Timing of molt and its effect on plumage reflectance in the Carolina Chickadee

Aria Sen, Luke K. Butler

Department of Biology, The College of New Jersey

INTRODUCTION

Birds which begin molt early tend to have a longer molt duration than those which begin late. This indicates that molt will end at the same time regardless of when it started, due to the need for migratory birds to have a completed molt period before winter begins. A shorter molt period is compensated for by concurrent growth of primaries. Feather color is a specific indicator of feather quality. More melanized feathers are considered more durable, showing resistance in wear due to abrasion and break force Feather quality may compromised by a rapid molt, as opposed to a normal molt, is because the bird is spending the majority of its energy in feather generation along, focusing on quantity instead of quality. We are exploring the effect of variation in molt dynamics on feather color of Carolina chickadees.

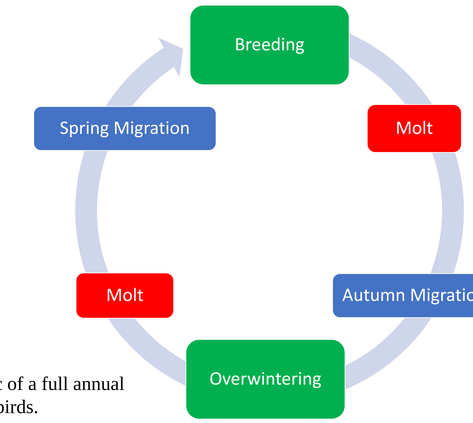


Figure 1. Schematic of a full annual cycle of migratory birds.

METHODS

Feathers were collected from birds in the Colliers Mills Wildlife Management Area in Ocean County, New Jersey. To catch the birds, playbacks of conspecific songs and calls were used to trap them in a mist net. A fifth primary feather, worn from the previous year's molt, was plucked and sealed in a plastic vial (Fig 11). The vials were then stored in a cabinet to prevent light and air degradation of the feathers.

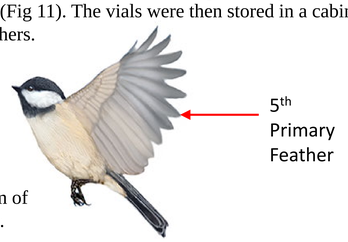


Figure 11. Diagram of chickadee in flight.

REFERENCES

1. Osario, D., A. D. Ham. 2002. Spectral reflectance and directional properties of structural coloration in bird plumage. The Journal of Experimental Biology 205:2017-2027
2. "Spectral Reflectance Curves." SABIC,, 2017, https://www.sabic-ip.com/cxp/jsp/user/LearnAboutColor/ColorBasicsDetail/reflectance_curves.jsp.

METHODS (CONT'D.)

Our proposed method for feather color assessment is to use spectral reflectance data collected from feather samples. This method utilizes spectroscopy, which measures light as a function of wavelength, effectively determining the relative brightness of a feather, *Fig. 2*. A white standard is used to measure reflectance such [illegible] o a known spectrum.

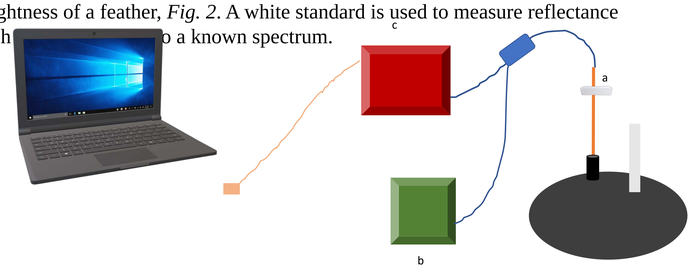


Fig 2. Schematic of the spectrometer set-up. Fiber optic probe (a) is mounted on a stand with a 2mm black cap fit on the end and is connected to both a PX 2 pulsed Xenon light source (b) and an Ocean Optics USB2000+UV-VIS spectrometer.

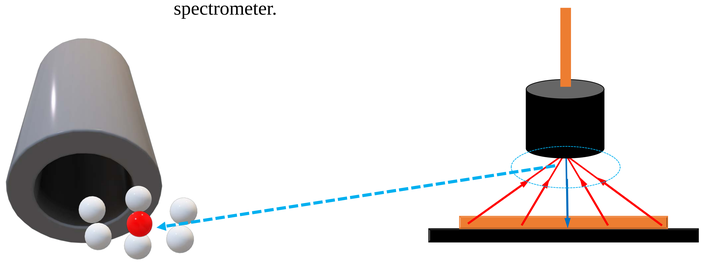
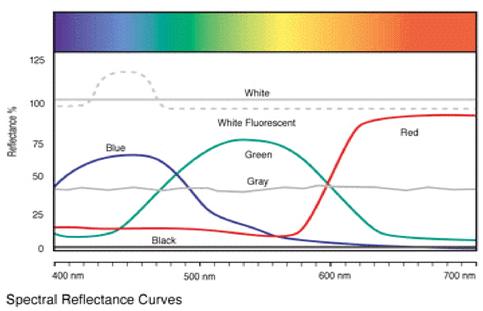


Figure 3. A magnified view of the underside of the fiber optic probe. White spheres represent illumination fibers, while the red sphere represents the collecting fiber.

Figure 4. Diagram of incidence and reflected rays from sample. Red arrows are reflected rays being captured by the collecting fiber. The blue arrow is the incident ray emitted by the illumination fibers.

Processed data is displayed in a graph where percent reflectance is a function of wavelength. Peaks in the graph correspond with the wavelength value of its respective color and indicate the brightness of the sample, indicated by Fig 5.



Spectral Reflectance Curves

METHODS (CONT'D.)

Calibrate spectrometer and capture reference spectrums. → Spectral measurements taken from feather sample. → OceanView exports data to a separate file to be recognized by CLR. → CLR groups and bins data before exporting into Excel file. → Graph is generated based off binned data.

A summary of the method used to analyze feather color via spectrometry.

This figure comes from a study[1] in which crown feathers from a magnificent hummingbird *E. fulgens* were measured using an almost identical method to ours. The lines in Fig. 7A represent different angles at which the probe was held to the sample, which were then normalized in Fig. 7B. The feather is a deep purple with flecks of blue, so this is an accurate measurement (Fig 8).

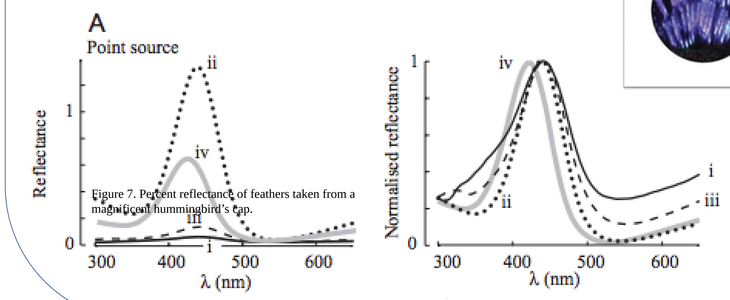
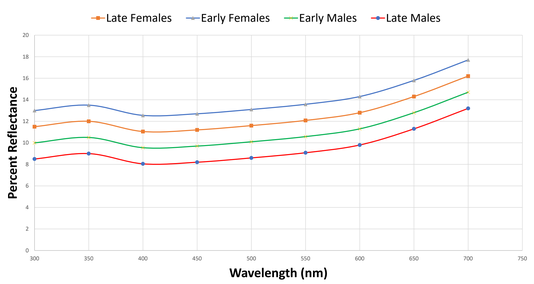


Figure 7. Percent reflectance of feathers taken from a magnificent hummingbird's cap.

EXPECTED RESULTS

This methodology will be used to compare reflectance spectra between feathers from years with either delayed or on-time molts. expect to see a lower level of brightness in feathers from delayed molt years. The proposed results shown in Figure 10 indicates a difference in brightness between feathers from normal and late molts.



ACKNOWLEDGEMENTS

I would like to thank the Office of Academic Affairs, as well as the MUSE program for the support and funding of this project.