Continuing Impacts of West Nile Virus on the Loggerhead Shrike and other Birds in California's Central Valley

Edward R. Pandolfino, 1328 49th Street, Sacramento, CA 95819, erpfromca@aol.com

Peer-reviewed paper

The first appearances of West Nile virus (WNV) in California during the summers of 2004 and 2005 were accompanied by substantial declines in several sensitive bird species, including the California Scrub-Jay (*Aphelocoma californica*), Yellow-billed Magpie (*Pica nuttalli*), American Crow (*Corvus brachyrhynchos*), and Oak Titmouse (*Baeolophus inornatus*) (Airola et al. 2007; Koenig et al. 2007, Pandolfino 2007, 2008a; Crosbie et al. 2008; Wheeler et al. 2009; Smallwood and Nakamoto 2009) and Loggerhead Shrike (*Lanius ludovicianus*; Pandolfino 2008b, Smallwood and Nakamoto 2009). Populations of the scrub-jay, crow, and titmouse in California's Central Valley (CV) have shown signs of recovery (Pandolfino 2008a, 2009, 2010) while Yellow-billed Magpie numbers have remained low (Pandolfino 2013). WNV persists in the CV with levels of virus activity fluctuating year to year (http://westnile.ca.gov/). Comparing responses of WNV-sensitive species to these fluctuations suggested that the Oak Titmouse has become largely resistant to the virus and the California Scrub-Jay and American Crow have also, to a lesser degree, developed resistance (Pandolfino 2018). In contrast, subsequent outbreaks of WNV continue to show large impacts on the Yellow-billed Magpie numbers (Pandolfino 2018, 2019). With WNV persisting in the CV, I updated the status of the three corvid species mentioned above using data from three additional years beyond that used previously (Pandolfino 2018). I also examined abundance data for the Loggerhead Shrike from 2000-2019. In each case, I compared the fluctuations in WNV activity with changes in these populations, as measured by Christmas Bird Count (CBC) data.

METHODS

I obtained CBC data from National Audubon Society (2010) and data on WNV infections from the California Department of Public Health (http://westnile.ca.gov/). I used data from the 17 CV CBC circles (see locations in Pandolfino 2018) that reported data consistently during the period covered by my analyses. CBC data were normalized for relative effort using the number of birds observed per party hour. WNV activity was determined using the total number of `WNV human infection cases reported from the following counties: Butte, Colusa, Fresno, Glenn, Kern, Kings, Madera, Merced, Placer, Sacramento, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Yolo, and Yuba.

RESULTS AND DISCUSSION

As previously noted, populations of the Yellow-billed Magpie, California Scrub-Jay, and American Crow were strongly correlated with year-to-year fluctuations in WNV activity in the CV from the initial outbreak in 2004 through 2016 (Pandolfino 2018). All three species showed significant declines during the peak WNV years (2004-2007) when WNV cases averaged 381/year. When virus activity subsided from 2008-2011 (79 cases/year), numbers of all three species showed signs of recovery, though the recovery of the Yellow-billed Magpie was modest and temporary. From 2012-2016, WNV activity increased again (187 cases/year) and populations of all three corvids showed evidence of slight declines. WNV activity in the most recent period (2017-2019), was lower than the preceding period (133 cases/year) and numbers of all three species showed small increases (Figures 1, 2, and 3, respectively).

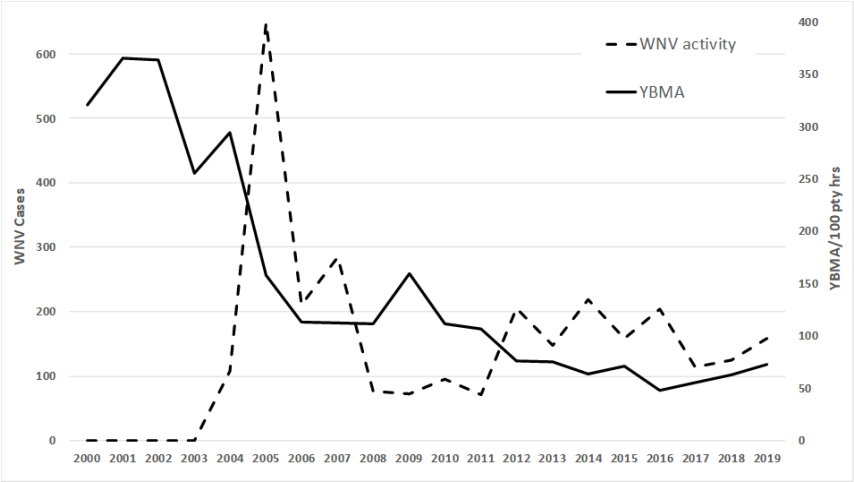

Figure 1. Yellow-billed Magpie (YBMA) abundance (birds/100 party hours) from CBC data and human cases of WNV reported in the Central Valley counties. For CBC data, the years correspond to the winter at the end of each calendar year (e.g. 2005 is the winter of 2005-06).

These data suggest that, although both the California Scrub-Jay and American Crow numbers remain somewhat sensitive to fluctuations in WNV activity, their populations have largely returned to pre-WNV levels. However, the magpie numbers continue to decline, with small recoveries during low-WNV years, followed by renewed declines in response to subsequent virus outbreaks. Indeed, the numbers of this species recorded on CV CBCs has declined by more than 80% since the first appearance of WNV.

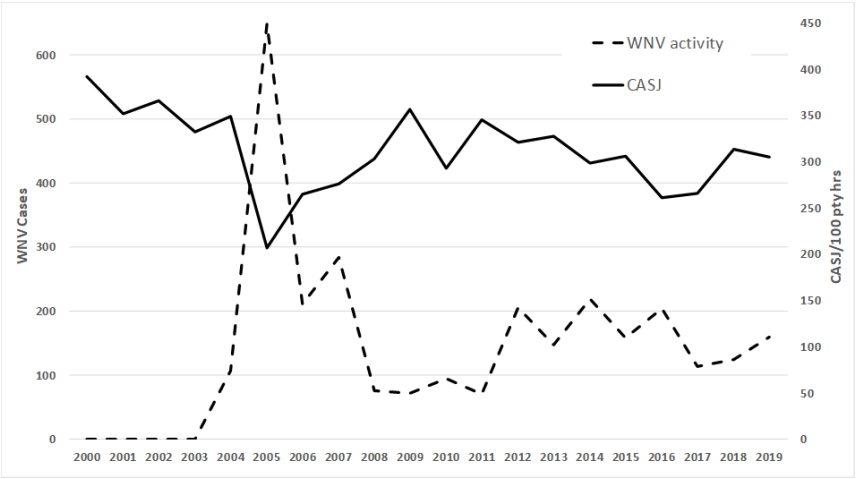

Figure 2. California Scrub-Jay (CSJA) abundance (birds/100 party hours) from CBC data and human cases of WNV reported in the Central Valley counties. For CBC data, the years correspond to the winter at the end of each calendar year (e.g. 2005 is the winter of 2005-06).

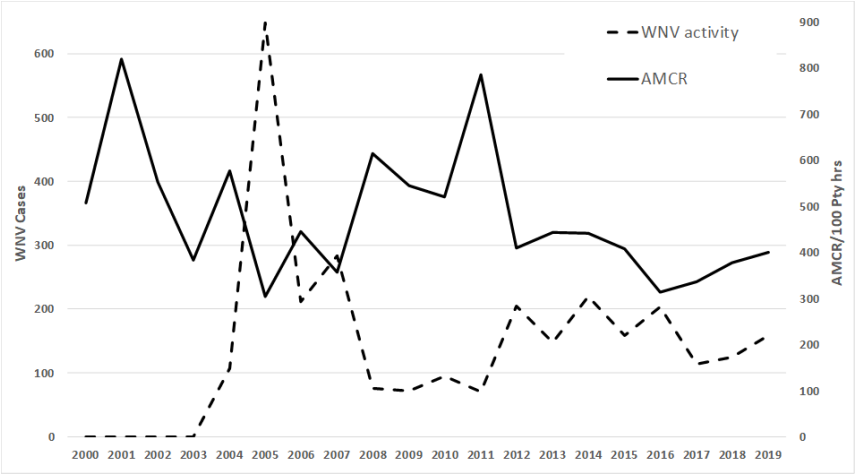

Figure 3. American Crow (AMCR) abundance (birds/100 party hours) from CBC data and human cases of WNV reported in the Central Valley counties. For CBC data, the years correspond to the winter at the end of each calendar year (e.g. 2005 is the winter of 2005-06).

Abundance data for the Loggerhead Shrike showed a qualitatively similar pattern, at least from 2004-2016. Following an initial significant decline (Pandolfino 2008b), numbers rebounded during the 2008-2011 period of low

WNV activity (Figure 4). Declines continued as the virus activity increased from 2012-2016. However, it appeared that Loggerhead Shrike numbers continued to decline during the most recent three years, with their recent abundance about half that of the pre-WNV period. This species has been in significant long-term decline in the CV (Pandolfino 2006, Pandolfino and Handel 2018), California (Sauer et al. 2017), and throughout its range (Sauer et al. 1995, Cade and Woods 1997, Sauer et al. 2017, Yosef 2020). This decline pre-dates the appearance of WNV in North America and the factors responsible for this remain unknown, although habitat loss and environmental chemicals (e.g., pesticides, rodenticides) have been implicated (Yosef 2020). This complicates any attempt to link changes in population to a single cause. The continued decline seen in recent years may simply represent the effects of these other factors.

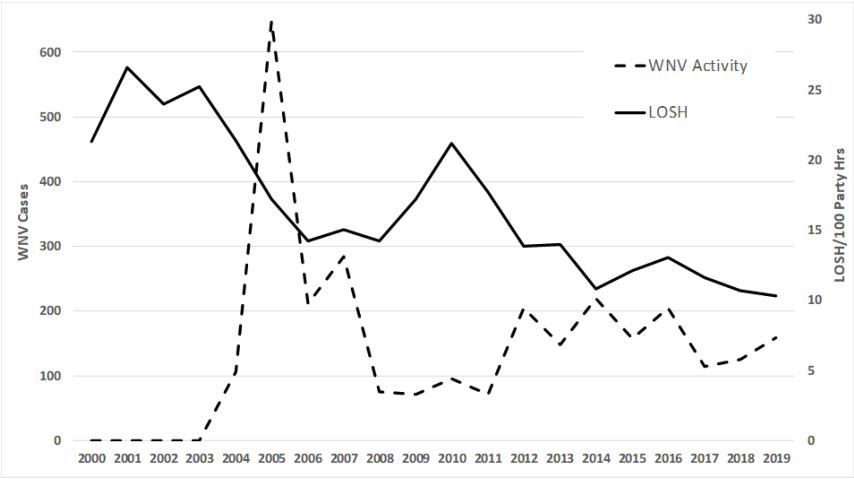

Figure 4. Loggerhead Shrike (LOSH) abundance (birds/100 party hours) from CBC data and human cases of WNV reported in the Central Valley counties. For CBC data, the years correspond to the winter at the end of each calendar year (e.g. 2005 is the winter of 2005-06).

One inherent weakness of this method of linking WNV effects to bird populations is its reliance on the number of reported human cases as a proxy for virus activity. As time passes, larger proportions of the human population become immune to the virus. Also, as publicity about this virus subsides, more cases may go undiagnosed or unreported. An alternative proxy would be data from county health authorities using sentinel chickens. This involves assessing virus infection among a population of immunologically naive chickens to determine local presence of WNV. However, over time, fewer and fewer county health officials are maintaining that database. Some counties also have

programs to collect and analyze mosquitos, but this is not done consistently from county to county. Therefore, our ability to link responses of very sensitive species such as the Yellow-billed Magpie to WNV may become more difficult.

ACKNOWLEDGEMENTS

I thank all those who gather data through their participation in CV Christmas Bird Counts and, in particular, to all the CBC circle compilers who organize, supervise, and manage these counts.

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