

Settlement, Breeding, Productivity, and Color-banding
of Tricolored Blackbirds in 2007 in the Central Valley of California

Final Report

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U.S. Fish & Wildlife Service, Pacific Region
911 NE 11th Ave
Portland, OR 97232-4181

and

Audubon California
4225 Hollis Street
Emeryville, California 94608

Robert J. Meese, Ph.D.
Department of Environmental Science & Policy
University of California
Davis, CA 95616

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Introduction

The tricolored blackbird (*Agelaius tricolor*), hereafter “tricolor”, is a highly colonial North American songbird that is nearly endemic to California (Orians 1980; Beedy and Hamilton 1999). Due to large-scale losses of its breeding and foraging habitats, the numbers of tricolors dropped dramatically during the 20th Century (Neff, 1937; DeHaven, et al., 1975a; Beedy and Hamilton, 1997; DeHaven, 2000; Cook and Toft, 2005) and concern for the future of the tricolor led to a petition by the Center for Biological Diversity to list the tricolor under the State of California and U.S. Endangered Species Acts (CBD, 2004).

The work described in this report continues and expands upon efforts which began in the 1930's (Neff, 1937) and continued more consistently in the 1970's (DeHaven et al., 1975a,b) and through the 1990's (Hamilton 2000) and into the 21st Century (Hamilton and Meese 2005, Meese 2006), to determine the breeding requirements, status, and trends of tricolors through field work conducted primarily during the breeding season. Tricolors were banded as nestlings in large numbers several decades ago by Neff and DeHaven but then not banded again until Hamilton banded 300 birds in one location in Kern County in 2000 (Hamilton 2000). Relatively large numbers of tricolors were color-banded in three locations this year, and the resumption of banding significantly expands upon recent efforts to study the species.

This as well as prior field work emphasized the Central Valley, although the tricolor has two distinct population segments: the Central Valley population and the southern California population. The tricolor historically nested in large numbers in coastal marshes in southern California (Baird, 1870; Neff, 1937; DeHaven, et al., 1975a; Beedy and Hamilton 1999; Cook and Toft, 2005; Unitt, 2004). Workers in southern California have documented severe population declines in the southern California population segment (Neff, 1937; Beedy and Hamilton, 1997; Unitt, 2004) and only two breeding colonies were detected in southern California in 2007 despite intensive survey efforts and much information-sharing (Tom Paulek, Phil Unitt, and Kimball Garrett, pers. comm., Tyler Grant, U.S. Fish & Wildlife Service, via email). Small numbers of tricolors are also found in northern Baja California, western Nevada, southern Oregon, and southern Washington (Beedy and Hamilton 1999; Seattle Audubon Society Birdweb website, <http://www.birdweb.org/birdweb/index.aspx>, accessed October 2007).

The annual search for, monitoring, and conservation of the largest tricolor colonies on private property, especially grain fields in the San Joaquin Valley, are the most essential components of recent attempts to stem the population decline and increase the numbers of tricolors in California. However, stochastic events over which we exert no control may play an important role in tricolor population regulation and, hence, our efforts to conserve the species, as was documented this year. Intensive efforts lasting the entire breeding season that detected and monitored 27 colonies throughout the

Central Valley, and three others reported by other researchers in San Diego and Colusa Counties, showed that the species suffered a near-complete range-wide reproductive failure in 2007, and only 3 of the 27 colonies monitored were known to fledge average numbers of young. The effects of this year's reproductive failure will be assessed by next year's triennial tricolored blackbird Survey.

Methods

Breeding Colony Search Criteria. Prior to field work, I contacted by telephone County Planning Department staff in Merced County to request a map of the locations of dairies, as the largest breeding colonies in the San Joaquin Valley are situated in grain fields adjacent to dairies (Beedy and Hamilton, 1999; Hamilton and Meese, 2005; Meese 2006) and I had obtained maps of dairies from other San Joaquin Valley counties prior to last year's field work. I then transferred all dairy locations from the original source map on to California State Automobile Association (AAA®) maps for use while conducting field surveys.

My early-season surveys for tricolor settlements and breeding colonies included all known previous colony locations in these counties as well as areas in close proximity to (effectively within closest driving distance using public roads) dairies, as field work in 2006 suggested that colony detection rates could be improved by a targeted search, i.e. by searching for settlements and colonies using defined criteria. My criteria in 2007, as they were in 2006, were dairies surrounded by silage fields (Meese 2006), although the environmental matrix required for successful breeding by tricolors requires productive foraging habitats and open water (Beedy and Hamilton 1999; Hamilton and Meese 2005), and the search criteria utilized are most appropriate for early-season colonies located in the "silage belt", i.e. the San Joaquin Valley. Colonies in the Sacramento Valley are most often located in freshwater marsh and several introduced plant species generally considered to be weeds (Himalayan blackberry, milk thistle, mustard), although other plant species are utilized and the locations of colonies may change from year to year (Meese 2006). Thus, maximizing the detection rate of settlements and colonies in the Sacramento Valley relies upon knowledge of the locations of suitable freshwater marsh and may be improved by the observations of volunteers who report aggregations of birds.

My search for mid-to-late season (Sacramento Valley) colonies focused on regions surrounding locations of previous large colonies and was supplemented by reports received from colleagues and others who posted messages to relevant news groups (e.g., CVBirds on Yahoo® Groups).

Field Work. Field work began in early April 2007 with surveys of the southern San Joaquin Valley. In most years, tricolor breeding in the southern San Joaquin Valley begins in mid-to-late March (Beedy and Hamilton, 1999). Field work continued with all known breeding colonies in the southern San Joaquin Valley surveyed within the first

two weeks combined with the targeted search of the immediate vicinity of all dairies within Kern, Tulare, Kings, Fresno, Merced, and part of Madera counties. After all settlements and colonies had been detected in the San Joaquin Valley, I revisited all occupied sites until a colony failed, was destroyed through harvest, or fledged its young. In most cases, colonies were monitored on a twice-weekly basis to assess current conditions as well as to best assess colony chronology to estimate optimal times for conducting reproductive success and breeding population size estimates. I enlarged the geographic scope of my detection and monitoring activities in the third week of April to include Yolo County after receiving an email from John Sterling, a local birder, that he'd seen tricolors at the west margin of Conaway Ranch on April 14th. I began surveys, and responded to reports of aggregations of tricolors, in Colusa and Glenn counties in mid-May. I monitored all active colonies through fledging of young.

Trapping and Banding. In late May I began to bait birds with cracked corn at the Conaway Ranch (Yolo County) colony. Cracked corn was placed in three sections of the dirt road that formed the southern edge of this colony. Three “dove traps”, borrowed from the San Luis National Wildlife Refuge, were evaluated for capturing tricolors but in two days of observation were found to be ineffective. These traps were returned to San Luis NWR and a modified “Australian crow trap” was borrowed from Stan Wright, Sacramento-Yolo Vector Control District. The “Australian crow trap”, baited with cracked corn purchased from a local hardware store, proved to be quite effective at capturing tricolors. The trap was placed on-site, with the door and roof panel left open, baited inside and around the perimeter on May 25th and birds were found inside and outside the trap early the next morning. I used the design of this trap as a template to construct two similar traps as I needed my own traps for subsequent banding efforts (Figures 1 and 2).



Figure 1. Baited, open tricolored blackbird trap.

The traps that I built were of like dimensions to the trap loaned by Stan Wright, but had three significant differences:

1. traps were constructed of individual panels that could be taken apart and reassembled on-site, making them portable

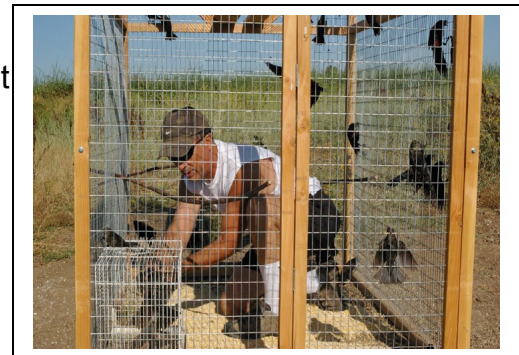


Figure 2. Tricolored blackbird trap

2. traps had 1x2" rolled welded wire instead of 1/2" mesh, which made them much easier on the birds (Figures 1 and 2)
3. traps had adjustable slats on top which allowed an evaluation of the optimum gap between the slats, defined as the smallest gap which allowed birds to pass through while simultaneously preventing birds from passing back out

The trap was left open (door open and top panels off; Figure 1) and baited with cracked corn during the intervals between banding bouts, allowing the birds to habituate to the trap. I would typically begin a trapping and banding bout before 8 am, when I would arrive, rebait the trap, replace the roof panels, and close the door. I would then retreat a short distance (10-50 m) and wait. Birds would typically enter the trap within seconds of my retreat, often when I was no more than 10 m from the trap, and I would wait for, in most cases, 10 minutes or so or until thirty or more birds had been captured. I would then return to and enter the trap, close the door behind me, and place 20-30 tricolors within a small cage typically used for parakeets and finches (Figure 2). I would release any remaining trapped birds and transport the caged birds to a nearby table for banding. I repeated this process until late morning, when the temperature was high enough that I was concerned for the safety of the birds.

I placed the required USGS aluminum band on the left tarsus and two additional color bands (Darvic 4 mm) as follows: if the bird was an adult, a white color band was placed on the left tarsus above the USGS band to denote year (2007) and a second color band was placed on the right tarsus to denote location of banding (green = Conaway Ranch, blue = Plumas-Arboga, orange = Pioneer Duck Club; Figure 3). If the bird to be banded was a fledgling, both color bands were placed on the right tarsus. This scheme enables the discrimination of birds banded as fledglings (year and place of birth known) to those banded as adults (year and place of birth unknown). Color bands were sealed with a small butane-powered soldering iron to prevent their removal by the birds, as tricolored blackbirds



Figure 3: Color-banded female tricolored blackbird.

are known to be able to remove plastic color bands from their legs (W.J. Hamilton III and Tom Gardali, pers. comm.).

All banding data were entered into Bandit, banding data management software developed by the USGS, and returned to the USGS Bird Banding Laboratory in Laurel, Maryland.

Collections of Brood-reduced Young, Eggs, and Carcasses of Adults. I searched for brood-reduced young around the margins of colonies. When fresh carcasses, i.e. those that appeared to be less than 24 hours old and in excellent condition, of brood-reduced young were found, these were collected, placed into a cooler at ca. 2-3°C, and then frozen within 8 hours. In instances where colonies were about to be destroyed through harvest, I collected eggs from nests. Eggs collected were placed into a cooler at ca. 2-3°C and maintained at this temperature. In rare instances, and despite an abundance of caution, adults died as a consequence of banding operations. When an adult died, its carcass was collected, chilled at 2-3°C and frozen within 8 hours. In all cases, frozen carcasses and chilled eggs were transferred to the Museum in the Department of Wildlife, Fisheries, and Conservation Biology at the University of California, Davis for deposit, curation, and addition to its collections.

The collection of carcasses and eggs is summarized in Table 1, below.

Table 1. Summary of carcasses and eggs collected.

Colony	Date	What Collected	Number	Comments
Poso 1	4/18/07	Eggs	7	2 clutches of 4 and 3 eggs
ECLA Pond	4/18/07	Dead nestling	1	
Poso 1	4/23/07	Brood-reduced young	24	Several other carcasses not collected due to poor conditions
Poso 1	4/24/07	Brood-reduced young	14	
Cornerstone 1	5/02/07	Dead nestling	1	
Conaway Ranch	5/28/07	Dead adult females	2	Two died after banding
Conaway Ranch	6/06/07	1 dead adult male	1	Found as carcass ca. 10 m from banding site
Pioneer Duck Club West Pond	6/15/07	Brood-reduced young	15	
Plumas-Arboga	6/17/07	Brood-reduced young	4	
Plumas-Arboga	6/19/07	Adult females	2	Died after banding

Results

Colonies Studied. Field work started on April 2nd and ended on August 2nd, 2007. The Plumas-Arboga colony, Yuba County, was still active on August 2nd, the first colony I've observed to still be active in August in three years of field work. On this date ca. 250 birds were present, all but three females and fledglings, and nearly all fledglings were

being fed large dragonflies, subsequently determined to be common green darners (*Anax junius*), a species that hatches in great abundance in this region at this time of year. This is the first time that I have documented large numbers of dragonflies being fed to fledglings, and it is likely that the feeding of dragonflies is related to the late breeding. In previous fieldwork, breeding was completed by mid-July, either because all young have fledged or because high summer temperatures result in colony abandonment (Meese 2006), and large numbers of dragonflies had not previously been observed, either as recently-emerged adults or as food being fed to nestlings. Previous studies of tricolor diets suggest that dragonflies are not significant components of the diets of adults or nestlings (Skorupa, Hothem, and DeHaven 1980), although they are heavily preyed upon by red-winged (*Agelaius phoeniceus*) and yellow-headed (*Xanthocephalus xanthocephalus*) blackbirds (Orians 1980). Thus, the heavy use of dragonflies by provisioning adults at the Plumas-Arboga colony may be an unusual occurrence due to the timing of the emergence of the adult dragonflies coincident with very late-season breeding.

A total of 27 sites was studied (Appendix I). In addition to these sites, 1 settlement was terminated by hazing prior to commencement of field work (Costa's Dairy, Kern County; Scott Frazer, USFWS, pers. comm.). Despite intensive, targeted searches, no settlements nor breeding colonies were detected in Kings, Fresno, or Madera counties.

In addition, I corresponded with biologists in southern California and was informed that only 2 breeding colonies, each consisting of between 500 and 1,000 birds, were detected there despite intensive searches by Tom Paulek and more limited searches by others with much tricolored blackbird survey experience (Tom Paulek, Phil Unitt, Kimball Garrett, pers. comm. and Tyler Grant, U.S. Fish & Wildlife Service, via email). Finally, a colony in willows was reported to me on a private ranch on the periphery of Colusa National Wildlife Refuge by Leah Culp, a biologist working for PRBO Conservation Science. The area and size (number of birds) of this colony are not known.



Figure 4: Female tricolored blackbird with common green darter.

Near-complete Reproductive Failure. All but three of the colonies intensively monitored failed to produce young at rates expected based upon previous experience (Table 2). I had not previously observed anything approaching this kind of widespread reproductive

failure, although desertion from individual colonies, even after eggs have been laid, has been observed by other investigators over some time (e.g., Neff 1937; Orians 1960).

Due primarily to the widespread failure to reproduce, reproductive success (RS) was estimated at only four colonies: Merced NWR East Farmfield 3, Conaway Ranch, Pioneer Duck Club, and Plumas-Arboga (Table 3). I calculated reproductive success for one additional colony, Delevan NWR T-43, to illustrate the extraordinary reproductive failure of many colonies with this traditionally occupied and often productive site. I entered the Delevan T-43 colony on June 14 and counted a total of 2 jumpers (nestlings that jumped out of their nests upon my approach) out of 132 nests, which included 25 nests that had been pulled down (preyed upon, most likely by raccoons; Orians 1960), and 2 that contained 1 cold egg each. Thus, the RS estimate for this site is $2/132$ or 0.015 young/nest. It was especially striking that a large majority of the nests observed (78/132, 59%) were immaculate – they showed no signs of having held eggs or young, and I believe that here, as in Poso 1 and ECLA Pond in Kern County, females built nests but did not lay eggs, apparently lacking the minimum nutritional requirements to do so.

Table 2: Fates of intensively monitored colonies

Colony	County	Substrate	No. Breeding Birds	Fate
ECLA Pond	Kern	Cattails	20,000	Near-complete failure; one crèche of 16 birds seen
Poso 1	Kern	Silage	50,000	Near-complete failure; maximum of 200 young produced
Toledo Pit	Tulare	Cattails	20,000	Very low output; not entered due to 2 nd breeding attempts and white-faced ibis chicks about to fledge; crèches of 500-1,000 birds seen on two occasions; estimate 2-3,000 young fledged
Cornerstone 1	Tulare	Silage	30,000	Very low output; a visually estimated 2,000 young fledged; heavy cattle egret predation
Merced NWR East Farmfield 3	Merced	Milk thistle	65,460	Very low output; maximum of 2,000 fledglings seen, and 6,240 young produced by RS estimate
Conaway Ranch Thistles	Yolo	Milk thistle	35,000	Highly productive colony; 30,000 young produced
Pioneer Duck Club West Pond	Colusa	Cattails	58,800	Highly productive colony; 37,000 young produced by RS estimate
Delevan NWR T-43	Colusa	cattails	Initially ca. 20,000	Near-complete failure; maximum of 500 young produced
Plumas-Arboga	Yuba	Cattails	23,400	Highly productive colony; multiple breeding attempts by the same or additional birds

Table 3: Reproductive Success

Colony	Number of nests	Number of adults	Number of young/nest (RS)	Number of young produced
Merced NWR East Farmfield 3	43,640	65,460	.143	6,240
Conaway Ranch Thistles	23,280	35,000	.91	21,180
Pioneer Duck Club	39,200	58,800	.95	37,240
Plumas-Arboga	15,600	23,400	.82	15,600

Colony Turnover. Previous studies have documented a relatively high degree of inter-year colony turnover, with sites occupied by relatively productive colonies in one year confirmed as unoccupied the following year (Neff 1937, 1942; Hamilton 2000). All four Merced County colonies that were originally detected in 2006 (Northrup Road, Dickenson Ferry, Owens Creek, and Plainsburg Road; Meese 2006) were unoccupied this year. Conditions at the Northrup Road site looked identical to last year, while nesting habitat at Dickenson Ferry, Owens Creek, and Plainsburg Road had been eliminated and these sites were unsuitable for nesting by tricolors this year. In addition, the Voice of America site in Tulare County, occupied in 2006, was unoccupied this year. Colony turnover may result from a variety of factors, and is of concern if formerly productive sites were active over a number of years and then abandoned, or used by far fewer birds, in subsequent years (e.g., Unitt 2004, Hamilton and Meese 2005). The Ellsworthy site in Merced County, used by 30,000 birds in 2006 and 6,000 birds in 2005 was used by a maximum of 5,000 birds this year. The primarily bulrush substrate may be growing senescent: it is not known to have been burned recently, and there are many lodged stems. Tricolors tend to shun marshes with a high proportion of lodged stems (e.g., Meese 2006) and prefer young, vigorously-growing cattails and bulrush (Meese 2006).

New Colonies. Three colonies were detected in locations not previously known to the author:

1. Crane Ranch, Merced County
2. Walker Creek, Glenn County
3. El Rio Bonito, Butte County

The Crane Ranch colony, actually several colonies in isolated Himalayan blackberry copses spread over several acres, was reported to the author by Dennis Woolington, Supervisory Biologist, San Luis NWR. Walker Creek was reported to the author by Mike Wolder, Supervisory Biologist, Sacramento NWR. The El Rio Bonito colony was detected by the author after reading a note posted to the Central Valley Birds Yahoo

group by Tim Manolis, who reported seeing several flocks of apparently foraging tricolors in the vicinity of the colony. It is likely that the Crane Ranch colony has been active for years, as access to this site is extremely limited and was provided by Steve Simmons, a long-time friend of the landowner who has been studying wood ducks on the property for over a decade. The Crane Ranch birds forage largely on the ranch itself, and would not necessarily be seen on foraging flights, making their detection difficult. The Walker Creek site is likely new, as it exists immediately adjacent to the southbound lanes of I-5 and is easily observed by passing motorists. The El Rio Bonito site has probably supported breeding tricolors previously, as it is a relatively large, vigorous copse of Himalayan blackberries growing in an agricultural drainage ditch surrounded by pasture. It should be checked annually.

Colonies Destroyed by Harvest. As in all recent years, several Tricolor breeding colonies were destroyed by harvest of the grain crop in which they had nested (Table 4, Figure 6). However, unlike in previous years, all of the colonies destroyed by harvest were located in Tulare County, and two of these were on the same dairy.

Table 4: Colonies destroyed by harvest

Colony	County	Number of birds	Date Harvested
North Toledo	Tulare	24,000	Prior to 5/17
East Toledo	Tulare	6,000	Prior to 5/9
Cornerstone 2	Tulare	30,000	Prior to 4/26
Cornerstone 3*	Tulare	10,000+	Prior to 5/8
Angiola's Dairy	Tulare	12,750	4/18
Alvin Souza Dairy	Tulare	24,000	4/23

* recently settled and increasing rapidly in number prior to harvest

Trapping and Banding. The modified Australian crow traps were very effective at capturing tricolored blackbirds when baited with cracked corn, were easily transported, and rapidly set up. Each bird received three bands: the required USGS aluminum band on the left tarsus and two color bands, as described in the Methods.

A total of 1772 birds was banded at three sites, as summarized below:

Number of days of banding: 30

First day: 5/27/07 at Conaway Ranch, Yolo County

Last day: 7/03/07 at Plumas-Arboga, Yuba County

No. birds banded: 1772

No. adults banded: 1766

No. juveniles banded: 6

No. females banded: 1274 (72%; 1272 adults, 2 juveniles)
No. males banded: 494 (28%; 491 adults, 3 juveniles)
No. unknown/unrecorded sex banded: 4

No. birds banded at Conaway Ranch: 700 in 18 banding days; green and white
No. birds banded at Pioneer Duck Club: 73 in 3 banding days; orange and white
No. birds banded at Plumas-Arboga: 999 in 9 banding days; blue and white

Discussion

Perhaps the most encouraging result of 2007 was the color-banding of nearly 1,800 birds, all but 6 adults, from 3 colonies - all of the colonies that fledged average numbers of young: Conaway Ranch Thistles in Yolo County, Pioneer Duck Club West Pond in Colusa County, and Plumas-Arboga in Yuba County. Prior to the breeding season it was unknown whether we could successfully capture birds, but it was learned in the first days at the first site that tricolors are strongly attracted to and readily consume cracked corn, and that they will hesitate only briefly before entering a blackbird trap (a modified "Australian crow trap") baited with cracked corn. Thus, in the future we may fairly easily trap and color-band large numbers of tricolors, although if future results are similar to this year's results, the trapped birds will be disproportionately adults and the sex ratio will be heavily skewed in favor of females. Marked birds hold the potential to teach us much about tricolor spatial and temporal movements, provided that we have observations of marked birds reported to us by informed, highly motivated, and competent volunteers. In an attempt to inform the largest possible number of potential observers, announcements and requests of assistance in reporting observations of color-banded birds have been widely disseminated and include items posted to news groups (CVBirds and CalBirds Yahoo groups), sent to Audubon California for publication in newsletters, announced in presentations given by the author, and sent to several prominent scientists, agency biologists, and birders.

Perhaps the most striking feature of the 2007 breeding season was the near-complete failures of breeding, beginning with ECLA Pond and Poso 1 in April and continuing on through Delevan T-43 and Walker Creek in June. Although not investigated directly, the most likely causes for the large-scale reproductive failure of tricolors in 2007 was the collapse of primary and secondary productivity due to drought, widely reported as the most severe drought in California since record-keeping began, with perhaps an additional role played by a late cold snap in April. Tricolored blackbird researchers were contacted at the end of the breeding season to determine whether they had documented such a reproductive collapse and all reported that they had not (Ted Beedy, Rich DeHaven, and Gordon Orians, pers. comm.). Thus, the relatively large reproductive outputs of 2005 (Hamilton and Meese 2005) and 2006 (Meese 2006) due to the conservation of the largest breeding colonies, which are believed to be largely responsible for the apparent increase in tricolor numbers since the population low in

2000 (Hamilton 2000), came to an abrupt end in 2007. The 2008 statewide Survey will be especially interesting and potentially significant as a means to document any effects of this year's reproductive collapse on the population trend. The documentation of this year's low reproductive output also illustrates the need for current, reliable information and the annual intensive monitoring of colonies by an experienced, dedicated tricolor biologist.

The 2007 productivity results also illustrate the roles to be played by colonies on private property, as in 2007 all three productive colonies were located on private property, and all three property owners were strongly supportive of tricolor conservation efforts.

Somewhat paradoxically, the three rather productive colonies were located in a fairly narrow geographic band from Yolo County in the south to Colusa County in the north. I contacted a University of California researcher with decades of field experience with butterflies and inquired whether butterfly populations were reduced in his field sites, all located within this latitudinal band; he informed me that they were not, but that other researchers in other parts of the state had reported the kinds of reductions in invertebrate populations that I suspected (Art Shapiro, Professor of zoology, via email). California butterfly populations, however, are known to have complex reactions to severe, prolonged drought (Ehrlich et al. 1980), and caterpillars are but one of many prey species consumed by breeding female tricolors (Skorupa, Hothem, and DeHaven 1980). Lepidopteran larvae likely play a much more limited role in the diets of marsh-breeding birds in the Sacramento Valley, where adults are known to forage heavily upon aquatic insect larvae (Hamilton and Meese 2005), so the extent to which butterfly abundance may be an indicator of tricolor reproductive success is unknown.

An important, but for now unanswerable, question is whether the current extreme drought is a symptom of global climate change. Extreme weather events are known to affect many terrestrial species (reviewed by Parmesan, Root, and Willig 2000), and extreme and persistent droughts have been a characteristic of California's climate for centuries (Hughes and Brown 1992, Stine 1994). The current drought is embedded within a long-term trend of greater aridity in the western U.S. (Cook et al. 2004). Tricolors have no doubt endured and persisted through periods of drought; however, with fewer birds and much reduced abundances of breeding and foraging habitats, tricolors may now be more vulnerable to drought than they were in the past.

An experiment with a dramatic result was conducted on Merced National Wildlife Refuge in April of this year. An estimated 65,000 tricolors established a colony on East Farmfield 3 in early April and many, perhaps most, of these birds foraged on the adjacent dairy on grains that were provided to dairy cows. The dairy owner, who had a tricolor colony on his property in 2006, called the refuge manager to complain about the foraging of the birds on his property and it was agreed to try to lure the birds off of the dairy by providing grains, in the form of rolled corn, in a pile to be dumped at the northeast corner of the field occupied by the breeding tricolors. The dairy owner offered

to provide the first load of corn, this offer was accepted by the refuge staff, and 3,000 pounds of rolled corn was dumped on the refuge on the morning of April 18. By the early evening of April 18, virtually no birds were foraging on the grains at the dairy; instead, birds were consuming the corn that had been provided at the margin of the colony. This near-instantaneous utilization of the lure corn by foraging tricolors not only resulted in improved communication and better relations with the adjacent landowner, but it has potentially great implications for tricolor conservation and management, as the provision of lure grains may, for example, be utilized to attract settlement of tricolors on to other protected areas (e.g., Kern NWR) with appropriate nesting and nearby foraging substrates.

A new form of silage colony conservation was attempted in 2007. Historically, silage colonies were conserved through the purchase of the silage occupied by breeding birds, a controversial and expensive option. The so-called silage buy-out is controversial because in most cases, the landowner needs the silage to feed his cows, and is expensive because of the value of silage, nearly always triticale, a wheat x rye hybrid. In one colony, Cornerstone 1 in Tulare County, an agreement was negotiated with a willing landowner to delay the harvest of one triticale field by adding an extra irrigation to this field, with the cost to the farmer of the extra irrigation to be reimbursed by the U.S. Fish & Wildlife Service. This type of silage colony conservation tactic may be an excellent alternative to the traditional silage buy-out because:

- the cost of this extra irrigation was relatively modest when compared to the cost of a silage buy-out (ca. \$4,600 vs. \$60,000 or more)
- the farmer kept his silage crop, and
- the young tricolors were allowed to fledge prior to the harvest of this colony.

This kind of arrangement is only possible for colonies with breeding chronologies that very nearly overlap the harvest of the silage field (the birds must be ready to fledge at about the same time that the farmer wants to harvest his crop), as the delay in maturity of the grain due to the extra irrigation is only on the order of two weeks, but if the farmer is willing to accept such an arrangement, this may be an excellent alternative to silage buy-outs which results in a win-win-win situation for the farmer, the Service (or other provider of the funds used to delay harvest), and the birds.

The necessity of a dedicated, full-time tricolor researcher was also illustrated at the Poso 1 colony. Initially, this colony was visually estimated to contain at least 50,000 birds, and was believed to be the largest silage colony in the Kern-Tulare County region. Negotiations between the Service and the landowner, who had prior experience with nesting tricolors and the silage buy-out process, resulted in the signing of a contract to sell the silage occupied by the nesting birds while allowing the farmer to harvest the triticale not occupied. The harvest of the unoccupied triticale proceeded as scheduled, but the day following harvest in excess of 90% of the tricolors deserted the site. The landowner was immediately contacted to inform him of the departure of the

birds and to request that the contract be canceled. The landowner agreed to cancel the silage buy-out, demonstrating the flexibility and willingness of the landowner, the Service, and Audubon California to work together to most effectively conserve nesting tricolors.

A complete surprise was the first observation of an albino tricolor seen at Angiola's Dairy on April 17th, the day before the colony was destroyed by harvest (Figure 5). This bird was subsequently seen again approximately 6 km away on May 2nd, at the north boundary of the Cornerstone 3 colony.

In what is likely an unprecedented occurrence, a single dairy, Cornerstone Dairy in Tulare County, hosted three tricolored blackbird breeding colonies in 2007. Two of these were destroyed by harvest (Table 4), while the third was conserved by the innovative harvest delay tactic described above.



Figure 5: Albino tricolored blackbird.

In an attempt to more thoroughly document the sizes of silage colonies prior to destruction by harvest, Scott Frazer of Kern NWR contacted all landowners as soon as possible after colonies were detected to report the presence of the birds and to request permission to enter the property. In all cases, permissions to enter the properties was obtained, and Scott and I used GPS to estimate the areas occupied by breeding birds and conducted nest transects to estimate the number of nests and to document nest contents. These actions may have several benefits, including increasing communication between the Service and landowners, raising awareness of tricolor conservation activities, and enabling estimates of the numbers of birds that are lost when colonies are destroyed through harvest.

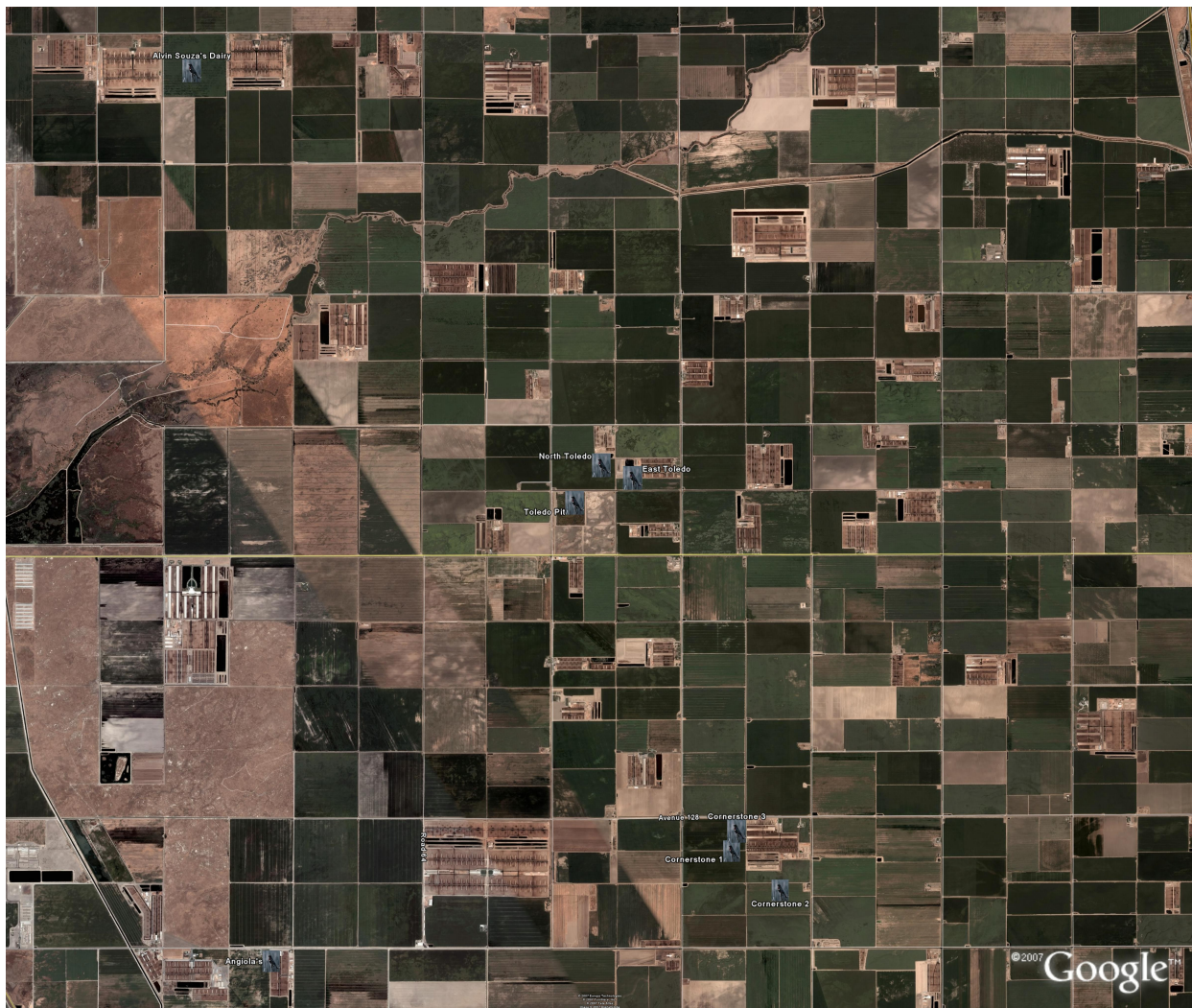


Figure 6: Toledo Pit (Tulare Co.) region 2007 colonies. There are 8 colonies in this image, each indicated by a tricolor icon. The city of Corcoran is just off the image to the left. The distance from Toledo Pit, in the center, to Alvin Souza Dairy, in the upper left, is 7 km.

The large number of colonies (8) in the immediate vicinity of Toledo Pit (one within one basin of the four Toledo Pit basins, two others within 500 meters, and five more within 7 km; Figure 6), as well as the large proportion of colonies destroyed by harvest in Tulare County (6/7, or 86%), clearly demonstrates the need for more secure breeding substrate in this region. Discussions on April 26th between the Service and the Lower Tule Irrigation District, managers of Toledo Pit, over the need for more nesting substrate at Toledo Pit resulted in an expression of willingness on the part of Lower Tule Irrigation District to work to provide a 2nd basin with marsh vegetation to create additional nesting substrate for tricolored blackbirds. However, the District expressed concern over the amount of water needed to keep the basin flooded, essential to deter mammalian predators, and the cost to the District to pump this water up into the basin during the spring and early summer. The District wants to reduce the rate of percolation of water out of the new basin as part of any plan to develop it into tricolored blackbird breeding habitat, as pumping additional ground water from the existing well would be too expensive.

The huge settlement, estimated at ca. 30,000 birds, at Conaway Ranch in early May followed an original settlement in mid-April of only several hundred birds and created a

colony that was likely the largest tricolored blackbird colony in Yolo County in decades and contained upwards of 10% of the known population of the species. The milk thistle (*Silybum marianum* (L.) Gaertner) field occupied by the birds was burned in 2006, and sits due south of the pond used most recently in 2005 (Hamilton and Meese 2005). The pond was completely renovated in 2006 and was vacant of any aquatic vegetation in 2007. The large breeding colony here, as well as those in Merced NWR East Farmfield 3 and Plumas-Arboga in 2007 suggests two characteristics of breeding tricolors:

1. they are strongly philopatric
2. they seek relatively young, rapidly-growing vegetation when selecting nest sites

All three of these sites have had prior tricolor colonies, and although the pond at Conaway Ranch was renovated in 2006 and is currently unsuitable for nesting by tricolors, they still returned to nest in an adjacent, recently-burned field in 2007 (i.e. moved off of cattail marsh and in to milk thistle). The milk thistles used by the Merced East Farmfield 3 birds were too short to provide nest substrate, but the birds settled in to and occupied the site until the thistle had grown to an adequate height. The Plumas-Arboga cattails had been burned in February, 2007 (landowner, pers. comm.). Thus, in all of these sites, despite the differences among the nesting substrates, the birds utilized nesting substrate that was young and rapidly-growing, and I believe that it is this strong preference for young, rapidly-growing substrates that gives rise to the impression that the birds tend to be vagrants, and move among years from one nest site to another without apparent cause (e.g., Neff 1937). My interpretation of the birds' habits is nearly the opposite: I believe that they are closely assessing the quality of potential nest sites, and sites that become unsuitable from the perspective of the birds are abandoned in favor of sites with more favored characteristics. The preference for young, vigorously-growing nesting substrate has been observed many times before, as summarized in Table 5. The preference exhibited by tricolors for young, rapidly-growing vegetation has implications for land managers, as more fully described below.

Table 5. Examples of tricolor breeding preference for young substrate.

Colony	County	Year	Substrate	Comments
Waegell's	Sacramento	2005	Bulrush	6,000 bird colony in 2005, not used in 2006 and 2007 despite birds seen and nesting in the vicinity in 2006 and 2007
Boys Ranch	Sacramento	2006	Bulrush	Reported by landowner to have burned in 2004
First Cattails	Kern	2006	Cattails	New, establishing cattail stand, too young and short to support nesting early in the season.
Conaway Ranch Thistles	Yolo	2007	Milk thistle	Large colony in field of milk thistle that burned in autumn, 2006 according to graduate student conducting research in area
Plumas-Arboga	Yuba	2007	Cattails	Owner said that cattails burned in February, 2007, occupied by breeding birds in June, 2007.

Colony	County	Year	Substrate	Comments
Delevan NWR T-43	Colusa	2007	Cattails	Birds nested in far eastern section of T-43 in 2005 but moved to central and western sections in 2006 and 2007; these were burned in 2004.
Pioneer Duck Club	Colusa	2007	Cattails	Birds moved from East Pond in 2006 to West Pond in 2007 due to younger, more vigorously-growing cattails. Had nested in East Pond in 2005 and 2006. West Pond dry until 2005.
San Jacinto	Riverside	2006	Bulrush	Abandoned for first time in recent memory in favor of nearby dairy winter wheat field.

The banding results speak for themselves and serve to encourage the annual banding of large numbers of breeding birds. Although the goal prior to the breeding season had been to band as many fledglings as possible, to document both the date and location of birth, the methods of trapping employed this year resulted in nearly all adult birds being trapped (1766 of 1772). As the only method employed was to use the modified “Australian crow trap” baited with cracked corn, it will wait until another field season to determine whether mist nets may be more effective at capturing fledglings. Previous large-scale banding efforts (Neff 1942; DeHaven, Crase, and Woronecki 1975b) concentrated exclusively upon the placement of aluminum bands on nestlings, whereas our efforts were concentrated exclusively upon adults and fledglings and utilized both the standard aluminum plus two color bands; no nestlings were banded. In previous studies, useful data were generated through the recapture or salvage of the carcass of a banded bird, as the number on the aluminum band provided the only means of determining when and where the bird was banded. The use of two color bands eliminates the requirement to have a bird or carcass in the hand and thus useful data may be provided by any observer who accurately reports an observation of a color-banded bird. It is hoped that this methodology for banding and reporting will vastly increase the number of observations obtained and, thus, the amount of information on patterns of movement through time and space. Such information, it is hoped, will better inform attempts to conserve the species and help ensure the long-term persistence of the tricolor throughout its range.

Management Implications

1. *Silage harvest delay vs. silage buy-out.* The innovative silage delay tactic employed for the first time this year has the potential to provide a relatively low cost and perhaps more sustainable solution to the silage harvest/colony destruction conflict. This method, which relies upon an extra irrigation of a silage crop to delay its maturation, provides for the conservation of the silage crop for the farmer along with the conservation of the reproductive output of the breeding birds, thus producing a kind of win-win situation for both. This tactic is dependent upon a close timing between the fledging of young and silage maturation (without additional irrigation) date as well as a willing

- farmer. The only potential downside to this tactic is the delay in the planting of the next crop, typically corn, and its attendant effects on yield. This delay may or may not also result in an increase in cost due to the rescheduling of a custom harvest of the delayed silage crop. But when compared to the more traditional silage buy-out and its loss of the crop, longer delay, and far higher cost, the silage harvest delay tactic is preferable and is likely to be more acceptable to the farmer, too, as the silage crop is conserved for his use without any additional cost.
2. *Use of corn lure crop.* The strong response of the tricolors to the provided rolled corn at Merced NWR East Farmfield 3, as well as the ease with which tricolors were lured into the traps baited with cracked corn, suggests that corn may be beneficially used to modify tricolor behavior. This may have implications for land managers, especially those who wish to try to lure tricolors back to formerly-occupied colony sites (e.g., San Jacinto Wildlife Area, Riverside County and Kern National Wildlife Refuge, Kern County). It may be worth experimenting with the provision of cracked or rolled corn in or adjacent to marshes that possess appropriate nesting substrate but that have lacked nesting tricolors in recent years, and where tricolors nest nearby. The best example of such a location may be Kern National Wildlife Refuge in Kern County, as large numbers of tricolors formerly nested on the Refuge but have instead nested on nearby (ca. 6 km away) silage fields.
 3. *Management of Nesting Substrates.* Anecdotal evidence in this and several prior years (Table 5) suggests strongly that breeding tricolors actively select young, rapidly-growing plants irrespective of whether they are aquatic perennials (cattails, bulrush) or terrestrial annuals (silage, milk thistle, mustard). In examples from Riverside County in the south (San Jacinto Wildlife Area) to Kern County (ECLA Pond, Kern Water Bank First Cattails), Sacramento County (Boys Ranch) to Yolo County (Conaway Ranch Thistles), Yuba County (Plumas-Arboga), and Colusa County (Pioneer Duck Club, Delevan NWR T-43) in the north, tricolor colonies are known to have been established in vegetation that was recently burned or is establishing for the first time. Land managers with responsibility for tricolors must be informed of the strong preference of nesting tricolors for young, rapidly-growing vegetation and incorporate active vegetation management into their management plans. Where air quality regulations permit, marshes should be burned during the winter to remove senescent vegetation or plant parts and to promote the vigorous growth of new plants or above-ground plant parts. Such active management is practiced in some cases to try to maintain conditions preferred by breeding tricolors (e.g., Delevan T-43, Sacramento National Wildlife Refuge) and in other cases to try to maintain overall marsh "health" (e.g., Plumas-Arboga, Yuba County), with the result that excellent breeding conditions are maintained. Such active management should be encouraged and in some cases may be essential to bring tricolors back to their former nesting locations (e.g., San Jacinto Wildlife Area, Riverside

County; Ellsworthy, Merced County; Waegell's, Sacramento County). In upland sites, burning or similar kinds of disturbance also appear to promote the kind of vegetation growth preferred by tricolors (e.g., Merced NWR, Merced County, Conaway Ranch, Yolo County). ECLA Pond, Kern County, merits special mention: ECLA Pond is a privately-owned duck club that has received Landowner Incentive Program (LIP) funding the past three years to provide for the pumping of water to sustain the growth of cattails and bulrush during the spring and early summer. However, the pumps are turned off during mid-summer and the basin holding the marsh is allowed to dry out, causing the existing stems to dry out and brown. It is these dry, brown, lodged stems that are to be strongly avoided in tricolor breeding marshes, as tricolors are known to avoid marshes with large amounts of dry, lodged stems, and several examples are known where formerly occupied sites are abandoned when lodged stems accumulate (Table 5). Breeding ponds in southern California (San Jacinto Wildlife Area) and Kern (ECLA Pond) and Tulare (Toledo Pit) Counties, especially, should be actively maintained to benefit tricolor breeding, as secure breeding sites surrounded by productive foraging habitats are exceedingly rare features in these regions and have and may continue to provide essential conservation functions if properly maintained in the conditions preferred by nesting tricolors.

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Appendix I: Characteristics and Fates of Tricolored Blackbird Settlements and Colonies Detected in 2007. The last three colonies were reported to me by collaborators but were not observed by me.

Colony	County	Substrate	Date Detected	Detected By	Area Occupied (acres)	Size (no. birds)	Comments
Poso 1	Kern	silage	Mid-March	Frazer	ca. 60	ca. 50,000	To have been conserved by buyout; near-complete nesting failure, field released back to owner for harvest 5/02/07; maximum of 200 birds remained on day of harvest
ECLA Pond	Kern	Cattails	Mid-March	Frazer	15	ca. 20,000	LIP-funded private duck club, access permitted, secure; near-complete nesting failure, likely < 100 young produced, largest (and only) crèche observed < 20 birds
Costa's Dairy	Kern	Silage	Mid-March	Frazer	Undetermined	Unknown	Hazed successfully by owner in mid-March; settlement terminated, birds likely go to ECLA Pond and/or Poso 1
Sprague Ranch	Kern	Cattails, bulrush	Early May	Tollefson	ca. 1 acre	3-500	Small colony on CDF&G Ecological Area reported by Reed Tollefson, mgr. of Audubon California Kern River Preserve; colony fails when irrigation water diverted away from pasture surrounding colony
Toledo Pit	Tulare	Cattails	Late March	Frazer	ca. 12	25,000	Far more birds in vicinity than can be accommodated by single basin; 1,500-2,000 fledglings observed in 2 crèches 5/02/07; birds cannot be caught in mist nets for banding as crèches are over water

Colony	County	Substrate	Date Detected	Detected By	Area Occupied (acres)	Size (no. birds)	Comments
North Toledo	Tulare	Silage	April	Frazer	ca. 20	ca. 24,000	“overflow” birds not able to nest in Toledo Pit; hazed by Scott Frazer beginning 4/19 and subsequently by owner; owner contacted, expected to harvest site in ca. 2 weeks; colony assessed 5/02/07, found to be extremely active, 36 of 39 nests with eggs; colony destroyed by harvest prior to 5/17
East Toledo	Tulare	Silage	April	Meese	ca. 5	6,000	In silage field NE of Toledo Pit and due east of North Toledo; owner not permitting access; destroyed through harvest by 5/09; also “overflow” birds that would otherwise have nested in Toledo Pit
Cornerstone 1	Tulare	Silage	April	Meese	19	16,120	Hardt/Frazer negotiating with landowner to conserve this colony through delaying harvest by late irrigation or outright purchase (buy-out); colony conserved through delayed harvest via extra irrigation; nest transects walked by Meese 5/17; heavy cattle egret predation; ca. 2,000 young fledged
Cornerstone 2	Tulare	Silage	April	Meese	24	30,000	destroyed by harvest prior to 4/26/07; albino tricolor seen here
Cornerstone 3	Tulare	Silage	April and early May	Meese	ca. 30	Undetermined	In field due north across farm road of Cornerstone 1; expected to be destroyed through harvest; multiple settlements in different parts of field, new settlement observed 4/26/07; albino observed (from Angiola's); destroyed by harvest prior to 5/8

Colony	County	Substrate	Date Detected	Detected By	Area Occupied (acres)	Size (no. birds)	Comments
Angiola's Dairy	Tulare	Silage/mallow	April	Meese	8.5	12,750	Destroyed through harvest before noon on 4/18; documented by Meese and Frazer on 4/17; albino tricolor seen/photographed in field; highest nest densities ever recorded by Meese
Alvin Souza Dairy	Tulare	Silage	April	Meese	20-25 acres	24,000 (assuming 20 acres)	destroyed by harvest 4/23/07; colony entered by Meese and Frazer 4/17/07, size estimated
Merced NWR East Farmfield 3	Merced	Milk thistle and mustard	April	Woolington	40 acres	65,000	Large, secure colony; decoy grains provided 4/18, found and utilized by breeding birds within hours; birds prefer provided grains to those at adjacent Homen Dairy, stop flying to Homen Dairy to forage by nightfall of first day; colony entered 5/8 with Joe and Jonathan, inspect 48 nests, none with nestlings, 5 with eggs, and see 8 fledglings; 16 of 34 nests seen by Bob destroyed by raccoons; visually estimated total production of 3,000 fledglings in several crèches in bulrush to west and southwest of East Farmfield 3 on 5/16
Merced NWR West Farmfield 1	Merced	Milk thistle and mustard	April	Woolington	3 acres	< 1,000 in first settlement, but 2 nd settlement increases to ca. 2,000	A small "satellite" colony ca. 1 mile from large colony; brown-headed cowbirds present 4/12; entered briefly by Bob on 5/8, 4 nests inspected, all with eggs; productivity unknown
Basalt Road	Merced	Stinging nettle	April 25	Meese	Very small, 1-2 acres	200	Very small colony at base of dam forming San Luis Reservoir; reported by previous investigators; not monitored

Colony	County	Substrate	Date Detected	Detected By	Area Occupied (acres)	Size (no. birds)	Comments
Conaway Ranch Thistles	Yolo	Milk thistle and mustard	April	Sterling, Meese	Originally small but with large second settlement ultimately 24 acres	30-35,000	First found by John Sterling on 4/14; private property, access permitted, secure; checked 4/15, revisited on 5/10 to find huge new settlement, visually estimated 30,000 birds, likely the largest colony in Yolo County in decades; field burned in '06; permission to trap and band birds granted 5/15; trap and color-band birds
Ellsworthy	Merced	Cattails, bulrush	April	Meese	Not estimated	ca. 5,000	Weekly monitoring since early April, not expected to grow to size of 2005 and 2006 colonies due to aging vegetation and unattractive structure (lodged stems); checked 5/16, appears to have grown, but still much smaller than in past two years, perhaps 8,000 birds
Road 88B	Yolo	Milk thistle, mustard	Late April	Meese	Very small, perhaps 1 acre	ca. 2,000	Active in 2005, not active in 2006, again active this year; owner (Syr Industries) contacted, will contact again to arrange monitoring; owner contacted 5/10, permission to enter granted, orange vest and hard hat provided
Bill's Grasslands	Yolo	Himalayan blackberry	Late April	Meese	Small, 2-3 acres	Undetermined	New colony in 2006; owner not contacted; access unlikely as per 2006 conversation
Triangle Rock Products	Sacramento	Milk thistle	Early May	Meese	Small, 1-2 acres	ca. 2,000	Operators delighted to have "their birds" back again, providing substrate specifically for tricolors; nest-building observed on 5/04/07
Lopez Ag. Services	Sacramento	Milk thistle	Early May	Meese	Small, ca. 1 acre	500	Settlement/nest building observed on 5/04/07

Colony	County	Substrate	Date Detected	Detected By	Area Occupied (acres)	Size (no. birds)	Comments
Pioneer Duck Club	Colusa	Cattails, bulrush	May 14	Meese	28	58,800	Very large settlement detected 5/14; owner called Meese at home to report "your birds are back"; private property, access and permission to trap and band birds granted; intensively monitored
Walker Creek	Glenn	Cattails, bulrush	May 10	Wolder	4-5 acres	5-10,000 birds	Reported by Mike Wolder 5/14, confirmed by Meese 5/14; private property; adjacent owner contacted by Meese, permission to access and monitor site granted; size dwindled after 2 weeks; much foraging across I-5 to east, several attempts made to find foraging destination, all failed; productivity low, not directly measured due to lack of access
Crane Ranch	Merced	Himalayan blackberry	May 23	Simmons and Woolington	Several copses, ca. 5 acres in aggregate	Ca. 5,000 birds in aggregate	New colony reported to Dennis Woolington by Steve Simmons, who is only person with permission to access this otherwise off-limits private ranch; seen only once, riding with Steve Simmons, and find that each copse/colony follows its own chronology
Howsley Road	Sutter	Himalayan blackberry	May 26	Meese	Small, perhaps 1 ac.	ca. 600	Adjacent horse pastures next to canal, reported to me by Ted Beedy who learned of it from consultants doing raptor surveys in area
Plumas-Arboga	Yuba	Cattails, bulrush	May 26	Meese	6 acres	23,400 birds	Detected by Meese on 5/26; owner contacted, obtained permission to monitor, trap, and color-band birds

Colony	County	Substrate	Date Detected	Detected By	Area Occupied (acres)	Size (no. birds)	Comments
Delevan NWR T-43	Colusa	Cattails	May 18	Wolder	ca. 60 acres	20,000+	Initially a large settlement, but number of birds dwindled rapidly; colony entered 6/14, count 125 nests in 1 ¼ hours, all empty
El Rio Bonito	Butte	Himalayan blackberries	May 29	Meese	Small, 2-3 ac.	2,000	Follow up on note posted to CVBirds Yahoo Group by Tim Manolis; private property, owners not contacted
Mendenhall (Private Ranch)	San Diego	Freshwater marsh	Unknown	Grant	Unknown	500-1,000	*** Not observed ; reported by Tyler Grant, USFWS
Rancho Jamul State Ecological Area	San Diego	Freshwater marsh	Unknown	Dillingham	Unknown	500-1,000	*** Not observed ; reported by Tom Paulek through Tim Dillingham, California Department of Fish & Game
Steidlemeyer (Private Ranch)	Colusa	Willows, cattails	June 1	Culp	Unknown	Unknown	*** Not observed ; reported by Leah Culp, PRBO Conservation Science