Continuing Decline of the White-tailed Kite in California's Central Valley and Possible Exacerbating Effects of the Recent Drought

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Peer-Reviewed

ABSTRACT

I used data from Central Valley Christmas Bird Counts (CBC) and eBird data from winter and breeding seasons to evaluate the recent population trend of White-tailed Kites (*Elanus leucurus*) in the Central Valley. CBC data showed that declines during the recent (2011-2015) drought were significantly greater than predicted by the underlying declining population trend. While eBird data currently lack the robust history, to allow estimation of long-term trends, both breeding season and winter eBird data also appear to show declines in White-tailed Kites during this recent drought. As drought conditions are known to reduce densities of small rodents, that is probably the key contributing factor to the observed decline in White-tailed Kite numbers.

The White-tailed Kite (*Elanus leucurus*), one of our most elegant and attractive raptors, is believed to be largely resident (i.e. non-migratory) within its North American breeding range, which extends from Mexico northward into southern Texas, Louisiana, Florida, and the U.S. Pacific coast states (Dunk 1995). Occasional nomadism was suggested by Stendell (1972) and others (see Dunk 1995), and this is supported by numerous extralimital records (eBird 2017). Data from CBCs suggest that California's Central Valley (CV) may support most of the U.S. population (Root 1988, Pandolfino 2006). After recovering from near extinction early in the 20th century (Dunk 1995), the species now appears to be in significant long-term decline in the CV (Pandolfino and Handel 2018), in California (Sauer et al. 2017), and throughout its range (Sauer et al. 2017). The California Department of Fish and Wildlife has designated it as a Fully Protected Species in California.

White-tailed Kites prey almost exclusively on small (20-70g) rodents, especially the California vole (*Microtis californicus*; Dunk 1995, Munoz-Pedreros et al. 2016). Rodent populations are known to decline substantially in response to drought conditions (Spevak 1983, Dickman et al. 1999, Bradley et al. 2006). Seasonal fluctuations in California vole populations have been linked to dry conditions (Batzli and Pitelka 1971), suggesting that this species may be sensitive to extended drought. California experienced a serious drought from 2011-15, with the period 2012-14 ranking among the driest in history, and the CV was particularly hard-hit (Williams et al. 2015). Therefore, I decided to examine CBC and eBird data to determine if this recent drought had affected the CV population of White-tailed Kites.

METHODS

Data Sources

I used CBC data (NAS 2010) from Count Year 87 (winter 1986-87) through Count Year 118 (winter 2017-18) from the count circles shown in Figure 1. All CBC data were normalized using the number of birds observed per party hour.

I used data from eBird from 2006 through 2017 (Sullivan et al. 2009, Sullivan et al. 2014). I started with 2006 because use of eBird in the CV was sparse before then (average of <100 checklists/month from 2000-05), but use more than doubled from 2005 to 2006 and continued to build to the present (2600 checklists/month for 2017). To restrict the analyses of eBird data mainly to the CV, I used data from the following counties: Colusa, Fresno, Glenn, Madera, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, Tehama, Yolo, and Yuba. To assess abundance from eBird data I used as the variable the percent of all checklists that recorded observations of the White-tailed Kite. For the winter period I used eBird data from December through January, and for breeding season I used data from mid-February through July.

Rainfall data for the CV was collected from four weather stations (Redding, Sacramento, Stockton, and Fresno) for the period of October 1985 through September 2017 (www.ncdc.noaa.gov/data-access).

Designation of Study Years

The timing of rainfall in California's Mediterranean climate (i.e., primarily from October-May) has led to the convention of defining water years for reporting rainfall as the period from October 1 to the following September 30. The annual rainfall affects the growth of annual vegetation that influences conditions during the breeding season and the subsequent early winter period. Therefore, I accordingly designated study years for comparison of rainfall and breeding and wintering populations. The following definitions, shown as an example for study year 1986, were applied to data sets for all years through 2017:

- Rainfall: October 1985-September 1986,
- Breeding Season, eBird: mid-February through July 1986,
- Winter, CBC: (winter 1986-87; Count Year 87),
- Winter, eBird: December 1986 through January 1987.

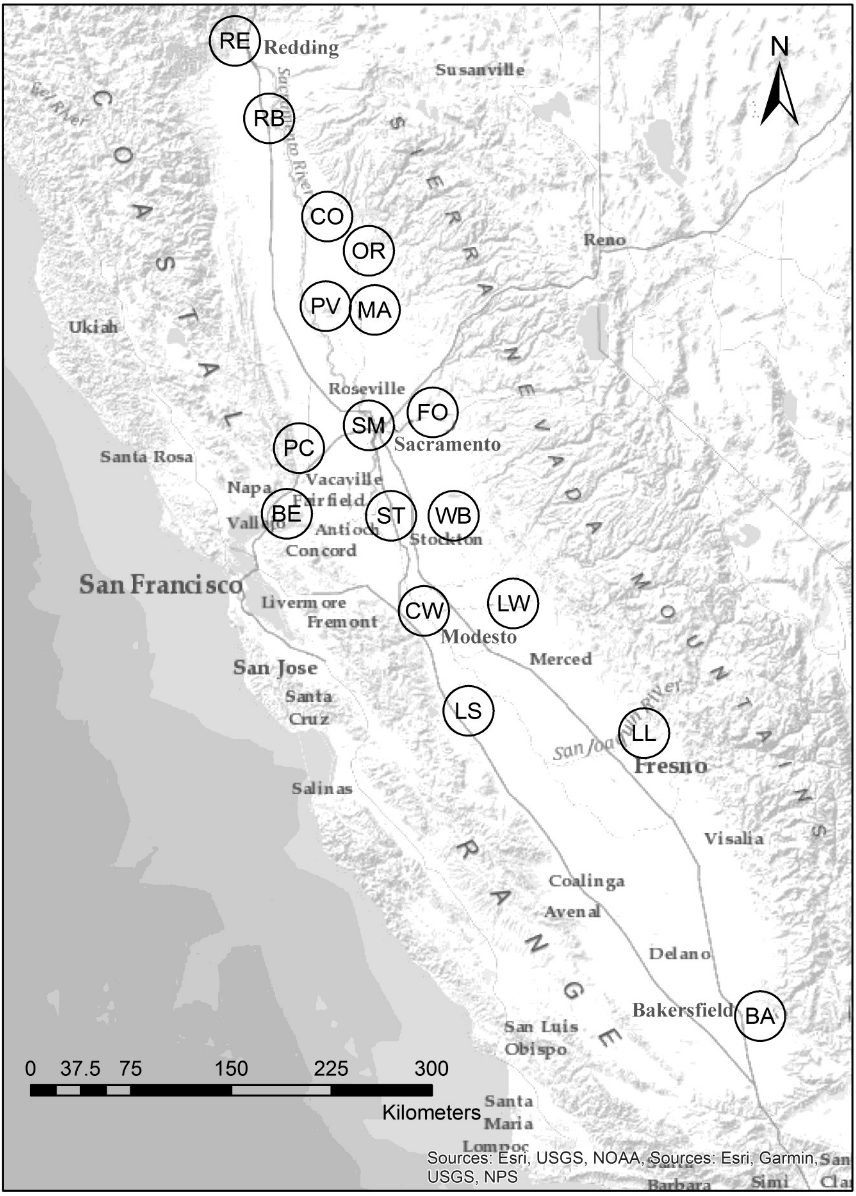

Figure 1. Location of 17 Christmas Bird Count circles in the Central Valley of California used for White-tailed Kite trend analyses. RE, Redding; RB, Red Bluff; CO, Chico; OR, Oroville; PV, Peace Valley; MA, Marysville; FO, Folsom; SM, Sacramento; PC, Putah Creek; BE, Benicia; ST, Stockton; WB, Wallace–Bellota; CW, Caswell–Westley; LW, LaGrange–Waterford; LS, Los Banos; LL, Lost Lake; BA, Bakersfield.

Statistics

To determine if White-tailed Kite abundance from CBC data differed significantly for the drought period from values expected based on long-term trends, I compared data from the years after 2010 to the expected values based on a projected linear trend from the proceeding 25-year (1986-2010) period using a method described by Airola et al. (2007).

RESULTS AND DISCUSSON

CV rainfall fluctuated greatly from year to year (Figure 2) but was mostly below the long-term historical average for the past few decades. Compared to the previous 25 years (1986-2010), the 2012-15 period was particularly dry. Rainfall for the first 25 years of the study period averaged 90% of the historical average, while rainfall for study years 2012-15 averaged 63%, with those four years among the ten lowest of the entire period of analysis.

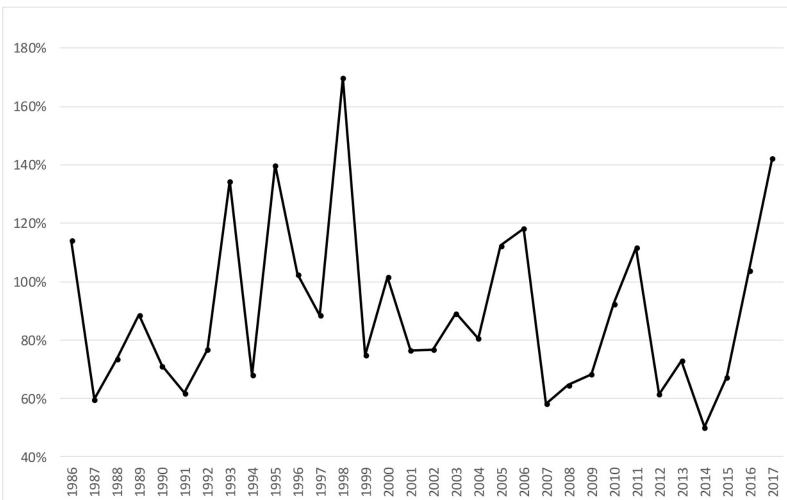

Figure 2. Central Valley rainfall for the 32-year study period compared to the historical average.

Both CBC and eBird data show that this drought period was associated with a decline in the abundance of the White-tailed Kite in the CV (Figure 3). As expected for a resident species, the eBird data from the subsequent winter generally reflected a similar pattern to the data from the preceding breeding season. EBird data for 2017, however, was a notable exception when a decrease in observations of kites for the breeding season contrasted with a large increase in detections during the following winter. Abundance of kites based on CBC data was significantly below the abundance predicted by the 25-year historical trend for 2013-16 (Table 1). CBC results from the final study

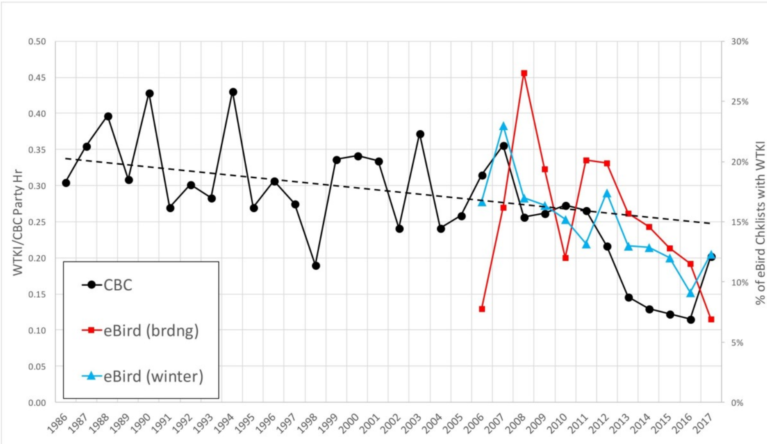

Figure 3. Abundance of White-tailed Kites from CBC and eBird data. Dotted line is based on linear regression of CBC data from 1986-2010, extrapolated to 2017. Note that winter abundance data reflect the winter following the preceding rainfall season.

year suggest a possible recovery of the White-tailed Kite population (Figure 3), consistent with the eBird data for that winter. However, the data from eBird are equivocal, and it is unclear why the low rate of kite observations from the 2017 breeding season was followed by a high level during the following winter. Perhaps there was an influx of birds that bred elsewhere into the CV for that winter or perhaps this was due to highly productive 2016 breeding season, following a relatively wet winter.

Table 1. Comparison of the observed winter abundance of White-tailed Kites (birds/party hour) from CBC data during 2011-2017 to the abundance predicted by extrapolation of the trend (linear regression) from the preceding 25 years. Significant results shown in bold.

Study Year	Count Period	Predicted	Actual	% of Predicted	p
2011	2011-12	0.266	0.266	100%	0.93
2012	2012-13	0.263	0.216	82%	0.41
2013	2013-14	0.260	0.146	**56%**	**0.07**
2014	2014-15	0.257	0.129	**50%**	**0.02**
2015	2015-16	0.254	0.122	**48%**	**0.04**
2016	2016-17	0.251	0.115	**46%**	**0.04**
2017	2017-18	0.241	0.202	81%	0.43

Among the factors that could be contributing to the long-term decline in White-tailed Kite numbers, loss of habitat is the one most frequently implicated (Dunk 1995). Conversion of grassland and other agricultural lands (e.g. alfalfa and other forage crops) used by kites to urban or more intense agricultural uses has been a major land use trend in the CV and throughout California in recent decades (CDOC 2008, Volpe et al. 2010, Cameron et al. 2014). However, one would not necessarily expect drought to have a direct, near-term impact on these habitat conversions. Indeed, drought conditions might be more likely to hinder conversion to more water-intensive agricultural practices.

Drought likely influenced two key factors known to be important to the White-tailed Kite: prey abundance and vegetative cover. Many studies have verified that drought conditions reduce vegetative cover (Bock and Bock 1999, Bartolome 1987) and densities of small rodents (Spevak 1983, Dickman et al. 1999, Bradley et al. 2006). A decline in prey density has been shown to reduce both breeding success and winter survival in the White-tailed Kite (Dunk 1992). In studies of two closely related (and previously conspecific) species, the Australian Black-shouldered Kites (*E. axillaris*) failed to breed during a drought season (Baker-Gabb 1984) and a population of the African Black-shouldered Kites (*E. caeruleus*) increased substantially in response to an increase in rodents (Malherbe 1963). Val Grant et al. (1991) also found a positive relationship between small rodent density and abundances of American Kestrels (*Falco sparverius*) and Loggerhead Shrikes (*Lanius ludovicianus*), two species whose prey base overlaps significantly with that of the White-tailed Kite. Populations of these small rodents appear to recover very rapidly following a drought, often within a few months (Spevak 1983, Dickman et al. 1999, Bradley et al. 2006). The increase in White-tailed Kite numbers in the winter of 2017 based on both CBC and eBird winter data (Figure 3), may be due to such a rapid recovery in prey densities following the wet 2016 winter, which could have resulted in high reproductive success.

White-tailed Kites preferentially used grasslands with tall, dense vegetative cover in the CV during winter (Pandolfino et al. 2011), although this may have been due to higher densities of rodents in these fields than in heavily-grazed grasslands (Johnson and Horn 2008).

Four habitat types have been found to be preferentially used by wintering kites in the CV: managed wetland, alfalfa, irrigated pasture, and other forage crops (i.e., mainly hay and winter wheat; Pandolfino et al. 2011). While precise data on year-to-year changes in the extent of these habitat types in the CV during the recent drought are not available, most of these habitats require substantial amounts of irrigation and thereby are likely to be reduced during periods of drought. Alfalfa acreage has steadily declined in California since about 1999, with particularly low acreages for the 2011-2014 drought years (Geisseler and Horwath 2016). During winter 2014-15, following the worst of the drought, the flooded area of managed wetlands in the CV was 75% below normal (Petrie et al. 2016). However, since kites are very unlikely to use flooded portions of these wetland complexes, one would not necessarily expect a reduction in flooded area to negatively affect them. In fact, an increase in unflooded, upland areas might even benefit foraging kites. Even in the absence of changes in the extent of these habitats, any reduction in the prey density within them in response to drought could have an adverse impact on kites (Dunk 1992, 1995). Therefore, a reduction in prey density is probably the most important contributing factor to the observed decline in White-tailed Kite numbers. Declines in prey density could be caused both by direct effects of drought on rodent reproduction and survival, as well as a reduction in the area of highly productive, rodent-rich habitats such as alfalfa and grasslands with extensive vegetative cover.

Recent work suggests that California can expect even more dramatic swings between periods of high rainfall and drought throughout the remainder of this century (Swain et al. 2018). Therefore, continued monitoring will be important to assess the impacts of these changes on species such as the White-tailed Kite and other species sensitive to such changes.

ACKNOWLEDGEMENTS

I am indebted to the many volunteers who compile and participate on Christmas Bird Counts, as well as the many birders contributing data to eBird. I thank Craig Isolda and Paul Buttner for assisting with data sources for flooded acreages during the drought in the Central Valley.

White-tailed Kite (*Elanus leucurus*). Placer Co., California.

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White-tailed Kite (*Elanus leucurus*). Sacramento Co., California.

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