LESSON 3

Making Tracks with Shorebirds

Learning Objectives

Students will investigate different technologies used to track shorebird migration, interpret and evaluate scientific datasets collected using those technologies, and identify the pros and cons of the different research methods.

Students will use prior knowledge of shorebird migration and their assessments of current tracking technologies to design a tracking plan for a selected species and share their plans with their classmates, clearly communicating their design rationale.

Activity 1: Tracking with Satellite Transmitters

Time: 30 min | Student Level: Grades 5-8

Materials:

Provided: Satellite Transmitters Worksheet (Activity Sheet 3.1)

From your Classroom: Internet, projector or individual tablets/computers

Engage: Share the *A Tale of Two Whimbrels* story map with students. Explain that this story map represents the migration of two Whimbrels that were tagged with a satellite transmitter to better understand the habitats they are using throughout the year. The team of biologists that tagged Salix and Sadlerochit traveled to the Arctic to capture six Whimbrels and attach satellite transmitters to track their annual migration.

Explore:

1. Students can read the story map on their own devices, review for homework, or it can be presented during class.
2. If desired, you can provide them with the discussion questions to consider while the story map is reviewed.

Discuss: Discuss as a class or have students complete the Satellite Transmitters Worksheet (Activity Sheet 3.1). If you are planning to do Activity 4, Design a Tracking Plan, be sure to emphasize advantages and disadvantages.

- What did you learn in this story?
- What challenges do the Whimbrels face on this migration?
- What did scientists learn with the results of this tracking study?
- What is the advantage of this type of tracking?
- What are the disadvantages of this tracking?
- Is there anything else you would like to learn about Whimbrel migration?

Activity 2: Resighting Flags

Time: 45 min | Student Level: Grades 5-8

Materials:

Provided: Banded Birds slideshow (Slideshow 3.1), Banded Birds Map (Activity Sheet 3.2), Data Collection Sheet (Activity Sheet 3.3), Banded Birds Worksheet (Activity Sheet 3.4)

From your Classroom: Bulletin board, pins, colored string, markers, white paper and colored paper with similar texture and weight, six boxes or buckets, large paper map of Western Hemisphere

Prepare for the activity:

1. Give each box a label: Arctic breeding site, Migration stopover at Delaware Bay, Migration stopover at Northern Brazil, Migration stopover at Lagoa do Peixe, Migration stopover, Bahia San Antonio, Argentina, Wintering site in Chile. These boxes will be the site.
2. Create six sets of 1.5"x 0.75" strips of white paper based on the chart below. Strips do not need to be precise in size or count. Place the strips in their respective boxes, based on the numbers in the chart below. It is recommended to try to get 60-75 strips of paper from one piece of paper.*
3. Create enough strips of color paper for each group of three to have six strips of paper, each set of six in a different color. The strips should be about the same size as the white paper, so that when eyes

are closed you cannot tell the difference between the white and colored.* Extra colored paper will be needed to test alternate trials.

4. Hang the large blank map on the bulletin board and mark the six sites as marked on the Banded Birds Map (Activity Sheet 3.2) so that pins can be used to mark bird locations. If a paper map is not available, project the Banded Birds Map (Activity Sheet 3.2) and mark with the paint tool on computer.
5. Distribute the sites around the room so that groups can easily move around the room.
6. If using pins or markers, make sure each bird/group has their own marker or pin color. Ideally the color of pins/markers would be the same color as the paper.

**Note: Students can help with this part of the preparation.*

Number of white paper strips for each box/bucket

Arctic	Delaware Bay	Northern Brazil	Lagoa do Peixe, Brazil	Argentina	Chile
130	10	50	25	25	75

Engage: Present the Banded Bird slideshow (Slideshow 3.1) to provide students with background information on how flags and bands are used to understand bird migration. Teaching guidance is included in the notes of the slideshow.

Explore:

7. Divide students into groups of three and explain to students that they are biologists and they have deployed their flags on Red Knots in the Atlantic Flyway.
8. Give each group six strips of the colored paper. These will be their flags. The students will create a flag 'id' to write on each flag. There should be five numbers or letters in any order, but they cannot form a word. The flag id will be the same for all of the flags in that group.
9. Have each group share their flag number with the rest of the class. Record the numbers on a whiteboard or other area that is visible to everyone. Assign each flag id a color (pin, marker, or on screen).
10. Explain that the white strips of paper in each box represent the difficulty of monitoring at that site, which is impacted by the density of birds at the site and the accessibility of the site.
    - The more strips of white paper in a box, the harder that site is to monitor.
    - The fewer pieces of white paper in a box, the easier that site is to monitor.
11. Provide students with background information about the monitoring difficulty at each 'site'.
    - **Arctic:** Very large area, difficult to access, and birds are only found in pairs over large territories. Monitoring is irregular.
    - **Delaware Bay:** Small area, easy to access, birds are densely concentrated at predictable locations and times. There are three long-term research projects which ensures that there are many biologists monitoring during the peak season.
    - **Northern Brazil:** Very large area, difficult to access, very little known about where birds are concentrated, but it is believed that there are many Red Knots along this coast. Monitoring is increasing here, but still infrequent.
    - **Lagoa do Peixe, Brazil:** Long, narrow beach that is mostly easy to access and find birds, but birds can be spread out along the coastline and can be time- consuming to monitor. Regular monitoring is conducted here.
    - **Bahia San Antonio, Argentina:** Preferred habitat at this site is well known and mostly easy to access. There can be significant human disturbance that prevents Red Knots from being able to use their preferred habitat. Regular monitoring is conducted here.
    - **Wintering site in Chile:** Red Knots will be at this site for the most time through the year and the areas were birds are concentrated are well-known, but it is very difficult to access in order to read flags. Typically aerial surveys are used for population counts, and flags cannot be read at that level.
12. Tell each biologist to distribute one flag at the different sites based on the chart above. Explain that each set of flags represents one bird's journey through the Atlantic Flyway.
13. Using the Data Collection Sheet (Activity Sheet 3.3), students will move between each site and randomly pull five pieces of paper, recording if it is white or if it is a flag. If it is a flag, have students record the id number of each flag pulled. The student pulling the paper should have their eyes closed or covered so they can't see the difference between the plain paper and flags.**
14. After each group pulls five pieces of paper, they will return them to the box for the next group.

15. After each group has completed all of the sites once (this represents one year of monitoring) have them come to the classroom map and record their flags based on the color-code created for their group at the beginning of the activity.
16. Reflect on how many flags were sighted and where.
    - Where did you see the most flags? Why?
    - Where did you see the least flags? Why?
    - What could be changed to increase the number of flags sighted?
        - Remind them that they cannot change the density of birds or the difficulty in monitoring as this is based on the natural system.
        - They can change:
            > How many flags are deployed: Each additional bird flagged = 6 new colored pieces of paper with a unique flag id.
            > How many people are monitoring at a site: Each additional person monitoring = additional pulls from each monitoring site box
17. Repeat by testing a few of the options that students suggest. Additional colored paper can be used to make new birds (use new flag ids). If more people are added to monitor you can pull more than five.

***It is likely that students will pull another group's flag. That is ok, in real life biologists see other scientists' flags frequently. They have a website bandedbirds.org to share these data with each other.*

Discuss: Discuss as a class or have students complete the Banded Birds Worksheet (Activity Sheet 3.4).If you are planning to do Activity 4, *Design a Tracking Plan*, be sure to emphasize advantages and disadvantages.

- Did you get a full migration route for any birds?
- Which modifications helped you see more flags? Why?
- What can scientists learn from a tracking study like this?
- How will they use that information?
- What is the advantage of this type of tracking?
- What are the disadvantages of this tracking?
- Is there anything else you would like to learn about using leg flags to track bird migration?

Activity 3: Motus Wildlife Tracking System

Time: 30 min | Student Level: Grades 5-8

Materials:

Provided: Motus Tracking Worksheet (Activity Sheet 3.5)

From your Classroom: Internet, projector or individual tablets/computers

Another technology that is used to understand migratory routes is the Motus Wildlife Tracking System (Motus). This tracking system consists of stations installed in a variety of habitats. Each station is composed of several antennae that can detect the movements of birds with tiny radio-transmitters attached to them. After antenna detects a bird with a transmitter, a computer on the tower records it and sends signals to a central database where users can access the data, seeing a list of all the stations where a particular bird has been detected. For more information on Motus, review the Learning Resources to better support the students.

Engage:

1. Give students 5-10 minutes to navigate the Motus Wildlife Tracking System website and look at the different stations around the world. Guidance for navigating the website is provided on the Motus Tracking Worksheet (Activity Sheet 3.5). The worksheet can be shared with students or projected on a screen while they are working.
2. Recommend to students that they explore the website looking at these specific data sets, including tracks of particular birds. There are many different species and projects in the database. Students should explore any that interest them, but they should also look at relevant shorebird maps by searching for projects under Explore Data > View Tracks and then indicating the project and/or species to search for.

Explore:

3. In pairs, have a student choose a shorebird from the Shorebird Cards to focus on.
4. Look at the migration maps of your shorebird on the Shorebird Superhighway online map have each group determine general areas where their species is at different times of the year.

Suggested Motus Projects to Review

Project	Species
Bahia Lomas Shorebirds	Red Knot
James Bay Shorebirds	Semipalmated Sandpiper
Monomoy - Steph Koch	Black-bellied Plover
Texas Gulf Coast Migratory Shorebirds	Red Knot, Sanderling
Brazil Non-breeding Shorebirds	Semipalmated Sandpiper
Semipalmated Sandpiper on the Bay of Fundy	Semipalmated Sandpiper
Nol - Wintering Shorebirds	Dunlin

5. Have students use the Motus website and interactive map to highlight some of the towers they think would pick up a signal from their species if tagged.
6. Now, have students choose a site where they would put up a new tower, i.e., a spot where there isn't one already and where it would be useful to get more data.
7. Students present their recommendations to the other students.

Discuss: Discuss as a class or have students complete the Motus Tracking Worksheet (Activity Sheet 3.5). If you are planning to do Activity 4, *Design a Tracking Plan*, be sure to emphasize advantages and disadvantages.

- How is this tracking method different from satellite tracking (Activity 1)?
- Why are these stations located where they are?
- What do you think impacts the decisions on where a station should go?
- Were the current sites in their region?
- Why do some of the tracks stop in North America even though we know these birds fly to South America?
- What are the advantages and disadvantages of this type of technology?

Activity 4: Design a Tracking Program

Time: 60 min | Student Level: Grades 5-8

Materials:

Provided: Tracking Program (Activity Sheet 3.6)

From your Classroom: writing materials, white board, smart board, or projector

Engage: Together as a class, brainstorm the pros and cons of each of the different tracking technologies (satellite transmitters, flags/bands, radio telemetry/motus) for 5 min, reflecting back on previous activities. Do not go into great detail, but make sure that students have a good understanding of each of the three types. The chart on the next page is included as a reminder for you.

Explore:

1. Split students into groups (numbers may vary based on class size and age group).
2. Distribute Tracking Program Worksheet (Activity Sheet 3.6).
3. Direct students to design a tracking plan. Groups can select one of the topics below or they can develop their own.

Pros and Cons of Tracking Technologies

	Flags and bands	Motus tracking	Satellite tracking
Pros	• Very inexpensive to deploy • Reliable, long lasting • Flags have been used for at least 20 years in some species so there is a large data set available	• Once the towers are in place, it is inexpensive to deploy • The towers can collect data from an infinite number of tags • Other species are also monitored with Motus radio transmitters	• Real-time results with precise location • Easy to use in difficult to access locations because it does not require monitoring or installation of additional equipment
Cons	• Numbers can fade and can become unreadable • Requires people to be present and monitoring regularly • Some of the locations are impossible to access for this type of monitoring	• Not enough towers in some of the important areas, particularly Midcontinent, Arctic, Boreal North America, and South America • Some towers need to have manual download • Towers can be destroyed by storms or vandals • Batteries are depleted after a year or two on transmitters	• Very expensive, can only deploy limited numbers • Heavy so can't be used on smaller birds • Technology is still evolving • Last for only a couple years • If one of the tags doesn't work or falls off it has a large impact on study

Topics:

- What other WHSRN sites is my local WHSRN site connected to based on the migration of species?
- Red Knots in the Atlantic Flyway have had extensive research done on their migration, but they also use the Midcontinent Flyway, where are the important places here?
- Where should we target a project that will work with ranchers on grassland management practices that are shorebird-friendly?
- How are shorebirds using the habitat at our WHSRN site during their stopovers?
- Where are the most important non-breeding locations for shorebirds in the Pacific Flyway?

4. Remind students of the Claim, Evidence, Reasoning framework or other similar framework that you use in your classroom.
   - Claim - What are the questions that they want to answer?
   - Evidence - What data do they need to collect?
   - Reasoning - How will the data help them answer their question?
5. Tell students they will have $15,000 to conduct a two-year study to answer their question(s). From the three different tracking techniques, students will select one technology for their tracking program. They should be prepared to explain why they selected the technique, potential drawbacks, how they will spend their funds, how they will collect and manage data, and then how they will use their results. The worksheet can be used to document the plan.
6. Once completed, each group will present their tracking plan.

Discuss: As a class, discuss the experience of designing a tracking program.

- What factors do you need to consider when designing the program?
- What are the other factors that you did not need to consider (ease of logistics, permitting for trapping birds, etc)?
- Would you choose a different technique if you wanted to study a different bird or migration path?
- Why is it important to understand the specific sites that shorebirds are using?

Expenses for each Tracking Technology

	Flags and bands*	Motus tracking*	Satellite tracking*
Flag or tag - Placed on bird	Flags: $2/flag	Radio Tags: $225/tag	Satellite tags: $1950/ tag
Registration of tag in network		$1500 for 20 tags (access to all tower data)	$80/tag
Equipment		$3400 for a new tower	
Staff for resighting flags	$1500/per site/year		

**All three technologies require the scientists to trap birds to put tags on them and to analyze data. For the purpose of this activity the cost is assumed to be the same for all three techniques and does not need to be included in the budget.*

Cultural Connections: Using technology to study bird migration is one way to understand where birds go, the timing of their migration, and what habitat is important. With their connection to land and stewardship, indigenous communities have other ways of understanding birds, habitat, and migration. Meet with local indigenous peoples to understand their traditional ecological knowledge on their shared space with shorebirds. How do they know when the birds will arrive? How long will they stay? Why are they important to the ecosystem?