Migratory Phenology of the Gray Catbird: A Circular Approach

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Objectives

1. Identify changes in mean date of capture for gray catbirds
2. Use circular statistics to investigate how gray catbirds may be adjusting to environmental change

Background

Avian Phenology

- Avian migration is an annual cycle that occurs in synchronization with the changing seasons
- Climate change is altering plant and insect phenology, which may cause passerines to change the timing of migration
- Changes in migratory timing may subject passerines to suboptimal conditions on their breeding and wintering grounds

Circular Statistics

- Field of statistics used to analyze periodic data, such as annual and daily phenological cycles, and directions (e.g. navigation)
- Used to investigate phenological changes in plant study systems
- A novel way to analyze the annual cycle of birds, a non-linear cycle, allowing for a more comprehensive approach

Catbird caught at Lake Lotus Park Photo: Maxfield Weakley

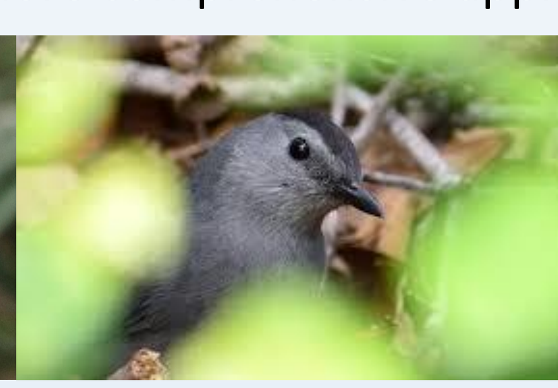

Photo: Ryan O'Meara

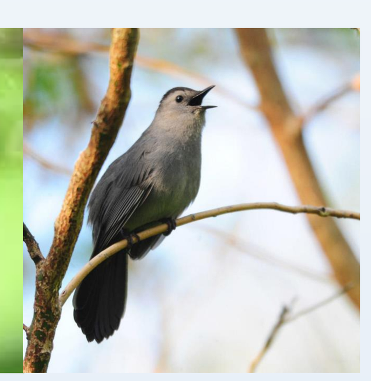

Photo: Alan Wei

Methods

1. Study system: Gray catbird (*Dumetella carolinensis*)

- Analyze citizen science banding data from gray catbirds (n=333) captured between 2009-2018 at the Wekiva Basin Banding Station

2. Interpret changes in peak capture date using circular statistics (using the R package "circular")

- Calculate the mean angle (i.e. Mean capture date) and 95% confidence interval for Spring and Fall migration timing
- Perform the Watson-Wheeler test to examine differences in migration timing
- Post-hoc Watson-wheeler pairwise comparison tests with Bonferroni correction

3. Determine changes in weight and fat score

- Spearman correlations in R package "ggpubr"

4. Circular-linear regressions using local climate data

- Use average daily temperature (NOAA) from capture dates

Results-Phenology

Spring

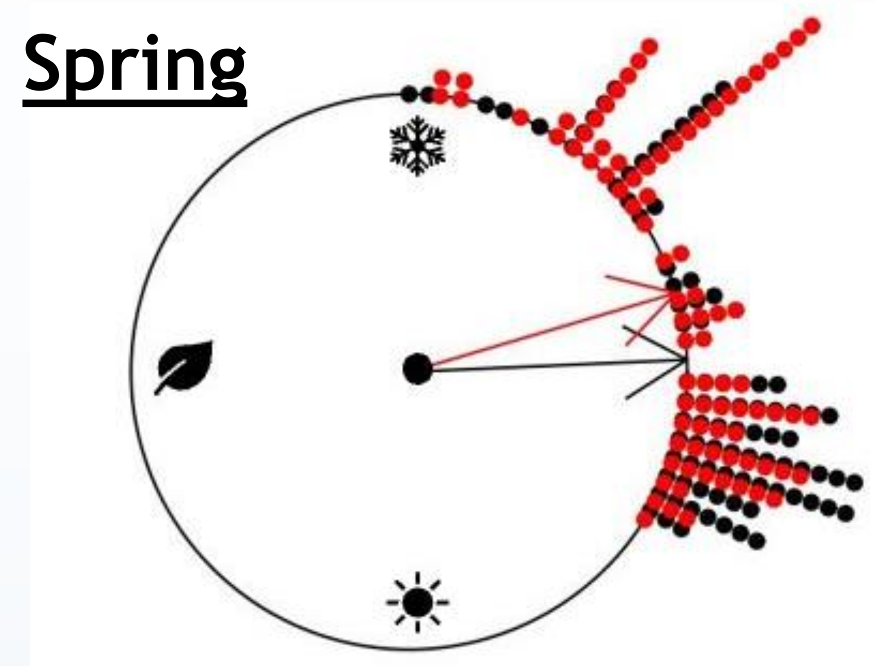

Fig 1. Black points= birds banded from **2009-2013**, black arrow (mean angle)= 87.5 degrees. Red points=**2014-2018**, red arrow (mean angle)=73.5. Watson-wheeler test p-value<0.05.

Spring	Mean	Upper	Lower
2009-2013	30-Mar	23-Mar	5-Apr
2014-2018	16-Mar	8-Mar	23-Mar

Table 1. Mean angle and Estimated confidence interval (alpha=0.05) upper and lower limits

Fall

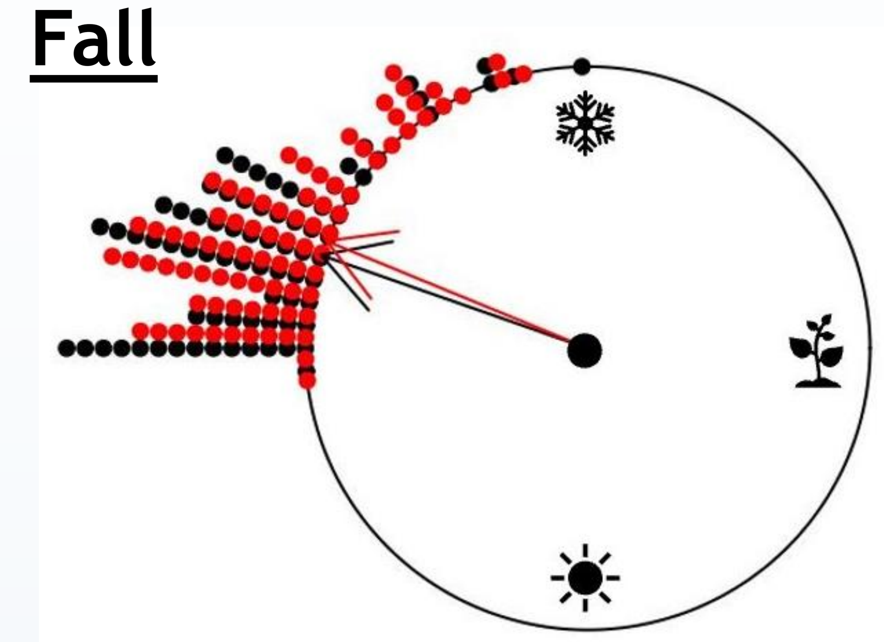

Fig 2. Black points= birds banded from **2009-2013**, black arrow (mean angle)= 289 degrees. Red points= **2014-2018**, red arrow (mean angle)= 292. Watson-wheeler test **p-value>0.05.**

Fall	Mean	Upper	Lower
2009-2013	20-Oct	17-Oct	24-Oct
2014-2018	23-Oct	19-Oct	28-Oct

Table 2. Mean angles and Estimated confidence interval (alpha=0.05) upper and lower limits

Results-Mass

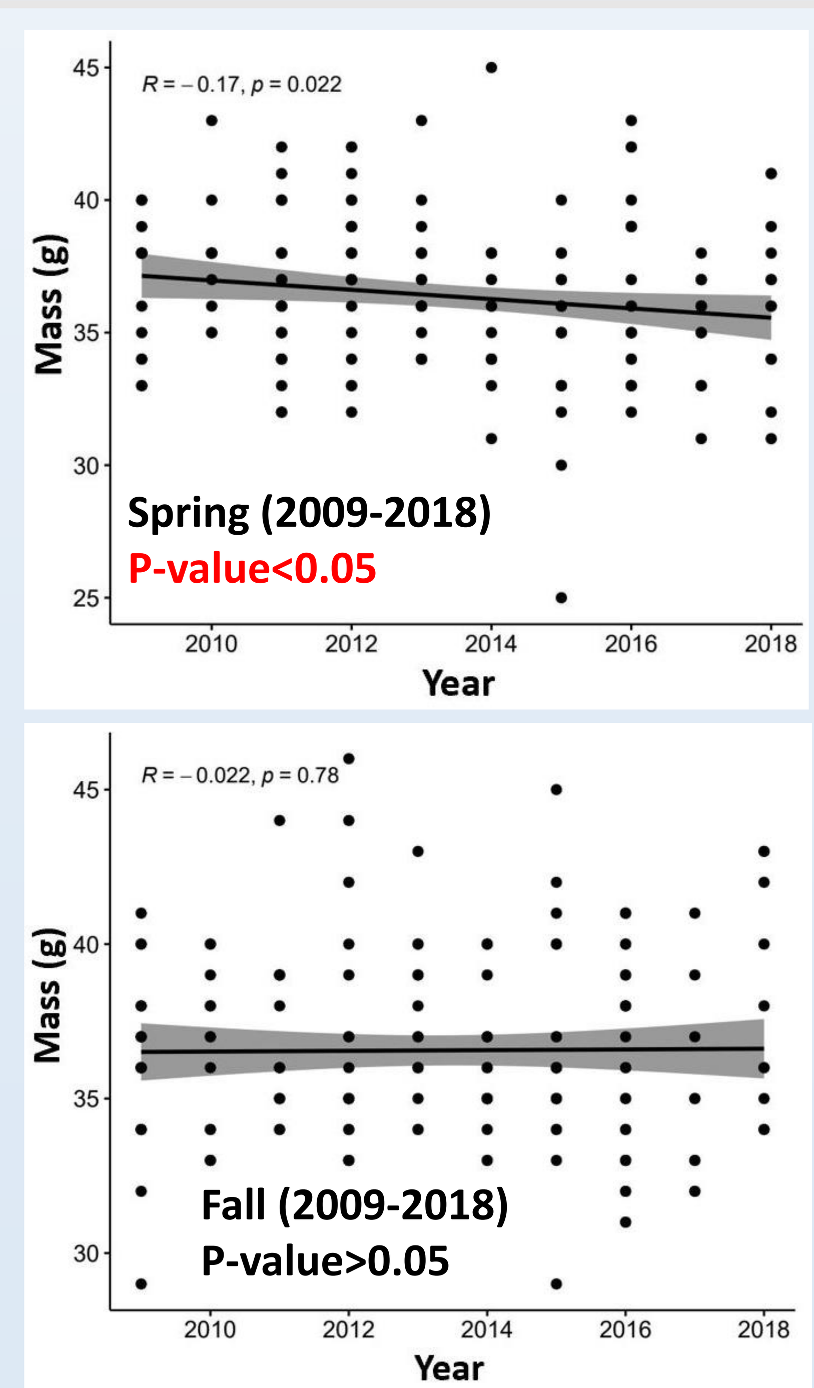

Fig 3. Spearman correlations with a confidence interval of (alpha=0.05)

Results-Climate

Circular-linear regression to predict (circular) capture date based on (linear) daily average temperature for Spring captures across 2009-2018

Banding date=0.80-0.058(Temperature)

- For each one degree increase in T (°C), the model predicted for the capture date to be 3.3 days earlier.

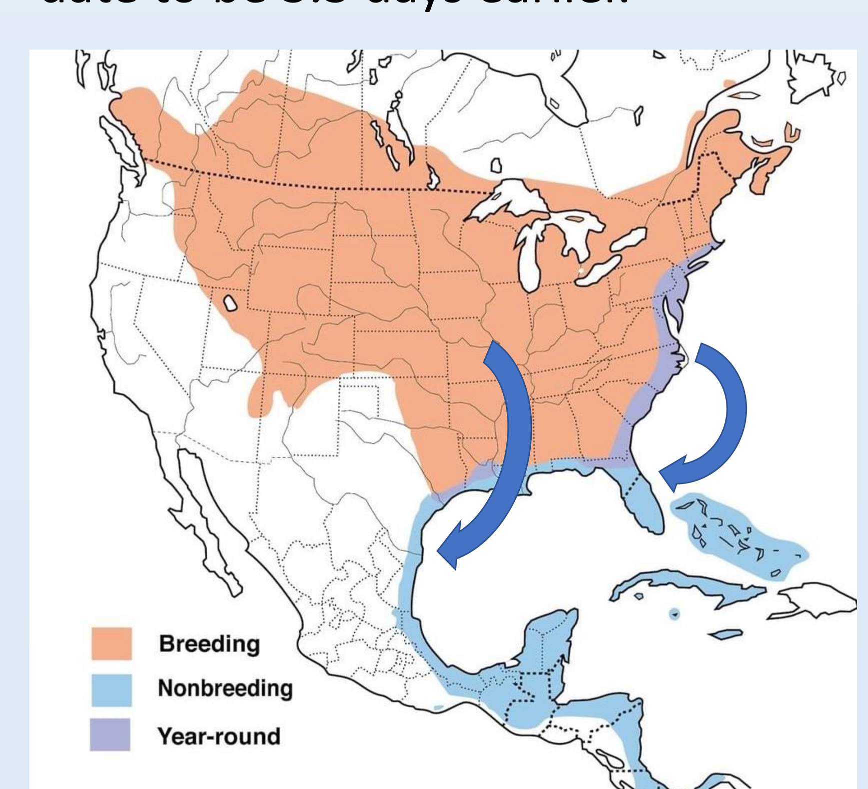

Fig 4. Gray catbird migratory connectivity and distribution

Summary

Phenology

- On average, the mean date of capture in **spring** was significantly earlier during the last 5 years (2014-2018) than during the preceding 5 years (2009-2018)
- No significant change in date of capture was observed during **fall** between the two time periods
- Pairwise Watson-wheeler tests did not identify any specific pairs of years with significantly different mean capture dates

Mass & Fat score

- On average, the mass(g) of birds captured decreased over time for the spring season indicating birds captured in the earlier years were heavier; not observed for fall
- No change in mean fat score over time for both spring and fall seasons (p>0.05)

Climate

- Over (2009-2018) the date of capture for **spring** occurred ~3 days earlier with increasing temperature (p-value<0.05)

Discussion

- Changes in spring phenology corroborate published trends, but it is still unknown if these changes are enough to offset the negative impacts of climate change
- Observed decrease in mass may suggest that changes in spring phenology may in turn be affecting gray catbird body condition
- Early departure from wintering grounds to ensure success on the breeding grounds may be leaving birds with insufficient time for pre-migratory fattening
- Further research may include comparing migratory phenology between short-distance and long-distance migrant populations of gray catbirds (Fig 4.) to identify varying vulnerabilities to global environmental change

References/Acknowledgements

Climate data station: ORLANDO INTERNATIONAL AIRPORT, FL
US WBAN: 72205012815 (KMCO)

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