

# Bird Population and Migration Module

## Grades 6-8



### SAN FRANCISCO BAY BIRD OBSERVATORY

This module is designed to promote place-based learning by engaging students in scientific inquiry related to their surrounding environment. Students will analyze bird capture data collected at the Coyote Creek Field Station and investigate how environmental and human impacts can influence bird migration patterns and population trends in the Bay Area of California. Each student will focus on one local bird species to foster a sense of connection and a desire to learn. If funding is available, students will visit the bird-banding field station in order to meet local bird species, see the data collection process in action, and interface with scientists. The field trip component is an opportunity for students to inquire like scientists and share the explanations for phenomena that they generated in the classroom.

The birds found at CCFS are representative of the birds students may see close to home in the Bay Area. Familiarization with birds in the area may prompt students to learn more about the ecology of their own backyards and to participate in citizen science projects.

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## **Classroom Lessons Overview: Exploring population trends**

Students will be using data from Coyote Creek Field Station (CCFS) to investigate nine songbird species commonly found in the area. In groups, they will graph a given bird's population over the course of one year, which will show its migration pattern. Next, they will graph each bird's population longitudinally over a 20-year period. Students will discuss possible reasons for any patterns they discover and match their bird's migration patterns to others in the classroom.

### **Learning Objectives:**

- Define the term migration and differentiate between residential, wintering (temperate), and summering (neotropical) migration patterns
- Observe how bird-banding stations collect data and how basic mark-recapture studies work
- Graph data and understand the relationship between independent and dependent variables
- Think critically and formulate an ecological explanation for patterns observed
- Inquire like scientists and practice communicating ideas

### **Science Education standards:**

- Next Generation Science Standards- MS-LS2-1
- California Science Standards- Ecology. Investigation and Experimentation 7 (a-h).

**Key materials:** Provided worksheets, pencils, graph paper, (optional poster paper).

**Concepts:** Bird migration, bird ecology, human and environmental impacts on population trends, mark-recapture, long-term data collection methods, citizen science

**Skills:** Graphing data, graph interpretation, spatial and scientific reasoning, inquiry-based learning, qualitative observation

**Vocabulary:**

- Independent and dependent variable
- X and Y axis
- Migration / Migratory
- Summer species
- Winter species
- Resident species
- Coniferous
- Deciduous
- Thicket
- Forage

**Module type:** 3-4 50-minute class periods and one full day field trip.

**Duration:** 3-4 days

### **Background for Teachers**

The Coyote Creek Field Station (CCFS), operated by the San Francisco Bay Bird Observatory (SFBBO), is situated within a partially restored riparian green space along Coyote Creek and bounded by the City of Milpitas. SFBBO employees and volunteers have been studying bird populations at CCFS by operating a banding station three days a week since 1987. The unique dataset collected at the station has led to numerous scientific publications related to habitat restoration, evolution, migration, climate change, and wildlife responses to urbanization: [Seasonal timing of migration](#), [Hermit Thrush migration patterns](#), [Avian body size and climate change](#), and [Evaluating risk of mist netting](#), among others.

**Teachers should be familiar with the 9 bird species and their migratory types.** There are three different migrant categories:

**Winter-** Winter species (known as temperate migrants) migrate to California from farther north during the fall (September - October) in search of more suitable climate, habitat, and food. In the spring (March - April), these species return north. Examples: *Hermit Thrush*, *Fox Sparrow*, *Ruby-crowned Kinglet*.

**Resident-** Resident species are birds that remain in one location all year long. Examples: *Bushtit, Bewick's Wren, California Towhee*.

**Summer-** Summer species (known as neotropical migrants) migrate to California during the spring (April - May) from farther south, then return south in the fall (August - September). Examples: *Wilson's Warbler, Swainson's Thrush, Pacific-slope Flycatcher*.

**Why this matters:** Birds are known indicators of environmental change. They react to pollution, natural disasters, and disease. As urban development and expansion has increased, so have the impacts on bird populations. Monitoring population trends plays an essential role in researching the impact of environmental changes and exploring potential solutions.

**Assumed background:** Students should have basic knowledge on the following:

- Ability to define dependent and independent variables.
- Define X and Y axis.
- Able to plot points on X and Y axis.
- Transfer data from a table to a graph.

### **Drawing in Google Docs:**

Worksheets 2 and 3 (see Links to Worksheets section, below) have the students graph species abundances within a single year (**Worksheet 2**) and across a 20 year period (**Worksheet 3**). These graphs can be edited directly in Google Docs. See [this website](#) for an overview, particularly section 5 (manipulative objects) and 6 (scribble). If this step is too advanced for the students, print the worksheets and have them draw directly on them.

### **Longitudinal Data Interpretation:**

Worksheets 2 and 3 also ask students to interpret the graphs they create. Abundance within a single year will be explained by the species' migration status (Winter, Resident, or Summer). Interpreting longitudinal data is more difficult due to natural annual variation. However, the following information should help guide classroom discussions:

Relative stability in bird abundance generally indicates no major changes to reproductive success or individual survival over that period of time. Likewise, fluctuations in bird abundance may indicate an increase or decrease in reproductive success or individual survival. However, CCFS has less opportunity to sample certain migrating species (since they only move through the station during a short window in the spring and fall), which may impact the data. Longer term trends, in general, are more reliable than short-term trends.

Long-term trends should be broken down into migration strategy since each of these groupings of birds has different environmental pressures on them.

Resident species: Bewick's Wrens and California Towhee populations show strong upward trends (population growth). Bushtit populations are relatively flat (stable populations).

Summering species: Wilson's Warbler, Swainson's Thrush, and Pacific-slope Flycatchers all show downward trends (population declines).

Wintering species: Hermit Thrush and Ruby-crowned Kinglets show a downward trend, while Fox Sparrows show an upward trend.

Potential causes:

- Drought conditions, which may favor resident species
- Rainfall, and timing of rainfall, impacting growth of vegetation and abundance of insects/food sources
- Changes in climate conditions on breeding grounds (up north) of wintering birds
- Resident species face less competition from summer and winter species due to downward trends of migrating birds (and vice versa if something were to happen to resident populations)
- Local habitat changes (CCFS is a restoration site, but it is also near increasing development which removes habitat; some species adapt better than others)
- Similar habitat changes / development may be happening on the summering and wintering grounds of migrating birds

## Links to Worksheets

**Worksheet 1: Species Introduction** ([Link to Google Drive](#)) Contains a picture of bird species, its common and scientific name and general information about the bird and its migration behavior.

**Worksheet 2: Migration Data** ([Link to Google Drive](#)) Contains a table with the number of a single bird species banded in each month of the 2016 year, along with general migration information.

**Worksheet 3: Long-term Data** ([Link to Google Drive](#)) Contains a table of the amount of a single bird species banded for every year, from 1996-2016.

**Worksheet 4: Vocabulary** ([Link to Google Drive](#)) A Vocabulary Key for student reference throughout the lessons.

**Worksheet 5: Answer Keys** ([Link to Google Drive](#)) Species identification and completed graphs keys for teachers.

**Worksheets 1 - 3: Organized by Species** ([Link to Google Drive](#)) Contains Worksheets 1 - 3 grouped by species for easier organization.

Note: Worksheets 1 - 4 contain Spanish translations within each document.

## Preparation for Lesson 1

1. **Print out Worksheets 1-4 for students. Arrange them into packets based on bird species** (i.e. worksheet 1, 2, & 3 for the Bushtit, along with the Vocabulary page). Make sure you have one packet for each student. Depending on class size you may have 3 students in each bird group ( $3 \times 9 = 27$ ) or possibly 4 ( $4 \times 9 = 36$ ), etc.
2. **Set up 9 stations** throughout the classroom. **Print the photograph of each bird species and its name to label each station.** [Module Aid - Bird Pictures](#)
3. Laptop setup. **Preload each bird call link below at its corresponding station.** If that is not possible, preload all the links to one laptop in nine different tabs. These are videos of bird calls to introduce the 9 birds to your

students. If they are all on your laptop, you can circulate among the groups to share them.

- Bushtit: <https://www.youtube.com/watch?v=pe9AZrWkzQA&t=43s>
- Bewick's Wren: <https://www.youtube.com/watch?v=IOzF9KU-hIk>
- California Towhee: <https://www.youtube.com/watch?v=aYv1Bj366BE>
- Wilson's Warbler: <https://www.youtube.com/watch?v=Wu5t7nPH2FO>
- Swainson's Thrush: <https://www.youtube.com/watch?v=lpLnRUnoJNQ>
- Pacific-slope Flycatcher: <https://www.youtube.com/watch?v=bjvIJSDbS9E>
- Hermit Thrush: <https://www.youtube.com/watch?v=o0mATRdzZSc&t=6s>
- Fox Sparrow: <https://www.youtube.com/watch?v=zZXH8AHPO2M>
- Ruby-crowned Kinglet: <https://www.youtube.com/watch?v=9-n5W4rUMzE>

### **Lesson Plan #1 (90 min, or 2 45-min sessions, etc.)**

If desired, administer a [pre-test](#) first. This will gauge the student's understanding of the material before they begin learning, and allow you to gauge the success of the module by comparing results to a post-test conducted after the module is completed.

**This lesson begins with an inquiry activity related to the phenomenon of migration. It will familiarize students with local birds and introduce them to the work of the bird banding station. Students will plot data points using specific information from data in a table and discuss results.**

At this time, students should be sitting in groups, but they are NOT yet assigned to a specific bird station.

1. **(10 min)** Ask students the following warm-up questions based on the phenomenon of migration. If possible, let students discuss in groups and share out. Have students record responses to revisit later. (Can be KWL chart).
  - What does migrate mean? (Accept answers related to both humans and other animals). Do you know any animals that migrate? What are some reasons that birds might migrate?
2. **(10 min)** Show [Pacific Flyway map](#).



On the same page/journal/digital file as warm-up, ask students to make observations as a SEE/MEAN/MATTER chart.

- What do they **see** on the map? What do they think it **means** regarding bird migration? Why might it **matter** to us as scientists?

3. (10 min) Guide students in locating the Bay Area on Flyway map. Provide brief introduction to SFBBO and CCFS using information from the **“Background for Teachers.”** Explain that we will be using data from the bird banding station shown in the video to investigate bird migration. Show a short [video](#) about bird banding at CCFS.

- Ask students to write down questions from the video underneath SEE/MEAN/MATTER chart.

4. (5 min) Creation of “expert groups”

Tell students they will each receive their own bird species to learn about. Pass out the packets so that each student in a given group gets a **different bird**. Make sure each of the three migration types (resident, winter, summer) are represented in the group. **Instruct students to stand up and go to the appropriate stations around the room, matching their bird packet. In this way, each student becomes an “expert” at that station in their new “expert groups.”** Afterwards, students will return to their original groups to teach the others what they have learned. This is why it is important that each migration type is represented in the original group.

5. (10 min) Once students are in “expert groups” instruct them to listen to the bird call preloaded on the laptops; if laptops are not available, teacher can circulate with bird calls. Students should then read **Worksheet 1: Species Intro** aloud, **highlighting important information related to food and habitat**, and circling unknown vocabulary words.

Refer students to Worksheet 4: Vocabulary for images, definitions and examples of unfamiliar words.

When students read text aloud in small groups, it can create more access for students with learning disabilities.

6. (15 min) After students are done reading **Worksheet 1: Species Intro**, ask several groups to share out something they chose to highlight. Next, instruct students to read **Worksheet 2: Migration Data** aloud as a group, again **highlighting any information related to migration**. Then, students will plot points on the graph using data from the table on **Worksheet 2**.
7. (10 min) Ask students to answer questions on the second page of **Worksheet 2: Migration Data**. They should look at **Worksheet 4: Vocabulary** and think about the different types of migration. Decide as a group their bird's migration pattern.

Mini-Lesson: English language learners may struggle with the word "migratory." Consider a brief mini-lesson on parts of speech to connect the words. "Migrate" is the **verb** or action the birds take, "migration" is the **noun** or event, and "migratory" is the **adjective** to describe the type of bird that travels from one place to another.

8. (10 min) Instruct students to return to their original groups with their bird packets. Choose a seat position to start, and ask each student to take a turn reporting back to their group key information about her/his bird and its migration type, using evidence from the handouts/graph. Teacher circulates to listen and take any notes based on student presentations (any misconceptions, interesting points to reinforce, etc.)
9. (10 min) Closing: Create a large chart on the white board or wall, labeled "Bird Migration Types" with the categories "Resident," "Winter," and "Summer." One student from each "expert group" should bring up the bird photo from the station and use tape/magnet/ etc. to stick it in the right place on the chart.
  - Final discussion here. Teacher can share excellent points overheard in small group presentations, address misconceptions, etc.
  - Ask students to make **predictions**: Which birds will we see at the banding station based on the time of year and **Worksheet 2: Migration Data**.

## Preparation for Lesson 2

1. Set up three stations in the classroom and label them the following: *Resident species*, *Winter species*, *Summer species*.
2. Provide graphing paper and poster paper (optional) for presentations.

### Lesson Plan #2 (100 min, or 2 50-min sessions, etc.)

**In this lesson, students will graph longitudinal data for their bird species, and then compare and contrast trends with other groups of the same migration pattern. They will generate hypotheses based on data and then present their findings to the class.**

1. (10 min) Warm-up question: Do you think every year the banding station found the same number of Bushits, Wilson's Warblers, Fox Sparrows, etc.? Why or why not? Students can discuss in groups. Ask several groups to share out.
2. (10 min) Students should return to (or already be in) expert groups. As a group, they will read **Worksheet 3: Long-term data** aloud. Ask students: What is a line graph? Why is it a good choice for this type of data? (If necessary, model the creation of a line graph with document reader or on whiteboard. Label x and y axes. Graph a few points of data from one of the bird's tables).
3. (15 min) In expert groups, students will use provided graph paper to complete line graph for their bird and answer question #1. They can use model on board for guidance (if needed).

For students with disabilities or others in need of differentiation, consider pre-drawing x and y axes on graphing paper and/or providing scale.

For a more substantial accommodation, or to save time, you can provide the [graph](#) or [graph with trendline](#), and have the students focus on the analysis.

4. (15 min) Once expert groups have completed line graphs and answered the first question, instruct them to go to the station that represents their bird's migration pattern (resident, summer, or winter).

**\*Option 1:** If each expert group has created one graph as a group: Arrange desks into one large group at each station to compare graphs.

**\*Option 2:** If each individual has created a graph: Arrange desks into small groups of 3 or 4 at each station, with just one student from each bird group represented to compare graphs.

Either way, at each station, students answer questions 2-4 together.

Teacher tip: Circulate among the stations and ask probing questions to help students generate explanations.

1. If \_\_\_\_\_ happened, how might your bird react?
2. Who might your bird be competing with for resources?
3. What are some ways that the habitat might be changing over time?

5. (15-20 min) Instruct students to return to expert groups. Now they will prepare a 3-minute presentation for the class. It may take the form of a poster and/or include placing graphs, photos, etc. on the document reader.

The presentation should include the following:

- Birds' common and scientific names.
- Picture of the bird. They may use the photograph from their station.
- Graph that shows migration pattern and explanation of what this means.
- Graph that shows long-term trends and explanation of similarities and differences with other birds of the same migration type.
- At least one benefit and one disadvantage of this migration type.
- A brief overview of any hypotheses or explanations generated regarding migration trends. This might include human impact on their bird's population, how natural disasters or other environmental phenomena affect bird habitat and population, or anything else they discussed.

6. (30 min) Presentations

Students should present by migration category (all residents, then all summer species, then all winter species). **Tell students they will be bringing their own hypotheses to the bird banding station to share with the scientists.** While they listen to presentations, they can write down questions, take notes, and revise their own explanation for any trends they observe (see [Module Aid - Student Presentation Handout](#)).

If desired, administer a [post-test](#). This will gauge the student's understanding of the material after the lessons have completed, and will allow you to gauge the success of the module by comparing it to the pre-test results.

## Module Options and Supplements

To shorten Lesson #2 by 30 (or more) min:

Conclude at Step 4. Have students stay in the larger "migration type" stations. They can report out their group's answers to the worksheet questions rather than returning to expert group to develop a presentation.

\*This is MORE ideal in terms of time, but LESS ideal in terms of getting students to develop deeper explanations.

To provide students with additional learning opportunities, see the Climate Change Extension section, below.

### Supplementary Links:

- Bird Song Hero <https://academy.allaboutbirds.org/bird-song-hero/>
- Merlin Bird ID app <http://merlin.allaboutbirds.org/>
- Macaulay Library, bird songs and videos <https://search.macaulaylibrary.org/catalog>

## Field Trip Component

Note: the field trip component requires funding to support SFBBO staff who lead the field trip. Contact the [Landbird Program Director](#) for details.

### **Purpose:**

- To observe how bird-banding stations collect data and learn how basic mark-recapture studies work
- To learn and practice scientific methods
- To practice communicating scientific ideas

### **Preparation:**

Divide students into 3 groups ahead of time for ease of grouping. Once at the station, students will be assigned to three different stations, and they will then rotate through them.

### **Overview:**

The three stations will be 1) Bird banding, 2) Extracting birds from nets, and 3) Hands-on activity (banding a partner and solving a mystery using bird feathers). After the students have rotated through all three stations, there will be a wrap-up session, the Summit of the Scientists. Here, students will have the opportunity to share what they've learned and discuss their hypotheses from the classroom data. The final wrap-up can either be whole class or in the three groups.

## Climate Change Extension

### Learning Objectives:

- Extend understanding of bird migration to include implications of climate change
- Make predictions based on scientific knowledge and data from bird migration module

### Science Education standards:

MS-ESS3-2, MS-ESS3-3, MS-ESS3-5 ([Earth and Human Activity](#))

MS-LS2-1, MS-LS2-2, MS-LS2-4 ([Ecosystems: Interactions, Energy, and Dynamics](#))

**Key Materials:** Laptop with prepared links, laptops for student use if available, [Climate Change handout](#), completed [Worksheet 2: Migration Data](#) & [Worksheet 3: Long-term Data](#), [Climate Change Vocabulary handout](#)

**Vocabulary:** phenology, green-up, cue

**Duration:** 60 min

### Lesson Plan

1. (5 min) Introduction. Ask students the following warm-up question based on the phenomenon of migration: How does a bird know when it is time to migrate? What **cues**, or signals, might it respond to? [This can be a think-pair-share leading to a whole class brainstorm. Teacher can record responses on chart paper or whiteboard].
2. (10-15 min) Show students Audubon [video](#).

Give them each a half-sheet of paper. On the front, have them write, “What are some consequences of climate change for birds?” On the back, “What can we do about it?” Students can fill out 2 responses on each side.

After the video, scroll down and show them the [species' range projection map](#). You can choose California and show them Hermit Thrush.

If possible, set up laptops in small groups and allow students to examine the impact of climate change on the current range of local bird species:

<http://climate.audubon.org/geographical-search/california>

They can toggle between decades to see the progression. (Only Hermit Thrush is available from their module, but they can choose other birds).

3. (5 min) Vocabulary preview: Introduce the concepts of “**phenology**” (or just use “life cycle”) and “**green-up**.”

You can use this [video](#). Pause at 0:19 to address “green-up.” Pause at 0:51 to discuss “phenology” and the mismatch between the bird, plant, and insect life cycles.

4. (10 min) Show students [the graphics on slides 1 and 2](#) from this [National Park Service article](#). Make sure students understand what the key means, in terms of the timing of the start of spring. Have students complete a [SEE/MEAN/MATTER](#) chart AND/OR ask students to make a prediction about how these trends might affect their bird’s migration pattern/fitness.

5. (15 min) Data analysis and prediction. In small groups, have students complete the [Climate Change Handout](#).

6. (10 min) Closing discussion. Have each group share their bird’s migration type and a prediction based on the data (either short or long-term).

Ask the class:

- How does the bird banding data help us understand the impact of climate change?
- Why is it important to be a part of this research?