TEOS 02 Avian Nestbox Studies at the James Reserve

TEOS 02.1 People

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- Graduate Students: Sharon Coe, Department of Biology, UCR.

TEOS 02.2 Overview

Avian studies being conducted at the James Reserve using imagers and environmental sensors have focused on species of birds that typically nest in holes (also known as cavities) in trees ("cavity nesters"). These species often occupy human-constructed nesting boxes when they are made available. Numerous studies use such data due to the ease with which the nest contents can be viewed relative to natural tree cavities.

- Employ image capture from wired video cameras in nestboxes to obtain data for biological applications.
- Collect data necessary to analyze and improve functionality of Cyclops as biological sensors for avian studies.
- Use embedded network sensing of environmental variables to correlate with video-based remote sensing
- Evaluate microclimatic influences on nesting activity and nest success in secondary cavity nesting birds.
- Collect data to test video content analysis software approaches for automated classification of avian behavioral activities from nest box video images in real time at remote nest sites.

TEOS 02.3 Approach

Our work is focused on recording still images inside nestboxes using either wired or wireless camera systems to record bird behavior, primarily during the breeding season in spring months. In addition, we are measuring environmental characteristics of the immediate nesting environment (i.e., inside the nestbox) including temperature, humidity, and dew point, as well as near the nesting environment (i.e., outside of the nestbox). Light intensity (Photosynthetically Active Radiation, PAR) and soil moisture content are also measured near the nestboxes. The environmental data and associated nestbox images are being used to answer questions about bird breeding behavior and breeding success.

TEOS 02.4 System(s) Description and/or Experiments

Images and data continue to be collected as in previous years. No specific experiments have been conducted during the past reporting year.

TEOS 02.5 Accomplishments

Completed the first formal statistical analysis of patterns of hatching asynchrony as a function of patterns of diurnal and nocturnal nestbox occupancy patterns of nesting Western Bluebirds and Violet-green Swallows. Our research question was: *Does nestbox occupancy prior to clutch completion lead to hatching asynchrony in cavity nesting species?* Hatching asynchrony is a significant life history trait as it typically results in within-brood size hierarchies. Such size hierarchies are associated with reduced survival of later-hatched (smaller) nestling, and usually result from onset of incubation with laying of penultimate egg. Cameras mounted in ceiling of nestboxes recorded images every 8-15 minutes, from which we calculated the proportion of images showing a bird in the nestbox during laying, and at 7 days after clutch completion (when incubation should be fully in progress). Diurnal occupancy was recorded between 10:00-16:45 hours; nocturnal occupancy was assessed by the presence of a bird in the nestbox at 01:00 hours.

Western Bluebirds showed higher *diurnal* nest occupancy as early as 2 days before Violet-green Swallows. Mean diurnal occupancy for bluebirds (n = 17) was significantly ($P < 0.01$) greater than for swallows (n = 11) on the penultimate day of laying, as well as on the ultimate day, but not on the first day. Violet-green Swallows showed greater *nocturnal* occupancy than Western Bluebirds. In 100% of swallow nests, one or both adults occupied the nestbox all nights between the laying start and clutch completion, whereas bluebird nocturnal occupancy ranged 0-100% of nights over the same period. *Both species showed hatching asynchrony*. However, under the typical synchrony definition ("all eggs hatched within a 24-hour period"), more swallow nests were *synchronous* than asynchronous. In contrast, if we define a synchronous nest as one that hatched within 1 calendar day (not 2), then more swallow nests were *asynchronous*. A nest whose eggs hatch over 2 calendar days can be expected to show greater nestling size variation, since the nestlings from two eggs that hatch near each other during the daytime should be closer in size compared to two eggs that hatch on separate calendar days; the intervening nighttime hours when nestlings go unfed are not equal to daytime hours when parents do feed regularly.

TEOS 02.6 Future Directions

No new initiatives are proposed at the James Reserve. Monitoring and data collection at the Reserve will continue until existing funding is completed.

Remaining energies will be devoted towards two tasks:

- Sifting through existing image and variable databases to answer biological research questions posed at the outset of the project.
    - Nestbox use during the non-breeding season (night-roosting)
    - Environmental variation among nestboxes with respect to nest site selection and adult breeding behavior
    - Inter-species competition for nestboxes
    - Laying patterns and behavior
    - Incubation (onset of behavior)
    - Fledging (variation in fledging date among nestlings within a nest)
- Exploration of the redeployment of the system (a) to monitor open-cup nests, and (b) to establish a monitoring network on a different reserve with less technically sophisticated infrastructure. The latter addresses the question of whether this or a very similar system can be exported to potential users.