USING CITIZEN SCIENCE TO EXPLORE SPATIOTEMPORAL PATTERNS OF AVIAN BOTULISM MORTALITY EVENTS IN LAKE MICHIGAN

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Since the 1960s, periodic outbreaks of avian botulism type E have contributed to large-scale die-offs of thousands of waterbirds throughout the Great Lakes of the United States. In recent years, these events have become more common and widespread. Occurring during the summer and autumn months, the prevalence of these die-offs varies across years and is often associated with years of warmer lake temperatures and lower water levels. Little information exists on how environmental conditions mediate the spatial and temporal characteristics of mortality events. Using data generated from a 4-year citizen science initiative - the Avian Monitoring for Botulism Lakeshore Events (AMBLE) program - our goal was to quantify the within-year characteristics of mortality events for multiple species, and to test whether the synchrony of these events corresponded to fluctuations in two environmental factors suspected to be important in the spread of avian botulism: water temperature and the prevalence of green macroalgae. During two separate events of mass waterbird mortality, we found that the detection of bird carcasses was spatially synchronized at scales of c. 40 km. Notably, the extent of this spatial synchrony in avian mortality matched that of fluctuations in lake surface water temperatures and the prevalence of green macroalgae. Our findings are suggestive of a synchronizing effect where warmer lake temperatures and the appearance of macroalgae mediate the characteristics of avian mortality. In future years, rising lake temperatures and a higher propensity of algal masses could lead to increases in the magnitude and synchronization of avian mortality due to botulism. We advocate that citizen-based monitoring efforts are critical for identifying the potential environmental conditions associated with widespread mortality events and estimating future risk to waterbird populations.

Keywords: Citizen Science; Sampling effort; Spatial Statistics; Moran effect; Waterbird