Determining the daily foraging activity of Chestnut-backed Chickadees (*Poecile rufescens*) using radio frequency identification (RFID) technology

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UNDERGRADUATE
RESEARCH PROJECT

Background

- The study of passerine behaviour has become increasingly important in recent years due to an overall decline in many passerine populations across North America (1).
- Actively monitoring passerine behaviour may help explain causes of their population decline and facilitate the development of passerine conservation strategies.

RFID Technology

- Radio frequency identification (RFID) technology serves as a promising and affordable tool for the study of passerine behaviour (2).
- In RFID systems used for ornithological studies, a passive integrated transponder (PIT) tag is attached directly to an individual bird, which is detected by an RFID reader when the tag passes through an electromagnetic field created by an antenna.
- PIT tags are ideal for use with small passerines since they are small, lightweight, and do not require an external power source. The use of remote technology also greatly reduces the direct interaction time normally required to study small birds (2).

Chestnut-backed Chickadees

- As the smallest of the New World chickadees, Chestnut-backed Chickadees (*Poecile rufescens*) are a small passerine species found on the Pacific coast of North America (3).
- They are common and abundant on Vancouver Island, and do not migrate, making them ideal for study in the winter months. They are regularly caught on the Vancouver Island University (VIU) Nanaimo campus during bird banding demonstrations.
- Chickadees are frequently observed foraging at supplemental feeding sites. They can reliably be observed returning to the same site frequently in the span of one day.

Objectives

- Build bird feeders equipped with RFID readers, and band locally common free-living Chestnut-backed Chickadees with integrated PIT tag leg bands.
- Determine patterns in the daily foraging activity of Chestnut-backed Chickadees, and possible correlations with environmental variables.

Materials and Methods

- A bird feeder was constructed based on designs by Bridge and Bonter in a similar study (5).
- RFID systems (including antenna, battery, circuit board, memory card and waterproof casing) were constructed, tested, and applied to the bird feeders.
- Five bird banding sessions were conducted on the VIU campus to apply PIT tags to eleven individual free-living Chestnut-backed Chickadees resident to the area (Fig. 1).

Fig. 1. Applying a passive integrated transponder tag to the tarsus of a Chestnut-backed Chickadee. (Photo courtesy Eric Demers)

- The feeder was monitored daily from November 2015 to January 2016 and remained stocked with black oil sunflower seeds for the duration of the study, and was periodically observed from a distance to observe the behaviour of birds feeding.

Results

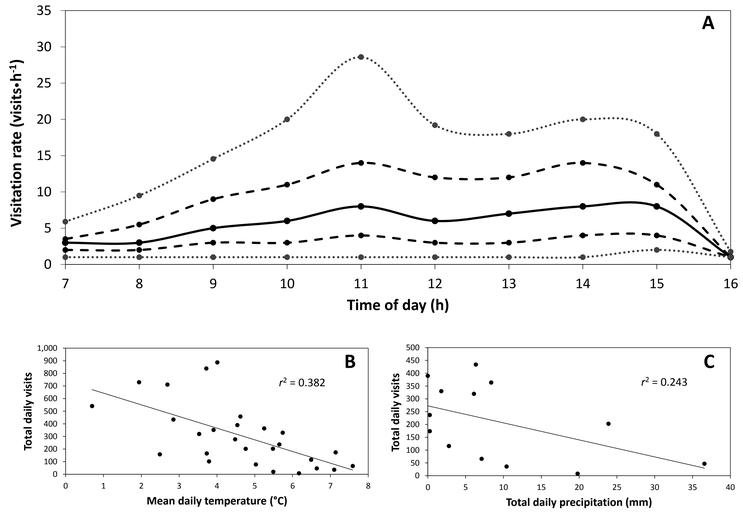

Figure 2. (**A**) Daily visitation rate profiles for eleven (n = 11) PIT-tagged Chestnut-backed Chickadees over 27 active days of study from November 2015 to January 2016. The number of transponder signals were averaged for each hour, and the 5th, 25th, 50th, 75th, and 95th percentiles of the distribution of hourly means across all days of study are shown. The total daily visits by all tagged birds were compared with (**B**) the mean daily temperature values (°C) over the course of all study days, and (**C**) the total daily precipitation (mm) over a period of two weeks in January 2016.

- PIT-tagged chickadees (n = 11) began visiting the feeder shortly after sunrise and visitation rate steadily increased throughout the morning, and peaked between 11:00 and 15:00. Visitation rate dropped sharply approximately one hour before sunset (Fig. 2A).
- A goodness-of-fit test indicates that feeder visitation rate was not uniform throughout different times of day (χ^2 = 2,729; df = 10; P < 0.001).
- Total daily visits to the feeder decreased significantly (P < 0.001) as mean daily temperature increased (Fig. 2B). Similarly, total daily visits generally decreased with increasing total daily precipitation, although this relationship was not significant (P = 0.190) (Fig. 2C).

Figure 3. One of the eleven Chestnut-backed Chickadees equipped with a passive integrated transponder tag on its tarsus. It is perched on the RFID antenna coil. (Photo courtesy Sharlene James)

Discussion

- These data suggest that the birds' daily energy reserves were being met before sunset and may have been maintained throughout the morning by relying on cached seeds from the previous day.
- This observed trend is supported by the risk-spreading hypothesis, which states that birds will continue to forage until their critical threshold for stored energy is reached, and that birds will forage at a higher rate in colder weather since more energy is required to maintain body temperature (2,6).
- By using RFID technology, individual behaviours of small passerines can be monitored remotely to obtain accurate records of their daily activities.

References

1. Ballard, G., G. R. Geupel, N. Nur, and T. Gardali. 2003. Long-term declines and decadal patterns in population trends of songbirds in western North America. The Condor 105: 737-755.
2. Bonter, D. N., and E. S. Bridge. 2011. Applications of radio frequency identification (RFID) in ornithological research: a review. Journal of Field Ornithology 82: 1-10.
3. Sibley, D. A. 2003. The Sibley Field Guide to Birds of Western North America. Alfred A. Knopf, New York. 472 p.
4. Bonter, D. N., B. Zuckerberg, C. W. Sedgwick, and W. M. Hochachka. 2013. Daily foraging patterns in free-living birds: exploring the predation-starvation trade-off. Proceedings in Biological Sciences of the Royal Society 280: 20123087.
5. Bridge, E. S., and D. N. Bonter. 2011. A low-cost radio frequency identification device for ornithological research. Journal of Field Ornithology 82: 52-59.
6. Bednekoff, P. A., and A. I. Houston. 1994. Avian daily foraging patterns: effects of digestive constraints and variability. Evolutionary Ecology 8: 36-52.

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