

**LESSON****Ecology Disrupted: Changes to Habitats Can Unexpectedly Disrupt Populations**

The bighorn sheep study is put in the context of ecological terminology and processes.

**What We Are Hoping For: Learning Goals**

- Populations
- Habitats
- Inbreeding
- DNA is a scientific tool
- Human Impact
  - A, B, C
- Nature of Science
  - A-E
- Data Representation
  - A-D

**Learning Goals:**

- Habitat is the physical environment where an organism lives.
- Habitat fragmentation, when an ecosystem is broken into pieces can harm populations of some species (leading to inbreeding or by preventing them accessing all necessary parts of their habitat).
- A population is a group of individuals of one species living in the same loc interbreeds.
- Our daily life can change habitat and affect populations.
- Changing habitat (e.g. roads and highways) can disrupt populations threat their survival.
- Data can be collected to learn about populations (we can study population
- People can use what they have learned from studying populations and their habitat to develop solutions for human caused disruptions.

**CHECKLIST**

**Ecology Disrupted: Changes to Habitats Can Unexpectedly Disrupt Populations**

In this lesson, students will:

- Discuss habitat and populations in the context of daily life and bighorn sheep. **(5 min)**
- Watch the *Science Bulletins* and complete the graphic organizers for each. **(50 min)**
- Discuss findings from the *Science Bulletins*. **(10 min)**
- Complete and discuss the *Final Thoughts* section of the Investigation Booklet. **(25 min)**

(Times indicated are approximate.)

## **Populations Live in Habitats**

Discusses habitats and populations in the context of daily life and bighorn sheep.

- Introduce the ecological principles of habitats and populations
- Connect the principles to this case study about bighorn sheep

### **Habitat and Populations**

A habitat is an environmental area that is inhabited by a particular species of animal, plant or other type of organisms. To reinforce the concept of habitat it is important for the students to understand that there is often a relationship between the health of the habitat and a species population size. The healthier the habitat, the more the population will flourish.

**Note:** Sometimes degraded habitats are no longer hospitable to native populations, but invasive species may move in and flourish.

#### **Discussion**

##### **Key Idea: Populations live in specific habitats.**

**Question:** What is habitat?

**Answer:** The environment where a population/organism lives.

**Question:** What is the habitat for bighorn sheep?

**Answer:** Mountaintops in the Nevada and California desert.

**Question:** What is a population?

**Answer:** A population is a group of the same species that lives in the same area.

**Question:** How are bighorn sheep populations defined?

**Answer:** By their mountaintop habitat.

## Highways Block Bighorn Sheep Graphic Organizer

This exercise should familiarize the students with the graphic organizers.

Before the students begin watching other *Science Bulletins*, ask them to complete the graphic organizer for *Highways Block Bighorn Sheep* without watching the Bulletin. This exercise should familiarize the students with the graphic organizers, which have the following questions:

- How have people changed the habitat in this example?
- Why do people change the habitat? How does it help us?
- How do the habitat changes impact populations in this area?
- How do you know that the habitat is being changed and that local populations are affected? Describe the evidence or data.
- Suggest how to solve this problem.

### Solutions Background

Culverts (drain crossings under highways), underpasses, and overpasses specifically made for animals to cross roads unharmed are a strategy to decrease habitat fragmentation. More animals are killed each year in the United States by cars than by any other method. Wyoming has begun to use culverts to protect deer and elk. Florida has built wildlife crossings, which are a combination of culverts and fencing to protect endangered Florida Panther populations. Scientists are studying wildlife crossings to determine whether they are helping species survive.

## Roads Influence Animal Genes

Roads connect people, but they separate animals.

Recall the Ecology Disrupted curriculum learning goals:

- Human daily life can disrupt ecological function leading to environmental issues.
- Scientists can collect data to investigate human impact local ecology.

Students watch additional Science Bulletins videos to learn about how human daily life can affect ecological function, and to pull out the ecological principles. An introduction to the video and background information are provided below.

While watching the Bulletins they will complete a graphic organizer with the following questions:

1. How have people changed the habitat in this example?
2. Why do people change the habitat? How does it help us?
3. How do the habitat changes impact populations in this area?
4. How do you know that the habitat is being changed and that local populations are affected? Describe the evidence or data.
5. Suggest how to solve this problem.

### Introduction

"Does anyone know what a badger is? Badgers are small mammals related to skunks that live forest habitats. Like the bighorn sheep, badgers also suffered from roads fragmenting their habitat. However, scientists and communities in Europe wanted to help the badgers so they came up with a plan to help them safely cross road. We are going to watch a Science Bulletins video like we did for the bighorn sheep, but this bulletin shows a way that we can help animals whose habitats are threatened by roads. Get ready to fill out your graphic organizers."

### Background Information

**Badger Biology:** European badgers are found in forests throughout Europe and East Asia. Their primary food source is earthworms, but they are omnivores and also eat insects, roots, dead organisms, and fungi. They are nocturnal and mostly move around at night.

**Badger Families:** Badgers live in family groups called clans that consist of up to twelve individuals. Usually several adults and their cubs live together in a burrow called a "sett". Badgers have a pecking order and there is typically one male that is the head of the clan. Young male badgers growing up in the clan may try to challenge the dominant male, and if they lose, they will set off to join another clan (and may have to travel across roads to do so). Badgers often use the same paths to get from their sett to feeding areas, and if roads are built in the way, they are at risk of being hit by cars.

**Badgers and Roads:** As road networks expanded in the 1970s, about 35% of the badger population in the Netherlands was killed crossing roads. To resolve the problem, the government of the Netherlands built over 600 tunnels to allow badgers to pass safely under the roads. Genetic evidence suggests that the tunnels are working, and badgers are safely crossing roads and interbreeding with distant badger populations.

## **New Blood Gives New Life to Florida Panthers**

Endangered Florida panthers benefited from the introduction of Texan pumas in their ranks.

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While watching the Bulletins they will complete a graphic organizer with the following questions:

6. How have people changed the habitat in this example?
7. Why do people change the habitat? How does it help us?
8. How do the habitat changes impact populations in this area?
9. How do you know that the habitat is being changed and that local populations are affected? Describe the evidence or data.
10. Suggest how to solve this problem.

### **Introduction**

" Have you seen pictures of lions and tigers in Africa? Did you know that we have large wild cats in America too? The biggest cat in North America is the puma, sometimes called a mountain lion, cougar or panther. There are many populations of panthers, and they all have slightly different traits. One population that is in danger is the Florida panther, and like the bighorn sheep, it has lost its habitat and suffered from inbreeding. However, scientists were able to help the Florida panther come back from near extinction. We are going to watch another Science Bulletin like we did for the bighorn sheep. This one will be about the Florida panther and how scientists helped it to survive. Get ready to fill out your graphic organizer."

### **Background Information**

**Biology:** Florida panthers are large cats with sandy fur with no spots or stripes. They are about six feet from nose to tail, and males are bigger than females. When baby panthers are born, they are gray with brown or black spots and 5 stripes on their tail, but they grow to look like adults in about 6 months. Panthers are solitary and hunt alone. They are carnivores and feed on mammals like deer and raccoons, and they will occasionally take pigs from farms.

**Habitat Loss:** In the 1940s, panthers were found throughout the southern United States, from Arkansas to South Carolina and Florida in the south. However, rapid economic growth after World War II resulted in the development of panther habitat into farms and cities. They now are found only in cypress swamps in southern Florida. By the 1990s, there were just 20 panthers left in the wild. These panthers showed evidence of genetic defects – they had heart problems, physical deformities, and low fertility.

**Breeding Program with Texas Pumas:** Scientists chose to introduce genetic diversity into the panther population by introducing eight female Texas pumas, a related population of pumas. Texas pumas are very similar in coloration and behavior to Florida panthers. The breeding program was a success and the panther population has now tripled.

## Loggers Imperil Monarch Butterflies

Satellites show severe deforestation in a rare monarch butterfly overwintering site.

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Students watch additional Science Bulletins videos to learn about how human daily life can affect ecological function, and to pull out the ecological principles. An introduction to the video and background information are provided below.

While watching the Bulletins they will complete a graphic organizer with the following questions:

11. How have people changed the habitat in this example?
12. Why do people change the habitat? How does it help us?
13. How do the habitat changes impact populations in this area?
14. How do you know that the habitat is being changed and that local populations are affected? Describe the evidence or data.
15. Suggest how to solve this problem.

### Introduction

"Have you ever seen a monarch butterfly? They are beautiful and orange (if no one volunteers). They live in New York City and the surrounding area from the end of August into the beginning of September. Do you know that these butterflies migrate just like birds? We are going to watch another *Science Bulletin* like we did for the bighorn sheep when we began this unit. This one will be about the monarch migration. Get ready to fill out your graphic organizers."

### Background Information

**Biology:** Monarch butterflies have a distinct orange and black pattern, and they are the only butterfly species that migrates north and south like species of birds. They fly all the way from Canada to Mexico.

**Migration:** Starting in August, Monarch butterflies found east of the Rocky Mountains begin migrating to an area in central Mexico. The Monarchs that fly south are different biologically than other generations of Monarchs because they are able to live much longer. The life cycle of Monarchs is usually 6-8 weeks, but the migrating generation lives for 6-8 months. These Monarchs go into a non-reproductive state called diapause, which allows them to make the long journey south and to survive the long winter months in Mexico. After the winter months, multiple generations successively make the journey north to the United States and Canada.

**Importance of Overwintering Sites:** The sites in central Mexico, 12 high-elevation Oyamel Fir forests, are extremely important because they keep the butterflies at an optimal temperature, a few degrees above freezing. This protects the butterfly. Too cold and butterflies die. Too warm and they use up their fat stores and will die without being able to reproduce and migrate north in the spring.

**Impact of Loggers:** Loggers in central Mexico have been illegally logging in some of these sites destroying the winter habitat of the eastern monarch butterflies. Without these trees the monarch butterflies will not be protected during winter, and there will likely be a large decrease in monarch butterfly populations because they are unable to reproduce.

## Oil Spill's Other Victims

Beyond oil-coated pelicans, the spill imperils many lesser-known species.

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While watching the Bulletins they will complete a graphic organizer with the following questions:

16. How have people changed the habitat in this example?
17. Why do people change the habitat? How does it help us?
18. How do the habitat changes impact populations in this area?
19. How do you know that the habitat is being changed and that local populations are affected? Describe the evidence or data.
20. Suggest how to solve this problem.

### Introduction

"Did you hear about the enormous BP Oil Spill in the Gulf of Mexico? It started when people drilled in an area in the ocean so deep that if you tried to swim down there, you would be crushed from all the pressure on top of you. Methane leaked from the drill site and exploded causing oil to gush day and night from the ocean floor for three full months. It is estimated that 185 million gallons of oil emptied into the Gulf in that time, enough to fill the fuel tanks of over 11 million cars. As the thick oil spread from off the Louisiana coast, people began to worry about how this might impact the Gulf ecosystem. This *Bulletin* discusses how. Get ready to fill out your graphic organizers."

### Background Information

What scientists know about how oil spills can affect the environment – and for how long – is drawn from a range of past oil spills, no two of which have been alike.

**Impact on Plant and Animal Species:** Oil causes harm to wildlife through physical contact, ingestion, inhalation and absorption. Floating oil can contaminate plankton, which includes algae, fish eggs, and the larvae of various invertebrates. Fish that feed on these organisms can subsequently become contaminated. Larger animals in the food chain, including bigger fish, birds, terrestrial mammals, and even humans may then consume contaminated organisms.

**Impact on the future of humans:** The health of countless people can be at risk as oil spreads. Oil can turn into a heavy vapor that can then be inhaled by humans in the surrounding areas. The volatile chemicals in oil can cause minor immediate health problems, but have been linked to cancer over longer periods of time. In addition, these chemicals have been associated with miscarriage and can damage airways, so pregnant women and people with respiratory diseases are especially at risk. Oil also

damages skin, and toxic chemicals can also be absorbed from contact, meaning that the local fisherman hired by BP to aid in clean-up efforts are at risk from inhalation.

**Cleanup & Recovery:** Cleanup and recovery from an oil spill is difficult and depends upon many factors, including the type of oil spilled, the temperature of the water, and the types of shorelines and beaches involved. Methods for cleaning up include: using microorganisms to break down or remove the oil, vacuuming and centrifuging, and watching and waiting.

## Plastic Trash Threatens Seabirds

Even isolated colonies of Pacific albatrosses can eat a stomach-full of plastic trash.

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Students watch additional Science Bulletins videos to learn about how human daily life can affect ecological function, and to pull out the ecological principles. An introduction to the video and background information are provided below.

While watching the Bulletins they will complete a graphic organizer with the following questions:

21. How have people changed the habitat in this example?
22. Why do people change the habitat? How does it help us?
23. How do the habitat changes impact populations in this area?
24. How do you know that the habitat is being changed and that local populations are affected? Describe the evidence or data.
25. Suggest how to solve this problem.

### Introduction

"Have you ever littered? Where does your litter go? Mostly to New York City beaches, but sometimes your litter ends up in the middle of the ocean. If you live out in California, your trash might end up affecting seabirds trying to raise their babies way out at sea. We are going to watch another *Science Bulletin*. This one will be about plastic trash that threatens seabirds. Get ready to fill out your graphic organizers."

### Background Information

**Biology:** Laysan Albatross are a species of albatross that live in the North Pacific Ocean. These seabirds nest in huge colonies of 400,000 breeding pairs and are able to travel great distances to forage for food. Their young stay at their nesting sites and their parents feed in the Pacific Ocean, fly back, and regurgitate food for their young.

**Eating Habits:** Laysan albatross and other seabirds eat a variety of squid, fish, jellyfish, and mollusks.

**Pacific Gyre/Western Garbage Patch:** The Pacific Gyre or Western Garbage Patch is a large area in the Pacific Ocean that contains immense amounts of human trash. Wind and ocean currents sweep debris from Asia and the western coast of the United States, like California, into one huge area in the Pacific Ocean. Most of the floating trash is non-biodegradable plastic trash.

**Affect on Seabirds:** Adult seabirds mistake the plastic for food. They regurgitate the plastic to their young, often killing them. This habit has led to a decrease in the size of seabird populations in the North Pacific.

**Atlantic Ocean Garbage Patch:** The Atlantic Ocean has a smaller garbage patch in the Sargasso Sea, which has plastic trash from the East Coast of the United States including New York City.

## Species and Sprawl: A Road Runs Through It

As the suburbs flourish, animals struggle to survive.

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While watching the Bulletins they will complete a graphic organizer with the following questions:

26. How have people changed the habitat in this example?
27. Why do people change the habitat? How does it help us?
28. How do the habitat changes impact populations in this area?
29. How do you know that the habitat is being changed and that local populations are affected? Describe the evidence or data.
30. Suggest how to solve this problem.

### Introduction

"Have you ever seen turtles in New York City parks? You can find them resting on logs in Central Park and Prospect Park. If you had to describe a turtle what words would you use? Have you ever heard the story of the Tortoise and the Hare? Yes, turtles are slow and this can be a problem when they are trying to cross a road. We are going to watch a *Science Bulletin* video about the plight of turtles and roads. Get ready to fill out your graphic organizers."

### Background Information

**Biology:** Wood turtles are a North American species of turtle that prefer wooded areas even though they are semi-aquatic. They grow to be 9 inches long.

**History:** Wood turtles were extremely common in the 19<sup>th</sup> century in the lower Connecticut Valley. Exact numbers are not known, but there are many anecdotes that describe people being able to collect over a hundred turtles within a few square miles. These turtles were able to move freely within their habitat.

**Impact of Suburban Sprawl:** Suburban sprawl is the term used to describe how people are spreading out across the landscape by building new single-family homes, new roads, and malls. The roads, homes, and malls associated with sprawl often disrupt ecosystems and fragment wood turtle populations. Cars and other motor vehicles have decimated the wood turtle, leading to a drastic decline in the number of wood turtles.

**Research:** Scientists have begun to track the healthiest wood turtles to gauge their habits, so as to devise ways to protect the remaining wood turtles from the impact of suburban sprawl. The roads cut the wood turtle habitat in two, forcing turtles to cross roads to reach breeding pools or meadows that they need to live. Scientists are tracking habitats that are still intact in order to protect them.

**NYC Connection:** New York City has such a high population density that it is in many ways the opposite of suburban sprawl. Everything in the City is close together, and many people use public transportation or walk instead of using cars like in Massachusetts. People living in densely packed cities like NYC help protect even more land from being developed.

## Bringing the Stories Together

How mundane or ordinary aspects of daily life can lead to environmental issues by disrupting ecological function.

Convene a final discussion of the *Science Bulletins* bringing the stories together through a discussion of:

How mundane or ordinary aspects of daily life can lead to environmental issues by disrupting ecological function (in this case harming populations by disrupting habitats).

### Discussion

**Key Idea: The daily lives of people disrupt habitats in many unforeseen ways, but there are solutions.**

**Question:** After watching the *Bulletins* on environmental issues that result from people changing habitat, give examples of some of the unexpected ways that people disrupt habitats and their consequences?

**Answer:** People disrupt habitats by:

- Building highways and roads to connect human population centers.
- Building cities and towns
- Cutting down trees for homes and wood products.
- Driving cars, flying, etc.
- Throwing away plastic garbage and littering.
- Constructing malls, roads, and single-family homes spread out across the landscape (suburban sprawl).

**Question:** What are some possible ways to reduce habitat disruption?

**Answer:**

- Building animal crossings.
- Breeding populations from different areas (doesn't affect habitat as much as some of its effects)
- Replanting trees and protecting important forests.
- Recycling and reducing the use of plastic in ways like turning down plastic shopping bags.
- Reduce our carbon footprint by driving less.
- Smart city planning that limits suburban sprawl and LIVING IN DENSE AREAS LIKE NEW YORK CITY (this also helps with our carbon footprint because it increases use of public transportation. Also smaller multi-dwelling housing use lets energy to heat and cool).