LESSON 3:
How can Tracking Data Inform Conservation?

Photo by Tim Romano, Smithsonian's National Zoo

LESSON 3:

HOW CAN TRACKING DATA INFORM CONSERVATION?

OVERVIEW

In Lesson Three, students will learn how tracking data informs conservation decisions made by scientists and that the type of tracking device you use depends on various factors, including bird morphology and annual cycle. Students will solve the mystery of declining Swainson's hawk populations and learn about biomagnification and its effects on animals.

ENGAGE	How do we use tracking data to help us conserve migratory birds?	Class engages in a group discussion on what is conservation. Students discuss how can tracking data be used to help conserve migratory bird species. Students then read about the annual cycle of the Swainson's hawk (including sudden population decline).	20 minutes
EXPLORE	What happened to the Swainson's hawk?	Students continue the story of the Swainson's hawk. They look at real tracking data and work in small groups to discuss why they think Swainson's Hawk populations decreased.	30 minutes
ELABORATE	What is biomagnification and what does it look like?	Students learn about biomagnification and how it might affect animals.	30 minutes
EVALUATE	Formative assessment	Students discuss why conserving habitat is critical to conserving bird populations. Individual students will write a paragraph.	10 minutes

DISCIPLINARY CORE IDEAS

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

OVERARCHING UNDERSTANDING

Tracking data informs conservation and the type of tracking device depends on a variety of factors.

Swainson's Hawk

LESSON 3: HOW CAN TRACKING DATA INFORM CONSERVATION?

ESSENTIAL QUESTIONS

1. How do scientists use tracking data to make conservation decisions?
2. What are some examples of using tracking data to conserve bird species?
3. Why is conserving bird habitat so critical to conserving bird populations?

RELATED MISCONCEPTIONS

- Students may think conserving bird species is all about birth rate.
- Students might not consider all of the habitats utilized during the annual cycle.

KNOWLEDGE

Students will know...

- How tracking data can be used to make conservation decisions
- What biomagnification is

SKILLS

Students will be able to...

- Explain how tracking data was used to understand Swainson's hawk populations.
- Justify why conserving bird habitat is critical to conserving bird populations.
- Describe biomagnification.

PRIOR STUDENT KNOWLEDGE:

- Students should be familiar with the annual cycle of migratory birds.
- Students should understand the different types of tracking devices used for migratory birds.
- Students should be familiar with the components and terminology related to food webs and food chains.

SCIENCE AND ENGINEERING PRACTICES:

- Asking questions
- Using mathematics and computational thinking
- Developing and using models
- Obtaining, evaluating and communicating information
- Analyzing and interpreting data
- Engaging in argument from evidence
- Constructing explanations

CROSSCUTTING CONCEPTS:

- Patterns
- Systems and system models

TERMS:

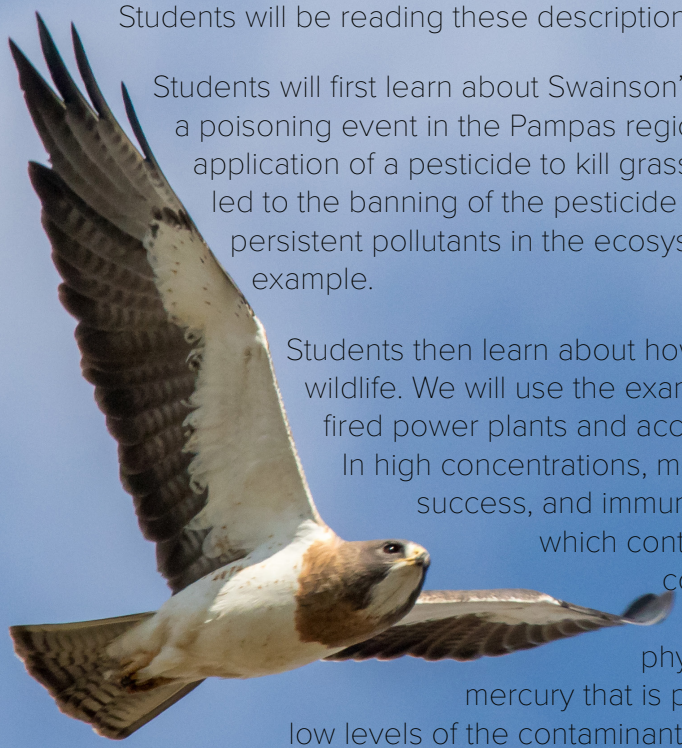
biomagnification • conservation

Refer to the Glossary in the Appendix

TEACHER BACKGROUND INFORMATION

In this lesson, students will learn about how tracking data can be used to inform conservation. We will address two processes by which pollution can impact wildlife: acute toxicity and biomagnification.

This lesson will use examples from two species, the Swainson's hawk and Pacific loon. Information about these species is available on the Follow that Bird! Website under Species Profiles. Students will be reading these descriptions in the lesson.



Swainson's Hawk

Students will first learn about Swainson's hawk (Activities 1 and 2), which experienced a poisoning event in the Pampas region of Argentina. This event was caused by the application of a pesticide to kill grasshoppers. Tracking data led to this realization. This led to the banning of the pesticide in the region. Students will then learn about how persistent pollutants in the ecosystem can harm wildlife using the Pacific loon as an example.

Students then learn about how the biomagnification of pollutants can impact wildlife. We will use the example of how mercury, which is emitted from coal-fired power plants and accumulates at high latitudes, impacts the Pacific loon. In high concentrations, mercury can affect the cognitive ability, reproductive success, and immune functions. Biomagnification is the process by which contaminants such as pesticides or heavy metals are concentrated in the tissues of organisms as you go up the food chain. In the provided example, phytoplankton at the bottom of the food chain absorb mercury that is present in the water. The phytoplankton contain only low levels of the contaminant. When phytoplankton are eaten, the contaminant becomes more concentrated in the higher-level organism. This process repeats and contaminant concentrations increase up the food chain.

For more information about how pesticides can affect migratory bird populations, read *Popular Pesticides Linked to Drops in Bird Populations*, an article from Smithsonian.com.

MATERIALS:

Activity 1: ENGAGE

- Whiteboard, chalkboard or large paper to record student ideas

Activity 2: EXPLORE

- Internet access or printouts of the Swainson's hawk description from the Follow that Bird! website

Activity 3: ELABORATE

- Colored plastic beads
- Test tube rack
- Tray
- 10 small test tubes per group
- 3 medium test tubes per group
- 1 large test tube per group
- 50 mL beaker per group
- Tape
- Markers

Activity 4: EVALUATE

- None

ACTIVITY 1

ENGAGE - How do we use tracking data to help us conserve migratory bird populations?

1. Activate students' prior knowledge. Ask students to define **conservation**. Allow students to respond and record answers on the board. Prompt students with additional questions, i.e.:
   - *What does it mean to conserve something?*
   - *How do you conserve water?*
   - *What might it mean to conserve wildlife?*

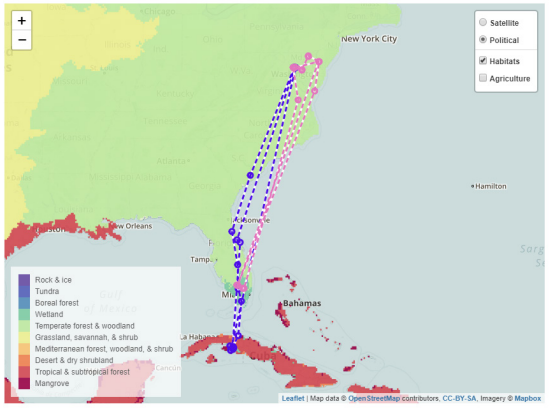
2. Introduce the concept of conserving migratory birds.
   - Ask: *Given what you now know about tracking devices, how can we use them to make wildlife conservation decisions?* Record responses on the board. Students should record all these in their notebooks.
   - Tell students that they are going to try to solve the mystery of a migratory bird called the Swainson's hawk. They are going to read about its annual cycle and look at tracking data.
   - Break students up into groups of two or three. Have groups navigate to the Follow that Bird! website to read about the Swainson's hawk or print and hand out the description. The Swainson's hawk description is located under the "Species Profiles" in the menu.

ACTIVITY 2

EXPLORE - What happened to the Swainson's hawk?

1. Look at tracking data for the Swainson's hawk using habitat and agriculture map layers.
   - Tell students to navigate to the tracking map by selecting "Migratory Birds Tracking Map" from the menu.
   - Once on the tracking map page, have students select Swainson's hawk from the "Bird Species" drop-down bar.
   - Then tell students to click "Habitats" from the filters in the upper right-hand corner of the map. Have students note the type of habitat Swainson's hawks use in their overwintering grounds.
   - Next, have students click "Agriculture" in the upper right-hand corner of the map.

Follow that Bird Tracking Map



Screen capture of map overlays

2. Discuss as a large group.
   - Ask: *Looking at the Swainson's hawk data with the habitat layer, what type of habitat does Swainson's hawk occupy in its winter range?*
   - Ask: *What do you think caused the population decline for Swainson's hawks?*

3. Read how tracking data helped inform Swainson's hawk conservation.
   - From the Follow that Bird! website, select Swainson's hawk from the "Species Profiles" in the menu.
   - Scroll to the bottom of the page profile to learn about how tracking data helped inform Swainson's hawk conservation.

Swainson's Hawk

4. As a class, discuss the resolution to the Swainson's hawk mystery. Ask:
   - *What killed the hawks? (Eating a lot of grasshoppers that were laced with a pesticide)*
   - *How did Dr. Woodbridge figure out what was really happening to the hawks? (First, he put satellite tags on the birds to find out where exactly they were going. Then he went down there to see for himself.)*
   - *How do you think the farmers reacted to this discovery?*
   - *What was the solution to this problem? (Many government and private organizations came together to ban the use of this pesticide)*

Pacific Loon
Photo by Ryan Askren, USGS. Public domain.

ACTIVITY 3

ELABORATE – What does biomagnification look like?

1. Predict and explain.
   - Ask students to predict: How do the quantities of toxins in small organisms (primary consumers) compare to the quantities in larger predatory animals in an ecosystem?
   - Have students explain their prediction.

2. Show students the Pacific loon food web.
   - Draw the following food chain on the board (or have students construct one):
     Plankton ➔ Small fish ➔ Large fish ➔ Pacific loon
   - Break students up into groups of three or four. Have materials ready for each group.

3. Label the tubes and beakers.
   - Instruct groups to use the tape and marker to label the small test tubes with the first organism in the food chain (plankton).
   - Next, have groups lavel the medium test tubes with the second organism (small fish).
   - Have groups label the large test tube with the third organism (large fish).
   - Finally, instruct groups to label the 50 mL beaker with the fourth organism (Pacific loon).

4. Fill the test tubes.
   - Have groups place the ten small test tubes in a test-tube rack standing on a tray. Tell groups to fill the test tubes with beads to simulate mercury pollution until approximately 0.5 mL of beads have fallen into each test tube.
   - The medium-sized test tubes represent the second organism in the food chain developed by the class (e.g., the small fish). Continue the story: *The small fishes eat three plants.* Instruct groups to add the contents of three of the small test tubes to one of the medium-sized test tubes. Have groups repeat for each of the other two medium-sized test tubes and set aside the remaining small test tube (of the original ten). Tell students that the last small test tube will be used later.
   - The large test tube represents the third organism in the food chain (e.g., the large fish). Continue the story: *The large fish eats three small fish.* Instruct groups to add the beads from the three medium-sized test tubes to the large test tube.
   - Tell groups to add approximately 1.5 mL of beads to one of the medium-sized test tubes (small fish) and set aside to facilitate comparison of the amount of toxins in each organism at the end of the demonstration.

- The 50 mL beaker represents the fourth organism (e.g., Pacific loon). Continue the story: *The Pacific loon eats three large fish.* Have groups place a mark on the large test tube at the level of the beads, and then transfer the beads from the large test tube to the 50 mL beaker. Tell groups to again add beads up to the line in the large test tube and then add it to the 50 mL beaker. Have groups repeat this action for a third time. Instruct groups to add beads up to the line in the large test tube one final time and set it aside for comparison later (do not add it to the 50 mL beaker).

5. Compare the contents of the four "organisms."
   - Ask: *Will all organisms at various levels in the food chain have the same toxin concentrations?* Ask students to explain their answers to this question.
   - Answer: *The higher the organism is in the food chain the more toxin will accumulate in its body. So the organisms higher in the food chain will have a higher concentration.*
   - Introduce the term "**biomagnification**" and tell students they just demonstrated what biomagnification is. Give them a few minutes to come up with their own definition and share. Provide them with the formal definition (refer to the glossary) and have them record it in their journals/notebooks.

Pacific Loon
Photo by Ryan Askren, USGS. Public domain.

ACTIVITY 4

EVALUATION - Formative Assessment

1. Discuss habitat conservation.
   - Tell groups to discuss why conserving habitat is critical to conserving bird populations.
   - Have students individually write a paragraph explaining why in their own words.

EXTENDING THE LESSON

1. Watch the career connection video (page 46).
2. Discuss what students can do to protect birds (page 46).

CAREER CONNECTION

SPOTLIGHT ON: KALI HOLDER, VETERINARY PATHOLOGIST

ENJOY SOLVING MYSTERIES LIKE A DETECTIVE?

That's what Kali Holder does as a Veterinary Pathologist at the Smithsonian's National Zoo and Conservation Biology Institute. She looks at animals that have died and pieces together the cause of death. Uncovering the answer may be the missing link that helps to determine how we can better save species.

HOW CAN YOU HELP?

Taking Action to Protect Birds!

As you've learned in this lesson, habitat conservation is important for conserving bird populations. You also learned that pollution and pesticides are harmful to animals. Want to do more to protect birds and other wildlife? **You can help** by...

- Encouraging your family to skip the pesticides. Instead, create a great habitat for birds and they'll do the work for you by eating lots of insects.
- Riding your bike, walking or taking public transportation. Car exhaust is one type of pollution. You can help by thinking of other ways to get from place to place without using a car.