolor*) (Conservation Plan), which was subsequently updated in January 2009. The Conservation Plan describes specific conservation goals, objectives, and tasks that address the conservation needs of the tricolored blackbird. Conservation goals described in the Conservation Plan include: the restoration, maintenance, creation, and protection of suitable nesting, foraging, and wintering habitat on public and private land; the identification of large and vulnerable colonies on private land; monitoring and documentation of the species' annual distribution and long-term population trends; monitoring of reproductive success and survivorship to assess population viability; development of a strategic monitoring program; research of the environmental variables associated with reproductive success; improvement of our understanding of population dynamics; and conducting education and outreach. A Memorandum of Agreement to implement the Conservation Plan was signed by all of the agencies that comprise the Working Group, with the exception of the California Rice Commission, Dairy Cares, Santa Lucia Conservancy, and U.S. Geological Survey (Tricolored Blackbird Working Group 2007, entire; Tricolored Blackbird Working Group 2009, entire). Although the University of California – Agriculture and Natural Resources were a signatory to the Memorandum of Agreement, they officially withdrew from the agreement in April 2017 (Arthur 2017, pers. comm.).

Silage Buy-Outs and Harvest Delays

As the tricolored blackbird has shifted to utilizing silage crops for nesting substrate, the timing of harvest is often before nestlings have fledged, resulting in large scale losses of the reproductive efforts of whole colonies (see section 4.1.3 Destruction of Breeding Colonies during Agricultural Harvest). In order to encourage farmers to allow nestlings to fledge prior to harvesting, silage buy-outs and harvest delays have been implemented to protect eggs and nestlings in silage crops. Although the difference between silage buy-outs and harvest delays are not always clear-cut when implemented, the basic definition of the different methods are as follows. A silage buy-out is when an invested party (often a government agency or an NGO) purchases the portion of a silage crop field that is occupied by nesting tricolored blackbirds at full market value. In this scenario, both tricolored blackbird young and the adults are able to utilize that portion of the field until they leave on their own volition. Harvest delays are when the farmer delays harvest until a biologist has made the assessment that the nestlings in the field have fledged and have become mostly independent of the field; however, sometimes the nestlings have not become fully independent. Since delaying silage harvest reduces the nutritional value of the crop, invested parties compensate the farmer for this reduction in value (Meese 2009b, p. 2). Between 2005 and 2009, almost $332,000 was paid to conserve 11 breeding colonies containing approximately 546,000 breeding adults that produced more than 396,025 young (Meese 2009b, pp. 4, 6, 8–10) (Figure 4.4).

There were four known colonies nesting in silage colonies in the San Joaquin Valley in 2005, totaling 142,000 breeding birds. Two colonies, consisting of 122,000 birds, were conserved through silage buy-outs. The other two colonies, totaling 20,000 breeding birds, were lost to harvest. In 2006 there were nine silage colonies in the San Joaquin Valley and Riverside County that contained a combined total of 371,900 breeding birds. Silage buy-outs conserved a total of 216,900 birds at three colony locations. In 2007, only one silage colony comprising 30,000 breeding birds was conserved out of eight known silage colonies in the San Joaquin Valley. The total number of breeding birds estimated between the eight colonies was 186,750 individuals. A second buy-out to conserve an additional 50,000 bird colony was canceled because the colony was deserted. It is thought the site was deserted due to reductions in insect prey base due to drought conditions, which prevented females from forming eggs. The other six colonies were lost to harvest. In 2008, a total of ten known silage colonies in the San Joaquin Valley comprised a total of 300,000 breeding birds. A total of 140,000 breeding birds were conserved through a silage buy-out for one colony and a harvest delay for another. Two additional colonies containing around 10,000 breeding birds each were also conserved through oral agreements. Eight of nine silage colonies in 2009 in the San Joaquin Valley were conserved, although the fate of one colony was ultimately unknown. The one 20,000 breeding bird colony that was harvested had just been recently settled and was still in the nest building stage (Meese 2009b, pp. 3–4).

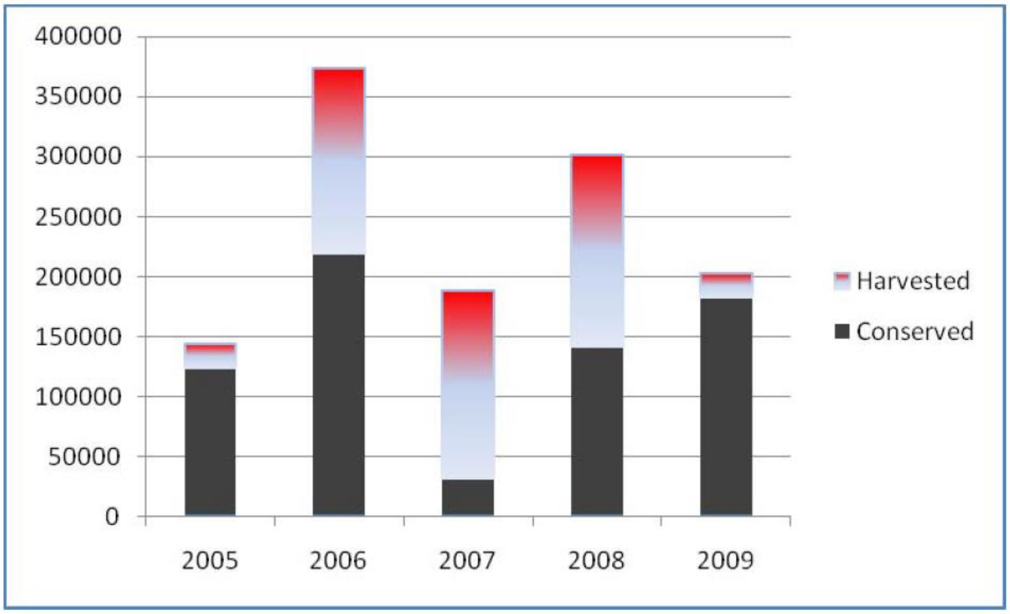

Figure 4.4 Number of breeding birds in harvested and conserved silage colonies 2005-2009 (Figure from Meese 2009b, p. 4)

The Natural Resources Conservation Service's (NRCS) Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to landowners and industry producers through partnership agreements. In 2015, the 5-year Protection, Restoration and Enhancement of Tricolored Blackbird Habitat grant was awarded under the RCPP, a newly formed program in the 2014 farm bill. The program has four main objectives, one of which is to protect silage colonies through harvest management. In 2015, at total of $223,000 was paid out to 5 producers enrolled in the program to protect a total of 1.485 km^2 (367 ac) containing an estimated 65,000 breeding adults (Audubon 2015, pp. 2–3). In 2016, all known silage colonies were protected through the grant program. Approximately $215,600 was paid to 6 dairy producers enrolled in the program to protect a total of 1.493 km^2 (369 ac) containing an estimated 55,500 breeding adults. In addition to the grant program, two other colonies were protected through other funding sources in 2016. Collectively, the two colonies were over 0.081 km^2 (20 ac) and contained an estimated 6,500 breeding adults (Audubon 2016, pp. 2–3). During the 2017 season, five colonies were enrolled in the RCCP grant program, another colony was protected under other funding sources, and an additional colony was lost to harvest (Arthur 2017, pers. comm.; Clipperton 2017, pers. comm.). Current management actions implemented by the NRCS grant program are likely to continue until funding runs out, which may occur as early as the end of the 2018 season due to the number of producers enrolled and the total acreages of silage that have been paid out over the last 3 years. Although it is uncertain whether additional public funding sources may become available in the future, it is possible additional funding may become available in the future since the program has the support of the dairy industry and conservationists.

Clean Air Act

The Clean Air Act of 1970 (42 U.S.C. 7401 *et seq.*) provides the platform for the Environmental Protection Agency (EPA) to develop and enforce regulations to protect the general public from exposure to airborne contaminants known to be hazardous to human health. In 2007, the Supreme Court held that gases such as carbon dioxide fit within the Clean Air Act's definition of "air pollutant," and thus that EPA has the authority to regulate the emissions of such gases from new motor vehicles (*Massachusetts et al.* v. *EPA*, 549 U.S. 497, 532 (2007).

California Global Warming Solutions Act

The state of California passed Assembly Bill 32 (AB 32), the California Global Warming Solutions Act of 2006, to reduce the amount of greenhouse gas emissions within the state to 1990 levels by 2020. AB 32 requires the California Air Resources Board to adopt regulations for reporting and verifying statewide greenhouse gas emissions and for monitoring and enforcing compliance with the program.

4.9 Climate Change

The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time and the term "climate change" refers to a change in the mean or variability of one or more measures of climate (for example, temperature or precipitation) that persists for an extended period, whether the change is due to natural variability or human activity (IPCC 2013a, p. 1450).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system, substantial increases in precipitation in some regions of the world, and decreases in other regions (for these and other examples, see Solomon *et al.* 2007, pp. 35–54, 82–85; IPCC 2013b, pp. 3–29; IPCC 2014, pp. 1–32). Results of scientific analyses presented by IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is "very likely" (defined by the IPCC as 90% or higher probability) due to the observed increase in greenhouse gas concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (Solomon *et al.* 2007, pp. 21–35; IPCC 2013b, pp. 11–12 and figures SPM.4 and SPM.5).

Scientists use a variety of climate models, which include consideration of natural processes and variability as well as various scenarios of potential levels and timing of greenhouse gas emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (e.g., Meehl *et al.* 2007, entire; Ganguly *et al.* 2009, pp. 11555, 15558; Prinn *et al.* 2011, pp. 527, 529). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that greenhouse gas emissions will stabilize or decline. Thus, there is strong scientific support for projections that show warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of greenhouse gas emissions (Meehl *et al.* 2007, pp. 760–764, 797–811; Ganguly *et al.* 2009, pp. 15555–15558; Prinn *et al.* 2011, pp. 527, 529; IPCC 2013b, pp. 19–23). See IPCC 2013b (entire), for a summary of other global projections of climate-related changes, such as frequency of heat waves and changes in precipitation.

Global climate projections are informative, and, in some cases, are the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (IPCC 2013b, pp. 15–16). Therefore, we use "down-scaled" projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick *et al.* 2011, pp. 58–61, for a discussion of downscaling).

Pierce *et al.* (2013) used different methods to produce down-scaled climate change models for California, using climate data from the period of 1985 to 1994, and predicted future temperature and precipitation changes for the future period of 2060 to 2069. The models suggest that by the 2060s, average state temperatures could increase 2.4°C with coastal temperatures rising about 1.9°C and inland areas warming almost 2.6°C. Increased temperatures will be more pronounced during the summer (June–August) compared to the winter (December–February) (Pierce *et al.* 2013, p. 844). In addition to temperature increases, the models predict a small annual decrease in precipitation in southern California and a negligible decrease in the north; however, precipitation patterns between seasons will be much more pronounced. Northern California is predicted to have wetter conditions in the winter with drier conditions during the rest of the year. In contrast, the southern portion of the state will experience a decrease in precipitation in every season except the summer, when projections show an increase in the amount of precipitation (Pierce *et al.* 2013, pp. 848–850). Precipitation projections also suggest there will be increased chances of flooding due to an increase in the 3-day maximum precipitation rate, especially in the northern portion of the state. It should be recognized that the projected seasonal changes are relatively small when compared to the state's natural variability (Pierce *et al.* 2013, p. 855).

Hayhoe *et al.* (2004) also produced down-scaled climate change models for California using climate data from the period from 1961–1990 to predict future temperatures and precipitation for the period 2070–2099. Their models indicate a decrease in winter precipitation concentrated along the north coast and in the Central Valley, which is the primary breeding range of the tricolored blackbird (Hayhoe *et al.* 2004, pp. 12423–12424). Since some of the species' current breeding and foraging habitats are often associated with irrigated agricultural land uses, the amount of precipitation projected for the Central Valley during the winter may not be a direct reflection of the available water on the landscape. This is due to the fact that irrigation water in the Central Valley is provided via reservoir water storage from snowpack melt. However, a majority of the simulations completed by Hayhoe *et al.* (2004) show a decline in the amount of reservoir inflow from snowpack melt, so the amount of available water on the landscape is likely to decline by the end of the century (Hayhoe *et al.* 2004, pp. 12424–12425).

Annual average air temperatures in California have increased by 1.5°F since the beginning of the 20th century (Bales 2013, p. 2). This coincides with increased aridity or drought conditions recorded within California since the early 1900s (Cook *et al.* 2004, p. 1016). This increase in aridity can impact the tricolored blackbird by reducing the amount of vegetative growth needed for nesting, the amount of water found in wetland habitats which provide some protection from predators, and the amount of vegetative growth that their insect prey base relies on and which the species relies on for plant-based diet items. All of these factors can impact the reproductive success of the species and could potentially reduce survival if food sources become scarce. In addition, during drought conditions, farmers in the Central Valley can let their fields go fallow or reduce the amount of crops they grow. In areas where the species depends on agricultural crops for breeding (silage) or foraging (alfalfa), the fallowing of fields due to drought conditions may prevent the species from breeding at those particular locations. Conversely, diminished irrigation supplies may result in the conversion of unsuitable crops back to suitable row crops, which may benefit the species.

Climate projections for the Pacific Northwest, which includes Oregon and Washington, from 2045 to 2054 suggest increased temperatures during the winter and spring seasons (Salathé *et al.* 2008, pp. 5714, 5718–5719, 5721). Projected changes in precipitation throughout the inland portion of the Pacific Northwest differ significantly compared to projected changes in California. The amount of precipitation along the Cascade Mountain Range is predicted to modestly increase in the fall and slightly increase during the winter, with no changes during the other seasons. In addition, the number of significant precipitation events is predicted to increase (Salathé *et al.* 2008, pp. 5714–5715, 5720–5723). Climate changes in the extreme western portion of Nevada where the species is known to occur are likely to be similar to the predicted changes in the extreme eastern portion of California, with temperatures increasing by 2–3°C and drier conditions in every season but the winter, when conditions are project to be wetter (Pierce *et al.* 2013, pp. 844, 848–850).

The effects of climate change will continue to impact the species throughout its range into the future. Since the primary range of the species occurs within the Central Valley, Sierra Nevada foothills, and Southern California locations, the colonies that occur within these regions are most likely to be affected. In the primary portion of the species range, projected climate change effects are likely to impact the amount and quality of available nesting and foraging habitats, potentially reducing reproductive success at certain locations. Although the increase of precipitation during the winter could allow wetlands to become inundated and will saturate the ground for vegetative growth, managed wetlands relying on water from reservoir storage may be negatively impacted if the amount of water allocated to these areas are reduced. In addition, the predicted decline in precipitation during the other seasons and the increase of temperatures could reduce the amount of suitable nesting substrates available on the landscape. In particular, the growth of non-native upland vegetation found outside of irrigated areas (i.e., excluding Himalayan blackberry) during the breeding season may be reduced, which could result in a reduction in the size and/or number of breeding colonies, and therefore resiliency, within regions that primarily depend on non-native vegetation for nesting (Sierra Nevada Foothills and San Francisco Bay Delta regions). The growth of silage crops within the San Joaquin Valley and alfalfa throughout the Central Valley is likely to continue, but with reductions in reservoir inflow and economic motivations to convert to perennial crops, it is possible the amount of silage crops and alfalfa grown will decline. If the amount of silage crops grown in the San Joaquin Valley result in smaller and/or fewer silage colonies, the resiliency of the San Joaquin Valley region will decline. If the amount of alfalfa grown within the Central Valley is reduced, the amount of available foraging habitat in the San Joaquin and Sacramento Valley regions will decrease. This decrease in foraging habitat is likely to result in smaller and potentially fewer breeding colonies within these regions, which would reduce the resiliency of the San Joaquin and Sacramento Valley regions.

A range-wide effect will likely be seen in the quality of foraging habitat due to reduced vegetative growth from a lack of rain and/or increased temperatures, although effects may be more pronounced in agricultural regions dependent on stored snowpack runoff. Low quality foraging habitat may not support an adequate abundance of insects during the breeding season to support nearby nesting colonies and may not provide abundant vegetative diet items for fledglings, juveniles, and adults. This would likely result in not only reduced reproductive success for the species, but could also impact adult survival, further reducing the resiliency of each region throughout the species' range.

The loss and/or reduction of suitable nesting substrate in the primary portion of the species range and the declining quality of foraging habitat and subsequent reduction in available insect and/or vegetative diet items throughout the species range will likely result in the loss of breeding colonies or a decrease in the size of breeding colonies within each region throughout the species' range, although potentially disproportionate in areas of intensive agriculture. This reduction in colony number and/or size will result in a decrease of the species' overall representation and redundancy.

The Clean Air Act and the California Global Warming Solutions Act address the threat of climate change by reducing greenhouse gas emissions within the United States and California, respectively. For more information on the Clean Air Act and the California Global Warming Solutions Act, see section 4.8 Management Actions.

4.10 Combined Effects

Multiple stressors can act on a species or its habitat at the same time, which can result in impacts that are not accounted for when stressors are analyzed separately. Stressors that appear minor when considered alone may have greater impacts on individuals, colonies, regions, or habitat when analyzed in combination with other stressors.

The tricolored blackbird evolved in California, which has always had a highly variable climate with natural periodic droughts and severe storms. However, the wide scale loss of nesting and foraging habitats has changed the distribution of the species on a landscape that is very different than what was seen historically. The concentration of a large proportion of the breeding population into just a few breeding colonies can make the species much more susceptible to severe storms, especially colonies that use nesting substrates other than Himalayan blackberry, which is sturdier than other substrates. The species' current use of certain upland substrates for nesting, particularly silage and milk thistle, make the species more vulnerable to severe storms in those vegetation types than historically. Likewise, if drought conditions further reduce the amount of nesting and foraging habitat available in a particular year, it likely has an effect on the collective reproductive success of all breeding colonies. However, when events such as severe storms do occur and an entire nesting colony is destroyed, the tricolored blackbird is biologically able to begin nesting again in a relatively short amount of time if alternative nesting substrate is available.

In addition to being more susceptible to severe storms, the concentration of a large proportion of initial breeding birds into silage colonies puts the species at an increased risk of reproductive failure due to silage harvest. Although breeding adults are able to fly to another suitable nesting location and breed again, the continued destruction of suitable breeding and foraging habitats makes locating a new suitable breeding location more difficult.

Individuals found within the regions in the primary portion of the species' range and in the smaller peripheral regions face risks from natural and anthropogenic sources. Climate change has already begun to affect the regions of the Central Valley where the tricolored blackbird occurs, resulting in higher air temperatures and increased aridity (Cook *et al.* 2004, p. 1016). Increased aridity can reduce the amount of certain types of vegetative growth used for nesting and foraging, putting regions in the Central Valley, and throughout the species range, at an elevated risk of current and future habitat loss. Additionally, ongoing development and increased conversion within the Central Valley of appropriate nesting and foraging crops to orchards and barren land would continue to eliminate available habitat for the species. Jongsomjit *et al.* (2013) used current and future climate projections, housing development density projections for California, and species distribution models to evaluate potential impacts of both climate change and housing development on a suite of bird species in California. Their results suggest the largest climate-induced decreases in species probability of occurrence and the highest levels of development will occur in the Central Valley (San Joaquin Valley and Sacramento Valley regions). They also found that some lower elevation portions of the Sierra Nevada (e.g., foothills) may experience climate-induced increases in species probability of occurrence while facing potentially large impacts due to future development (Jongsomjit *et al.* 2013, pp. 187, 195–197). In addition, future State Water Project deliveries to various users is projected to decline in the future (DWR 2013, p. S-2, 45–51), which would impact the amount of available nesting and foraging habitats that depend on irrigation. The magnitude of these combined effects on the tricolored blackbird is unknown; however, these results suggest there will be a decrease in available habitat within the Central Valley for the species and potentially a decrease within the Sierra Nevada foothills as well.

These risks, alone or in combination, could result in the extirpation of the smaller peripheral regions outside of the primary range of the species and/or vulnerable regions within the primary range of the species that contain only a few small breeding colonies, further reducing the overall redundancy and representation of the species. Historically, the tricolored blackbird's primary wetland habitat was likely less resilient to stochastic events such as drought since the growth of wetland vegetation depends on water availability. Under current conditions, the species has replaced and supplemented its nesting and foraging needs with agricultural habitats and non-native vegetation that can be found in upland habitats, which also depend on either stored water or direct precipitation.

4.11 Summary

Our analysis of the past, current, and future influences on what the tricolored blackbird needs for long term viability revealed that there are four influences that pose the largest risk to future viability of the species. These risks are primarily related to habitat changes: the loss of nesting and foraging habitats to development and conversion to unsuitable crops, the destruction of breeding colonies during agricultural harvest, the threat of severe storms and drought, and the application of pesticides throughout the species range, but primarily in the Central Valley. Furthermore, these influences are all exacerbated by the effects of climate change. We did not assess the use or take of tricolored blackbirds for scientific and commercial purposes because these risks do not appear to be occurring at a level that affects entire regions (i.e., all colonies within the region). The loss of nesting and foraging habitat, the destruction of silage colonies, the threat of severe storms and drought, the application of pesticides throughout the species range, and the effects of climate change, as well as management actions, are carried forward in our assessment of the future conditions of tricolored blackbird regions and the viability of the species overall.

4.12 Current Condition

The available information indicates that the tricolored blackbird's current range is either larger than its historical range or has begun to shift northward as portions of the range in southern California and Baja California have been unoccupied in recent years (Clipperton 2017, pers. comm.; Robinson *et al.* 2018, pers. comm.). Historical records do not indicate that the species occurred in the state of Washington; however, since the 1990s, small colonies have been observed within the interior of the state. These recent observations are considered a northward expansion of the species' known historical range (Beedy and Hamilton 1999, pp. 3–4). It should be noted that although the species' range may have expanded, the distribution of the species has changed as the landscape within its range has changed, and the species' overall population has declined. The number of individuals within southern and Baja California have declined to very low numbers compared to historical accounts; however, breeding colonies are still found in these regions. The number of individuals found within the Sierra Nevada foothills may have increased in response to management practices associated with livestock grazing and the increased presence of upland vegetation for nesting.

In order to analyze the current and future condition of the species, we have broken the entire range of the species into regions. All of the nesting colonies found within Baja California comprise the Baja California region, all of the nesting colonies found within Nevada (of which there may only be one) comprise the Nevada region, all of the breeding colonies within Oregon are considered the Oregon region, and likewise, all of the breeding colonies within Washington comprise the Washington region. Since a large majority of the overall population occurs within California, we sub-divided the state into regions, which include specific counties within each region. The counties within each region (except for Baja California) are described in Table 3.1 and depicted in Figure 3.1. The regions within California were based on Meese 2014, Meese 2017, and Graves *et al.* 2013, and the counties identified for Oregon, Washington, and Nevada were based on eBird data.

4.12.1 Current Regional Resiliency

Methodology

To summarize the overall current condition of each tricolored blackbird region, we sorted them into three categories (high, moderate, and low; defined in Table 4.3) based on the species' regional needs and habitat elements discussed in section 3.1 Regional Resiliency (Tables 4.4a and 4.4b; Figure 4.5). Since the core and peripheral regions contain vastly different proportions of the overall population and they likely behave in different ways in respect to social facilitation of foraging and/or predator avoidance, the current condition category for the core and peripheral regions are discussed separately. The current condition category is a qualitative estimate based on the analysis of the species' regional needs and habitat elements. For the core regions, this analysis will include the three core regional needs (reproduction, abundance, and survival) and two habitat elements (only one is being categorized). The analysis for the peripheral regions will include the three peripheral regional needs (reproduction, survival, and connectivity) and two habitat elements (only one is being categorized). In determining the summary categories, we doubled the weight of the regional needs because, to some degree, the regional needs would already reflect habitat elements that are currently influencing the colonies within those regions.

Overall, tricolored blackbird colonies occur in areas with adequate nesting substrate and foraging habitat. However, colonies in the San Joaquin Valley primarily nest in substrates that are not considered the best quality for the species as silage crops are non-native and subject to harvest while the species is actively nesting in it. In addition, it is possible all of the regions may not have adequate foraging habitat that supports abundant insect populations and/or enough nesting substrate to support larger, successful breeding colonies like seen historically.

There were numerous early season breeding colonies, or concentrations of birds seen during the early breeding season, identified within each region (except for Nevada) in 2017 (Meese 2017, p. 12; eBird 2017). In the San Joaquin and Sacramento Valley regions, there were breeding colonies identified at 56 and 34 locations, respectfully, spread throughout their respective regions. The Southern California region had breeding colonies identified at 24 different locations. The other regions have varying numbers of colonies; Nevada only has one, which is mostly due to past and current land uses and environmental conditions (annual rainfall, amount of vegetative growth, etc.). The occurrence of individuals within each region during the early portion of 2017 breeding season indicates all of the regions support early season breeding colonies that are potentially recruiting individuals into the overall breeding population. It should be noted, however, that the timing of the Statewide Survey, which allows the most accurate population estimate of the species state-wide, would capture few individuals breeding within the northern regions (Sacramento Valley, North Coast, Northeast Interior, and portions of the Sierra Nevada Foothill and San Francisco Bay Delta regions) since these areas typically support breeding tricolored blackbirds during their second nesting attempt later in the season. The Sacramento Valley, Sierra Nevada Foothills, San Francisco Bay Delta, Central Coast, and Southern California regions are currently at a moderate condition, the North Coast region is currently at a moderate to low condition, and the San Joaquin Valley region is currently at a low condition (the definitions for high, medium, and low condition are defined in Table 4.3).

4.12.2 Current Species Representation

We consider the tricolored blackbird to have representation in the form of ecological setting diversity, as defined by the EPA Level III eco-regions. As described in section 3.2 Species Representation, these eco-regions are able to support different sizes and types of dominant vegetation for nesting and foraging, which likely has an effect on the size and density a nesting colony could be at a particular location. The species currently occupies fourteen eco-regions. Assuming the species has always occupied each eco-region within Oregon as the species currently does (see Range and Distribution for a discussion of the species' range within Oregon), the species historically occupied fourteen EPA Level III eco-regions, despite the species' apparent range expansion into Washington in the 1990s. This is due to the fact that the Columbia Plateau eco-region, which is the only eco-region the birds in the Washington region occupy, also occurs within Oregon.

4.12.3 Current Species Redundancy

We consider redundancy for the tricolored blackbird as the number of resilient regions found throughout the species range. Tricolored blackbird regions are considered resilient when they contain multiple successful breeding colonies. Currently, the tricolored blackbird has twelve resilient regions throughout its range, although some of the peripheral regions contain fewer breeding colonies, which make them less resilient than others.

Assumptions for Tables 4.3, 4.4a, and 4.4b

Reproduction: Although previous estimations for reproductive success should not be used to suggest average success for the species overall (Beedy *et al.* 2017, Demography and Populations section), it is the best available information we have to create a condition category for reproduction. So for the purposes of this SSA Report, we are assuming reproduction is at 0.62 across all regions minus the Sierra Nevada Foothills region since we do not have specific data on reproductive success for those other regions or colonies within those regions (Meese 2013, p. 103). Since the overall population has been declining over time, this reproductive success rate is considered a low condition. Airola *et al.* (2015a) found colonies within the Sierra Nevada Foothill region had an average reproductive success of 0.84, so for that region, the reproductive success rate is considered a moderate condition (Airola *et al.* 2015a, pp. 68–69).

Abundance: For abundance, we will look at the Statewide Survey trend data for each core region from 2008 until 2017 (Meese 2017, pp. 12, 14–16) and the Sierra Nevada foothill trend data from 2014–2017 (Airola *et al.* 2016, p. 95; Airola 2017, entire). The categories for abundance should only be used for the core regions since these are the regions that rely on colonies having a high density of individuals to increase reproductive success via avoidance of nest and colony failure due to predation pressure or to readily exploit available resources in a changing environment via social facilitation. Since the peripheral regions (Northeast Interior, Oregon, Washington, Nevada, and Baja California regions) contain a small number of individuals and it is unknown whether these areas could support large breeding colonies that may increase their reproductive success, this category for the peripheral regions will be considered a low condition.

Survival: We are assuming an average annual survival rate of 0.6 across the range, based on previous estimates obtained from the analysis of recaptured birds banded by Robert Meese. Since we are unsure if this is sufficient to support the overall population but have survival rates of related species that are less than the tricolored blackbird, we are setting the survival rate for the species across all regions at moderate.

Protected Nesting Substrate: We weighted native substrates at a high condition since that is the species' natural habitat and non-native substrates are weighted at a low condition. Although reproductive success is thought to be higher in wetland and non-native vegetation compared to silage crops, it is actually the food availability associated with that substrate type that is thought to impact reproductive success (Meese 2013, p. 103, 110).

Foraging Habitat: Appropriate foraging habitat that supports abundant insect populations need to be within 5 km (3.1 mi), and at most 13 km (8.1 mi), of a breeding colony during the breeding season. Although we could calculate the amount of potential foraging habitat within 5–13 km (3.1–8.1 mi) of a known breeding colony for each region, this calculation will not tell us the condition or the productivity of that habitat at any given time. Therefore, we will not include a condition for this habitat element for the current and future condition categories. However, we will continue to include a description of this element throughout the rest of the document since insect prey base availability is likely driving the population trends we see today.

Figure 4.5 Assumptions for Tables 4.3, 4.4a, and 4.4b

Table 4.3 Regional needs and habitat characteristics used to create condition categories in Tables 4.4a and 4.4b

Condition Category	Regional Factors			Habitat Elements	
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Insect Foraging Habitat
High	Reproductive success is > 1	Total regional abundance has increased since 2008	Annual survival is > 0.6	Cattails and bulrushes found in extensive wetland habitats. Wetlands contain ponded water during the nesting season. Use of native vegetative species in upland habitats (e.g., nettles)	Abundant foraging habitat within 5 km of the nesting site
Moderate	Reproductive success is ≤ 1, but > 0.62	Total regional abundance has stayed stable since 2008 or is highly variable	Annual survival = 0.6	Use of both wetland habitats (wetlands have some ponded water during the nesting season) and non-native or agricultural vegetation	Abundant foraging habitat within 13 km of the nesting site, but not within 5 km of the nesting site <u>or</u> limited available foraging habitat within 5 km
Low	Reproductive success is ≤ 0.62 but > 0	Total regional abundance has declined since 2008	Annual survival is < 0.6 but > 0	Non-native and agricultural vegetation in agricultural, disturbed, and/or upland habitats. Very small proportion of overall nesting colonies using cattails and bulrushes in wetland habitats	Some available foraging habitat within 13 km of the nesting site, but not within 5 km of the nesting site <u>or</u> very limited available foraging habitat within 5 km of the nesting site
Ø	Reproductive success is 0	Region is extirpated	Annual survival is 0	Non-native and agricultural vegetation in agricultural, disturbed, and/or upland habitats that is threatened with destruction during the nesting season	No available foraging habitat within 13 km of the nesting site

Table 4.4a Current resiliency of tricolored blackbird core regions. See Table 4.3 for a description of condition categories.

Core Region	Regional Needs			Habitat Elements		
	Reproduction[1]	Abundance[3]	Survival	Protected Nesting Substrate[5]	Foraging Habitat*	**Current Condition**
San Joaquin Valley	Low	Low	Moderate	Low	Unknown	Low
Sacramento Valley	Low	Moderate	Moderate	Moderate	Unknown	Moderate
Sierra Nevada Foothills	Moderate[2]	Moderate[4]	Moderate	Moderate[6]	Unknown	Moderate
North Coast	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
SF Bay/ Delta	Low	Moderate	Moderate	Moderate	Unknown	Moderate
Central Coast	Low	Moderate	Moderate	Moderate	Unknown	Moderate
Southern California	Low	Moderate[#]	Moderate	Moderate	Unknown	Moderate

Table 4.4b Current resiliency of tricolored blackbird peripheral regions. See Table 4.3 for a description of condition categories.

Peripheral Region	Regional Needs			Habitat Elements		
	Reproduction[1]	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat*	**Current Condition**
Northeast Interior	Low	Low	Moderate	Moderate[5]	Unknown	Moderate/Low
Oregon	Low	Low	Moderate	High[7,8]	Unknown	Moderate/Low
Washington	Low	Low	Moderate	High[8]	Unknown	Moderate/Low
Nevada	Low	Low	Moderate	Moderate[9]	Unknown	Moderate/Low
Baja California	Low	Low	Moderate	High[10]	Unknown	Moderate/Low

[1] Meese 2013, p. 103; [2] Airola *et al.* 2015a, pp. 68–69; [3] Meese 2017, p. 8, 10-11; [4] Airola *et al.* 2016, p. 95; Airola 2017, entire [5] Graves *et al.* 2013, p. 6-8; [6] Airola *et al.* 2016, p. 99-101; [7] Marshall *et al.* 2003, p. 579; [8] Wahl *et al.* 2005, p. 345; [9] NDOW 2017, p. 2; Averill-Murray 2017, pers. comm.; [10] Feenstra 2013, p. 2, 4; [#] Although the results of the Statewide Survey show the number of individuals within the Southern California region has increased from 2008 to 2017, over half (6,300) of the individuals nesting in this region were found at one location within a state wildlife area where efforts have been made to provide the species with nesting and foraging habitats (Meese 2017, p. 23). If this colony is eliminated from the analysis, the Southern California region would be categorized as Moderate or Low. Since species experts agree this region can no longer support a large number of birds, we are placing the Southern California region at a moderate level of abundance.

* We do not have enough information regarding the condition or productivity of potential habitat within each region at any given time, so we will not include a condition for this habitat element. However, since insect prey base availability that is likely the limiting factor affecting reproductive success for the tricolored blackbird (Meese 2013, p. 110), we will retain this category for the discussion of future scenarios.

CHAPTER 5: FUTURE VIABILITY

We have considered what the tricolored blackbird needs for viability (Chapters 2 and 3), and we evaluated the past, current, and future influences that are affecting what the tricolored blackbird needs for long term viability and the current condition of those needs (Chapter 4). We now consider what the species' future conditions are likely to be. We apply our future forecasts to the concepts of resiliency, representation, and redundancy to describe the future viability of the tricolored blackbird.

5.1. Introduction

Although the tricolored blackbird has declined significantly in overall abundance, it currently occupies most of its historical range (possible retraction in southern California and Baja California) and has actually expanded its range north into the state of Washington. Over 99% of the tricolored blackbird's overall population occurs in California, with small numbers of birds in Oregon, Washington, Nevada, and Baja California. Historically, the species utilized the expansive wetland habitat available throughout California to support large nesting colonies that were known to accommodate up to 300,000 individuals. However, in response to the loss of over 96% of their wetland habitat in the Central Valley, the species has adjusted to using agricultural crops and other non-native vegetation found on the landscape. A large proportion of breeding birds within the Central Valley concentrate into a handful of colonies found in San Joaquin Valley dairy silage fields, which are at risk of being harvested while nestlings are still in their nests. The Statewide Survey, which is completed throughout the range of the species in California during the species' first nesting attempt at a specific interval of time, provides the best overall population estimate for the species and can be directly compared to interpret trends within each region. However, the Statewide Survey does not accurately indicate the breeding status of the species in the northern portion of California since the species breeds in these areas as a subsequent nesting attempt later in the breeding season. To accurately survey the central and northern core regions, properly timed and repeated surveys over the entire nesting season would need to be conducted within each region. Although unquantified, the Statewide Survey also likely underestimates the total population as a result of limited public access to large areas of private lands. For example, intensive breeding season surveys in the grassland region of the Sierra Nevada foothills have been determined to only cover about one-third of available habitat (Airola *et al.* 2015b, p. 110; Airola *et al.* 2016, p. 92). In addition, the species' itinerant, nomadic, and colonial nesting habits may contribute to over- or underestimates of the total breeding population; however, the Statewide Survey is conducted by experienced individuals and the results of the survey provide the most consistent and best available data. The results of the last Statewide Survey estimated that approximately 177,000 birds comprised the 2017 breeding population (Meese 2014, pp. 7, 12).

The effects of habitat conversion extend beyond just breeding habitat; the resultant conversion has reduced the amount of foraging habitat that supports abundant insect populations required for egg and nestling development. Add to this the exacerbating effects of climate change, the harvest of active colonies found in silage fields, and the application of pesticides—decreased vegetative growth to support nesting and foraging habitat, reduced insect abundances, and loss of suitable nesting substrate—and tricolored blackbird colonies within each region face varying levels of risk into the future. For the colonies found in the peripheral regions occupying areas away from the Central Valley, Southern California, the Sierra Nevada foothills, and California coast, a single stochastic event such as drought could eliminate nesting within that geographic area for a year or more.

The different combinations of influences and management actions discussed in Chapter 4 could result in varying changes to each of the tricolored blackbird regions and colonies found within those regions throughout its range. A reduction or increase in the number and/or size of breeding colonies within a region reduces or increases that region's resiliency. The loss of regions will reduce the species' overall redundancy and the loss of regions occupying different EPA eco-regions will reduce the species' overall representation. As a consequence of these influences acting on the species and the species' current condition, the future viability of the tricolored blackbird now primarily depends on ensuring successful reproduction to maintain or increase overall abundance, preventing further destruction of existing breeding and foraging habitat, and potentially, the restoration and/or creation of appropriate nesting and foraging habitat where feasible.

5.1.1. Scenarios

Because we have significant uncertainty regarding if, when, and/or where crop conversion, habitat removal or management, pesticide application, or development may occur (although we do know the Central Valley and Sierra Nevada foothills are projected to have the greatest increase in development), we have forecast the possible viability of the tricolored blackbird in terms of resiliency, representation, and redundancy under four plausible future scenarios. We chose to forecast the future scenarios for tricolored blackbird viability over the next 50 years because it is within the range of the available climate change model projections (Hayhoe *et al*. 2004; Pierce *et al*. 2013). Scenario 1 evaluates the condition of the tricolored blackbird if there is no increase in risks in each of the regions from what exists today, while the other scenarios evaluate the response of the species to different changes in each of those risks. For each scenario we describe the stressors that would occur in each region. Since the number of individuals within the core and peripheral regions represent vastly different proportions of the overall population and perhaps behave in different ways in respect to social facilitation when finding prey items and/or predator avoidance, we continue to separate the core and peripheral regions when analyzing future scenarios.

We examine the resiliency, representation, and redundancy of the tricolored blackbird under each of these four plausible scenarios. The resiliency of a particular tricolored blackbird region depends on future environmental conditions within that region and the availability of breeding and foraging habitat within that region. We expect each region to experience changes to these aspects of their habitat in different ways under the different scenarios. We projected the expected future resiliency of each region based on the events that may occur under each scenario and then projected an overall condition for each region. For these projections, regions in high condition are expected to have high resiliency at that time period; i.e., they have multiple breeding colonies, are at the high end of the known density range, colonies within the region are reproducing successfully, and the amount and quality of breeding and foraging habitat is sufficient to allow for varying population densities within that region. Regions in high condition are expected to persist into the future, beyond 50 years, and have the ability to withstand stochastic events that may occur. Regions in moderate condition are less resilient than those in high condition, but the majority (approximately 70 to 90%) of these regions are expected to persist beyond 50 years. Regions in moderate condition may contain fewer breeding colonies that are less dense than those in high condition. Finally, those regions in low condition have low resiliency and may not be able to withstand stochastic events, depending on the region they occur and the number and size of breeding colonies remaining in the region. As a result, regions in low condition are less likely to persist for 50 years; however, a region in a low condition does not automatically mean the region will become extirpated.

5.2. Scenario 1

Under Scenario 1, those factors that are having an influence on each of the tricolored blackbird regions continue at current rates for all of the influences but one, which may show a small reduction. The effects of climate change are already occurring at nearly all locations, although the effects of increased aridity are not apparent every year. In this scenario, pesticide application continues at the same rate as currently applied for that region (see section 4.5 Pesticides and Other Contaminants), the NRCS silage buy-out program funding is extended or other source(s) of funding is acquired, farmer participation to delay harvest each year is inconsistent, habitat destruction and conversion is still occurring, members of the Working Group continue to work with landowners in California to manage suitable nesting substrates and foraging habitats, and wetlands that are currently managed at National Wildlife Refuges to benefit the species are continued to be managed for the benefit of the tricolored blackbird. The conversion of crops to those unsuitable for foraging will continue under this scenario, but the rate at which fields become fallowed or barren will decrease and some fallowed and barren fields may be re-planted with suitable foraging crops. The fallowing of fields, especially in the Central Valley, will primarily occur during drought periods, but may be re-planted when conditions become suitable again. Destruction of suitable foraging and nesting habitat for development will continue, especially around established urban centers. The future condition for the core and peripheral regions under Scenario 1 are shown in Table 5.1a and 5.1b, respectively.

5.2.1. Resiliency

San Joaquin Valley – In Scenario 1, the San Joaquin Valley region experiences an increase in aridity during some years due to climate change. The increase in aridity would result in less non-native nesting substrate growth, such as thistle, and a reduction in the amount of wetland habitats available to the species. Since individuals within this region rely primarily on agriculture-associated habitats for nesting and foraging, large silage colonies will likely still occur within this region and the distribution of the species throughout the region would be similar to the current distribution. However, due to current abundance trends for this region, it is likely this region would not contain as many individuals and the extent of the large colonies within this region and/or the number of them throughout the region is likely to be reduced. In addition, it is possible that drought conditions could reduce the amount of silage growth these colonies use as nesting substrate and/or could result in the conversion of orchards back to suitable crops; however, the extent in which either of these could happen is unknown. Under this scenario, the San Joaquin Valley region would maintain a low resiliency.

Sacramento Valley – The Sacramento Valley region experiences increased aridity during some years due to climate change, which may impact the extent of non-managed wetland habitats throughout the region. Wetlands that are currently being managed for the species, which are found throughout the region, would still provide nesting habitat for the species. The effects of climate change may also reduce the extent of these managed wetlands due to reduced water storage. Under Scenario 1, the Sacramento Valley region would maintain a moderate resiliency.

Sierra Nevada Foothill – Under Scenario 1, the Sierra Nevada Foothill region would likely have a reduction in the amount of non-native vegetative growth the species uses for nesting due to increased aridity during some years due to climate change; however, non-native vegetative growth associated with irrigation will remain and non-native vegetation would provide nesting substrate in years of increased precipitation. The Sierra Nevada Foothill region would maintain at a moderate resiliency under this scenario.

North Coast – The North Coast region would likely have a reduction in the amount of Himalayan blackberry and wetland vegetation growth the species uses for nesting due to increased aridity during some years due to climate change; however, blackberry and wetland vegetation would grow during years of increased precipitation and any vegetation associated with irrigation would remain. The number of individuals within this region would remain low. Under Scenario 1, the North Coast region would maintain a moderate to low resiliency.

San Francisco Bay Delta – Due to increased aridity during some years due to climate change, under Scenario 1 the San Francisco Bay Delta region would likely have a reduction in the amount of non-native nesting substrate. Wetland habitats, especially in tidally influenced areas, would remain consistent, although the species may not utilize these areas for nesting. This region would maintain a moderate resiliency under Scenario 1.

Central Coast – Under Scenario 1, the Central Coast region would likely have a reduction in the amount of wetland habitats that are not tidally influenced due to increased aridity during some years due to climate change; however, this region would likely continue to have multiple breeding colonies in other habitat types. This region would be moderately resilient under Scenario 1, although the number of individuals within the region may decrease.

Southern California – Due to increased aridity during some years due to climate change, under Scenario 1 the Southern California region would likely have a reduction in the amount of non-native nesting substrate available for the species and the extent of existing wetland habitats may be reduced. Foraging habitat within this region may decline due to development, but will likely be concentrated around existing urban centers. Under Scenario 1, the Southern California region would maintain moderate resiliency as this region would likely still maintain multiple breeding colonies, although potentially with fewer individuals.

Table 5.1a Tricolored blackbird core regional resiliency under Scenario 1.

Core Region	**Regional Needs**			**Habitat Elements**		**Future Condition**
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat	
San Joaquin Valley	Low	Low	Moderate	Low	Unknown	Low
Sacramento Valley	Low	Moderate	Moderate	Moderate	Unknown	Moderate
Sierra Nevada Foothills	Moderate	Moderate	Moderate	Moderate	Unknown	Moderate
North Coast	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
SF Bay/ Delta	Low	Moderate	Moderate	Moderate	Unknown	Moderate
Central Coast	Low	Moderate	Moderate	Moderate	Unknown	Moderate
Southern California	Low	Moderate	Moderate	Moderate	Unknown	Moderate

Peripheral Regions (Northeast Interior, Oregon, Washington, Nevada, Baja California) – Since the information available for the peripheral regions is limited, the number of birds within these regions are small compared to the other regions, and the nesting substrates described are similar (except for the Northeast Interior and Nevada regions which have recently been documented as using stinging nettle and wild rye as a dominant substrate), we assume they will react similarly under Scenario 1. Climate change projections in the Pacific Northwest predict an increase in precipitation during the fall and winter and no change in the amount of precipitation during the other seasons, so the effects of climate change within those regions will not result in the loss of nesting habitat for the species. Due to increased aridity during some years due to climate change, the Nevada region may have a reduction in the amount of vegetative growth the species uses for nesting; however, since the species is only known to regularly breed at one location within this region when environmental conditions are favorable, the effects of climate change under this scenario should be minimal. Because of the small size and isolation of the colonies found in the peripheral regions, under Scenario 1 the peripheral regions would maintain a moderate to low resiliency.

Table 5.1b Tricolored blackbird peripheral regional resiliency under Scenario 1.

Peripheral Region	**Regional Needs**			**Habitat Elements**		**Future Condition**
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat	
Northeast Interior	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
Oregon	Low	Low	Moderate	High	Unknown	Moderate/Low
Washington	Low	Low	Moderate	High	Unknown	Moderate/Low
Nevada	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
Baja California	Low	Low	Moderate	High	Unknown	Moderate/Low

Scenario 1 projects the condition of each tricolored blackbird region if the current risks continue on the same, or very similar, trajectory they are on now. Overall, all regions would be at a moderate, moderate to low, or low condition, with the peripheral regions only having multiple nesting colonies within the region during favorable environmental conditions.

Over the next 50 years, this scenario is most likely to occur since we expect climate change to continue (thereby increasing the likelihood of aridity), the use of pesticides is likely to continue at current levels throughout the range, the conversion to crops that are unsuitable for the species is likely to continue, and development is likely to continue. However, we believe the rate at which fields are fallowed or left barren is likely to either decrease or reverse in the future since the trend we have seen over the last 10 years is most likely due to extreme drought conditions from 2012 until 2017. The effects of climate change on water delivery in California, and the rate at which fields are fallowed or converted to more suitable crop types in the future is unknown.

5.2.2. Representation

As identified above, we consider the tricolored blackbird to have representation in the form of ecological setting diversity, as defined by the EPA Level III eco-regions. In Scenario 1, the current level of representation in the U.S.A. would be maintained. The number of individuals within the peripheral regions is likely to remain low and the Nevada region in particular may not maintain a breeding colony every year, resulting in a reduction of the level of representation within those regions until environmental conditions improve again.

5.2.3. Redundancy

Within each region, we examined what redundancy would exist under the various scenarios. Under Scenario 1, redundancy would remain similar to current levels because breeding colonies would continue to persist within each region and because each region would maintain its resiliency. The peripheral regions would continue to contain relatively few individuals and may not support numerous breeding colonies, or any in the case of the Nevada region, when environmental conditions are unfavorable. During those years, redundancy will be reduced, but will increase again when conditions improve.

5.3 Scenario 2

Scenario 2 is a best case scenario under which all regions retain or improve their current condition. Under this scenario, the effects of climate change are continuing to occur at nearly all locations, the use of pesticides throughout the species' range is reduced, the NRCS silage buy-out program funding is extended and there is full participation, members of the Working Group and other partners have been able to implement restoration efforts and outreach to private landowners within California that have appropriate nesting and foraging habitat for the species, managed wetlands are managed to benefit the species and not just waterfowl, crop conversion to unsuitable crops stops and/or slightly reverses, and some fallowed/ barren fields are planted with suitable foraging crops. The future condition for the core and peripheral regions under Scenario 2 are shown in Table 5.2a and 5.2b, respectively.

5.3.1 Resiliency

San Joaquin Valley – In Scenario 2, there is an increase in the amount of suitable foraging crops (e.g., alfalfa) planted within the San Joaquin Valley region and the existing crops within the region are more productive due to the reduction in insecticide use. An increase in the available prey base will allow colonies to potentially be more abundant and will increase reproductive success. The large silage colonies found within this region are fully protected and the young are able to fledge without being harvested. Furthermore, due to efforts of members of the Working Group, there are likely to be additional breeding colonies found in wetlands and non-native vegetation that is allowed to grow (i.e., is not being treated with herbicides) or is being managed to benefit the species. The distribution of breeding colonies would be similar to the current distribution, but there is likely to be an increase both in the number of individuals and potentially colony sites found within the region, both in response to the increase in available nesting substrate and increase in insect abundance. Under this scenario, reproductive success and abundance increase for the colonies found within the San Joaquin Valley region, which would increase the resiliency of the region to a moderate level.

Sacramento Valley – The amount of available wetland habitat within the Sacramento Valley region will increase due to restoration efforts and outreach to private landowners. In addition, the reduction in pesticide use and the planting of suitable foraging crops will result in additional breeding colonies throughout the region. It is also likely under this scenario that the size of breeding colonies will increase due to the increased availability of insects and the increase in the species' overall breeding population. Under Scenario 2, the Sacramento Valley region would stay at a moderate resiliency even though the colonies within this region are likely to experience an increase in both reproductive success and abundance.

Sierra Nevada Foothill – Under Scenario 2, the Sierra Nevada Foothill region would likely have an increase in the amount of available foraging habitat due to the outreach efforts of individual members of the Working Group with private landowners to maintain nearby nesting substrates and reduce the amount of pesticides applied. With an increase in the amount of available foraging habitat adjacent to managed nesting habitat, and an increase in the overall breeding population, the Sierra Nevada Foothill region would slightly increase to a moderate to high resiliency.

North Coast – The North Coast region would have an increase in available foraging habitat due to the conversion of unsuitable crops to suitable crops, and from efforts of members of the Working Group with landowners to manage foraging habitats and adjacent nesting substrates that were previously unsuitable for the species. Under this scenario, the North Coast region would increase to a moderate resiliency.

San Francisco Bay Delta – Under Scenario 2, the San Francisco Bay Delta region would experience management changes similar to the North Coast region; however, the resiliency of this region would be maintained at moderate.

Central Coast – Under this scenario, the Central Coast region would likely have an increase in the amount of available breeding and foraging habitat due to efforts by members of the Working Group, and there will likely be a greater abundance of insects within the region due to the reduction in pesticide use. This increase in available habitat and insects will result in a slight increase in the number of breeding colonies and number of individuals within the region; however, even with an increase in the amount of available habitat and foraging items, the resiliency of the Central Coast region would stay at a moderate condition.

Southern California – The Southern California region would experience management changes similar to the North Coast and San Francisco Bay Delta regions.

Table 5.2a Tricolored blackbird core regional resiliency under Scenario 2.

Core Region	**Regional Needs**			**Habitat Elements**		**Future Condition**
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat	
San Joaquin Valley	Moderate	Moderate	Moderate	Low	Unknown	Moderate
Sacramento Valley	Moderate	High	Moderate	Moderate	Unknown	Moderate
Sierra Nevada Foothills	High	High	Moderate	Moderate	Unknown	High/Moderate
North Coast	Moderate	Low	Moderate	Moderate	Unknown	Moderate
SF Bay/ Delta	Moderate	Moderate	Moderate	Moderate	Unknown	Moderate
Central Coast	Moderate	Moderate	Moderate	Moderate	Unknown	Moderate
Southern California	Moderate	High	Moderate	Moderate	Unknown	Moderate

Peripheral Regions (Northeast Interior, Oregon, Washington, Nevada, Baja California) – Under this scenario, conservation efforts in California and increased insect availability throughout the range from the reduction in pesticide use will result in an increase in the number of breeding birds throughout the primary range of the species, which will likely benefit the peripheral regions by not only contributing new individuals to their breeding colonies, but also increasing reproduction rates within the breeding colonies in each region due to increased insect availability. With the increase in individuals and reproduction rates, the peripheral regions will increase to a moderate resiliency, but colonies within these regions would still be relatively small.

Table 5.2b Tricolored blackbird peripheral regional resiliency under Scenario 2.

Peripheral Region	**Regional Needs**			**Habitat Elements**		**Future Condition**
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat	
Northeast Interior	Moderate	Low	Moderate	Moderate	Unknown	Moderate
Oregon	Moderate	Low	Moderate	High	Unknown	Moderate
Washington	Moderate	Low	Moderate	High	Unknown	Moderate
Nevada	Moderate	Low	Moderate	Moderate	Unknown	Moderate
Baja California	Moderate	Low	Moderate	High	Unknown	Moderate

Scenario 2 provides an idea of the tricolored blackbird's best possible condition over the next 50 years. This scenario presumes all regions are able to maintain or improve their current condition. Overall, there would be one region in moderate to high condition and eleven regions in moderate condition.

Over the next 50 years, the probability of occurrence of this scenario diminishes as we expect climate change to continue, thereby increasing the likelihood of aridity; the use of pesticides is unlikely to decline from current levels; long-term funding to protect silage colonies is uncertain; and the conversion to crops that are unsuitable for the species is not likely to stop or reverse, even slightly. Therefore, we consider this scenario unlikely to occur.

5.3.2 Representation

As identified above, we consider the tricolored blackbird to have representation in the form of ecological setting diversity, as defined by the EPA Level III eco-regions. In Scenario 2, the current level of representation in the U.S.A. would be maintained and the level of representation within the peripheral regions may increase as new breeding colony locations become established within those regions and their respective EPA eco-regions.

5.3.3 Redundancy

Within each region, we examined what redundancy would exist under the various scenarios. Under Scenario 2, the tricolored blackbird would maintain all twelve regions. Since the Sacramento Valley, Sierra Nevada Foothills, North Coast, San Francisco Bay Delta, and most of the peripheral regions become more resilient under this scenario, the species would increase overall redundancy.

5.4 Scenario 3

Under Scenario 3, some of the risks we forecasted would continue to occur, and some that are predicted to decrease in intensity may not decrease. In this scenario, climate change results in more arid conditions throughout most of the range, the application of pesticides in the Central Valley continues at the same rate, the NRCS silage buy-out program funding or any other silage buy-out funding is unreliable and participation is inconsistent, crop conversion to unsuitable crops continues at the same rate seen over the last 10 years, fallowed and barren fields are not planted with suitable foraging crops, and wetlands that are currently managed to benefit the species are continued to be managed for the tricolored blackbird and not just waterfowl. It should be noted that although there will be increased aridity throughout the range, irrigated and upland habitats still provide nesting and foraging habitats for the species. The future condition for the core and peripheral regions under Scenario 3 are shown in Table 5.3a and 5.3b, respectively.

5.4.1 Resiliency

San Joaquin Valley – The San Joaquin Valley region experiences an increase in aridity during some years due to climate change. The increase in aridity would result in less non-native nesting substrate growth, such as thistle and blackberry, and a reduction in the amount of wetland habitat available to the species. In addition, the continued conversion of suitable foraging crops and the application of insecticides will reduce the productivity and the amount of available foraging habitat. Primarily due to the reduction of foraging and nesting habitats and the harvest of some silage colonies, the resiliency of the San Joaquin Valley region under Scenario 3 would maintain a low resiliency.

Sacramento Valley – Under Scenario 3, the Sacramento Valley region experiences an increase in aridity during some years due to climate change. The increase in aridity could result in a reduction of non-managed wetland habitats throughout the region, and some managed wetlands might experience increased predation rates due to a lack of deep ponded water beneath the native nesting substrates. The growth of non-native vegetation that is suitable for nesting would also be reduced in drought years, but would likely return in wetter years. The continued conversion of suitable foraging crops and the application of insecticides will reduce the productivity and the amount of available foraging habitat, although not to the extent seen in the San Joaquin Valley since the conversion of suitable foraging crops happens at a reduced rate within this region. Under Scenario 3, the Sacramento Valley region would decrease to a low to moderate resiliency.

Sierra Nevada Foothill – Under Scenario 3, the Sierra Nevada Foothill region would likely have a reduction in the amount of non-native vegetative growth the species uses for nesting due to increased aridity during some years due to climate change; however, non-native vegetative growth associated with irrigation will remain and non-native vegetation would grow in years of increased precipitation. The Sierra Nevada Foothill region would maintain a moderate resiliency.

North Coast – Due to increased aridity during some years due to climate change, the North Coast region would likely have a reduction in the amount of Himalayan blackberry and wetland vegetation the species uses for nesting. However, during years of favorable conditions, both of these vegetation types are likely to re-grow. Under Scenario 3, the North Coast region would maintain a moderate to low resiliency.

San Francisco Bay Delta – Under Scenario 3, the San Francisco Bay Delta region would likely have a reduction in the amount of non-native nesting substrate available due to increased aridity during some years due to climate change. Wetland habitats, especially in tidally influenced areas, would remain consistent; however, this vegetation may not be suitable for the species since it has not been documented using tidal wetlands for at least 15 years (Meese 2017, pers. comm.). Under this scenario, the region would decrease to a moderate to low resiliency.

Central Coast – Due to increased aridity during some years due to climate change, the Central Coast region would likely have a reduction in the amount of freshwater wetland habitats. There would also be a potential reduction in the amount and quality of available foraging habitat due to the effects of climate change and pesticide application. The reduction in foraging habitat would likely reduce the number of birds that breed within the region. Under Scenario 3, the Central Coast region would decrease to a moderate to low resiliency.

Southern California – Under Scenario 3, the Southern California region would likely experience an increase in aridity during some years due to climate change. This would likely result in a reduction in the amount of non-native nesting substrate available within the region and the extent of existing wetland habitats, although there would continue to be growth in wetter years. The increasing arid conditions will likely have a negative effect on the quality and quantity of foraging habitats, reducing the number of breeding birds the region can support. Under this scenario, the Southern California region would decrease to a moderate to low resiliency.

Table 5.3a Tricolored blackbird core regional resiliency under Scenario 3.

Core Region	**Regional Needs**			**Habitat Elements**		**Future Condition**
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat	
San Joaquin Valley	Low	Low	Moderate	Low	Unknown	Low
Sacramento Valley	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
Sierra Nevada Foothills	Moderate	Moderate	Moderate	Moderate	Unknown	Moderate
North Coast	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
SF Bay/ Delta	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
Central Coast	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
Southern California	Low	Low	Moderate	Moderate	Unknown	Moderate/Low

Peripheral Regions (Northeast Interior, Oregon, Washington, Nevada, Baja California) – Under Scenario 3, there would likely be a reduction in the extent and quality of wetland habitats and the amount of non-native upland vegetation available for the species to nest in, although during wetter years the growth of non-native vegetation that is suitable for nesting would likely increase. Since climate change projections in the Pacific Northwest predict an increase in precipitation during the fall and winter and no change in the amount of precipitation during the other seasons, climate change will not result in a loss of nesting substrates in those regions. Under Scenario 3, all of the peripheral regions would maintain a moderate to low resiliency.

Table 5.3b Tricolored blackbird peripheral regional resiliency under Scenario 3.

Peripheral Region	**Regional Needs**			**Habitat Elements**		**Future Condition**
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat	
Northeast Interior	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
Oregon	Low	Low	Moderate	High	Unknown	Moderate/Low
Washington	Low	Low	Moderate	High	Unknown	Moderate/Low
Nevada	Low	Low	Moderate	Moderate	Unknown	Moderate/Low
Baja California	Low	Low	Moderate	Moderate	Unknown	Moderate/Low

Scenario 3 provides an idea of the tricolored blackbird's condition over the next 50 years when the effects of current and future stressors continue to act on the species at the rate we have seen over the last 10 years. Overall, there would be one region in moderate condition, ten regions in moderate to low condition, and one region in low condition.

Over the next 50 years, this scenario is likely to occur since we expect climate change to continue, thereby increasing the likelihood of aridity; the use of pesticides is likely to continue at current levels; and the conversion to crops that are unsuitable for the species is not likely to stop. However, the increased acreage of fallowed and barren fields over the last 10 years was likely due to extreme drought conditions from 2012 until 2017. This rate could decrease or reverse in the future, but there is a potential it could increase when prolonged drought conditions occur again, especially if the effects of climate change result in increased aridity.

5.4.2 Representation

As identified above, we consider the tricolored blackbird to have representation in the form of ecological setting diversity, as defined by the EPA Level III eco-regions. In Scenario 3, all of the eco-regions will still be represented in the U.S., but the level of representation within each eco-region, especially in the peripheral regions, may be reduced. The Nevada region in particular may not maintain a breeding colony every year, resulting in a loss of representation in the Central Basin and Range eco-region until environmental conditions improve again. However, there are known breeding colonies within the Northeast Interior region that are just on the periphery of the Central Basin and Range eco-region, so it is possible this eco-region will still have representation in the Northeast Interior region.

5.4.3 Redundancy

Within each region, we examined what redundancy would exist under the various scenarios. Under Scenario 3, all of the regions would contain breeding colonies (Nevada in favorable years); however, as most of the regions lose resiliency, the overall level of redundancy is reduced. The loss of resiliency in the Sacramento Valley, San Francisco Bay Delta, Central Coast, and Southern California regions puts them at an increased risk of extirpation.

5.5 Scenario 4

Under Scenario 4, all of the risks we forecasted would occur, although the full scope and magnitude of some risks are challenging to predict, and some of the management actions that are currently happening cease. In this scenario, climate change results in more arid conditions throughout most of the range, pesticide use increases throughout the range, the NRCS silage buy-out program funding ends, crop conversion to unsuitable crops continues at an increased rate from what has been seen over the last 10 years, fallowed and barren fields are not planted with suitable foraging crops, and managed wetlands are no longer managed to benefit the species. Under this scenario, there is a range-wide reduction in the amount of foraging and nesting habitats, reducing reproductive success across all regions to a low condition. In addition, the continued harvest of silage colonies greatly reduces the reproductive success of the species in the San Joaquin Valley and Southern California region, further reducing the number of individuals within each region into the future. It should be noted that although there will be increased aridity throughout most of the range, irrigated and upland habitats may still provide nesting and foraging habitats for the species (Tables 5.4a and 5.4b).

5.5.1 Resiliency

San Joaquin Valley – In Scenario 4, the San Joaquin Valley region experiences an increase in aridity during some years due to climate change, which will reduce the amount of vegetative growth to support nesting and foraging. Without the NRCS silage buy-out program, a majority of silage colonies are lost to harvest. The conversion of suitable foraging crops will further reduce the quantity of available foraging habitat and the application of insecticides will reduce the quality of any suitable foraging crops remaining within the region. The reduction of suitable foraging habitats and the harvest of breeding colonies will maintain the resiliency of this region at a low condition.

Sacramento Valley – The Sacramento Valley region would experience increased aridity during some years, which will reduce the amount of non-managed wetland habitats and non-native vegetative growth throughout the region under Scenario 4. In addition, although the species is still likely to nest in managed wetlands found throughout the region, those colonies would be subject to an increased rate of predation due to a lack of deep ponded water beneath the colonies during the breeding season. The amount of foraging habitats available will decline due to ongoing crop conversion and the quality of any remaining suitable foraging crops will be reduced from the application of insecticides. Under this scenario, the Sacramento Valley region would decline to a low resiliency.

Sierra Nevada Foothill – Under Scenario 4, the Sierra Nevada Foothill region would decline to a moderate to low resiliency. The effects of climate change and the application of pesticides may reduce the amount of available nesting and foraging habitat for the species within this region, but the greatest impact is the reduction of the species' overall population due to the continued loss of reproductive effort in the San Joaquin and Southern California regions, and the overall reduction in reproductive success throughout the range.

North Coast – The North Coast region would likely have a reduction in the amount of vegetative growth the species uses for nesting and foraging in this region. The North Coast region would decline to a low resiliency under Scenario 4.

San Francisco Bay Delta – The San Francisco Bay Delta region would experience changes similar to the North Coast region. Under Scenario 4, the San Francisco Bay Delta region would decline to a low resiliency.

Central Coast – The Central Coast region would experience changes similar to the North Coast and San Francisco Bay Delta regions. The Central Coast region would decline to a low resiliency under Scenario 4.

Southern California – Under Scenario 4, the Southern California region would likely have a reduction in the amount of wetland nesting substrate available within the region, and if wetland vegetation remains, colonies nesting within it may experience increased predation risk due to the loss of ponded water beneath the colony. In addition, effects from climate change and increased development will reduce the quality and amount of foraging habitat. The Southern California region would decline to low resiliency and would be increasingly vulnerable to extirpation.

Table 5.4a Tricolored blackbird core region resiliency under Scenario 4.

Core Region	**Regional Needs**			**Habitat Elements**		**Future Condition**
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat	
San Joaquin Valley	Low	Low	Low	Low	Unknown	Low
Sacramento Valley	Low	Low	Low	Low	Unknown	Low
Sierra Nevada Foothills	Moderate	Low	Low	Moderate	Unknown	Moderate/Low
North Coast	Low	Low	Low	Low	Unknown	Low
SF Bay/ Delta	Low	Low	Low	Low	Unknown	Low
Central Coast	Low	Low	Low	Low	Unknown	Low
Southern California	Low	Low	Low	Low	Unknown	Low

Peripheral Regions (Northeast Interior, Oregon, Washington, Nevada, Baja California) – Since all of the peripheral regions outside of the Pacific Northwest primarily rely on the abundance of the overall breeding population and the presence of colonies within those regions vary with environmental conditions, it is likely the Northeast Interior, Nevada, and Baja California regions may not contain breeding colonies every year. However, small colonies throughout the Oregon and Washington regions are likely to still occur since some of the birds within these regions are resident and the effects of climate change may not affect the amount of nesting substrate on the landscape. Under Scenario 4, the Oregon and Washington regions would maintain a moderate to low resiliency. The other peripheral regions would decline to a low resiliency and would be extremely vulnerable to extirpation, although in favorable conditions they may become re-occupied.

Table 5.4b Tricolored blackbird peripheral region resiliency under Scenario 4.

Peripheral Region	**Regional Needs**			**Habitat Elements**		**Future Condition**
	Reproduction	Abundance	Survival	Protected Nesting Substrate	Foraging Habitat	
Northeast Interior	Low	Low	Low	Low	Unknown	Low
Oregon	Low	Low	Moderate	High	Unknown	Moderate/Low
Washington	Low	Low	Moderate	High	Unknown	Moderate/Low
Nevada	Low	Low	Low	Low	Unknown	Low
Baja California	Low	Low	Low	Moderate	Unknown	Low

Scenario 4 provides an idea of the tricolored blackbird's condition over the next 50 years when the effects of current and future stressors continue to act on the species at an increased rate or at the rate we have seen over the last 10 years, and all management actions to protect the species have ceased, primarily the protection of silage colonies within the San Joaquin Valley region. Overall, there would be three regions at a moderate to low resiliency, two of which are peripheral, and nine regions at a low resiliency.

Over the next 50 years, this scenario is unlikely to occur since the NRCS silage buy-out program and other silage colony protections have been successful and are supported by both conservation agencies and the dairy industry. However, the sources of funding to continue the buy-out programs are uncertain. In addition, the increased acreage of fallowed and barren fields over the last 10 years were likely due to extreme drought conditions from 2012 until 2017, and this rate is likely to either decrease or reverse in the future, until prolonged drought conditions occur again, which may occur more often due to the effects of climate change.

5.5.2 Representation

As identified above, we consider the tricolored blackbird to have representation in the form of ecological setting diversity, as defined by the EPA Level III eco-regions. In Scenario 4, the level of representation within the U.S.A. will decline due to the reduction in resiliency of all twelve regions. Breeding colonies found in remaining managed wetland habitats will be more vulnerable to predation since they will no longer be managed for the species, and other non-managed remnant patches of wetland habitat will have reduced water input due to climate change. In addition, the size and number of colonies breeding in agricultural habitats will be reduced due to declining insect abundances from increased pesticide use and the conversion of suitable foraging crops. Depending on if and where breeding colonies may be lost within a region, the species may no longer be represented in certain eco-regions in any particular year, which would further reduce the species' overall representation. At particular risk of extirpation is the Nevada region since it only has one breeding colony. If this region were to lose its one breeding colony, the species would lose representation in the Central Basin and Range eco-region within Nevada. However, there are known breeding colonies within the Northeast Interior region that are just on the periphery of the Central Basin and Range eco-region, so it is possible this eco-region will still have representation in the Northeast Interior region. Therefore, although it is possible that all of the eco-regions would still be represented under Scenario 4, it is unlikely all eco-regions will be represented every year. Under this scenario, each of the regions will have a reduced level of representation in each of their respective eco-regions and there will be an increased risk of losing representation in certain eco-regions altogether.

5.5.3 Redundancy

Within each region, we examined what redundancy would exist under the various scenarios. Under Scenario 4, the overall level of redundancy would be reduced since the resiliency of all the regions except for the Oregon and Washington regions would be reduced. As regions throughout the species range become less resilient, they will be subject to an increased risk of extirpation, further reducing the redundancy of the species.

5.6 Status Assessment Summary

We used the best available information to forecast the likely future condition of the tricolored blackbird. Our goal was to describe the viability of the species in a manner that will address the needs of the species in terms of resiliency, representation, and redundancy. We considered the possible future condition of the species. We considered a range of potential scenarios that we think are important influences on the status of the species. Our results describe a range of possible conditions in terms of the number and location of where tricolored blackbird regions, both core and peripheral, are likely to persist into the future (Tables 5.5a and 5.5b).

The tricolored blackbird faces a variety of risks from habitat destruction and removal, crop conversion, silage colony harvest, pesticide application, and climate change. These risks, and the level in which they act upon the various regions, play a large role in the future viability of the tricolored blackbird. If regions lose resiliency, the species overall will have a reduced level of representation and redundancy, which increases their risk of extirpation. If regions or the breeding colonies contained within those regions become extirpated, the species will lose representation and redundancy throughout the range.

Table 5.5a Summary of tricolored blackbird core region resiliency under each scenario.

Core Region	Condition				
	Current Condition	Scenario 1	Scenario 2	Scenario 3	Scenario 4
San Joaquin Valley	Low	Low	Moderate	Low	Low
Sacramento Valley	Moderate	Moderate	Moderate	Moderate/Low	Low
Sierra Nevada Foothills	Moderate	Moderate	High/Moderate	Moderate	Moderate/Low
North Coast	Moderate/Low	Moderate/Low	Moderate	Moderate/Low	Low
SF Bay/ Delta	Moderate	Moderate	Moderate	Moderate/Low	Low
Central Coast	Moderate	Moderate	Moderate	Moderate/Low	Low
Southern California	Moderate	Moderate	Moderate	Moderate/Low	Low

Table 5.5b Summary of tricolored blackbird peripheral region resiliency under each scenario.

Peripheral Region	Condition				
	Current Condition	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Northeast Interior	Moderate/Low	Moderate/Low	Moderate	Moderate/Low	Low
Oregon	Moderate/Low	Moderate/Low	Moderate	Moderate/Low	Moderate/Low
Washington	Moderate/Low	Moderate/Low	Moderate	Moderate/Low	Moderate/Low
Nevada	Moderate/Low	Moderate/Low	Moderate	Moderate/Low	Low
Baja California	Moderate/Low	Moderate/Low	Moderate	Moderate/Low	Low

APPENDIX A: LITERATURE CITED

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