Wildlife Express

February 2022 – Migration

Activities:

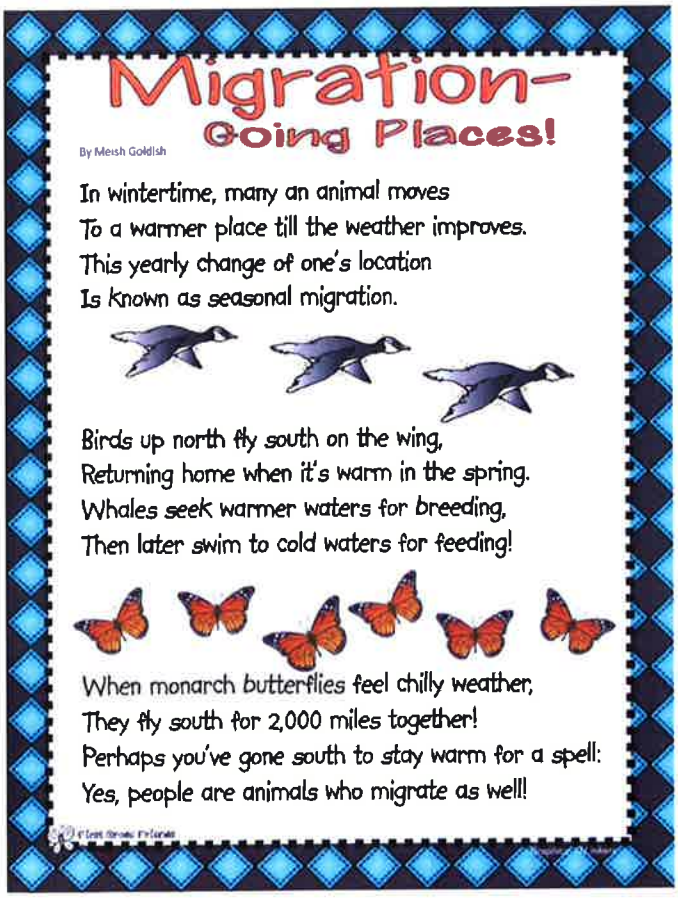
Great Migration Challenge: Children go through a physical maze to learn about challenges bats face during migration. Also available for birds and monarchs – contact lori.adams@idfg.idaho.gov

National Environmental Education Foundations Animal Migration Activity Guide:

Monarch Mapping: Students Map longitude and latitude coordinates for a monarch's migration.
Make Your Own Bird Feeder: An easy bird feeder to create with a pine cone for migrating birds.
Create a Mental Map: Students draw a map from memory, to replicate how salmon find their way home…are there any smells?

Project WILD's *Lights Out*: In this activity, students learn about light pollution and how it effects migrating wildlife. After studying, students develop plans for solutions.

WILD about Elk's *Migration Barriers*: Students play an active game that looks at limiting factors affecting populations of migrating elk.



Great Migration Challenge Idaho Bat Version

Materials:

- Large playing area
- Six large dice or cups with a regular-sized die in them.
- Bat course (You can print the following pages.)

Background Information:

Spring and fall migrations typically are associated with waves of songbirds, shorebirds and waterfowl, but numerous studies show that some bat populations also make seasonal migrations over hundreds of miles.

In Idaho, all 14 bat species migrate either short distances of up to about 60 miles seasonally between breeding and hibernating roost sites, or in the case of the hoary bat and silver-haired bat, up to about 600 miles to spend the winter in the southern third of the United States, including California, Arizona or farther south.

Bats leave their territory for one of two reasons. One is a seasonal lack of food. The second is lack of appropriate winter living quarters.

Directions:

1. Set up "course" (like a board game)
2. Add dice to the following stations: 1, 10, 11, 13, 15, & 17.
3. At station 7, add a roll of flagging.
4. You could have cups of water with a pitcher at station 19.
5. Review migration with students. Discuss what they know about bat migration in Idaho.
6. Students roll die to start the activity.
7. Students move the number on the die and follow directions at that station. Students continue on the journey until the game ends for them.
8. Track who survived. Discuss obstacles.
9. As an extension, have students create a similar game for Idaho salmon migration.
10. If you're interested in the monarch migration version of this, email lori.adams@idfg.idaho.gov

Your migration challenge is just beginning!! Will you reach your destination?

Let's find out! Roll the die and move ahead that number. Good luck!

1

Bad luck. Your colony was just infected with White-Nose Syndrome. Die a slow death. The game is over for you!

3

Bad News. You land by a polluted marsh and become sick by the bugs you eat. Sit down, and count to 30. Groan 10 times and move back 1 station.

2

Good news! Food is plentiful! Mosquitos recently hatched at the Farmer's Pond. Smack your mouth 10 times and move ahead 5 stations!

4

Watch out for the Great Horned Owl! It wants to eat you! Hide under some bark on a tree. Count to 40 and sneak ahead 3 stations.

5

Scientists catch you for research. They put a band around your leg and set you free. Tie a piece of flagging around your ankle. Move ahead 2 stations.

7

You escape capture by a predator, but slightly sprain your handwing. Get it back in shape. Slowly swing your left arm around 10 times. Then move ahead 2 stations.

6

You get tangled in fishing line and can't eat. You are weak from hunger. A wildlife rehabilitator cuts the line and feeds you. Hop on one leg in a circle, count to 25, then move ahead 4 stations.

8

You find a bat house that someone has built for shelter. Take a snooze for 30 seconds and move ahead 1 station.

9

Strong winds throw you off course. Roll the die and blow *BACK* that many stations.

11

It's raining, it's pouring, and you don't want to fly in this rainstorm. Wrap your wings around yourself while you wait for the storm to stop. Count to 50 by 10s. Roll the die and move ahead.

10

A pet cat catches you and eats you. SORRY! The game is over for you. Die dramatically before you leave the game.

12

You just flew into a tall glass building in town. Sit down, hold your head, and count to 35 by 5s. Then roll the die and move ahead that number of stations.

13

You reach your favorite abandoned mine to roost for the winter. It has been filled in rather than gated. In a panic, you fly around looking for a suitable roost! Fortunately, you find one. Sigh with relief and count to 50 until spring arrives. Roll the die and migrate ahead that many stations.

15

Ouch! You just flew into a wind turbine! (You thought it was a tree.) Unfortunately, you died. Sorry, the game is over for you!

14

A logging company has removed some trees from a forest, but they left plenty of old, dead trees (snags) with lots of cracks, cavities, and loose bark for roosting! You are able to spend a few days eating and resting before moving on. Make a snoring sound and then fly ahead 3 stations.

16

You are caught by biologists in a net. They put a transmitter on your back so that they can learn about where you fly at night and sleep during the day. Hold still for 20 seconds. Roll the die and move ahead.

17

A storm has left some puddles of water in the desert. Awesome! Take a few drinks. Move ahead one station.

19

You encounter a hatch of moths and stuff yourself full. Yum!! You roost for a few hours to digest your food before moving on. Rub your belly 10 times and then move ahead 4 stations.

18

You are exiting a pile of rocks after a day of rest. A sly fox is waiting to eat you. You get away but you are a bit shaken. Count to 10 and move *BACK* three stations.

20

You are ready to spend a night of eating bugs and slurping some water, but there is a full moon tonight! You are nervous you will be easy to spot by a predator so you decide to stay in your roost for the night. Count to 20 then move ahead 3 stations.

21

Your favorite cave has been opened to human visitors. Normally that isn't a problem, but some of the visitors are loud and throw things at you when you are trying to rest. You leave in a panic and now have to find a new place to roost. Move ahead 1 station.

23

You accidentally get into someone's house. The people are panicked and run around yelling and waving their arms. You panic and fly around in circles. Finally they calm down, open a door for you, and leave the room. You relax and find your way out! Move ahead 2 stations.

22

You find a bridge over a stream with lots of narrow openings and beams for roosting. This is a perfect place to have your babies. Squeak with excitement! You have successfully migrated to your spring home!

Congratulations!!!

24

Animal Migration Activity Guide

Name: _____

Date: _____

As the seasons start to change, you might notice that certain animals are on the move. This is known as an animal migration. A **migration** occurs when animals of a single species move a great distance to nest or mate, or as a result of a change in regional temperatures or food availability. You may have even seen some animals in migration without realizing they were undertaking such an important journey.

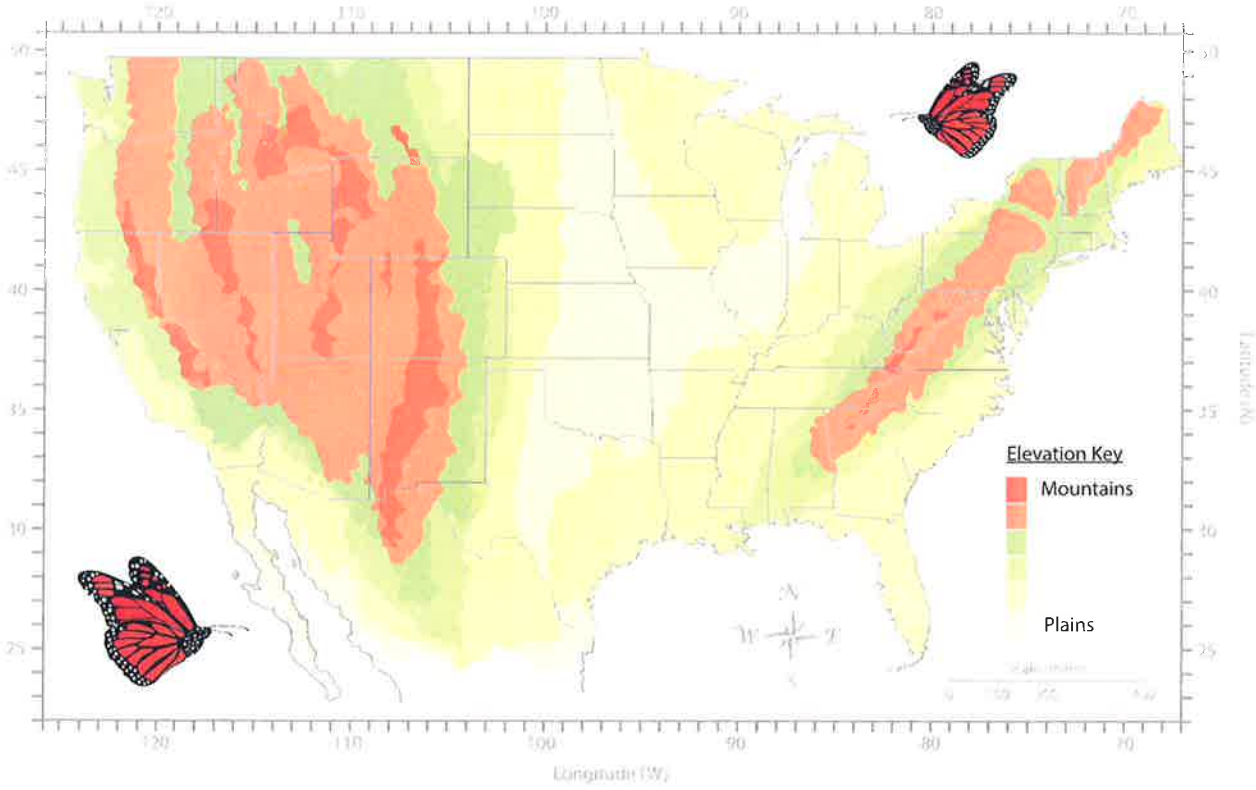
In this activity guide, you'll learn about the migrations of monarch butterflies, birds, and salmon, and find ways to get involved through citizen science!

Monarch Mapping

Monarchs are the only species of butterfly that make a two-way migration each year. Some will travel up to 3,000 miles between their winter and summer territories. Use the GPS coordinates provided in the table below to plot the migration routes of four monarch butterflies as they make their way south for the winter. The first number is the latitude (north-south) and the second is the longitude (east-west). Connect each series of coordinates with a line to see the flight pattern of each butterfly.

Why do you think each one chose the path it took?

Hint: Think about challenges the landscape might present or their needs along the way.



Monarch 1
46N, 69W
41N, 75W
34N, 80W
31N, 92W
Monarch 2
41N, 81W
39N, 89W
35N, 96W
26N, 100W
Monarch 3
49N, 106W
43N, 103W
36N, 101W
28N, 102W
Monarch 4
44N, 123W
38N, 121W
33N, 116W
29N, 111W

Make Your Own Bird Feeder

For birds and other animals, finding food and water during a migration can be a real struggle. Exhaustion from flying or walking such long distances, combined with the unfamiliar territory, makes it more difficult to stop and search for the next meal or drink of water. You can help out birds on the move by providing a simple bird feeder or bird bath outside your home. Follow these easy steps to make your own bird feeder.

Materials:
- pine cone
- peanut butter
- bird seed (any type)
- string

*You can also use a cardboard toilet paper tube instead of a pine cone

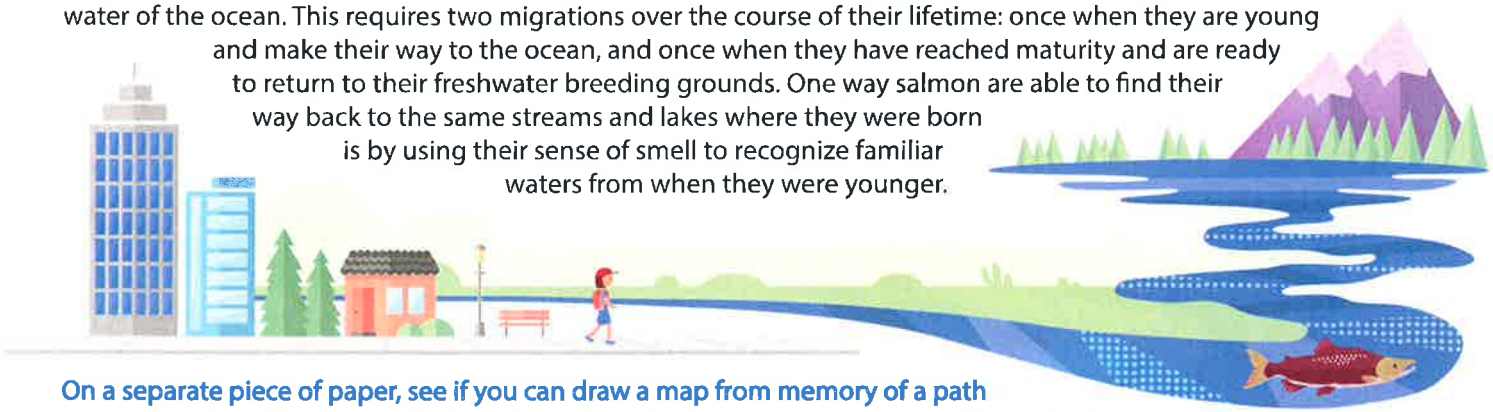
*If you have a peanut allergy, you can use Crisco or any other spreadable nut or seed butter

1) Tie the string to the top of the pine cone with enough left over to hang it from a tree or overhang. **2)** Coat the pine cone in peanut butter. **3)** Roll the pine cone in bird seed so that the seeds stick to the peanut butter. **4)** Hang your feeder on a tree branch or from an overhang. If you hang it near a window, make sure it is less than three feet away from the window glass or more than 30 feet away to avoid collisions. **5)** Watch the birds stop by for a snack!

Create a Mental Map

Animals use many different senses to guide them during migration. All together, these sensory cues create a mental map of landmarks like mountains, forests, rivers, or coastlines that help tell an animal where to go. Recognizable sounds and smells can even be part of the map too!

Pacific salmon are born in the fresh water of northern streams and rivers, but spend most of their adult lives in the salt water of the ocean. This requires two migrations over the course of their lifetime: once when they are young and make their way to the ocean, and once when they have reached maturity and are ready to return to their freshwater breeding grounds. One way salmon are able to find their way back to the same streams and lakes where they were born is by using their sense of smell to recognize familiar waters from when they were younger.



On a separate piece of paper, see if you can draw a map from memory of a path you are familiar with--maybe it is from home to school or from your bedroom to the front door. Try to include as many details as you can. Are there any sounds or smells included in your map?

Citizen Science

Citizen science projects like the ones below let you help scientists track animals as they undertake large-scale migrations. Visit any of the projects below and learn how to get involved locally. Then add your observations to the national effort!

Journey North MonarchLIVE eBird

NEEF National Environmental Education Foundation

Sources: National Geographic, US Forest Service, The Cornell Lab of Ornithology, US Fish & Wildlife Service, Journey North, MonarchLIVE, eBird

Lights Out!

Bright ideas for Dark Sky Heroes

Grade Level: Upper Elementary, Middle School, High School

Content Areas: Social Studies, Environmental Education, Science, Language Arts

Method:
Students discuss light pollution, how it affects humans and wildlife, and actions people can take to reduce light pollution. Students then conduct a lighting audit of their school grounds or other study site and develop their own action plans to address light pollution in their community or school.

Materials: See the following page.

Activity Time: two or three 45-minute sessions, including one evening visit to study site

People Power:
any, may choose groups of two or more

Setting: indoors

Conceptual Framework Topic Reference:
HIIB, HIIIB, RAID

Terms to Know:
light pollution, sky glow, glare, light trespass, clutter, ordinance, migration, diurnal, nocturnal, crepuscular, circadian rhythm

Objectives

Students will (1) define light pollution; (2) describe the adverse effects of light pollution on wildlife; and (3) develop plans to reduce the adverse effects of artificial light.

Background

When viewing the night sky, it is uncommon to see clear views of the Milky Way, meteor showers, or the Northern Lights. Most people today are unable to even see constellations that prior generations knew so well. While artificial lighting may enable people to see more in their immediate surroundings during hours of darkness, lighting up an otherwise dark sky comes with a cost.

The term light pollution refers to excessive, misdirected, or obtrusive artificial light. As human development increases and more lights brighten the night sky, negative cultural, economic, and environmental impacts of light pollution have developed.

When we lose clear views of the stars, moon, and other celestial bodies, we risk the loss of cultural values and heritage associated with the night sky. Art, literature, science, and various religions reveal how the night sky has inspired human ancestors throughout history. Astronomical knowledge—both in the past and in current times—is important for humanity to understand its place in the universe. Yet for many people today, even the simple pleasure of stepping out into the dark and searching for constellations in the night sky is becoming a forgotten pastime.

The loss of the cultural and aesthetic value of darker nights is only part of light pollution's impact. Poorly designed lighting that unnecessarily sheds light in all directions rather than at targeted locations, as well as light fixtures that use excessive wattage, are key contributors to the hefty economic and environmental impacts of artificial lighting. The International Dark-Sky Association (IDA) estimates that in the United States, at least 30 percent of all outdoor light is wasted, with a

resulting cost of $3.3 billion and the release of 21 million tons of carbon dioxide per year. As a greenhouse gas, carbon dioxide is the leading contributor to global warming. Earth's increasing temperature impacts wildlife habitat in a variety of ways, including changing animals' geographic distribution and altering available resources, in part through changes in precipitation patterns.

In addition to the indirect impacts of greenhouse-gas emissions, light pollution also impacts wildlife directly by influencing innate behaviors. Excessive light can disrupt circadian rhythms, the natural 24-hour physiological cycles of plants and animals that are affected by periods of light and dark. Natural patterns of light and dark guide many aspects of animal behavior, including foraging, reproduction, growth, development, communication, and movement.

Light pollution also adversely affects many categories of wildlife, including mammals, amphibians, insects, birds, and reptiles. Too much light can confuse migratory patterns, alter competitive interactions, and change predator-prey relationships. For example, many species of birds and bats that migrate at night

Materials

Photographs of the night sky (at least one of a clear, starry night sky and at least one of an urban/city view); copies of *Types of Lighting Fixtures* and *Dark Sky Hero* pages for each student (pages 373 and 374); pencils; graph paper

For older (middle and high school) students, in addition to the above materials, copies of *School Outdoor Lighting Audit Guide* (one per small group of 2-3 students) accessible from the "Additional Resources" section at ***www.projectwild.org***; pencils, graph paper, ruler/tape measure (one per small group), cameras or hand-held devices with cameras.

Illuminating Light Pollution

The International Dark-Sky Association (IDA), a nonprofit organization dedicated to preserving dark skies worldwide through education and responsible outdoor lighting, describes four common instances of light pollution: urban sky glow, light trespass, glare, and clutter. Artificial lighting that causes these types of light pollution reduces our ability to see distant stars, planets, and other objects—thereby reducing opportunities for many people to learn about and develop an appreciation of the cosmos.

Type of light pollution	Description
sky glow	illumination of the night sky often associated with artificial lights of cities and other urban areas
light trespass	occurs when light spills into areas where it is not needed, wanted, or intended such as into a neighbor's windows
glare	the presence of excessive bright light that causes discomfort and interferes with depth perception. Example: bright LED billboards on highways
clutter	excessive grouping of artificial lights, frequently occurring in urban areas. Example: large parking lots (such as car dealerships) and areas around a sport stadium

have been negatively affected by bright artificial lights on towers, lighted airport runways, and other structures. Birds can become disoriented and sometimes circle lighted structures until exhaustion, or collide into cables, windows, turbines, or buildings, resulting in injury or death. In North America, according to the Fatal Light Awareness Program (2015), collisions with buildings are estimated to kill 100 million to 1 billion migrating birds annually.

A well-documented case of harm caused by artificial lighting is the movement of sea turtle hatchlings, which are guided to the safety of water by the reflection of the moon and stars off the ocean. Artificial lights confuse hatchling turtles, causing them to crawl away from the ocean and onto roads or into communities along the shorelines.

While the impact of light pollution is most significant to nocturnal species of wildlife, effects on other species—even plants—are being observed and studied as well. Since plants and animals in ecological systems live in a web of interdependence, the effects on one nocturnal species can in turn impact others, whether they are active at dawn, daytime, dusk, or night.

Some general effects of light pollution on wildlife are provided in the table below.

Examples of Wildlife	Effects of Light Pollution
Nocturnal mammals (e.g., bats, coyotes, raccoons, moose, deer, etc.)	Decreased reproduction; difficulty in foraging for food; increased visibility to predators; impairment of night vision.
Nocturnal or migrating birds and bats	Colliding with lighted towers, high-rise buildings, turbines, and other structures; continuously flying near source of light until exhaustion and/or death; steering off course and not reaching intended destination.
Amphibians	Decreased reproduction; reduced foraging for food; confusion and disorientation, increasing susceptibility to predators and other threats.
Nocturnal reptiles	Disorientation; decreased appetite and feeding behavior; reduced mating; increased susceptibility to predation and other threats.
Moths and other insects	Attracted to light sources—waste energy circling light throughout the night; interference with mating and migratory behaviors; increased susceptibility to predation.

Fortunately, light pollution is an issue that can be addressed by everyday people. Reaching out to educate business owners, utility companies, government officials, and local members of a community offers a way to significantly reduce light pollution in an area. For example, many counties in Florida have passed ordinances requiring beachfront businesses such as hotels to comply with lighting restrictions in order to protect sea turtle hatchlings. Educational materials are distributed to visitors and hotel guests as well as homeowners of oceanfront property to increase awareness of the lighting ordinances. Grassroots organizations across the state are staffed by volunteers who educate their communities, advocate for sea turtles, collect data on sea turtle nests, and work to improve beach habitats for nesting. As a result, green sea turtle nesting sites, which are some of the best monitored in the world, have shown a huge increase since the species was listed as endangered in 1978.

In addition to working with the local business community and government, people can take action in their personal surroundings to reduce light pollution. Some strategies include using lower wattage bulbs; making sure outdoor lights are fully shielded and directed downward—not upward into the sky (see *Types of Lighting Fixtures* student page); installing motion detectors and light dimmers; and using curtains or blinds at night to keep indoor light indoors. Finally, two of the most basic steps are to turn off lights when they are not needed and to not light areas unnecessarily.

The major purpose of this activity is for students to understand the effects of light pollution on wildlife and consider real-life examples of how to address light pollution. Students are encouraged to become active in reducing light pollution and to become "Dark Sky Heroes" in their community.

Procedure

Part I

1. Locate and present to students pictures or video of a clear night sky (many can be found online), preferably showing the Milky Way and stars. Then show students a picture of the night sky from an urban or city view. What do students notice in comparing the two images? Students should note the decreased visibility of the stars in the urban night sky picture. Ask students what is causing the difference between the two settings. Which setting would students prefer to be in? Why? Which setting do they think wildlife would prefer? Why?

2. Ask students to define pollution. How would they define light pollution? Students may research light pollution and related terms such as sky glow, light trespass, glare, and clutter, or the meaning of these terms may be provided for them in discussion. How many students have experienced sky glow, light trespass, glare, or clutter? Based on their experiences, would they consider light pollution a problem that society should address? Why or why not?

Part II

3. Ask students to consider how light pollution may affect wildlife. How might light pollution affect a nocturnal, diurnal, or crepuscular (active at dusk and dawn) animal? Show the students the table provided in the "Background" section that lists effects of light pollution on wildlife. Students may be given the option of researching more examples of adverse effects artificial lights have on wildlife.

4. Next have students pick a wildlife species in their local region or state. How do you think excessive light may harm this species? Is there any research on the impact of light pollution on this species or a closely related species?

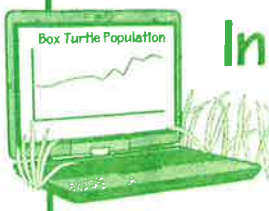
WILD Work

Scientists who study celestial bodies (e.g., stars, moons, planets, galaxies, etc.) are called **Astronomers**. What might an Astronomer's role be in combating light pollution?

A **City Planner** is a person who plans for how land will be used in cities, towns, and other communities. This job may require advising on placement of buildings, roads, parks, and other infrastructure; zoning regulations; and consideration of impacts on the environment. How might a city planner combat light pollution?

Professionals who specialize in the science and art of lighting are called **Lighting Designers**. What may be some advantages of hiring a Lighting Designer?

For more information on these and other careers, visit ***www.projectwild.org***.



In Step with STEM

For links to online resources related to the ideas and projects below, visit ***www.projectwild.org***.

- Investigate light intensity around your school, neighborhood, or state park using a light meter, a free light-measuring app on a hand-held device, a digital camera, or other measuring tool. Compare light intensity results to data on local wildlife populations such as bird counts. What, if any, correlations can be made between the location of certain species and the intensity of the light in those areas?
- Enjoy counting the stars? Explore how light pollution may change the visibility of stars in the night sky in different locations. Use a cardboard tube as your "star counter" and count how many stars you see through it in various locations.
- Digging deeper, students can learn more about light pollution and how to measure the magnitude of lights by joining NASA's national citizen science program, Globe at Night. Students can submit data and observe the magnitude of light pollution for their region.

Part III

5. Inform students that there are individuals and organizations working to reduce the effects of light pollution on wildlife. Encourage students to research efforts to reduce light pollution either in your local community or in distant locations. As an optional additional resource to help students learn about an effort to combat light pollution, provide the *Dark Sky Hero* student page for students to read. If using this student page with younger students, review the main points in the text to assist in the students' comprehension.

6. Discuss how individuals, communities, or organizations reduce light pollution. What individual or organizations would students nominate if there was a "Dark Sky Hero Award?" Can students see themselves contributing in any of these ways? What actions, if any, might help reduce light pollution in the local community?

Part IV

7. For younger students: Have elementary level students develop a basic plan to take action on light pollution in their community. Start by having students use graph paper to map the location of outdoor lighting fixtures at school, home, or other study sites (see "Guidelines for Mapping Field Study Sites" on page xxv). Using the "For Students" page titled *Types of Lighting Fixtures*, students can determine which fixtures at the site produce glare and light trespass, and those that better shield and direct light to minimize glare and light trespass. Students can indicate on their maps which lighting fixtures they think contribute to excessive lighting and which help reduce light pollution.

As an option, arrange for students to visit the site at night to collect data on what areas and features on the study site are illuminated by artificial lighting. Students can use shading on their maps to distinguish areas and objects that are dark and those that are illuminated at night.

Have students write down actions that could be taken to help reduce light pollution at the site—such as replacing light fixtures, using timers to reduce the amount of time outdoor lighting is on, or using lighting that is switched on with light sensors during evening hours and off during hours of daylight. What species of wildlife could benefit from reducing light pollution at the site?

For older students: Challenge middle and high school students to conduct a lighting audit of their school grounds. Distribute copies (one per small group) of the "For Students" page titled *School Outdoor Lighting Audit Guide* that is available from the "Additional Resources" section at ***www.projectwild.org***.

Questions students will address in their lighting audit include:

- What type of bulbs are being used in lighting fixtures on the school grounds or study site?
- What type of shielding is used to direct where light falls?
- Where does lighting fall on the site?
- Does the lighting fall where needed?
- When are the lights on, and for how much time?
- How much power (in kilowatt-hours) is being used?
- What is the annual cost of operating outdoor lights on the site?
- What is the estimated amount of carbon dioxide released when electricity is generated to power the outdoor lights?

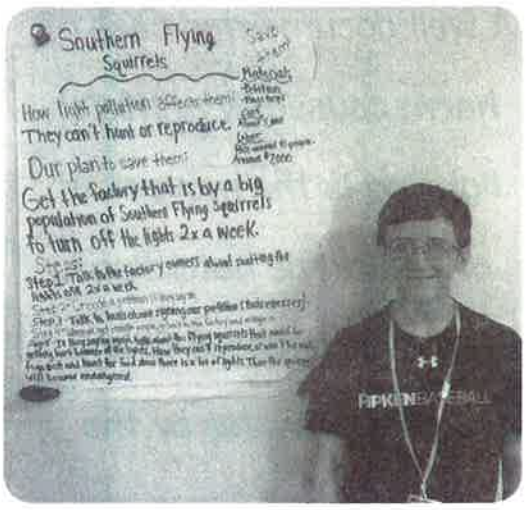
As part of their lighting audit, students will present an action plan to recommend changes to the current lighting at the site. Student plans should attempt to answer the following questions:

- Why is reducing excessive amounts of light from light fixtures helpful to people?
- Why is reducing excessive amounts of light from light fixtures helpful to wildlife?
- What are the current lighting conditions at your school?
- What steps can be taken to improve lighting at your school or study site?
- What materials will you need for your plan?
- What is the estimated cost of your plan?
- How many hours of work will be needed, and from whom?
- How much power can be saved with your plan?
- How much money can be saved with your plan?
- What species of wildlife do you think will benefit from your action plan?

These questions, as well as step-by-step instructions, are on the *School Outdoor Lighting Audit Guide* student page.

8. Have students present their action plans to the class. Allow time for other classmates to ask questions or make recommendations. After all presentations are given, have students reflect on what they have learned about light pollution and the steps people can take to reduce it. What is the individual's responsibility for light control? The community's responsibility? What can students do personally—as individuals, groups, or families—to help increase and maintain an informed awareness and responsible behavior concerning the effects of light on wildlife?

A well-documented case of harm caused by artificial lighting is the movement of sea turtle hatchlings, which are guided to the safety of water by the reflection of the moon and stars off the ocean. Artificial lights confuse hatchling turtles, causing them to crawl away from the ocean and onto roads or into communities along the shorelines.



While artificial lighting may enable people to see more in their immediate surroundings during hours of darkness, lighting up an otherwise dark sky comes with a cost.

Extensions

1. Have students share their light pollution action plan presentations at public meetings with potential stakeholders such as the school board, homeowners association, or town councils.

2. View films (e.g., *The City Dark*; *Brilliant Darkness: Hotaru in the Night*; *Light of the Genji*; *There Once was a Sky Full of Stars*) or other media related to light pollution, dark sky initiatives, effects on wildlife, etc. Students may organize a "dark sky movie night" at their school, featuring films related to light pollution.

3. Organize an evening visit to the school. Students can bring telescopes or ask a local astronomy club to provide telescopes. What is visible in the night sky around the school? Do students notice any light pollution occurring around the school building?

4. Have students identify constellations they can view at night in their community. What are some facts, myths, and interpretations of common constellations? What explains the apparent brightness of the sun compared to other stars like those of the constellations observed?

5. Take a class field trip to a local planetarium star show. Visit with staff in advance to request that they offer students information on local efforts to educate people about the importance of dark skies for wildlife and for people.

6. Plan to attend a "dark sky" festival, or encourage students to start their own. Search the key words "dark sky festival" for more information. Students can showcase the action plans they created and raise awareness of any light pollution issues they identified in the community.

7. Students can launch a public awareness campaign on light pollution by developing recordings (sound or video) of public service announcements (PSAs). For guidance on working with students to develop PSAs, see the Aquatic WILD activity "Conservation Messaging."

8. Search key words "Earth Hour" to learn about participating in this annual event.

Assessment

1. What is light pollution? Describe how it can affect wildlife. What species in your area might be impacted by too much light?

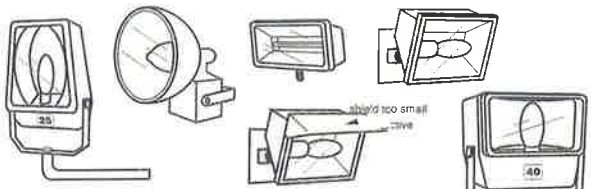
2. Explain how people can reduce adverse effects of artificial light.

3. After watching each group's presentation, have students identify (1) the main problem or issue; (2) actions that can be taken to help solve the problem; and (3) expected outcomes of the plan. Does the plan seem feasible or apt to be successful? Why or why not?

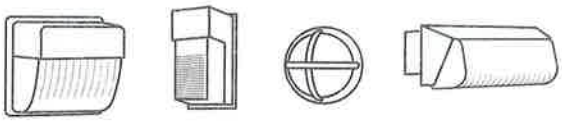
Types of Lighting Fixtures

FOR STUDENTS

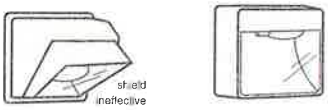
Fixtures that produce glare and light trespass

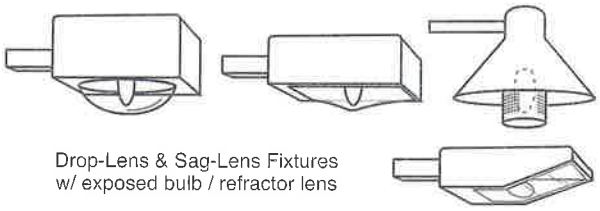


Unshielded Floodlights
or Poorly-shielded Floodlights

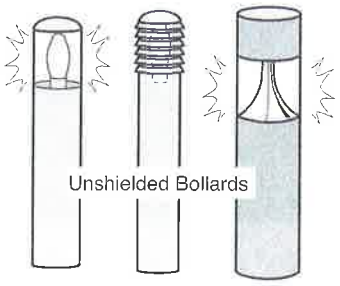


Unshielded Wallpacks
& Unshielded or
Poorly-shielded Wall
Mount Fixtures

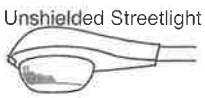




Drop-Lens & Sag-Lens Fixtures
w/ exposed bulb / refractor lens

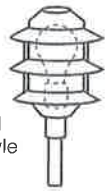


Unshielded Bollards

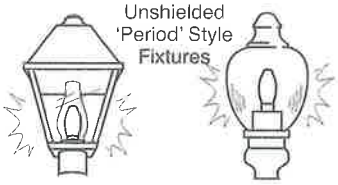


Unshielded Streetlight

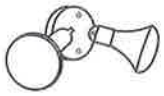
Unshielded
Barn Light



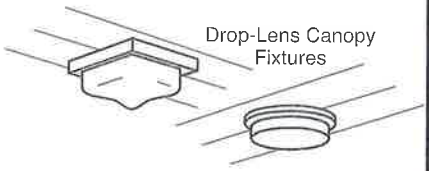
Louvered
'Marine' style
Fixtures



Unshielded
'Period' Style
Fixtures

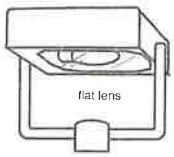


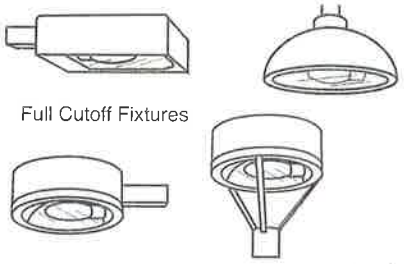
Unshielded
PAR
Floodlights



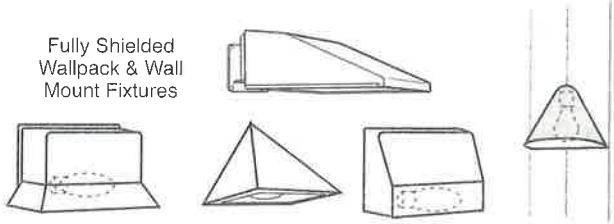
Drop-Lens Canopy
Fixtures

Fixtures that shield the light source to minimize glare and light tresspass and to facilitate better vision at night

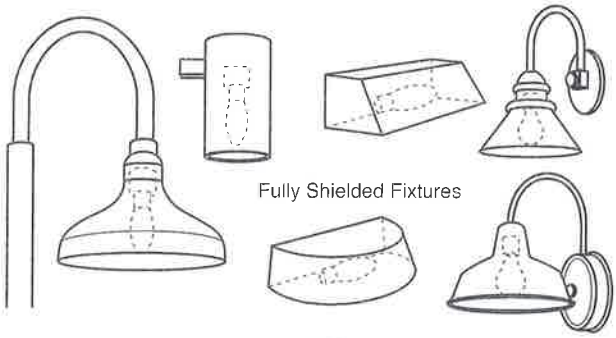




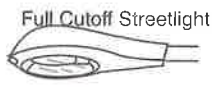
Full Cutoff Fixtures



Fully Shielded
Wallpack & Wall
Mount Fixtures



Fully Shielded Fixtures

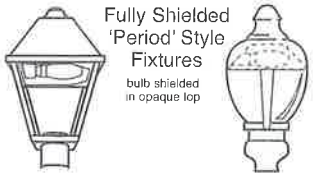


Full Cutoff Streetlight

Fully Shielded
Barn Light

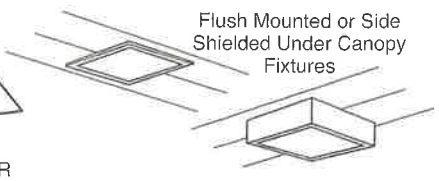
Fully Shielded
Walkway
Bollards

Fully Shielded
Decorative
Fixtures



Fully Shielded
'Period' Style
Fixtures

Shielded /
Properly-aimed PAR
Floodlights



Flush Mounted or Side
Shielded Under Canopy
Fixtures

FOR STUDENTS

Dark Sky Hero – Susan Harder Case Study

Reducing the intrusion of light on residents and the night sky was a goal Susan Harder set out to accomplish many years ago. Her hard work has not gone unnoticed by those who share her goal. In 2008 she received an Executive Director Special Award from the International Dark-Sky Association (IDA), whose New York state chapter she has led since that year. In 2010, the Sierra Club Long Island Group recognized Susan's efforts by honoring her as "Environmentalist of the Year." The New York Senate also applauded Susan's achievements, stating in a legislative resolution:

> "...As President of the Dark Sky's New York Chapter, Susan Harder has been responsible for many important progressive, innovative, environmental contributions to the citizens of this great Empire State; and WHEREAS, In her official acts, Susan Harder has focused her efforts on educating Long Island municipalities and the Long Island Power Authority to implement policies and enact regulations to control light pollution; and WHEREAS, Through Susan Harder's extensive labors, many Long Island communities including Brookhaven, Riverhead, Southold, Southampton, and East Hampton, have now enacted dark sky lighting codes; and WHEREAS, This indomitable woman, eager in her efforts and driven in her initiative, has distinguished herself in her career and her community involvement; the citizens of this great Empire State have profited greatly from her dedication and service..." (K216-2011, Thiele)

Susan's undertaking of reducing light pollution had seemingly small beginnings during the 1990s. As a resident of New York City, she was familiar with excessive artificial lights through her own personal experience with light trespass into her apartment. Enduring light pollution as a city dweller was a source of frustration, but it was a burden that many seemed to tolerate as part of living in a large city. However, experiencing light intruding into her country home in East Hampton, New York, was intolerable. A neighbor's outdoor floodlights were disturbing her sleep at night. For two years she left messages for the neighbor to no avail.

A fortuitous turn of events led Susan to discover the IDA. During a discussion with a community member, Susan learned about the nonprofit group created to address light pollution's effect on dark skies. As a retired art dealer, she had been fully unaware of the growing concern of light pollution—as well as its effects on health and the environment—to organizations like the IDA. After becoming aware of the broader issue and impacts, she immersed herself in learning about light pollution. Her concern grew as she learned about how light affects humans and wildlife such as birds, bats, and algae, and about how sky glow obscures the night sky. She joined the IDA and formed the Dark Sky Society based in Long Island.

As a full-time dark sky advocate, Susan has succeeded in passing legislation to enact lighting regulations that reduce pollution. Although many municipalities continue to implement her recommendations, others are reluctant to make changes. Despite difficulties in encouraging people to change behaviors, Susan continues to educate officials, industry representatives, and citizens on the use of more efficient lighting. She enjoys helping others understand light pollution and the steps they can take to make a difference. All of these actions make Susan, and those who follow in her footsteps, a Dark Sky Hero.

Migration Headache

Grades:
4–12

Subjects:
Science, Social Studies, Physical Education, Math, Language Arts

Skills:
analysis, comparing similarities and differences, discussion, evaluation, generalization, hypothesizing, inference, kinesthetic concept development, prediction

Duration:
One 45-minute period

Group Size:
20–40 students or more

Setting:
Outdoors or large indoor area

Project WILD Conceptual Framework:
WP II A 2 b 2

WP II A 2 a 2 a

Key Vocabulary:
habitat, limiting factor, migration, population

KEY TEXT:
Chapter 2, pp. 12 & 17; Chapter 3, pp. 20–22; Chapter 4, pp. 24 & 29; Chapter 5, pp. 35–39

Objectives

Students will be able to list limiting factors affecting populations of migrating elk and predict the effects of such limiting factors.

Method

Students role-play migrating elk traveling between their summer and winter range, and simulate the effects of hazards at each end of the migration.

Background

In this activity, students experience some of the important factors that affect the survival of elk that migrate. Healthy populations of elk show little change in numbers over the course of several years. However, various factors can lower a population's number from one year or season to the next. For example, when extremely heavy snows come early in the mountains, elk may become trapped in a narrow valley where there is little winter food. Many elk might die and thus the population would be much lower in the spring.

This activity simplifies the events of migration. For the simulation, the hazards of migration occur at either the calving or the wintering areas. In reality, many of the hazards faced by migrating elk occur en route between the two ranges, or are encountered gradually rather than all at once. After the simulation, you may want to emphasize this point. Also be aware that elk populations can be quite large, so each student may represent many elk, not just one. Because of this, try not to emphasize occasional losses to predation and other events of a relatively small scale during the simulation as they are not likely to affect the size of a real elk population.

For more informatiom about elk migration, see Chapter 4, pp. 24 & 29.

Materials

Large playing field or gymnasium (at least 70´ x 40´)

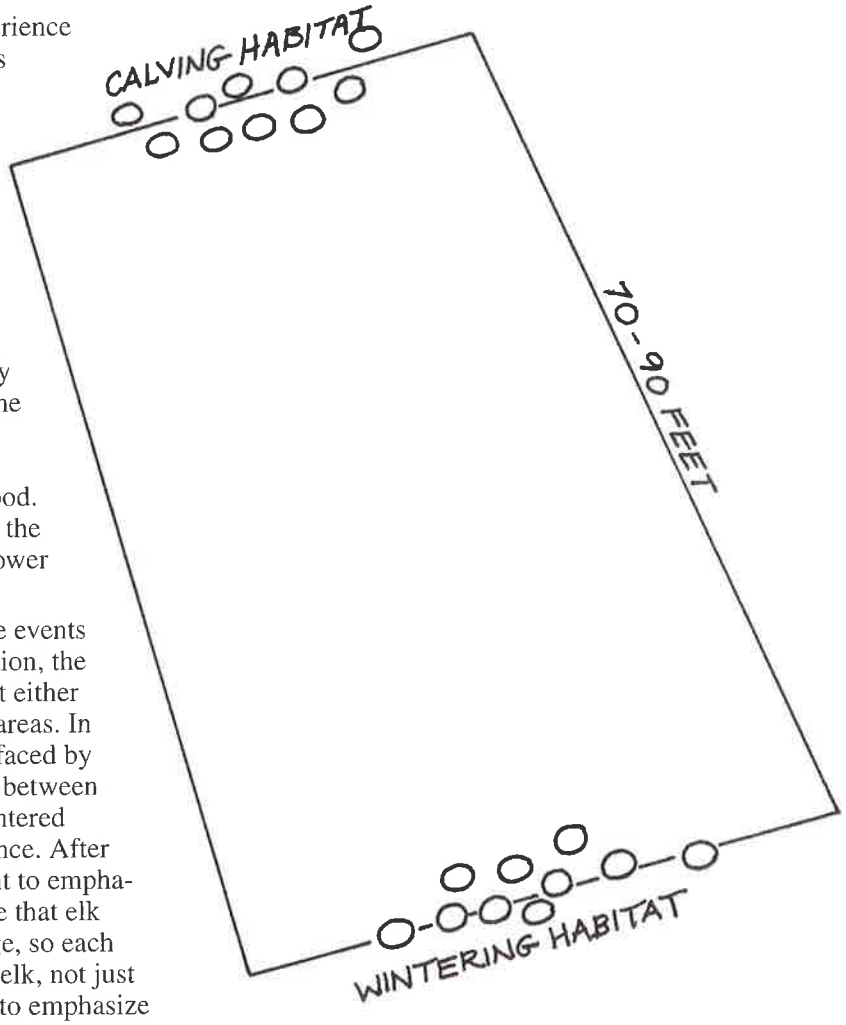
Two paper plates for every three students

Large sheet of butcher paper or graph paper

Marking pens

Procedure

1. Place half of the paper plates in a patch at one end of the playing field, and the other half of the plates in a patch at the other end.



2. Explain to the students that they are elk and will migrate between these two areas at your signal. Explain that as they migrate, students must *walk* because elk do not run when they migrate. Tell them that the paper plates represent suitable habitat for elk. Ask students what must be in an elk habitat. *(See Chapter 3 for more information.)*

3. Explain that at the end of each journey, the students will have to have one foot on a paper plate in order to continue. Tell them that for the purposes of this activity only three elk can occupy a habitat (paper plate) at any one time. If they cannot get their foot on a plate, that means they have not found any suitable habitat, and they "die." Elk that have died move to the sidelines—at least temporarily—and watch.

4. Begin the activity with all students at the wintering habitat. There should be three students for each paper plate. Announce the start of the first migration. Have students migrate to the calving habitat. Because there is enough habitat (paper plates), all the elk will migrate successfully to the calving habitat.

5. Explain that many factors can limit the survival of populations of migrating elk. Some of these factors involve changes in the wintering and calving habitats. For example, there may be times when there is abundant food, water, shelter, and space suitable for the elk. At other times any or all of these elements may be reduced, limiting the elk's potential for survival.

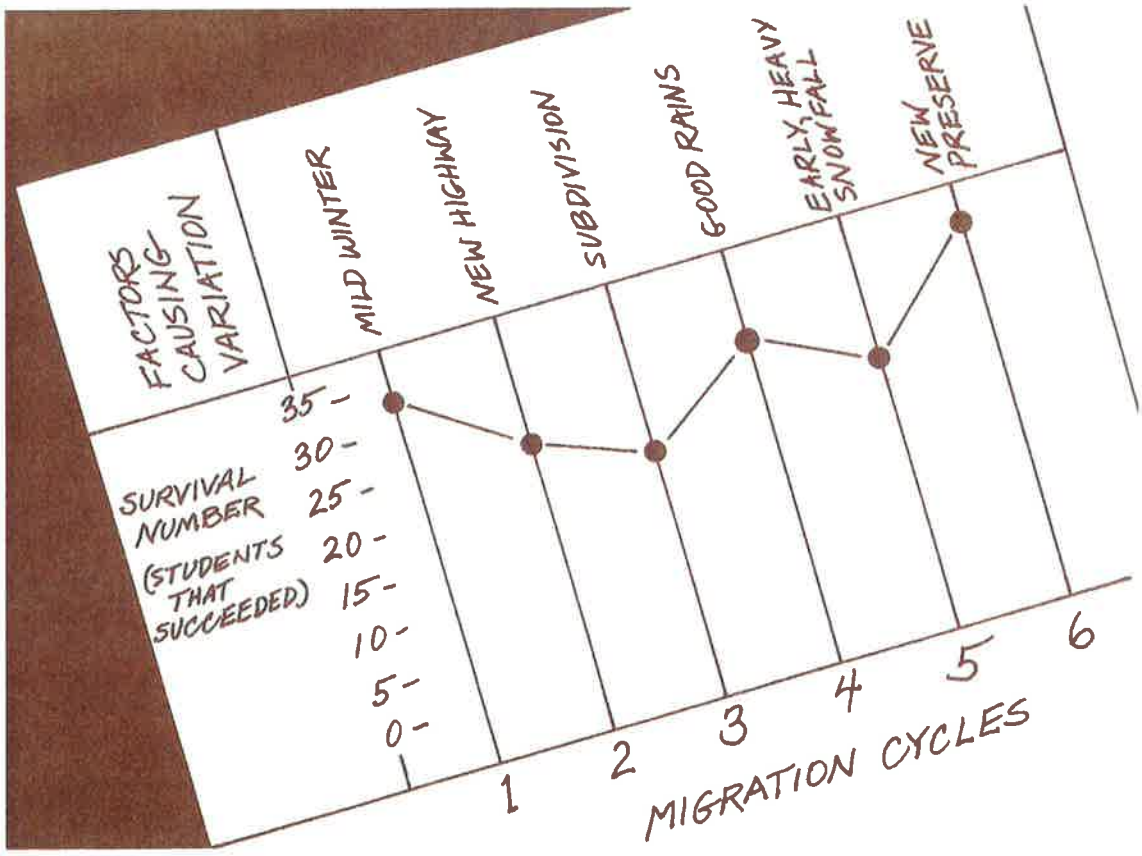
6. Before the elk migrate back to the wintering habitat, remove one plate from the wintering range. Explain that a road has been built through the wintering range resulting in a loss of habitat and an increase in accidents with cars.

7. Repeat the instruction to migrate, and send the elk to the wintering habitat. Three students will be displaced; have them stand on the sidelines. Tell the students that these three elk died as a result of habitat loss and accidents. Remind any "dead elk" that they can come back as surviving calves when habitat is available in the calving area.

8. You may want to graph the migration cycles using butcher or graph paper as shown below.

9. Remove three plates in the calving habitat. Explain that this catastrophic loss is due to a new subdivision that reduced the amount of habitat. Instruct the students to migrate.

This will result in many students waiting on the sidelines, so provide them with an opportunity for re-entry in one of the next cycles.



10. Repeat the process for eight or ten migration cycles to illustrate changes in habitat conditions that affect elk. See the list below for suggestions. *(See also pp. 35–39.)*

Be sure to create one or more "disaster" years to illustrate catastrophic loss of large areas of habitat. Overall, suitable habitat for elk is diminishing and so the activity should end with less habitat than the elk need.

Factors limiting survival of migrating elk populations

- urban expansion
- drought
- pollution and contamination of water
- poaching
- highways
- heavy snowfall (greater than 24″) causing lack of winter food
- wet, cold weather during calving
- human activity on roads during times of migration
- loss of migration corridors
- loss of thermal cover and hiding cover
- human activity on calving or wintering grounds

Factors favoring survival of migrating elk populations

- preservation of range lands
- preservation of migration corridors
- early spring plant growth due to mild temperatures and abundant rain
- restoration of habitat
- regulation of hunting
- dynamic balance with predators
- freedom from disturbance during wintering and calving times
- road closures on public lands
- restrictions on public lands during periods of elk use

11. Lead a discussion about what students learned, including:

- What are the apparent causes of the elk population decline?
- What seem to be the major factors contributing to habitat loss and degradation?
- What factors affect the success of elk migration?
- Which are human factors and which are environmental factors?
- What kinds of things can and should be done to protect and restore habitats for migrating elk?
- What are potential trade-offs of these recommendations?

Evaluation

Have students write about the following:

Name two human activities and two environmental factors that might interfere with elk migration. For each, describe possible effects on the elk. Distinguish between effects on individual elk and effects on populations of elk, and indicate if an effect is long- or short-term.

Extension

Repeat the activity using the Lincoln Index (described below) to estimate population size:

1. Identify 2–4 students to be "biologists," and provide them with masking tape, paper, a marking pen, a pencil, and a clipboard. These students will predict the elk population size, based on data they collect.

2. Explain the Lincoln Index, which can predict a population size based on the number of animals captured after a marking program has begun. To use the Lincoln Index, biologists mark a certain number of animals one year. In subsequent years they can calculate the total population by capturing the same sample size and finding out how many of the captured animals were marked. For example, if biologists were to capture 100 elk in year 1 and mark them with collars, the sample size is 100 elk. In year 2, biologists would capture the same sample size (100 elk). If 50 have collars and 50 are unmarked, the total population size would be estimated to be 200 elk.

$$\text{Total Population} = \frac{\text{known sample size}}{\%\text{ of the sample that is marked}}$$

If only 10 elk had collars and 90 elk were unmarked, the total population would be estimated as 100 ÷ 10%, or 1,000. Point out that this method of estimating population sizes does not take into account birth or death rates or any outside influences.

3. Have the biologists mark elk on three of the plates chosen at random, placing a piece of masking tape on the arm of each of these nine elk. The biologists should record this sample size.

4. The biologists should choose at random three plates in the calving area and wait for the elk to return there. They then count the marked and unmarked elk at these three plates, and estimate the size of the total elk population. For example, if three elk are marked and six are unmarked, the population estimate would be 9 ÷ 33%, or 27.

Discuss the accuracy of the estimate and of the Lincoln Index with the class. How close is the estimate to the actual population size (number of students)? What are some reasons why the estimate might be different? Why can't biologists just count the number of animals in a population? Why do biologists use the Lincoln Index even though it gives only a rough estimate?

5. Repeat this procedure using different marks on the tape to denote each year. More than one group of biologists can be marking elk, and different groups can be working in both the calving and wintering areas.

6. As various conditions are introduced in the activity, the population estimates may fluctuate as elk populations really do. The biologists may also observe elk that are "trap-wise" or "trap-friendly." A student may always want to be marked (as sometimes happens in elk studies) or certain elk may always escape being captured. It is critical that the biologists choose at random the plates they are going to use.

This activity was adapted from "Migration Headache," Project WILD Aquatic Education Activity Guide, *© 2000, 1992, 1987 Council for Environmental Education .*