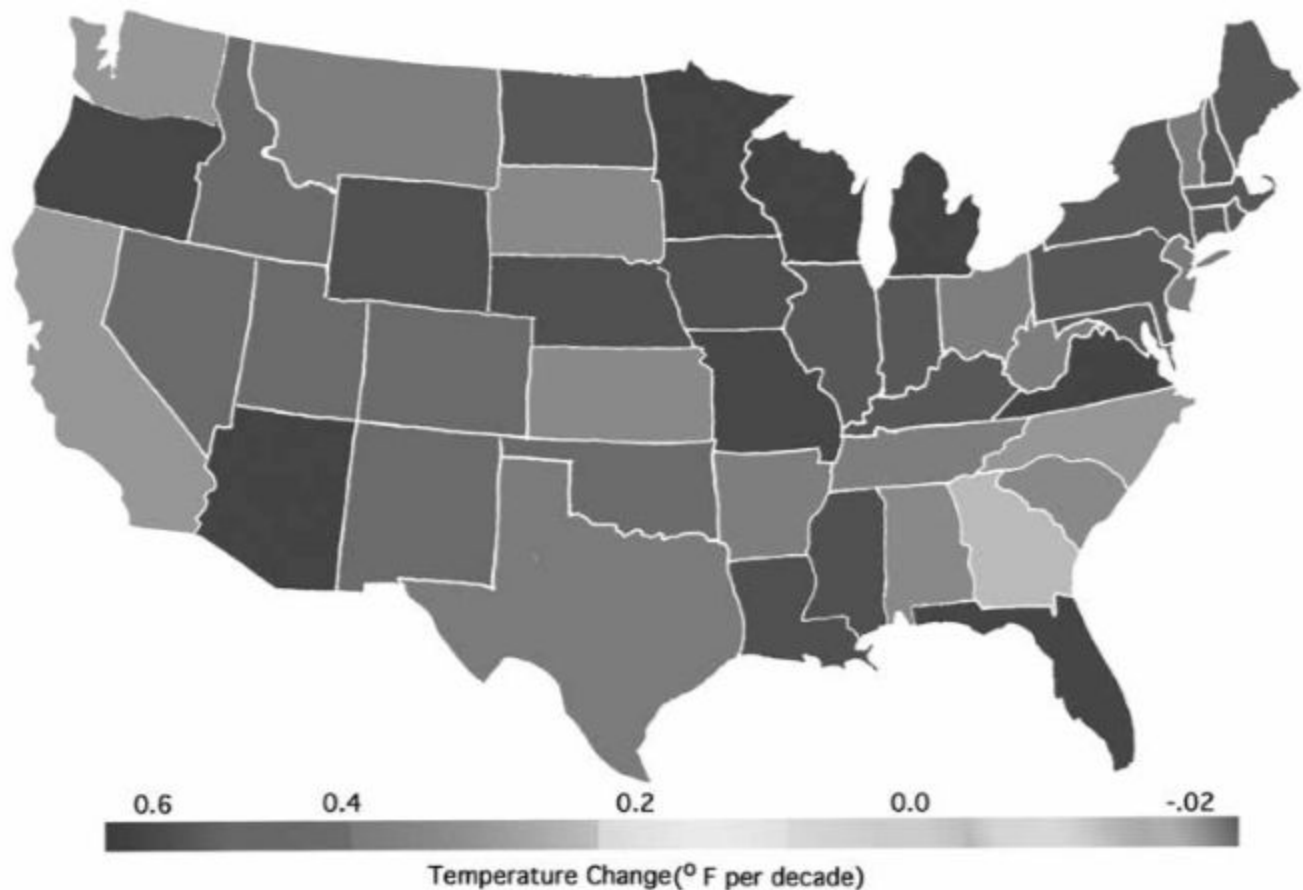


Lab 12: Environmental Influences on Animal Behavior: How Has Climate Change Affected Bird Migration?

Introduction

The average temperature in the United States has increased by about 1.3°F since 1910, but the increase in average temperature has not been uniform. Some states have warmed more than others (see the figure below). The *pace* of warming in *all* regions of the United States, however, has accelerated dramatically since the 1970s. This change in pace coincides with the time when the effect of greenhouse gases began to overwhelm the other natural and human influences on climate at the global and continental scales.

A map illustrating how fast each state has been warming each decade since 1970



This increase in average temperature could have a negative impact on many different species of plants and animals because it could lead to changes in seasonal weather patterns, which could then lead to droughts, habitat loss, or food shortages. Migratory birds are one type of animal that may be influenced by a change in climate because birds migrate when the seasons change. Migratory birds tend to fly north in the spring to breed and return to the warmer wintering grounds of the south when temperatures get colder.

The migration of birds in response to a change of seasons is an example of animal behavior with both a proximate cause and an ultimate cause. A proximate cause is the stimulus that triggers a particular behavior (such as a change in temperature). An ultimate cause, in contrast, is the reason why the behavior exists. In this case, birds migrate because of food and because the longer days of the northern summer provide extended time for breeding birds to feed their young. Migratory birds, as a result, are often able to support larger clutches than nonmigratory species that remain in the tropics year round. This is clearly a benefit of migration.

Environmental conditions serve as both the proximate and ultimate cause of bird migration. Therefore, climate change could have drastic effects on bird migration because it changes seasonal weather patterns. For example, climate change could influence when the temperature drop that serves as the proximate cause of migration for many species of bird happens. Climate change, as noted earlier, can also lead to widespread droughts, habitat loss, and food shortages. These changes in environmental conditions could potentially eliminate the benefits associated with migration because they limit how much access birds have to the resources they need to survive and reproduce after they arrive at their destination.

Your Task

Use the All About Birds website to identify several migratory species of bird that can be found in the United States; then use the eBird online database to determine if the migration behaviors for these species have changed over the last 40 years. If you do see a change, you can then use the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service and National Climatic Data Center databases to explore weather conditions and changes in climate over the same time period.

The guiding question of this investigation is: **How has climate change affected bird migration?**

Materials

You may use any of the following websites during your investigation:

- All About Birds (Cornell Lab of Ornithology): www.allaboutbirds.org
- eBird: <http://ebird.org>
- NOAA National Weather Service: www.weather.gov
- NOAA National Climatic Data Center: www.ncdc.noaa.gov

Getting Started

To answer the guiding question, you will need to design and conduct an investigation using three different online databases. Your first step in your investigation, however, is to learn more about birds, why birds migrate, the different migration patterns, and which types of birds migrate. To do this you can visit the website All About Birds, which is sponsored by the Cornell Lab of Ornithology. Your next step is to learn how to use the eBird database to find information on where and when different species of bird have been observed across the United States and over time. You will also need to learn how to use the NOAA National Weather Service database to access information about current weather conditions and the NOAA National Climatic Data Center database to access historical weather conditions for different regions of the United States. Once you have learned how to use these databases, you will need to determine what type of data you will need to collect, how you will collect it, and how you will analyze it.

To determine what type of data you will need to collect, think about the following questions:

- How will you determine if there has been a change in bird migration over time?
- What will serve as your dependent variable (e.g., location of breeding and winter locations, abundance of birds, arrival and departure dates in a specific area, distance traveled)?
- What information will you need to be able to link a change in a migration pattern to a change in climate?
- What type of comparisons will you need to make (e.g., different species of bird, birds in different regions, current observations vs. past observations)?

To determine how you will collect your data, think about the following questions:

- Where in the eBird and NOAA databases will you look to gather the information you need?
- What tools in the eBird and NOAA databases will you need to use?
- How will you keep track of the data you collect from the three different databases, and how will you organize the data?

To determine how you will analyze your data, think about the following questions:

- How will you demonstrate that a change in climate is or is not related to a change in the migration behaviors of bird species?
- How will you quantify a difference or amount of change?
- What type of calculations will you need to make?
- What type of graph could you create to help make sense of your data or to share the data with others?

Report

Once you have completed your research, you will need to prepare an investigation report that consists of four sections (be sure to have section headings):

1. Introduction: Give some background information on the topic. Explain what question were you trying to answer and include a hypothesis. (Background info, research question and hypothesis)
2. Procedure: What did you do during your investigation and why did you conduct your investigation in this way? (How you collected and analyzed data)
3. Data: Include a data table and/or graph to show your results. Be sure to include a title for your table or graph with labels for the variables.
4. Conclusion: What is your argument? (Claim - Evidence - Reasoning)

Your report should answer these questions in two pages or less. The report must be typed, and any diagrams, figures, or tables should be embedded into the document. Type your report on Google Docs (12 point font, double-spaced) and share it with your teacher. Your report will be graded based on the rubric in the class syllabus.