The Eurasian Collared-Dove Invasion in California: Has it Peaked?

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ABSTRACT

The invasion by Eurasian Collared-Doves of North America has been characterized by very rapid spread and initial exponential growth as this species colonized new areas. The recent occurrence and rapidity of this invasion have given ornithologists an ideal opportunity to study population dynamics of an exotic species. Some groups have developed predictive models of dispersal and population growth that can be tested using subsequent data from the invasion. Recent reports from the southeastern U. S. where the invasion first began suggest that populations there have peaked and now seem to be declining. Even in California, where the doves arrived relatively recently, there are now reports of localized declines. I used Christmas Bird Count (CBC) data from 84 California Count Circles from eight different regions of the state and statewide Breeding Bird Survey (BBS) data to assess recent population dynamics and examine qualitatively how those dynamics compare to the model predictions for this species. CBC data from all eight regions and statewide BBS data suggest that the Eurasian Collared-Dove population in California has reached or is reaching a peak. Some areas, particularly in the northernmost parts of the state, showed patterns that suggest a declining population. These patterns are discussed in the context of the predictions of some of the models proposed for Collared-Dove population dynamics.

Since the first Eurasian Collared-Doves (*Streptopelia decaocto*) appeared in Florida in 1986 (Smith and Kale 1986), the species has spread across North America on a scale and at a pace likely unprecedented for any other invasive bird species (Ingenloff et al. 2017, Romagosa and Labisky 2000, Romagosa and McEneaney 2000, Romagosa 2020). The species reached California early in the 21st century, then increased exponentially and spread rapidly through California and the Pacific Northwest (Hampton 2006, Pandolfino 2010, Pandolfino 2011, Slager 2019) reaching southeastern Alaska by 2008 (McClory and Gotthardt 2008). However, recent reports suggest that the period of growth and expansion may be ending. Data from Christmas Bird Counts (CBCs) in Colorado showed that by winter 2013-14, both the exponential increases

and range expansion seemed to have ended there (Leukering 2018). Numbers are clearly down where it all started for North America, with Florida CBCs for Count Year 2019 (Dec-Jan 2018-19) reporting approximately half the numbers seen at the population's peak (Pranty 2019). Others cite reports of declines in Alabama, Louisiana, Texas, Alaska, and several locations in California (Hess 2020, Lehman 2020, Leukering 2020).

Because invasive, exotic species have the potential to harm native species, it is important both to try to understand the dynamics of the population growth and range expansions of these species and monitor their impacts. To date, there has been little data to suggest that Eurasian Collared-Doves are causing declines in native birds. The Mourning Dove (*Zenaida macroura*) would seem to be the species most likely to be negatively impacted by this invasion because its range and habitat use overlaps most broadly with that of the Eurasian Collared-Dove. Data from Alabama, Florida, California, Colorado, and several western Great Plains states however, did not show negative impacts on Mourning Dove populations (Duncan 2004, Bonter et al. 2010, Pandolfino 2017, and Leukering 2018, Green et al. 2020, respectively). Eurasian Collared-Doves are mainly restricted to low-moderate intensity urban areas and low-moderate intensity agriculture. They are generally absent from highly urbanized areas, intense agriculture, forests, and large expanses of open habitats such as pasture and grassland (Scheidt and Hurlbert 2014, Romagosa 2020). Perhaps the much broader spectrum of habitats used by Mourning Doves (Pandolfino 2017, Leukering 2018, Otis et al 2020) and preference for slightly different food types (Hayslette 2006, Fujisaki et al. 2010, Romagosa 2020, Otis et al 2020) explain the apparent ability for these species to co-exist.

Reports of Collared-Dove declines in California were localized and largely anecdotal. Therefore, I looked more comprehensively for trends from CBC and Breeding Bird Survey (BBS) data since 2003 across several broad regions of the state. I also wanted to evaluate how the results of my analysis compared qualitatively to the predictions of three models of Collared-Dove invasion (Bled et al. 2011, Scheidt and Hurlbert 2014, Ingenloff et al. 2017).

METHODS

I obtained CBC data from National Audubon Society (2010) using selected Count Circles from each of eight regions (Southern Coastal, Southern Inland, Central Coast, San Francisco Bay Area, Central Valley, East Sierra, North Coast, Northeast California; Figure 1). I included only count circles that recorded an average of >10 Eurasian Collared-Doves per year and were conducted in at least nine of the 17 years used (Count Years 104-120; Dec-Jan 2003-04 through Dec-Jan 2019-20). Count Circles used are listed by region.

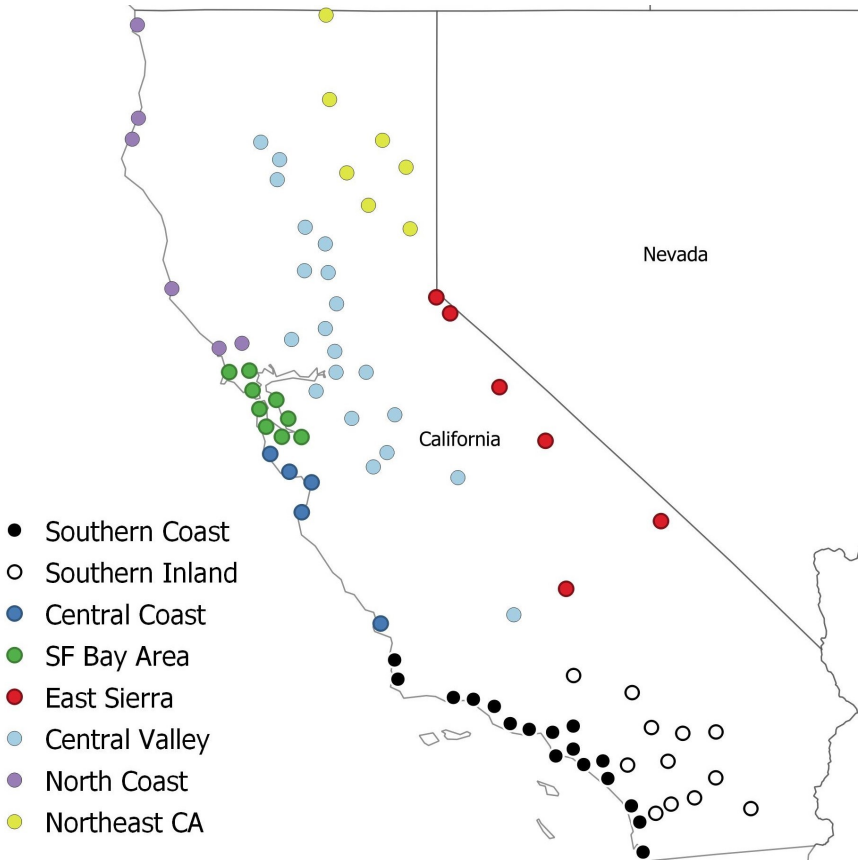

Figure 1. Locations of all CBC circles used and the region to which each was assigned.

- Southern Coast: Carpinteria, Los Angeles, Long Beach-el Dorado, La Purisima, Malibu, Orange County-coastal, Orange County-northeastern, Oceanside-Vista-Carlsbad, Palos Verdes Peninsula, Pasadena-San Gabriel Valley, Rancho Santa Fe, Santa Barbara, San Diego, Santa Maria-Guadalupe, San Juan Capistrano, Thousand Oaks, Ventura
- Southern Inland: Anza-Borrego Desert, Elsinore, Escondido, Idyllwild, Joshua Tree N.P., Lake Henshaw, Lancaster, Mojave River Valley, Morongo Valley, Redlands-Mill Creek, Salton Sea-north, Salton Sea-south
- Central Coast: Año Nuevo, Moss Landing, Monterey Peninsula, Morro Bay, Santa Cruz

- San Francisco Bay Area: Contra Costa County, Crystal Springs, Cheep Thrills, Hayward-Fremont, Marin County-southern, Oakland, Palo Alto, Point Reyes Peninsula
- Central Valley: Anderson River Park, Bakersfield, Benecia, Chico, Caswell-Westley, East Contra Costa County, Lincoln, Lost Lake-Fresno, Los Banos, La Grange-Waterford, Marysville, Merced NWR, Oroville, Putah Creek, Peace Valley, Red Bluff, Rio Cosumnes, Redding, Sacramento, Stockton, Wallace-Bellota
- East Sierra: Bishop, Death Valley, Mono Lake, South Lake Tahoe, South Fork Valley, Woodfords
- North Coast: Arcata, Centerville Beach to King Salmon, Del Norte County, Manchester, Santa Rosa, Western Sonoma County
- Northeast California: American Valley, Eagle Lake, Fall River Mills, Honey Lake, Lake Almanor, Sierra Valley, Tule Lake).

Recent trends were determined from the most recent 5-year period (Count Years 116-120) based on linear regression using the Data Analysis Package from Microsoft Excel. I used a p-value of 0.05 as a basis for determining significance of trends.

I used BBS data (Pardiek et al. 2020) from all active California Survey Routes from 2003 through 2019 to assess changes using an independent data source from a different period of the year.

RESULTS

Each of the eight California regions showed similar patterns with Eurasian Collared-Doves first appearing in the early years of the 21st century (Figures 2 and 3). As has been the pattern throughout North America, numbers of doves built rapidly toward a peak, then appeared to plateau or even decline. Interestingly, although Collared-Doves first appeared in the state in the south, the two most southerly regions (Southern Coastal and Southern Inland) both took longer than other regions to approach peak numbers. The Southern Coastal region, while clearly on a plateau, may not have reached a peak. In contrast, the two most northerly regions (North Coast and Northeast California) reached peak numbers early (2014-17) and seemed to show the clearest signs of decline. While the patterns vary somewhat, the early period of rapid growth appears to have ended in all regions.

Regional trends using data from the most recent five years (Count Years 116-120; Table 1) suggest that only the Northeastern California region showed a significant trend, which was a decline. The slightly positive trend in the Southern Coastal region and the negative trend in the North Coast, however, both approached statistical significance.

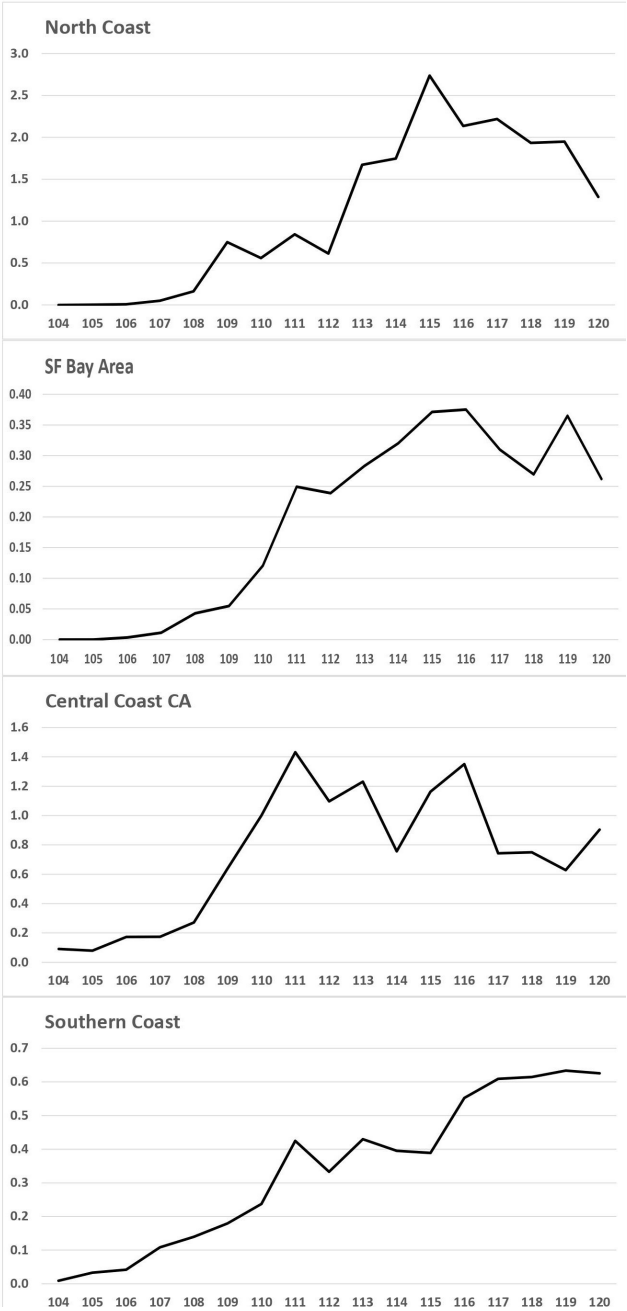

Figure 2. Eurasian Collared-Doves reported per party–hour for each CBC Count Year from four coastal regions.

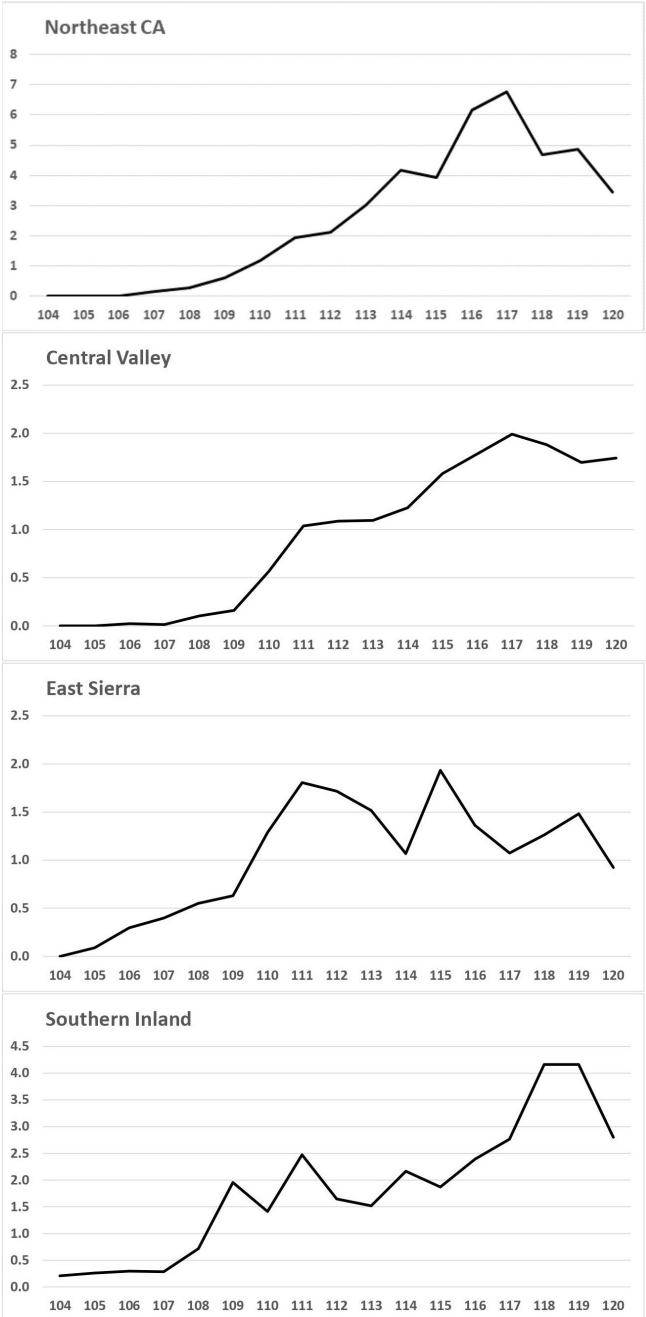

Figure 3. Eurasian Collared-Doves reported per party–hour for each CBC Count Year from four inland regions.

Data from the BBS showed a pattern consistent with those from CBC data (Figure 4). This data set also shows a rapid increase starting in the middle of the decade of the 2000s, with numbers peaking and possibly beginning to decline in the past few years.

Table 1. Eurasian Collared-Dove CBC trends (birds/party hour/year) and 95% confidence intervals for the most recent 5-year period (Count Years 116-120).

REGION	5-yr Trend	Lower 95% C.I.	Upper 5% C.I.	p
Southern Coast	0.017	-0.003	0.037	0.07
Southern Inland	0.22	-0.67	1.11	0.49
Central Coast	-0.10	-0.32	0.17	0.32
S. F. Bay Area	-0.02	-0.07	0.04	0.37
East Sierra	-0.05	-0.29	0.20	0.59
Central Valley	-0.07	-0.16	0.08	0.38
North Coast	-0.19	-0.04	0.03	0.07
Northeast CA	-0.73	-1.43	-0.03	0.04

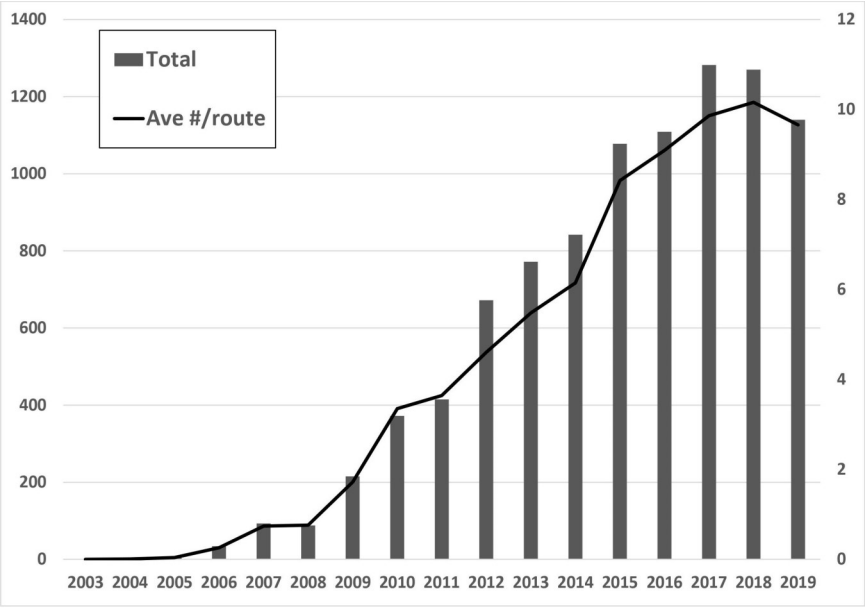

Figure 4. Eurasian Collared-Doves reported from California BBS routes (includes both total numbers and average numbers per route).

DISCUSSION

The three population models developed based on Eurasian Collared-Dove data each used somewhat different data sets and focused on different predictive variables. Bled et al. (2011) used BBS data for the U.S. from 1986 to 2006 and looked at rate and direction of spread and persistence of doves at colonized sites. Scheidt and Hurlbert (2014) used both BBS and CBC data from the U.S. through 2010, and they focused on predicting growth rates and carrying capacity of colonized areas using land cover type, distance from the original invasion location, and climate factors as key effect variables. Ingenloff et al. (2017) based their models on data from the spread of this dove in the Old World and examined rate and direction of spread based on density of suitable habitats.

The prediction by Bled et al. (2011) that this species would spread mainly in a northwesterly direction has been generally true through most of the west (Ingenloff et al. 2017). The spread in California seems to have been mainly to the north-northwest (Hampton 2006, Ingenloff et al. 2017), however, the rate of spread in the state was so rapid that the direction is difficult to assess. Within two years of the first accepted records in southeastern California in 2002, there were reports of Eurasian Collared-Doves as far as north as Del Norte County in the extreme northwestern corner of the state (Hampton 2006). The Bled et al. model also predicted that as regions approached high density, the numbers of Eurasian Collared-Doves would peak and decline, which seems to be the case, at least in the most northerly regions of California.

Scheidt and Hurlbert (2014) predicted that growth rates would be highest furthest from the point of origin and would slow and then decline in older sites. This prediction suggests that the original areas of colonization in southern California would be the first to show slower growth or decline. The opposite appears to be the case, with the two southern California regions reaching peak numbers very recently and the most northerly regions showing the first clear signs of decline. This pattern may be explained by the Scheidt and Hurlbert finding that the carrying capacity of a region is positively related to the presence of moderate-low density human development (agriculture or urban), negatively related to undeveloped or forested land, and positively related to average annual temperature. The two northern regions, North Coast and Northeast California are the coldest of the regions covered, and among the least developed. Thus, it may be that those regions, having a lower carrying capacity, reached full capacity earlier than other regions.

The Ingenloff et al. (2017) model, based on the historical spread of this species in Europe and Asia, predicted that the dove would spread most rapidly in the direction of the closest suitable habitat. However, they found exactly the opposite in North America. Eurasian Collared-Doves spread

relatively slowly in the southeast and along the east coast, where the density of suitable habitat (based on their model) was highest. The spread to the west, where the best habitats were more dispersed and often separated by expanses of unsuitable habitat, was very rapid. For example, it took nearly three decades for Collared-Doves to reach eastern Canada (a distance of approximately 2,000 km from southern Florida), but only eight years to spread from Texas to southeastern Alaska (3,800 km). This difference is likely a testament to the species' ability and willingness to make long dispersal flights in search of new habitats to occupy. The many pelagic reports of this species showing up on ships well offshore, both from Europe (Casement 1983) and North America (Slager 2019), gives ample evidence of this aspect of their behavior.

The general pattern seen in all California regions from CBC data, and statewide from BBS data, suggests that Eurasian Collared-Doves are approaching (or have reached) maximum carrying capacity in nearly every part of the state. Data from Florida CBCs (Pranty 2019) show recent dramatic declines and both Bled et al. (2011) and Scheidt and Hurlbert (2014) predict a pattern of decline following peak concentrations. Scheidt and Hurlbert (2014) speculate that this may be evidence of a tendency to "overshoot" maximum carrying capacity. That is, an area already at full capacity will continue to receive dispersing birds from other areas causing a temporary over-capacity density, followed by a decline. What remains unknown is the ultimate population levels one should expect. Will these populations reach some steady state equilibrium and stabilize? Or will they decline precipitously as have other invasive exotic birds such as the Spotted Dove (*Streptopelia chinensis*; Garrett and Walker 2020) in southern California and several *Psittacula* (parrot) species in Florida (Aagaard and Lockwood 2016)? The latter seems unlikely as most of the dramatic collapses of exotic birds have been species which were well-established only in very restricted ranges (islands or a few urban centers) and the Eurasian Collared-Dove now occupies much of North America. The apparent stabilization and declines of this species in California are based on only a few years of recent data. Any firm conclusions about the population dynamics should await the demonstration of a consistent, sustained trend over at least the next decade.

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Eurasian Collared-Dove (*Streptopelia decaocto).* 26 April 2020. Wilton, Sacramento Co. California. *Photo © Linda Pittman*