# TEN DIFFERENT SPECIES OF BIRDS AS INDICATOR SPECIES ON CLIMATE CHANGE BASED ON MIGRATIONAL PATTERNS IN OHIO


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## Abstract


This project was chosen because climate change has been in the news, reported as a problem with increased heatwaves, hurricanes, wildfires, and floods. A project on the GLOBE website from 2012 was *Snipe (Gallinago gallinago delicata), Killdeer (Charadrius vociferus), and American Woodcock (Scolopax minor) As Indicator Species On Climate Change Based On Migrational Patterns in Ohio* by Justin Rumel. This was the inspiration to "take the next step." This posed the question, do changes in winter abundance of selected bird species in Wooster, Ohio correlate with long-term air temperature trends associated with climate change? Ohio birds selected for this 2025 project are American Black Duck (*Anas rubripes*), American Crow (*Corvus brachyrhynchos*), American Robin (*Turdus migratorius*), Canada Goose (*Branta canadensis*), Belted Kingfisher (*Megaceryle alcyon*), Bald Eagle (*Haliaeetus leucocephalus*), Blue Jay (*Cyanocitta cristata*), Cedar Waxwing (*Bombycilla cedrorum*), Dark-Eyed Junco (*Junchoyemalis hyemalis/carolinensis*), and European Starling (*Sturnus vulgaris*). A variety of habits were researched when selecting this list. The Audubon Society's Christmas Bird Count (CBC) data was used. The hypothesis is during the course of this 30-year study, bird sightings across spectrum of species targeted should increase. Methods utilized were GLOBE Program protocols and time series analysis from CBC data sets, incorporating annual weather patterns. Results varied from species dependent upon situational variables such as feeding, habitat, and breeding requirements. Conclusions were as varied as the results, however, overall suggesting an increase in these bird populations in Ohio. The findings supported the hypothesis for 6 of the targeted bird species but the findings did not support 4 targeted bird species.


## Research Question

How do changes in the winter abundance of selected bird species in Wooster, Ohio relate to long-term air temperature trends associated with climate change?

## Hypothesis

The hypothesis for the American Black Duck (*Anas rubripes*) is that the numbers seen in the CBC will increase because the water has not yet frozen over.

The hypothesis for the American Crow (*Corvus brachyrhynchos*) is that the numbers seen in the CBC will increase because snow has not yet fallen so the items they forage for are not yet covered up.

The hypothesis for the American Robin (*Turdus migratorius*) is that the numbers seen in the CBC will increase because the ground has not yet frozen, so earthworms are more accessible.

The hypothesis for the Canada Goose (*Branta canadensis*) is that the numbers seen in the CBC will increase because the water has not yet frozen over.

The hypothesis for the Belted Kingfisher (*Megaceryle alcyon*) is that the numbers seen in the CBC will increase because the water has not yet frozen over.

The hypothesis for the Bald Eagle (*Haliaeetus leucocephalus*) is that the numbers seen in the CBC will increase because less pesticides are being used on farm fields.

The hypothesis for the Blue Jay (*Cyanocitta cristata*) is that the numbers seen in the CBC will stay relatively the same because even though it might not get as cold, their food source is nuts from trees, and the trees stop producing nuts regardless.

The hypothesis for the Cedar Waxwing (*Bombycilla cedrorum*) is that the numbers seen in the CBC will stay relatively the same because even though it might not get as cold, their food source is berries from trees and shrubbery, and the trees and shrubbery stop producing berries.

The hypothesis for the Dark-eyed Junco (slate-colored) (*Juncohyemalis hyemalis/carolinensis*) is that the numbers will decrease because they migrate from Alaska and Canada down to the rest of the USA and since it is warmer, they may migrate later.

The hypothesis for the European Starling (*Sturnus vulgaris*) is that the numbers will increase because the insects will still be out because it is not as cold.

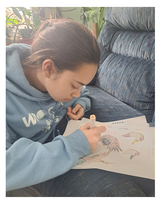
## Introduction

The reason this project was chosen was because climate change has been talked about a lot on the news, being seen as a problem with heatwaves, stronger hurricanes, wildfires, and floods. A previous project studied on the GLOBE website was *Snipe (Gallinago gallinago delicata), Killdeer (Charadrius vociferus), and American Woodcock (Scolopax minor) As Indicator Species On Climate Change Based On Migrational Patterns in Ohio* by Justin Rumel. The project studied ten birds to see if climate change affected the birds, which, as the results indicate, climate change does, and shall continue affecting them.

Justin Rumel did this project starting from the year 1880 to 2012. As a result, the selected birds have shown that climate change has affected their migration patterns. The birds have shown to be staying later and leaving earlier than past migrations. Justin Rumel's results showed that climate change is beginning to affect the environment around the world and should begin to affect more in the future if the present trend continues. As a comparison, the amount of American Woodcock found to be in 2015 was 15 and it increased to 57 by 2024 based on hunting records in September, showing how Justin Rumel was correct, that the birds are staying longer and are increasing in numbers.

Justin gave me inspiration to look further into this area of research. Using the Christmas Bird Count data, I began to dig deeper, especially since nowhere could I find a similar study such as I was proposing here. The birds I chose for this project are the American Black Duck (*Anas rubripes*), the American Crow (*Corvus brachyrhynchos*), the American Robin (*Turdus migratorius*), the Canada Goose (*Branta canadensis*), the Belted Kingfisher (*Megaceryle alcyon*), the Bald Eagle (*Haliaeetus leucocephalus*), the Blue Jay (*Cyanocitta cristata*), the Cedar Waxwing (*Bombycilla cedrorum*), the Dark-eyed Junco (slate-colored) (*Juncohyemalis hyemalis/carolinensis*), and the European Starling (*Sturnus vulgaris*). All birds can be found in Ohio. These birds were chosen because they migrate for mostly different reasons. Some require water (American Black Duck, Canada Goose, and Belted Kingfisher), which freezes in the winter, some eat worms (American Crow and American Robin), which the ground gets too hard for them to obtain in the winter, and some eat insects and flowers (Blue Jay, Cedar Waxwing, Dark-eyed Junco, and European Starling) which are not commonly seen in the winter, and all migrate to breed.

The point of this project was to use the selected birds as a reference to climate change to see if any change was happening, following Justin Rumel's project.



## Research Methods

**Air Temperature Protocol:**

1. Open the instrument shelter and the cover flap of the digital max/min thermometer being careful not to breathe on or touch the air temperature sensor.
2. Record the time and date on your Data Sheet.
3. Turn the air temperature display on by pressing the air sensor "ON" button (upper left button labeled "ON" on the front of the instrument casing).
4. Read the current air temperature shown in the upper section of the digital display. Record this temperature on your Data Sheet.
5. If soil measurements are being taken, turn the soil temperature display on by pressing the soil sensor "ON" button (upper right button labeled "ON").
6. Read the current soil temperature from the lower section of the digital display. Record this temperature on your Data Sheet.
7. After all measurements have been taken close the cover flap of the instrument. It will shut off automatically after a short time.

**Cloud Coverage Protocol:** Data was collected from the CBC Database.

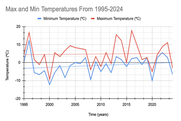
1. Look at all the clouds in the sky, in all directions.
2. Identify the types of clouds that you see using the GLOBE Cloud Chart and the definitions found in Observing Cloud Type (shape and height).
3. Check the box on your Data Sheet for each and every cloud type you see on each level (low, mid, and high).
4. There are three types of contrails. Record the number of each type you see.

**Time Series Analysis**

1. Obtain data from the Audubon Society Christmas Bird Count website
2. Make a table with the number of birds and years from 1995-2024
3. Make a line graph and include a trend line
4. Analyze the trend of the number of birds to what year it is

## Materials

Digital max/min thermometer
Infrared thermometer
Pencil
Pen
Notebook
Computer
Map of Wayne County, Ohio
GLOBE Cloud Identification Chart
Audubon Christmas Bird Count database
eBird database
Audubon Bird field guide
Peterson Bird field guide



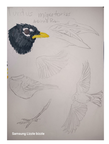


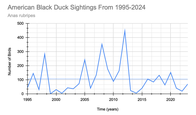
### GLOBE Data Used

GLOBE Protocol used: This project is based on GLOBE Air Temperature and Clouds Protocols.

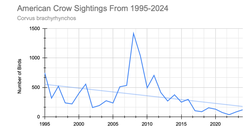
## Results

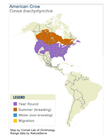
| Year | Time (hr) | # of people | Low Temp (°C) | High Temp (°C) | Sky | Rain | Snow | Date |
|---|---|---|---|---|---|---|---|---|
| 1995 | 56 | 16 | 0.56 | 4.44 | Partially Cloudy | None | None | 12/26 |
| 1996 | 39.5 | 11 | 12.22 | 16.67 | Cloudy | None | None | 12/28 |
| 1997 | 47 | 13 | -5.56 | 1.67 | Partially Cloudy | None | None | 12/27 |
| 1998 | 35 | 9 | -6.67 | -1.11 | Clear | None | None | 12/26 |
| 1999 | 30.7 | 5 | -4.44 | 4.44 | Clear | None | None | 12/19 |
| 2000 | 47.85 | 14 | -12.22 | -9.44 | Cloudy | None | None | 12/23 |
| 2001 | 76.75 | 19 | -5.56 | 5.56 | Partially Cloudy | None | None | 12/22 |
| 2002 | 73.5 | 23 | -1.67 | 3.33 | Cloudy | None | None | 12/21 |
| 2003 | 49.25 | 25 | -8.33 | 6.67 | Cloudy | None | None | 12/27 |
| 2004 | 40.5 | 16 | -1.67 | 9.44 | Partially Cloudy | None | None | 12/18 |
| 2005 | 91.25 | 28 | 0 | 8.33 | Partially Cloudy | None | None | 12/24 |
| 2006 | 91.75 | 27 | -0.56 | 7.78 | Partially Cloudy | None | None | 12/23 |
| 2007 | 85.25 | 29 | 2.78 | 7.22 | Cloudy | None | None | 12/22 |
| 2008 | 102.25 | 35 | -9.44 | -3.89 | Partially Cloudy | None | None | 01/01 |
| 2009 | 95.75 | 36 | 0.56 | 3.33 | Partially Cloudy | None | None | 12/26 |
| 2010 | 144.5 | 30 | -5 | -2.22 | Cloudy | None | Light | 12/27 |
| 2011 | 103.5 | 32 | -0.56 | 5.56 | Cloudy | None | None | 12/24 |
| 2012 | 76.75 | 22 | -5.56 | -0.56 | Cloudy | None | None | 12/22 |
| 2013 | 40 | 15 | 3.33 | 15.56 | Cloudy | Light | None | 12/21 |
| 2014 | 81.5 | 36 | 1.67 | 12.22 | Cloudy | None | None | 12/27 |
| 2015 | 91 | 27 | -2.22 | 0 | Cloudy | None | Light | 12/19 |
| 2016 | 115 | 25 | 2.22 | 17.78 | Partially Cloudy | None | None | 12/26 |
| 2017 | 78.75 | 26 | 2.78 | 10 | Local Fog | Light | None | 12/23 |
| 2018 | 105.25 | 29 | -1.11 | 1.67 | Cloudy | None | None | 12/22 |
| 2019 | 59.5 | 19 | 2.78 | 2.78 | Cloudy | None | None | 12/21 |
| 2020 | 87.25 | 29 | -10 | -5 | Partially Cloudy | None | None | 12/26 |
| 2021 | 68.5 | 20 | 2.78 | 4.44 | Fog | Light | None | 12/18 |
| 2022 | 37.25 | 15 | 5.56 | 8.89 | Local Fog | Light | None | 01/02 |
| 2023 | 56.25 | 17 | 2.78 | 11.11 | Cloudy | Light | None | 12/23 |
| 2024 | 97.4 | 21 | -6.67 | -3.33 | Cloudy | None | Light | 12/21 |

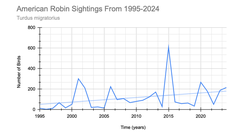




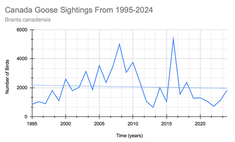




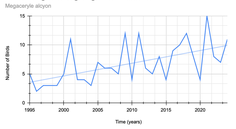



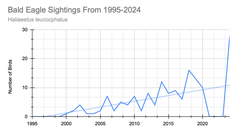






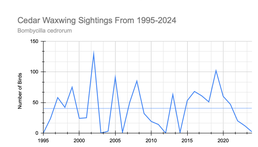




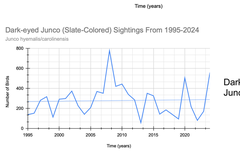




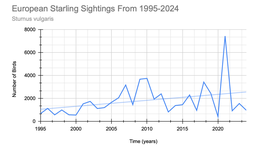














## Result Analysis and Discussion

**Potential Outliers:**

Air temperature data was collected from the CBC database. Average time spent for the 30-year study was 73.49 hours. Average low temperature is -3.63ºC. Average high temperature is 6.23ºC. Average number of people looking for birds is 22.3 people. 1995: Only 56 hours spent looking for birds. 1996: Only 39.5 hours spent looking for birds, very warm with a temperature of 16.67ºC. 1997: Only 47 hours spent looking for birds. 1998: Only 35 hours spent looking for birds, only 9 people looking for birds.1999: Only 30.7 hours spent looking for birds, only 5 people looking for birds. 2000: Only 47.85 hours spent looking for birds. 2003: Only 49.25 hours spent looking for birds. 2004: Only 40.5 hours spent looking for birds.
2010: It was snowing. Nicknamed the "Great Freeze of 2010," the entire mid-west was covered in snow.*
2013: Only 40 hours spent looking for, very warm with a temperature of 15.56ºC, it was raining. 2015: It was snowing
2016: Very warm with a temperature of 17.78ºC. 2017: It was foggy and raining. 2021: It was foggy and raining.
2022: It was foggy and raining. 2023: It was raining. 2024: It was snowing.

Mean winter temperatures during CBC dates show an overall warming trend, with increased frequency of above-freezing conditions after 2000. The Canada Goose (also migratory), Bald Eagle, and Belted Kingfisher (species associated with open water) generally increased in winter abundance. The American Robin, Blue Jay, and European Starling (short distance and partial migrants) showed stable or increasing winter presence. The Dark-eyed Junco (long-distance migrants) did not decline as predicted and showed recent increases.

*In 2010, the El Niño-Southern Oscillation ("ENSO") climate pattern swung first through its warm phase and then its cool phase, with significant influences on seasonal climate around the globe. ENSO is a natural pattern of seesawing changes in ocean temperatures and winds in the tropical Pacific Ocean. The pattern has two end points: El Niño (the warm phase) and La Niña (the cool phase). During El Niño events, the easterly trade winds that blow across the tropical Pacific Ocean are weaker than usual and sea surface temperatures in the central and eastern Pacific become warmer than usual. During La Niña events, the pattern is reversed: easterly trade winds are stronger than usual, and sea surface temperatures in the central and eastern Pacific are cooler than usual.

## Conclusions

Because of the nature of this study, my conclusion will focus on the individual feeding, habits, and breeding of each bird species. Air temperature data was collected from the Christmas Bird Count database.

The data did not support my hypothesis for the American Black Duck. There was a data outlier in 2012 of an increase in birds, and below average temperatures from -5.56ºC to -0.56ºC. The number of Black Ducks has decreased significantly, but now are slowly increasing. They may have decreased due to the 2010 freeze, but are increasing since then and overall temperatures are warming up.

The data did not support my hypothesis for the American Crow. There was a data outlier in 2009 of an increase in birds, where a high of 36 people were out looking for birds. The number of American Crows have initially decreased significantly, but are slowly increasing. They may have decreased due to the 2010 freeze, but are increasing since then and overall temperatures are warming up.

The data supported my hypothesis for the American Robin. There was a data outlier in 2015 of an increase in birds, where there was light snow and the temperature did not rise above 0ºC. The amount of American Robin sightings is slowly increasing.

The data did not support my hypothesis for the Canada Goose. There was a data outlier in 2016 of an increase in birds, where a high of 155 hours were spent looking at the temperature was a high of 17.76ºC. The number of American Crows have initially decreased significantly, but are slowly increasing. They may have decreased due to the 2010 freeze, but are increasing since then and overall temperatures are warming up.

The data supported my hypothesis for the Belted Kingfisher. Though the Belted Kingfisher has been up and down, that pattern has been increasing in number, even though there were never many Kingfishers sighted to begin with.

The data supported my hypothesis for the Bald Eagle. They were slowly increasing in numbers, disappeared, then came back with the highest number ever recorded.

The data supported my hypothesis for the Blue Jay. There was a data outlier where the number of Blue Jay spotted was low in 2013, where there were only 40 hours spent looking for birds between 15 people. Even though there is fluctuation between highs and lows, the pattern stayed relatively the same, though increasing slightly.

The data supported my hypothesis for the Cedar Waxwing. Though there are many fluctuations in numbers, they have been staying relatively the same.

The data did not support my hypothesis for the Dark-eyed Junco. There was a data outlier in 2008 of an increase in birds, where a high of 102.25 hours were spent looking for the birds. Their numbers have been up and down, however, they have been increasing in numbers over the last couple years. They may have decreased due to the 2010 freeze, but are increasing since then and overall temperatures are warming up.

The data support my hypothesis for the European Starling. There was a data outlier 2021 where there was an increase of birds, where the temperature had a high of 4.44ºC and there was light fog. Though there was a huge spike in numbers near the end, they have been steadily increasing in numbers.

This project can be used to see how climate change has affected the local bird populations, and how climate change impacts each species of bird differently.

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