**The effects of vegetation structure and management on nest box temperature and the consequences for chick growth and survival**

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Habitat loss to anthropogenic disturbance is the primary driver of species loss and endangerment. Efforts to increase biodiversity in working landscapes, such as installing nest boxes for cavity-nesting birds, may allow more species to thrive in human-dominated landscapes. However, as climate change progresses, human-dominated landscapes may expose birds to new temperature extremes because converting land to agriculture removes trees that insulate the understory from ambient temperature. In bird species with altricial young, nestlings are ectothermic, so both low and high temperatures divert energy from growth to thermoregulation. The lethal effects of cold are well-documented, but the effects of heat will also be salient in the future as climate change increases both mean and maximum temperatures. Accordingly, I will investigate the effects of climate change and land use change on nest temperatures as well as nestling growth and survival.

***Questions***

*Question 1.*How does land usage affect temperature profiles inside and outside of a bird’s nest?

*Hypothesis 1*.In habitats that have closed canopies (i.e. closed riparian and orchard sites) I expect nest boxes to show fewer and less severe temperature spikes over the nesting season. Forest canopies have the ability to insulate the area below the canopy from both high and low macroclimatic temperatures, so I expect that more closed canopies will offer a higher buffering capacity.

*Question 2****.*** How do next box temperature and land usage affect nestling growth and survival rates?

*Hypothesis 2.*Temperature spikes will be more frequent and more severe in open land uses (i.e. row crop and grassland systems) which will correlate with slower weight gain and lower survival rates in nestlings in those sites. Without the buffering capacity of a canopy, nest boxes in open land uses will suffer more frequent and severe temperature spikes. Nestlings are ectothermic and therefore vulnerable to temperature changes. High temperatures may cause hyperthermia, causing nestlings to expend more energy on maintenance and lowering their growth rates.

***Methods***

To address question 1, I will monitor three nest boxes at each of three unique sites in each of four land use treatments (row crop agriculture, orchard agriculture, grassland, and high canopy cover riparian forests) for a total of 36 nest boxes monitored simultaneously beginning in late March. I will partner with the Bohart Museum of Wildlife and Fish Biology to access their existing Putah Creek Nest Box Highway, a network of 169 nest boxes along Putah Creek from Solano Diversion Dam past the English Hills. However, the Nest Box Highway does not include nest boxes in row crop agriculture, so we will secure permission from landowners to place 10 boxes each at three new row crop sites and one grassland site. I will use HOBO temperature loggers to measure and record temperature every 5 minutes inside and outside of the nest box. Specifically, I will place a HOBO on the inside and outside of each nest box after eggs are laid. I anticipate moving each HOBO to a new nest two more times during the nesting season after the end of each nest, for a total of 108 nests monitored from mid-March through the end of July. Sample size will vary according to availability of nestlings. Finally, after field work ends, I will compare the frequency and severity of temperature spikes between land uses using linear models.

         To address question 2, I will partner with the Bohart Museum of Wildlife and Fish Biology to monitor nestling growth and survival. As part of a larger, long-term survey of bird use of the Putah Creek Nest Box Highway, Hanika Cook and her team will record mass, tarsus length, bill length, and wing chord of nestlings twice during the nestling period and band them at the appropriate time. I will also be trained to handle, measure, and band nestlings according to their protocol and will monitor boxes outside of the Putah Creek Nest Box Highway weekly. I will compare the effects of land use and temperature on nestling growth and survival probability using linear models.

***South Fork Preserve’s role***

I request permission to monitor nest boxes and associated nestlings in the South Fork Preserve weekly as described above in Methods from late March through mid-July 2021.