A novel study of Cliff Swallow (*Petrochelidon pyrrhonota*) feather coloration in relation to habitat characteristics and morphology

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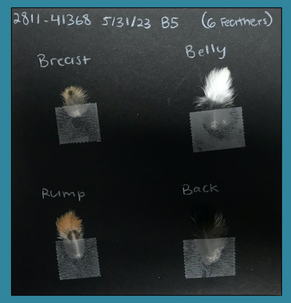
Abstract

Feather coloration is used for social signaling in many avian species, and can be associated with their ability to live and breed in habitats with high quality resources (Jenkins et al. 2013, Saino et al. 2013). It can signify individual quality, (Saino et al. 2013) and influence mate choice (Bennet et al. 1996). We analyzed different aspects of Cliff Swallow (*Petrochelidon pyrrhonota*) feather coloration in relation to morphology and habitat characteristics. We measured luminance, hue (theta and phi), and saturation for four different color patches on the swallows. **We predicted that individuals in brighter coloration would be able to settle in larger colonies and areas with higher quality resources, such as higher water levels. We also predicted individuals in brighter coloration would be in better body condition and have heavier mass. We predicted males and females would differ in coloration.**

An adult Cliff Swallow (above).



Feathers from the four color patches (left), and Cliff Swallows in their nests (right).

Methods

- Data collected May-July 2024 in Barton and Ellis counties, KS
- 15 total colony sites
- Captured up to 15 birds at each site using mist nets
- Birds were sexed and aged when possible
- Measured mass, tarsus, and wing length
- Each bird was fitted with a federal aluminum leg band
- 6-9 feathers were collected from four different color locations:
  - Back
  - Belly
  - Breast
  - Rump
- Feather reflectance measurements collected with a spectrometer
- The Pavo package in R (Maia et al. 2019) was used to analyze aspects of feather coloration

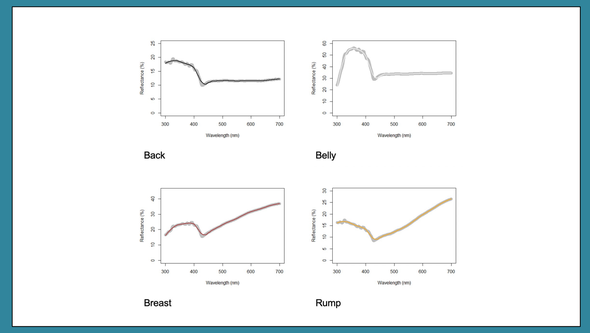


Figure 1. Feather reflectance in the four color locations.

Results

- **Smaller colonies had birds with significantly higher values of belly luminance** ($F_{1,11}$=13.1, P=0.004).
- There were no other significant relationships between feather coloration and habitat characteristics or body condition.
- **Higher values for back theta were related to heavier mass in birds** ($F_{1,126}$=7.2, P=0.008).
- **Higher values for rump theta were correlated with lower mass** ($F_{1,126}$=5.0, P=0.027), but this seemed to be driven by a single individual with an exceptionally low rump theta value.
- **Higher belly saturation values were correlated with heavier birds** ($F_{1,132}$=11.7, P=0.001).
- **Higher breast luminance values correlated with heavier birds** ($F_{1,125}$=6.7, P=0.011).
- **Belly phi was significantly higher in females than males** ($F_{1,119}$=7.3, P=0.008).
- Back phi was marginally, but not significantly higher in females than males ($F_{1,118}$=3.3, P=0.073).
- Rump phi was marginally, but not significantly, higher in females than males ($F_{1,121}$=3.766, P=0.055).

Results cont.

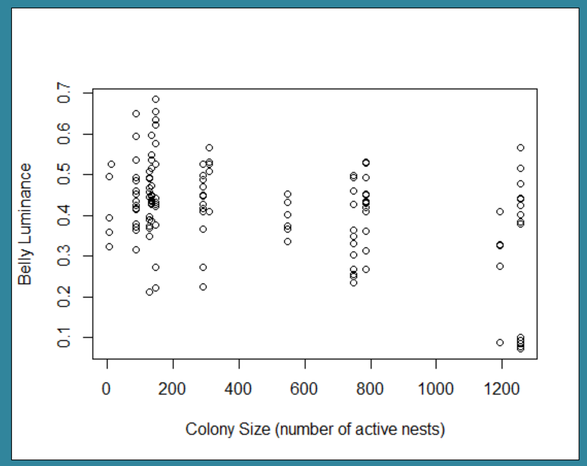


Figure 2. Colony size (number of active nests) in relation to belly luminance.

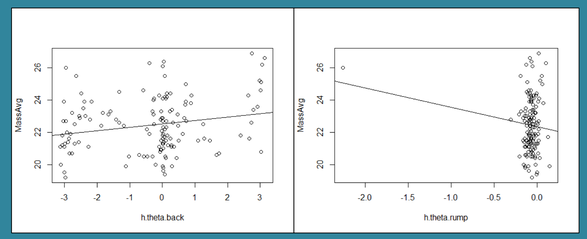


Figure 3 (left). Theta at the back in relation to mass (g) of birds.
Figure 4 (right). Theta at the rump in relation to mass (g) of birds.

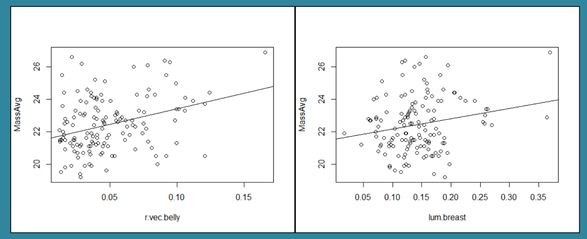


Figure 5 (left). Saturation at the belly in relation to mass (g) of birds.
Figure 6 (right). Luminance at the breast in relation to mass (g) of birds.

Discussion

Because smaller colonies were correlated with brighter coloration, it is possible that coloration is used as a social cue in Cliff Swallows that determines the social interactions and the colony size in which they can settle. There were relationships between feather coloration and mass, and it is possible that coloration is related to body condition and acts as an indicator of individual quality. There was no relationship between feather coloration and body condition, but this is probably due to there being multiple assistants with various skill levels in taking body condition related measurements in the field, causing variation even though they all used the same method. There was some variation in male and female coloration, suggesting that coloration may act as a socio-sexual signal, or help distinguish the sexes from one another.

Conclusion

This is a novel study in Cliff Swallow feather coloration. Our results indicate that there are relationships between feather coloration and environmental factors, as well as morphology, and sex. It is possible, that similar to related swallow species, and because Cliff Swallows have a relatively high number of intraspecific interaction, that feather coloration plays a role in social signaling.

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