NERRS Motus Education – Lesson Plan Reference Sheet

Overview

This document serves as a lesson plan reference for educators leading this program. It includes a PowerPoint presentation to guide the lesson. The duration of the lesson can range from 2 to 5 hours, depending on how many activities are selected.

Activity Table of Contents

Learning Objectives

- Introduce students (grades 6-12) to the Motus Wildlife Tracking System and its connection to the National Estuarine Research Reserve System (NERRS).
- Engage students with hands-on, creative, and collaborative activities to enhance the learning experience.
- Develop scientific skills such as data analysis, critical thinking, and applying knowledge to make educated predictions in response to posed questions.

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Introduction

Slide 1: Lesson and educator introduction slide

Slide 2: Learning Objectives

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Slide 3: Motus

What is Motus?

- The **Motus Wildlife Tracking System** is a radiotelemetry-based system used to detect tagged animals and track their locations and times of detection. This allows scientists to gather unprecedented data on migratory species as they move to lower latitudes in the fall and higher latitudes in the spring.

How Does It Work?

- **Motus** consists of two main components:
    1. **Towers**: These can be purchased and set up by individuals, organizations, etc., along migratory routes. Towers, built in a specific grid and frequency range, can detect tagged animals up to 10 miles away. They resemble miniature cell phone towers and require minimal maintenance, especially when equipped with solar panels.
    2. **Tags**: These vary in size depending on the species. For example, tags for songbirds are worn like a backpack, with two loops around the legs and an antenna on the back. Butterfly tags are more like stickers and have shorter battery lives due to the shorter lifespan of butterflies. Tags must weigh less than a certain percentage of the animal's body weight to avoid hindering their movement. The towers detect these tags, and the data is sent to a central Motus database, where it is processed and made available on the open-source Motus platform.
        - **For more details** on tower construction and images, please refer to the NERRS Motus Stations: Photo Gallery on the NERRS Motus website.

Who Can Use the Data?

- **Anyone!** One of the great advantages of Motus is that the data collected is open source and accessible to anyone interested. This dramatically reduces research costs and promotes collaboration, offering unique educational opportunities with real data.

- **Potential Challenges:** Towers are fairly expensive to put up (anywhere between 5-10 thousand dollars) and require expertise in putting up and maintaining the towers. Open-source data may increase the initial costs for the person collecting the data. Additionally, making research and publications open source can require additional expenses. While Motus is largely free, some specific data or articles might not be included in the open-source database. This is a theoretical concern but could be worth mentioning if students ask about other open-source data or research.

Slide 4: What is the National Estuarine Research Reserve System?

- The National Estuarine Research Reserve System is a network of 30 coastal sites designated to protect and study estuarine systems in collaboration with and service to surrounding communities. Established through the Coastal Zone Management Act, this partnership program between NOAA and the coastal states supports ecosystem health and the interconnectedness of people and the environment. A broad range of perspectives are incorporated, including Indigenous peoples and tribal nations.
- You are currently at the (INSERT YOUR RESERVE HERE). Include some information about your own reserve here.

Slide 5: Motus and the NERRS

- The NERRS use the Motus system to study topics like migration patterns and flight speeds. Due to the significance of estuaries in the breeding and migration of coastal birds, Motus has greatly helped understand bird populations in the reserves. Knowledge gathered through Motus can then inform the NERRS to improve management and conservation practices!

Slide 6: What is Migration? When Does it Occur?

- **Migration** is the large-scale movement of species (not just birds) between their breeding grounds (summer homes) and non-breeding grounds (winter homes). While the common image is a flock of geese flying in a V-formation, North America alone has over 300 species of migratory birds.
- Typically, migration to lower latitudes (closer to the equator) happens in the fall, while migration to higher latitudes (closer to the Arctic, though distances vary by species) occurs in the spring.
    - **Source:** All About Birds.org

What Types of Animals Migrate?

- Animals that migrate include birds, dragonflies, butterflies, bats, whales, sea turtles, wildebeest, caribou, salmon, zooplankton, red crabs, sharks, and tuna.
    - **Source:** Treehugger.com

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Slide 7: What Are the Benefits of Migration?

- Migration allows animals to access resources that are seasonally scarce in other locations, particularly food and nesting areas.
- It improves the survival chances of both adults and offspring.
- Migration helps birds escape competition and predators during breeding seasons.
    - **Source:** Audubon.org

What Are the Potential Challenges with Migration?

- **Climate Change:** Rapid climate shifts alter access to resources, forcing species to adapt and compete with other species. This can lead to endangerment or extinction for some species.
- **Overharvesting of Food Sources:** Overfishing and depletion of certain species can reduce the value of migration or even threaten the survival of migratory species. For instance, the overharvesting of horseshoe crabs in the Northeast has led to a decline in the number of red knots that migrate to that area each year. While birds can adapt and find new migratory paths, it introduces greater scarcity and challenges.
- **Loss of Habitat:** The loss of essential habitats due to deforestation, development, or environmental change further threatens bird populations, disrupts nesting practices, and reduces the already vulnerable niches of keystone species. For example, silver-haired bats only inhabit old-growth deciduous or coniferous forests, and the reduction of these habitats threatens their migration and survival.
- **Anthropogenic Factors and Human Development:** Beyond habitat loss, human activities introduce new risks. These include pets preying on migratory birds, development that alters stopover points, and seabird bycatch in commercial fishing.
    - **Source:** All About Birds.org

Slide 8: Range

What Is a Species' Range?

- A species' range refers to the total area where that species can be found throughout its lifetime. This includes individual and community spaces, migration routes, and hibernation grounds. It doesn't necessarily distinguish between populations of the same species.

How Is Range Different for Migratory Species?

- Migratory species generally have larger ranges that are divided by season. In our hemisphere, their range may include:
    - **Breeding (Summer) Grounds:** The area where species nest, typically from late spring to early fall.

- **Non-breeding (Winter) Grounds:** The area where species spend the winter, usually from mid-to-late fall to early spring, when resources are scarce.
- **Migratory Pathways:** The routes species travel between breeding and non- breeding grounds. Although species spend less time here, these pathways are crucial for their survival.

Slide 9-10: Examples of Animal Ranges and Migrations

- **Monarch Butterfly:**
  Monarchs have a range across the United States, with a dividing line at the Rocky Mountains. Eastern populations spend summers near the Great Lakes, spring in the southern U.S. from Texas to Maryland, and winter in southern Mexico. Western populations spend summer from southern British Columbia to the U.S.-Mexico border and winter along the California coast and into Mexico.
  - **Source:** Monarch Watch
- **Painted Bunting:**
  Painted buntings range from Nebraska, Arkansas, and Texas to the coast of Virginia. They are divided into two distinct populations that rarely intermix: the "Eastern" population migrates to Florida, Cuba, and sometimes the Yucatán Peninsula, while the "Western" population migrates through Mexico to the Caribbean and Central America. They may interact in Central America but are generally considered separate populations.

Slide 11-12: Conservation

- **How Does Motus Help Conserve Species?** Motus enables researchers to track migration patterns and changes over time. By comparing data from different periods, researchers can identify factors affecting migration and population trends. This information allows for informed actions to conserve and protect vulnerable species.
- **How Do NERRs Help Conserve Bird Species?** NERRs protect critical habitats, supporting the migration, nesting, and feeding of bird species. They collaborate with local groups on conservation projects and have increased involvement with the Motus program to enhance research, education, and public awareness.

Slide 13: Current Efforts to Protect Migratory Bird Species

1. **Conventions for the Protection of Migratory Birds**
   These conventions, in place for over a century, recognize the global importance of migratory birds. In the U.S., they are reinforced by Executive Order 13186, which directs federal agencies to enhance bird protection efforts.
2. **North American Waterfowl Management Plan**
   Launched in 1986 to address declining waterfowl populations, this plan involves Mexico, Canada, and the U.S. working together to conserve critical wetland habitats. It also benefits other wetland species by extension.

3. **Partners in Flight**
   A public-private partnership focused on improving bird monitoring, research, and education. Initially aimed at birds nesting in North America and wintering in Central and South America, it has since expanded to include a wider range of species.
4. **U.S. Shorebird Conservation Plan**
   The program aims to:
   1. Identify and protect critical habitats for shorebirds
   2. Support the development of conservation organizations
   3. Raise public awareness of shorebird conservation
   4. Promote policies that protect shorebirds and wetlands
   5. Gather and share data on shorebirds

   Source: U.S. EPA

Slide 14: What Can You Do to Help Conserve Birds?

- Keep pets indoors and away from birds
- Avoid using pesticides in your yard
- Create a bird-friendly habitat or feeder in your backyard
- Donate to conservation groups
- Reduce your carbon footprint
- Buy organic, shade-grown coffee
- Support bird-friendly legislation
- Join local or national bird conservation groups

  Source: National Wildlife Federation

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Motus Mysteries Website Investigation

Objective:
The Motus Mysteries section on the NERRS Motus website allows instructors to engage students with real, applied data presented in a creative format. Students will apply their knowledge of migration, species range, and the Motus system.

Website Link:

https://storymaps.arcgis.com/stories/c2264e6701e44ff1a3f1e9768e018c58

Time Estimate:

- 20-40 minutes for investigation
- 15-20 minutes for discussion

Guided Group Run-Through

Instructions:

1. Open the NERRS Motus website and navigate to the education section.
2. Introduce the concept of Motus Mysteries and explain the topics that will be discussed.
3. Select 1 species to investigate as a group. Each species sections includes:
    - A picture and description of the species
    - A range map showing Motus detection points for some individuals
    - A map tour showing the migration path of a specific individual

    Species options to investigate:

    - Monarch Butterfly
    - Silver-haired Bat
    - Dunlin
    - Least Bittern

4. Explore the website together, discussing the species and their migration patterns.
   Once you have completed 1 as a full group, either break into small groups or individuals to pick 2 more to run through and then come back together to discuss. After the group discussions, open the floor for a class-wide discussion. Have each group share what they learned about their species, including migration patterns, range information, and interesting discoveries made during their investigation.

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Use the following guiding questions:

- What surprises or interests you about this species?
- Did you expect the species' range to look like this? Why or why not?
- Do you think the individual stayed in the area or moved on after detection?
- Motus tracks are dependent on where towers are located. If you wanted to help elucidate
- more about this individuals' migratory path, where would you suggest more towers be built?
- What stands out about the individual's flight path?
- Do you believe the detections are accurate?

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Working with Motus Data

Objective:
Students will use the Motus dashboard to explore how Motus data is processed and presented on an open-source platform.

Time Estimate:
30-60 minutes (depending on age group and technology proficiency)

Materials:
A data sheet is available to guide students through using the Motus dashboard and tables.

Preparation:
Instructors should review the activity sheet and familiarize themselves with the online Motus dashboard before the lesson.

Instructions:

1. Students can work individually or in pairs to explore the Motus dashboard.
2. Direct students to visit Motus.org and access the data dashboard.
3. Detailed instructions for each section are provided in the activity sheet.
4. **Note:** Inform students that occasional errors may appear in the dashboard, such as mismatched dates or unusual detections. Encourage them to note any discrepancies they observe. Below are some talking points regarding error in data if these questions arise with your students.

- **What errors exist on Motus? What could cause these errors?**
    - **False detections**: Incorrect detections that require researchers to assess if they're realistic based on animal range or migration patterns.
    - **Dashboard display errors**: Errors in the way data is presented, which can usually be fixed by refreshing the dashboard or using a different system.
    - **Time of detection errors**: Times may appear out of order. Checking the table view of the data helps resolve this issue.
    - **Contradictory information**: Data in the dashboard may differ from the table or downloaded files. If the contradictions are minor, researchers can still use the data based on broader trends.
    - **Impact of errors:**
    - Each type of error affects the interpretation of the data differently, but they all lead to confusion that researchers must resolve.
- **Why is it important to find and report errors in open-source content?**
    - Open-source data, like Motus, relies on the public and users to monitor and report errors since there is no central authority overseeing data accuracy. Accurate data is crucial for entities like NERRS, which use Motus data to inform conservation strategies.
    - A helpful analogy is litter clean-up efforts in a community: without a single organization managing the process, various groups work together to keep the area clean.

- **How are errors identified and corrected in Motus? Who oversees the process?**
    - The public and researchers accessing the data are responsible for identifying and reporting errors. However, decisions to remove erroneous data points are made by the research teams sponsoring specific projects, such as those tagging animals or setting up Motus towers.

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Create Your Own Story and Present Motus Data

Objective:
Students will creatively work with Motus data, either individually or in groups, to develop a narrative based on an animal's movement.

Time Estimate:
45-90 minutes

Adaptability:
If PowerPoint or Google Slides is unavailable, students can use a paper map or poster board. A paper map is useful for spatial analysis, while a poster board allows for more creative interpretations.

Instructions:

1. Using their "Working with Data" activity sheet, students should select an individual animal to investigate.
2. Students will create a presentation (PowerPoint, poster, or map) that tells a narrative similar to "Motus Mysteries." They should explore what the species might be doing at each location and what could be happening between detections.
3. **Essential Information to Include:**
    - Picture of the species
    - Range of the species
    - Typical migration pattern (space and time)
    - Significant detections
    - Errors or unusual detections
4. After creating their presentations, students will present to the group or take part in a "conference-style" setup, where they walk around and view each other's work.
5. **Optional:** For added motivation, students can vote for their favorite narrative. The winner could receive a prize or have their presentation displayed at the reserve for a set time.

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Optional Supplemental Activities

- **Birding Walk:**
  Lead students on a birding walk around the reserve to engage them with local species. This can be used as an icebreaker at the start or to break up other activities and presentations.
- **Discuss Bird Diet and Habitat:**
  Although not directly related to Motus, this could be included in the introductory PowerPoint or as a separate lesson. Comparing local bird species and their diets/habitats can help students understand differences in their environment.
- **Discuss Bird Banding (Outside of Motus):**
  Tie this topic into the conservation discussion at the end of the lesson. Use local examples of bird banding to explain how it helps researchers track populations and improve conservation efforts.
- **Working with SWMP Data:**
  Use SWMP data or personal knowledge of local weather to lead an activity on how meteorology impacts bird migration and wildlife tracking. Linking this to climate change could also be valuable.