

Trends of PA Migratory Bird Counts and Their Relationship to PA Temperature



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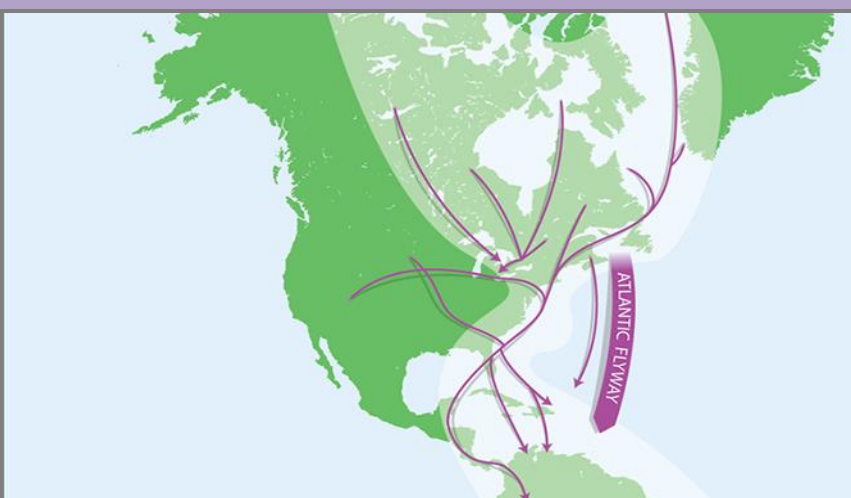
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Introduction

- Climate change has been a growing issue for the past couple of decades (Bateman, 2020).
- The full extent of climate change impacts are still **unknown** (Rushing, 2020).
- In Pennsylvania, 2/3 of bird species **risk extinction** without climate action (Bateman, 2024).
- One issue that has not been studied is the impact of climate change on migratory bird species counts in PA.



- Using bird data from the North American Breeding Bird Survey (NABBS, 2025), and climatological data from The Pennsylvania State Climatologist, two different relationships were explored:

1. Temporal trends in bird counts
2. Bird counts and Pennsylvania temperature

Data / Methodology

- Annual bird count data during the 1966–2019 summers for 16 migratory birds along different routes over PA were obtained.
- Almost every bird was missing data from at least one year.
- A data review revealed that 31 birds along various routes had 6 or less (9%) missing years.
- For this subset, an interpolation technique was applied to fill in missing non-consecutive years.
- The technique was an average of the counts before and after the missing years.



From left to right: Chimney Swift, Scarlet Tanager, Wood Thrush, Bobolink

- Past maximum and minimum temperature data at Penn State were collected every day from May to September from 1966–2019.
- The average maximum and minimum of each month were averaged to obtain the mean temperature for each year.
- Graphs were made for: a) time series of bird counts, and b) bird counts vs temperature.
- P-tests were conducted to test the significance (**alpha = .05**) of the relationship between variables.

Results

Two tables were made -- one for the bird count vs temp; the second for the time series -- to show correlations for all PA migratory birds.

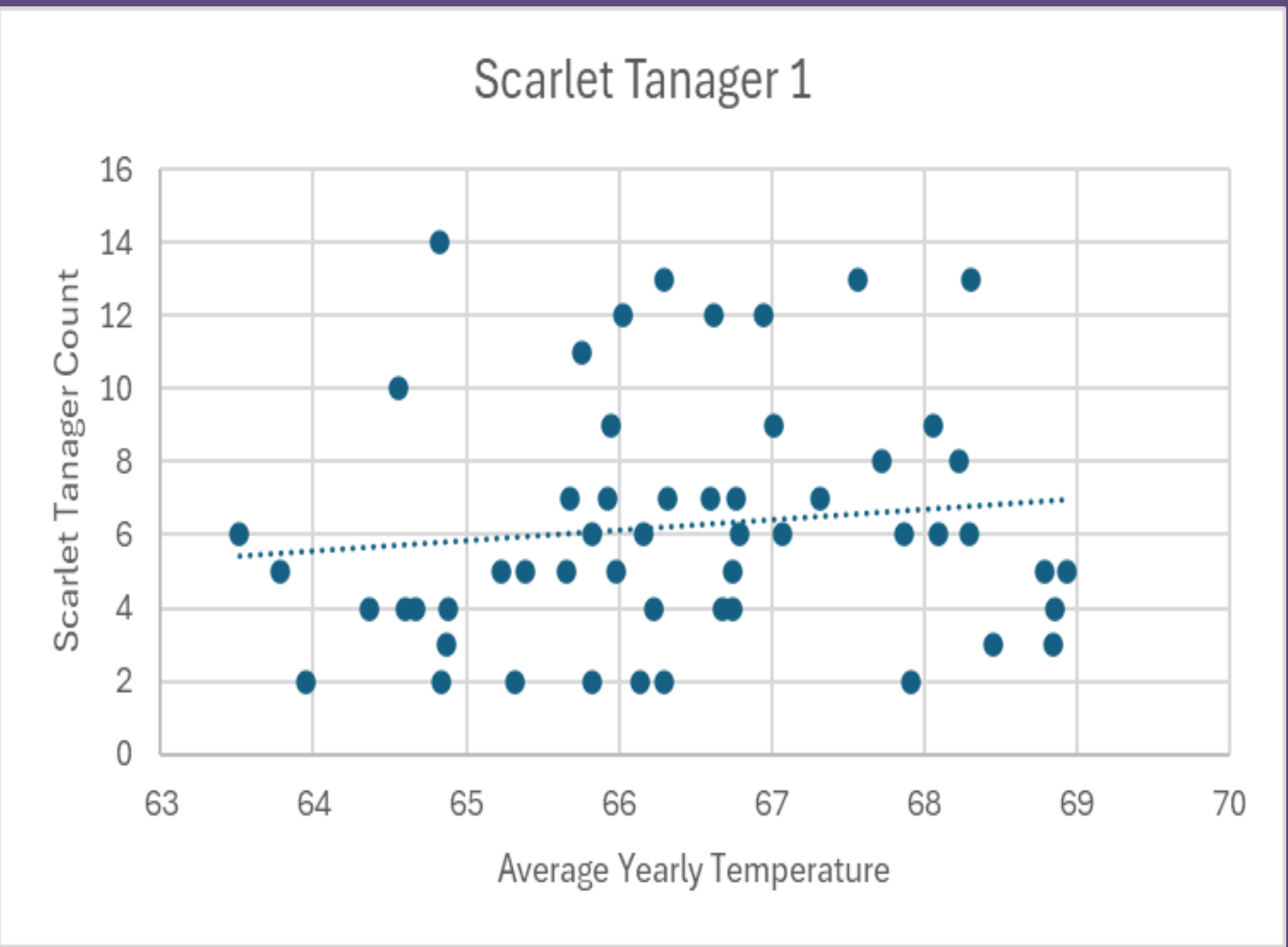
BIRD DATA VS TEMPERATURE

Bird Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Chimney Swift	Red	Green	Gray	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
Scarlet Tanager	Gray	Gray	Green	Green	Green	Gray	Green	Gray	Gray	Gray	Black	Black	Black	Black	Black	Black
Wood Thrush	Gray	Red	Gray	Gray	Gray	Red	Red	Red	Gray	Green	Gray	Gray	Gray	Red	Gray	Gray
Bobolink	Green	Gray	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black

KEY

Green fill = Statistically significant **POSITIVE** correlation
Red fill = Statistically significant **NEGATIVE** correlation
Gray fill = **NO** correlation
Black fill = **No data**

- Results show that the majority (58%) of scatterplot showed **no correlation**, at the 95% statistical significance, between bird count and temperature.
- 23% of the scatterplots showed a statistically significant **positive** correlation, while 19% showed a statistically significant negative correlation.
- Overall, this study **cannot** conclusively determine if temperature influences migratory bird population in PA.
- An example scatterplot of bird count (Scarlet Tanager) and PA annual temperature, with no statistically significant correlation, is shown to the right.



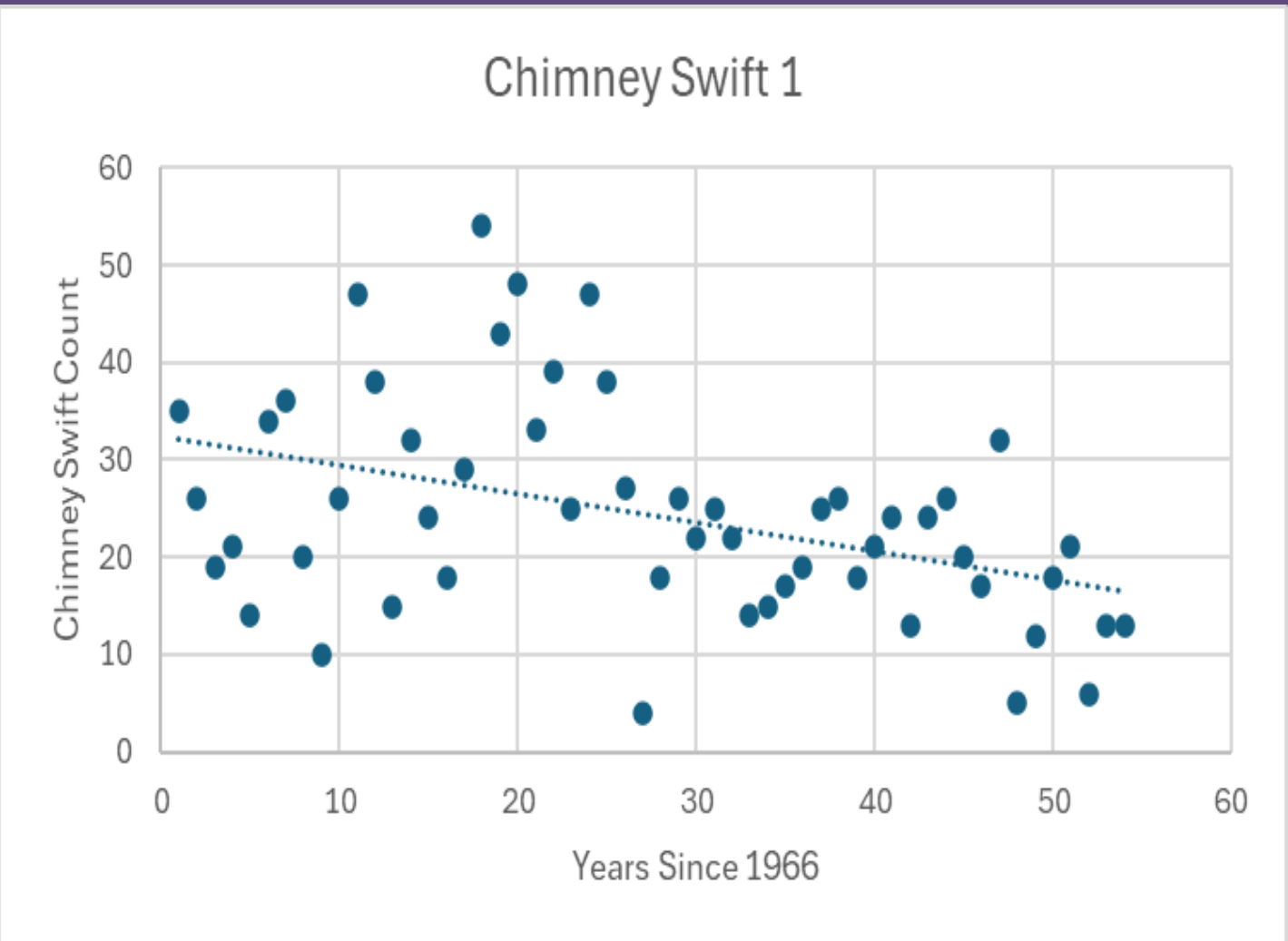
BIRD DATA TIME SERIES

Bird Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Chimney Swift	Red	Red	Gray	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
Scarlet Tanager	Gray	Red	Green	Green	Green	Red	Gray	Gray	Gray	Green	Black	Black	Black	Black	Black	Black
Wood Thrush	Green	Red	Gray	Gray	Gray	Red	Red	Red	Green	Green	Red	Red	Red	Red	Gray	Green
Bobolink	Green	Gray	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black

KEY

Green fill = Statistically significant **POSITIVE** correlation
Red fill = Statistically significant **NEGATIVE** correlation
Gray fill = **NO** correlation
Black fill = **No data**

- Results shows that 39% of the scatterplots between bird count and time were **NEGATIVELY** correlated to the 95% statistical significance level; 29% showed **POSITIVE** correlation.
- 32% of the results showed **NO** correlation.
- Overall, this data **cannot** conclusively determine if PA migratory bird counts have increased or decreased over time.
- To the right is a graph showing an example of the number of Chimney Swifts decreasing with time (i.e., a negative correlation).



Discussion

- Overall, results show generally there is **no statistically significant correlation** between bird count and temperature, and bird count and time.
- The results from this study depart from other studies (e.g., Rushing 2020) who showed that over the past 50 years migratory birds in North America have **declined rapidly**.
- Suggestions for this discrepancy include:
 - Our sample size was quite small, while other research studies used a more extensive sample.
 - Our study focused solely on migratory birds within PA. Other studies expand beyond migratory birds and other areas beyond PA.
 - Our study used a simple averaging interpolation technique for missing data.
 - Other studies used Bayesian dynamic occupancy models, for example (Rushing, 2020).

Future Work

- Most of the articles published discuss futuristic scenarios as to how bird species would be at risk.
- For example, the Mid-Atlantic coast is **most at risk** for future bird decline (Saunders, 2025).
- Future research will expand the current research in the following ways:
 - Using a more robust model to fill in missing bird data.
 - Accounting for the various routes PA migratory birds.
 - Comparing NABBS data to other bird count databases.

References

