

The
**NATURE OF
TEACHING**



UNIT 6

The Great Clearcut Controversy

In this inquiry-based unit, students use real scientific data to investigate how a bird community and individual forest animals respond to a clearcut timber harvest. In this investigation, students:

- *Use scientific inquiry to gain knowledge and answer questions*
- *Apply that knowledge to the engineering design process*
- *Design a viable management solution given the constraints and tradeoffs they discover*

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AUTHORS

Skye M. Greenler and Mike R. Saunders, *Department of Forestry and Natural Resources, Purdue University*

TARGET AUDIENCE

Middle school (grade 6–8) science or environmental science classroom

ESTIMATED TIME

Three 45–90 minute lessons

VOCABULARY

- Canopy cover
- Clearcut
- Early successional
- Ground cover
- Understory
- Habitat conditions
- Habitat structure
- Hardwood forest
- Sustain

UNIT OBJECTIVES

Students will be able to:

- Analyze how a clearcut affects both the total number of bird species living in a forest and the abundance of other individual animals
- Explain how and why an animal's life history traits influence its habitat preference
- Describe how to use outside information to interpret scientific data
- Design an appropriate forest-management plan based on investigation of scientific data
- Critique a promotional video; explain how promotional videos can be misleading; and describe how to check for misinformation
- Explain why it is important to manage forests for multiple species

TARGETED LEVEL INDIANA STANDARDS

6–8 Science and Engineering Process Standards

- 6–8.SEPS.1
- 6–8.SEPS.4
- 6–8.SEPS.6
- 6–8.SEPS.7
- 6–8.SEPS.8

6–8 Literacy in Science/Technical Subjects Standard

- 6–8.LST.1.1
- 6–8.LST.1.2
- 6–8.LST.2.1
- 6–8.LST.4.1
- 6–8.LST.4.3
- 6–8.LST.7.1

6–8 Science Content Standards

- 6.LS.1
- 6.LS.3
- 6.LS.4
- 7.ESS.7
- 8.ESS.3
- 6–8.E.1
- 6–8.E.2

REQUIRED MATERIALS

- Computer with internet connection, projector, and speakers
- Notecards
- Pencils
- Colored pencils or markers
- Scissors
- Tape
- Provided materials
 - How do bird communities change after clearcuts? (pages 9-12)
 - PowerPoint with bird community graphs (PowerPoint, *Supplementary Material B*)
 - Do I use clearcuts? Why? Species investigation (page 17)
 - Forest species information packets (*Supplementary Material F*)
 - Indigo bunting
 - Ovenbird
 - Eastern chipmunk
 - Northern short-tailed shrew
 - Northern slimy salamander
 - Timber rattlesnake
 - Indiana bat
 - Eastern red bat
 - Clearcut poster (*Supplementary Material E*)
 - Species cutouts (*Supplementary Material D*)
 - Letter to Indiana State Forester Assignment/Rubric (*Supplementary Material G*)

REFERENCE MATERIALS

- Indiana Forest Alliance video: <https://www.youtube.com/watch?v=HEwpLAXFUyw>
- Additional information about the Hardwood Ecosystem Experiment: <https://heeforeststudy.org>

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DEFINITIONS

Canopy cover: the amount of sky obscured by the leaves and branches of the top layer of trees in the forest, measured as a percent (For example, if you were in a forest with 60% canopy cover and looked up, you would only be able to see 40% of the sky, because the other 60% would be covered by leaves and branches.)

Clearcut: an area in the forest where most trees have been cut down

Early successional: animal or plant species that live in areas that have just had a large disturbance that removed much of the canopy, such as an extreme weather event like a windstorm or a clearcut timber harvest

Ground cover: the amount of the ground in a forest covered by plants, measured as a percent (For example, if you were standing in a forest with 60% ground cover and looked down you would only be able to see 40% of the ground because the other 60% would be covered in plants.)



Habitat conditions: characteristics of the natural environment such as sunlight, temperature, moisture, and wind

Habitat structure: physical characteristics of the natural environment, such as how many trees there are, how tall they are, and what species they are

Hardwood forest: a forest comprised mostly of trees that have broad leaves, such as oak, cherry, and hickory (Most forests in Indiana are hardwood forests.)

Sustain: Provide what is needed for an animal or plant to survive

Understory: the shrubs, young trees, and plants near the forest floor

*Vocabulary lists integrated into each species investigation packet (Lesson 2) help students understand the primary documents. A complete list of all vocabulary words can be found in *Supplementary Material A*.

BACKGROUND INFORMATION—TIMBER HARVESTING AND FOREST MANAGEMENT

Forest management is a contentious issue—on the surface it appears all timber harvesting is directly in conflict with forest conservation, but frequently that is not the case. When done intentionally and carefully, timber harvesting can produce conditions similar to those resulting from natural disturbances. It can help conserve biodiversity, promote important ecosystem process, and maintain ecosystem resilience. In fact, many forest animals primarily use the young, regenerating forest habitat that results from timber harvesting or from severe weather events such as windstorms. These openings also promote regeneration of shade-intolerant trees, such as oak and hickory, which do not grow well in the shade of a forest, but grow quickly after a disturbance removes the canopy and increases sunlight levels.

Foresters seek to mimic the conditions produced by natural disturbances through harvesting of timber and, thereby, to promote a healthy, sustainable ecosystem. Forest management not only provides the wood and paper that people need for daily life, but also an income that land managers can use to improve their forests through activities such as reducing invasive species, managing threatened/endangered species, building recreational facilities (i.e., trails, picnic shelters), creating education programs, and conducting or monitoring research projects.

The goal of most forest management is to create diverse structural conditions across a forest so that there is habitat for all types of species, from those that use early successional habitat to those that like mature forest habitat. A very dense understory of shrubs, small tree seedlings, and other plants usually grows after a large natural disturbance or small clearcut. For many animals, this dense understory is a safe habitat to hide from predators. The habitat also has a lot of food that is accessible to herbivores, because the regrowth is very thick and low enough to reach. Some forest species live exclusively in these early successional openings; others use both the openings and the surrounding older, mature forest.

The ground in many mature forests has fewer understory plants and is covered by a deep layer of leaves. Some animals are specially adapted to use this leaf litter layer for both feeding and habitat. Mature forests are also frequently darker and cooler, which is critical for other groups of animals. The food resources available in mature forests are often different from what is available in clearcuts. Therefore, habitat characteristics in different-aged forests vary greatly. Ecologists and foresters believe that forests with higher levels of habitat diversity (all types of forest ages and structures) will sustain higher levels of animal diversity.

LESSON DESCRIPTIONS

Lesson 1

How do bird communities change after clearcuts?

Students begin discussing the importance of forests, talk about the necessity of forest products (wood, paper, etc.), and watch a short anti-logging video. After discussing the video, they learn about the Hardwood Ecosystem Experiment, where researchers are studying how different animals use clearcuts. Students work through an activity using the researchers' data on the bird community in clearcuts and the mature forest. They begin the activity by making quantitative and qualitative predictions about how they think the bird community will change after a clearcut is implemented. As more of the researchers' data is revealed, students revise their predictions and formulate questions they need to answer to better understand the researchers' results.



Lesson 2

Do I use clearcuts? Why?

Working in groups, students investigate a single forest animal using a packet of provided information including graphs, pictures, and excerpts from scientific papers. Students then investigate how their animal responds to clearcuts and why it responds that way. Finally, groups present their findings to the class and add a cutout picture of their animal to the correct habitat on a poster of a forest with a clearcut.



Lesson 3

Big management decisions in the boardroom!

Using information gathered in Lessons 1 and 2, students participate in a mock boardroom activity and work with a "forest owner" to decide on the best management plan for a forest in southern Indiana using the engineering design process. There is an optional summative assessment for performance-based outcomes that can be introduced after this lesson.



HOW DO BIRD COMMUNITIES CHANGE AFTER CLEARCUTS?

QUESTIONS

In this lesson, students investigate how the community of birds in a forest changes after a clearcut.

Estimated Time

1 Hour

Procedure

1. Review Teacher Information Packet section on timber harvesting and forest management.
2. Hand out notecards and have students write about a time they visited a forest (front of notecard) and 2 reasons why forests are important (back of notecard). Have students share their experiences and knowledge of why forests are important.
3. Ask students what they think about logging in forests and the purpose of timber harvesting. Ask if trees are a renewable resource. Discuss how trees are a renewable resource, but since they grow slowly, we need to make sure we use the resource carefully.
4. Tell students that they are going to watch a short video about logging in southern Indiana to see what some people think about it.
5. Watch the Indiana Forest Alliance video (<https://www.youtube.com/watch?v=HEwpLAXFUyw>). Afterwards ask students:
 - How did the video make you feel? Why?
 - Do you think this video provides enough information for a viewer to make an informed decision on the issue?
 - Do you think that everything in the video was true? Why?
 - Do you have any questions about the video?
6. Read or describe the Hardwood Ecosystem Experiment background information (Page 8) and explain that this experiment investigates exactly what the video they just watched was talking about.
 - Maps of the Hardwood Ecosystem Experiment are in *Supplementary Material B*.
 - Photograph of a clearcut is in *Supplementary Material B*, Slide 3.
 - For more information about the Hardwood Ecosystem Experiment see *Supplementary Material C*, a Purdue Extension Publication overview of the experiment.
7. Ask students if they think that scientists agree with the people in the video. Why will they or won't they? Explain that the students are going to graph their own predictions of what they think will happen after a clearcut harvest. Throughout the activity, students will be able to revise their predictions just as real scientists do! (It is critically important that students feel okay in making a wrong prediction in this

Required Materials

- Notecards
- Computer with projector, internet, and speakers
- Colored pencils or markers
- Provided materials:
 - How do bird communities change after clearcuts? (pages 9-12, worksheets)
 - Bird community data (*Supplementary Material B*, PowerPoint and PDF)

activity. They are making educated predictions just like real scientists. If students are wrong, it will likely make them more interested in figuring out why their predictions were incorrect.)

8. *Optional:* Discuss what students know about graphing from math class and how it can be used in science.
9. Project the data from years 1–3 (2006–2008), before the clearcut treatment was implemented (*Supplementary Material B*, Slide 2).
10. *Optional Graphing Extension:* Delete pre-graphed points from the graphs in the student worksheet. Guide students through the activity as specified in steps 12 through 14, but use the table in *Supplementary Material B*, Slides 10 to 17 to have students make their own graph of the actual data rather than used the pre-graphed data.
11. Handout the *How do bird communities change after clearcuts?* worksheet to each student (pages 9-12).
12. Guide students through directions 1–4 on their first page of their handout. Begin by graphing predictions individually for each site (clearcut, control, total number of birds in the whole forest), then instruct students to write their prediction for how the bird community at each site will change using the words “increase,” “decrease,” or “stay the same.”
13. Show students the first year of data (2009) after the clearcut and allow students to use one of the additional graphs to revise their predictions, if they want (*Supplementary Material B*).
14. Reveal the rest of the data year by year and allow students to revise their predictions after every year or two of data, if they want (*Supplementary Material B*, Slides 6–9).
15. Instruct students to answer synthesis questions 1–3.
16. Ask the class the following questions:
 - Did the data match their original predictions?
 - How were your predictions similar/different from the scientists' results?
 - Do these results support what the video that we watched said?
 - Why do you think the researchers got these results?

HOW DO BIRD COMMUNITIES CHANGE AFTER CLEARCUTS?

17. Explain that scientists frequently get intriguing results, but don't fully understand why; this drives the scientists to do more focused research and experiments to explain those results. Ask students: What questions do you need to answer to better understand why the scientists got these results?
18. Finally, explain that in the next lesson we are going to investigate how some individual forest animals respond to

clearcuts. We will try to figure out why the animals responded that way.

19. *Optional:* Ask students if they have any ideas why the number of bird species declined so much in 2012? (*Answer: There was a serious drought that summer.*) Ask: What do scientists do so that things like the drought did not confuse their data? (*Answer: Include control sites.*)

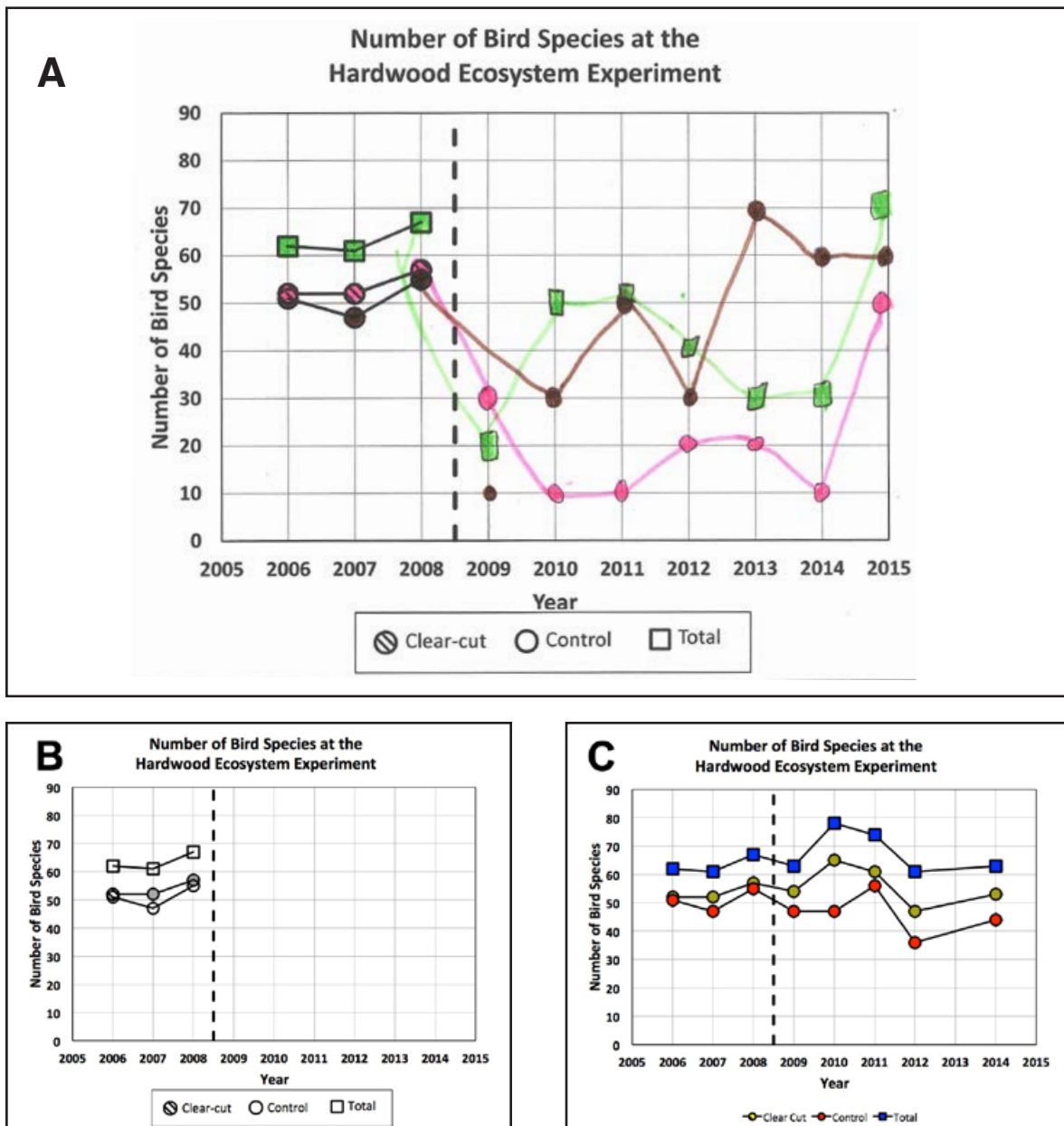


Figure 1: Graphs from the activity *How do bird communities change after clearcuts?* (A) Example of a student's original graphical predictions. (B) Original blank graph from student worksheet. (C) Actual data from the hardwood Ecosystem Experiment that is revealed throughout the activity.

HOW DO BIRD COMMUNITIES CHANGE AFTER CLEARCUTS?

QUESTIONS

Initial Predictions:

I think the control sites will increase because they birds are not bothered.

I think the clearcut sites will decrease because they birds cant nest or eat.

I think the whole forest will stay the same because the clear cut won't have any birds and the rest of the forest is stable.

Figure 2: Example of a student's original written predictions for how the control sites, clearcut sites, and whole forest will change after a clearcut and why.



PHOTO: HUI-HUI WANG

Figure 2: Students work on the activity *How do bird communities change after clearcuts?*

HOW DO BIRD COMMUNITIES CHANGE AFTER CLEARCUTS?

The Great Clearcut Controversy LESSON PLAN 1

HARDWOOD ECOSYSTEM EXPERIMENT

In 2006 ecologists and forest scientists in Indiana started a long-term experiment called the Hardwood Ecosystem Experiment to study different ways to manage forests. Just as your lawn looks better when you manage it by mowing, picking weeds, and planting flowers, the researchers thought that forests might be better for wildlife if they were managed carefully. Specifically, the researchers wanted to know how animals and plants responded if they removed, or clearcut, all of the trees in a small area within the forest.

To answer this question, researchers installed a really big experiment in a forest in southern Indiana. In the summer of 2005, they marked out 6 big circles, approximately 230 m in diameter (50 cars across!) in the forest. They monitored the number of birds, small mammals, beetles, snakes, and bats inside these circles for 3 years before clearcutting, so that they knew what animals were living in those areas.

After 3 years, the researchers randomly picked 3 of the circles and had loggers cut down all of the trees within the circle to make a clearcut. They left the other 3 circles unharvested, exactly the way they were, so that they could compare the newly created clearcuts to intact, mature forests. They have been monitoring the birds, mammals, beetles, snakes, and bats in the clearcuts (striped circles) and control sites with no logging (white circles) ever since, in order to figure out if different species were living in these areas now or if the number of individuals using the areas have changed.

The graph on your worksheet has the data for the number of bird species the scientists found in the clearcut circles, the control circles, and the total number of species found in the whole forest (including clearcut sites, control sites, and the areas in between) after they marked out the 6 areas, but before they clearcut any sites. Now it's your turn to think like a scientist and predict what will happen after they clearcut some of the sites!

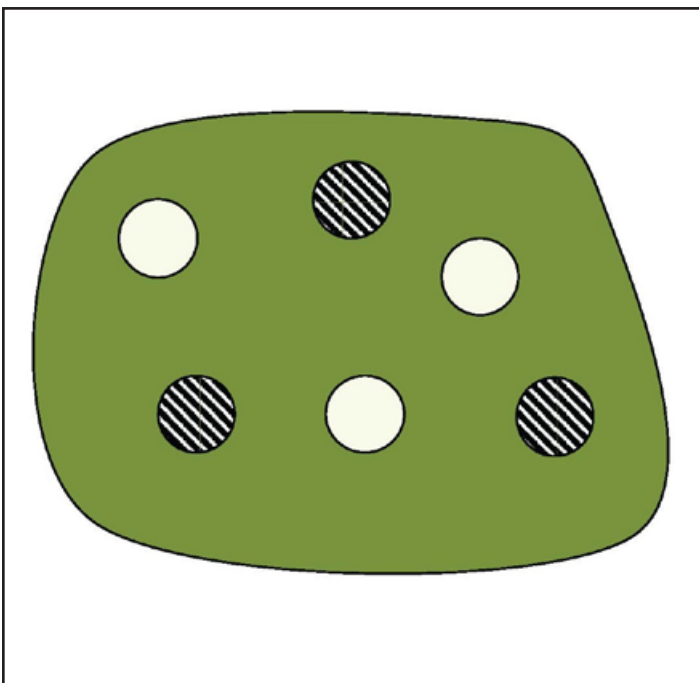


Figure 4: Conceptual map of the clearcut sites (striped circles) and the control sites (white circles) within a forest at the Hardwood Ecosystem Experiment.



Figure 5: Map with the approximate location of the Hardwood Ecosystem Experiment in Indiana.

HOW DO BIRD COMMUNITIES CHANGE AFTER CLEARCUTS?

Name _____

Date _____

Background and Directions

Overview

Using the information from your teacher about the Hardwood Ecosystem Experiment and the data researchers collected before they clearcut three sites in the forest, estimate how the number of bird species will change after the clearcut harvests.

Directions

1. Predict the number of bird species that will be in the *clearcut sites* each year from 2009 to 2014. Use a colored pencil or marker to mark your predictions on the graph. Don't forget to connect your points with a line so you can see the trend! Write down your prediction for how the clearcut sites will change and why you think they will change that way.
2. Predict the number of bird species that will be in the *control sites* for each year from 2009 to 2014. Use a colored pencil or marker to mark your predictions on the graph and connect them with a line. Write down your prediction for how the control sites will change and why you think they will change that way.
3. Predict the number of bird species that will be in the *whole forest* for each year from 2009 to 2014. Use a colored pencil or marker to mark your predictions on the graph and connect them with a line. Write down your prediction of how the whole forest will change and why it will change that way.
4. Fill the colors you used on the legend beneath the graph.

Vocabulary

Clearcut: An area in the forest where most trees have been cut down.

Experimental Control: Sites that scientists measure, but do not change at all. Scientists use these as a comparison for the sites they changed. In this case, they compared the intact forest in the control sites to the clearcut sites.

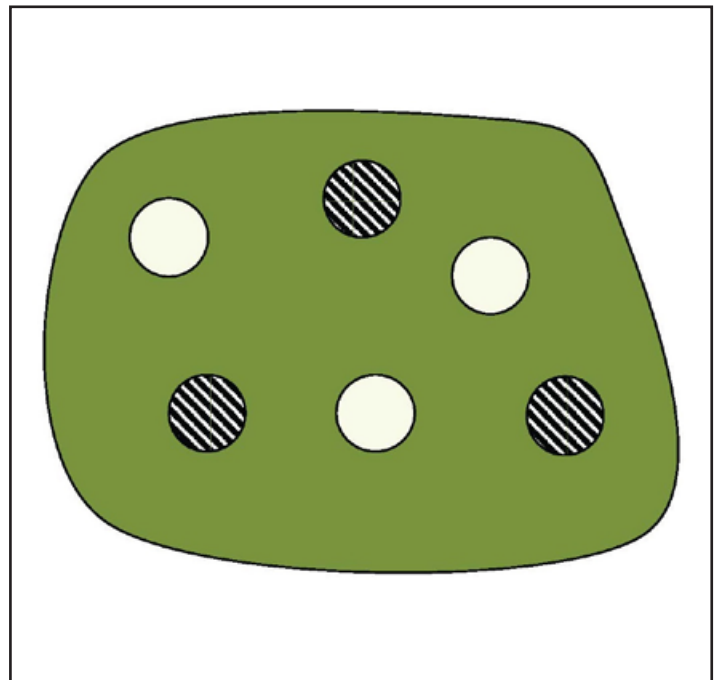
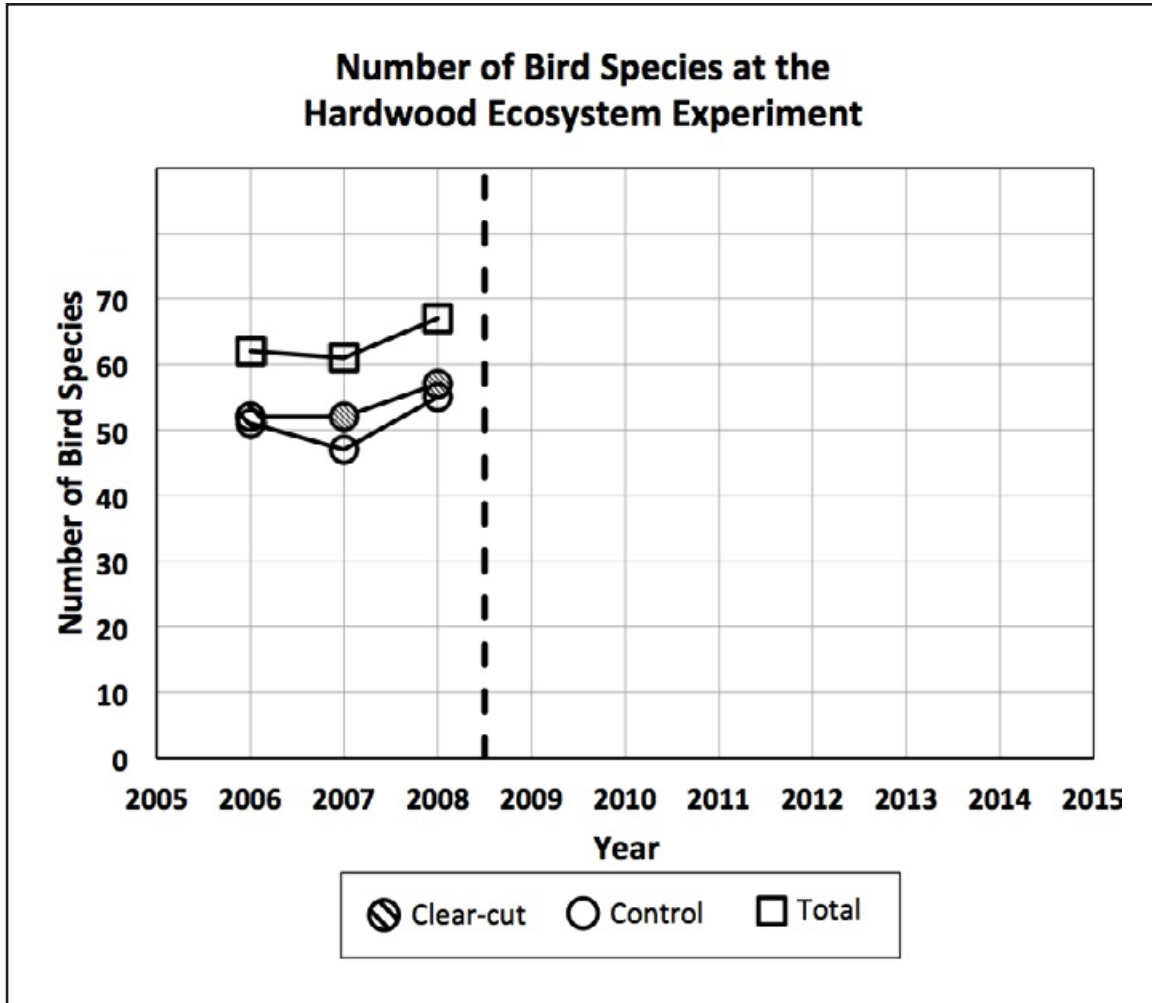


Diagram of the clearcut sites (striped circles) and the experimental control sites (white circles) within the forest at the Hardwood Ecosystem Experiment

HOW DO BIRD COMMUNITIES CHANGE AFTER CLEARCUTS?

Name _____

Date _____



HOW DO BIRD COMMUNITIES CHANGE AFTER CLEARCUTS?

Name _____

Date _____

Initial Predictions

I think the clearcut sites will _____ because _____

I think control sites will _____ because _____

I think the whole forest will _____ because _____

Synthesis Questions *(Please don't answer until instructed)*

1. Did your prediction change after your teacher showed you the number of bird species the researchers found the first year after the clearcut? If so, how?

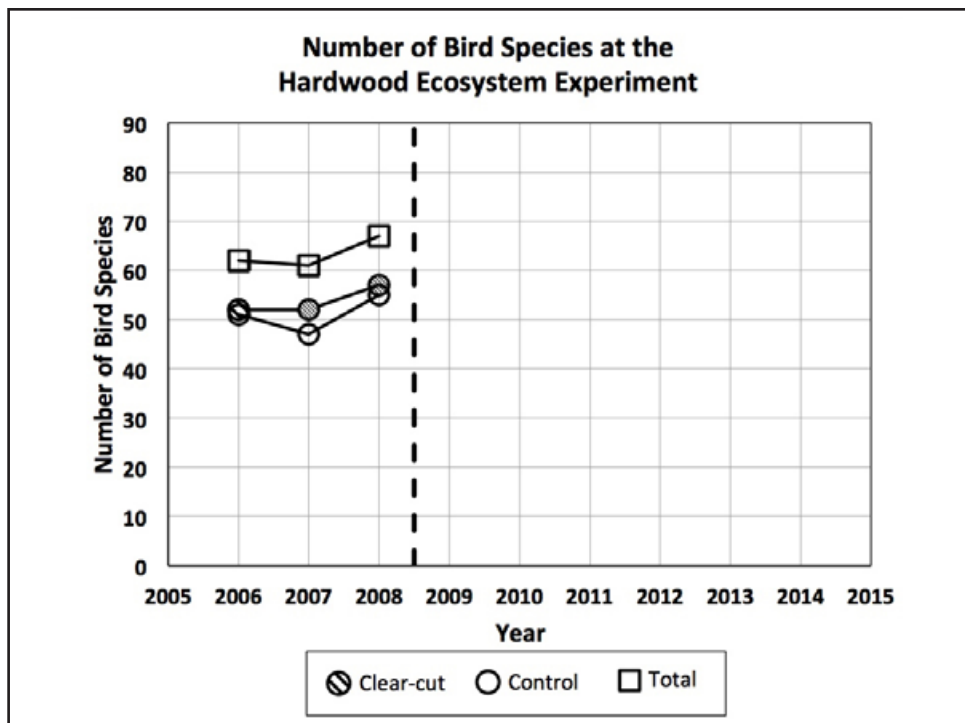
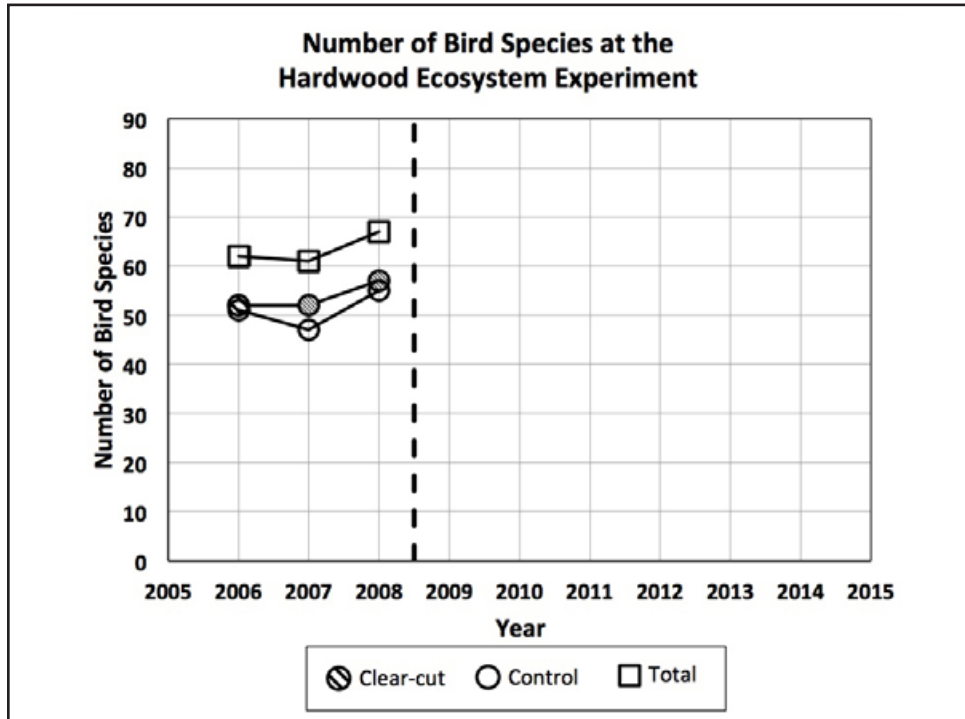
2. Did your prediction change after your teacher showed you the number of bird species the researchers found two and three years after the clearcut? If so, how? Why do you think this happened?

3. In the end, were your predictions correct? If your predictions were different from what the scientists' at the Hardwood Ecosystem experiment found, what do you think might have caused the different results?

HOW DO BIRD COMMUNITIES CHANGE AFTER CLEARCUTS?

Name _____

Date _____



In this lesson, students research how different forest animals respond to clearcuts and investigate why they respond that way.

Estimated Time

1 Hour

Procedure

1. Review Teacher Information on timber harvesting and forest management, if needed. Cut out animal cutouts (or have students cut them out before making the poster in step 9) and put the clearcut poster on the classroom wall, if using a printed poster (*Supplementary Materials D and E*)
2. Review Lesson 1 with students. Ask: What did we discover in Lesson 1? What questions did we still have at the end of Lesson 1? Review what the Hardwood Ecosystem Experiment is, what they tested, and what results they found. You can also review why forests are important and why we harvest trees. (*Answer: for lumber, paper, wood products*)
3. Explain to students that they are going to work in small teams to investigate how specific forest animals respond to clearcuts and why they respond in that way. Hopefully, this will help explain the scientists' results from Lesson 1!
4. Optional introduction: Choose one of the species information packets in *Supplementary Material F* and go through each document in the packet as a class. Work together to use the information to figure out how the animal responds to clearcuts and why it responds that way. Explain to students that each group will receive similar packets of information, which they will use describe how and why real forest animals respond to clearcuts.
5. Split students into groups of 2–4 and let each group pick the animal they want to research. Animals to choose from include: Indigo bunting, Ovenbird, northern short-tailed shrew, eastern chipmunk, northern slimy salamander, timber rattle snake, Indiana bat, and eastern red bat. (*Note: If only using a subset of the animal options, make sure to pick species that respond both positively and negatively.*)
6. Handout the worksheet *Do I use clearcuts? Why?* (page 17) and species packet to every student in each group (*Supplementary Materials F*).

Required Materials

- Do I use clearcuts? Why? (page 17)
 - Species Information Packets (*Supplementary Material F*)
 - Computer with projector
 - Clearcut poster (*Supplementary Material E*, printed is best—see 9 below)
 - Species cutouts (*Supplementary Material D*)
 - Scissors
 - Tape
7. Give students 20 minutes to learn as much as they can about their species using the species information packets. Have them fill out the worksheet *Do I use clearcuts? Why?* If needed, project a timer on the board to help students budget their time.
 8. Have each group present their findings to the class. Make sure to include:
 - The name of their species
 - If their species likes to live in clearcuts or the mature forest
 - Three reasons why the species likes to live where it does
 9. Give students a cut-out picture of their species to tape on the clearcut poster in the habitat the species would be most likely to use (forest or clearcut). If the species would use both habitats, give the students two cutouts, so they can put that species in both habitats. (*Note: The poster can be projected onto the board or a wall, but it is better to print it as a poster as it will be used again in Lesson 3.*)
 10. Ask students the following:
 - After this investigation, what do you think about the video you watched in Lesson 1? What parts of it were right? What parts of it were misleading?
 - Have you ever seen video before that tried to convince you of something that you didn't believe?
 - What can you do to try to understand something better if you don't know if you should believe it?

Names: _____

Date: _____

Species Investigation: Do I use clearcuts? Why?

Overview:

Since we've just found out that the number of birds in a forest does not decrease after a clearcut, its time to figure out why! Using the packet of information from real scientists about your species try to discover as much as you can about where they live in a forest and why. Just like we like to live in a house because we don't like being wet or cold, animals choose where they live because they like things about that site. Using your packet of information you will be able to figure out not only how your species responds to clearcuts, but also *why* they respond that way. What they like to eat, how they move, where they build their homes, what temperatures they like and lots of other things help them choose whether or not they want to live in a clearcut!

Using all the sources in your packet Investigate:

- 1) How your species responds to clear cuts?
- 2) Why they respond that way.

When everyone is done investigating their species you are going to share your discoveries with the class, so taking good notes below will help you remember everything that is important!

How does your species respond to clear-cuts?

(Hint: Does its population increase, decrease, or stay the same?)

decrease

Where does it live in the forest? Are the things it needs to make its home available in clear-cuts?

Hardwood forest

What does it eat? Is there lots of food for it in clear-cuts?

WORMS

What kind of environment does it need? Is this environment similar or different from clear-cuts?

(Hint: think about things like water, moisture, cover, sunlight, and temperature)

Doesn't like things on the ground, like lots of big tree

Can you figure out the TOP THREE reasons your species likes or doesn't like to live in clear-cuts?

- 1) likes shade
- 2) doesn't like little trees on the ground
- 3) they need litter.

Figure 6A: Example of students' work investigating northern short-tailed shrews from the activity *Do I use clearcuts? Why?*

Names: Colbyence

Date: _____

Species Investigation: Do I use clearcuts? Why?

Overview:

Since we've just found out that the number of birds in a forest does not decrease after a clearcut, its time to figure out why! Using the packet of information from real scientists about your species try to discover as much as you can about where they live in a forest and why. Just like we like to live in a house because we don't like being wet or cold, animals choose where they live because they like things about that site. Using your packet of information you will be able to figure out not only how your species responds to clearcuts, but also *why* they respond that way. What they like to eat, how they move, where they build their homes, what temperatures they like and lots of other things help them choose whether or not they want to live in a clearcut!

Using all the sources in your packet Investigate:

- 1) How your species responds to clear cuts?
- 2) Why they respond that way.

When everyone is done investigating their species you are going to share your discoveries with the class, so taking good notes below will help you remember everything that is important!

How does your species respond to clear-cuts?

(Hint: Does its population increase, decrease, or stay the same?)

increase

Where does it live in the forest? Are the things it needs to make its home available in clear-cuts?

Barrows in the ground

What does it eat? Is there lots of food for it in clear-cuts?

Seeds, fruit, fungi, and animal foods,

What kind of environment does it need? Is this environment similar or different from clear-cuts?

(Hint: think about things like water, moisture, cover, sunlight, and temperature)

areas where it can observe from a place atleast fence high and where it can burrow

Can you figure out the TOP THREE reasons your species likes or doesn't like to live in clear-cuts?

- 1) They can climb the fallen trees
- 2) seeds, fruit and fungi get there
- 3) They can burrow into the ground

Figure 6B: Example of students' work investigating eastern chipmunks from the activity *Do I use clearcuts? Why?*



Figure 7: A student presents his groups findings from the activity *Do I use clearcuts? Why?* and adds his species to the mature forest areas.



Figure 8: Students pose with their completed clearcut poster after presenting their findings from the activity *Do I use clearcuts? Why?*

Name _____

Date _____

SPECIES INVESTIGATION

Background and Directions

Overview

Since we've just found out that the number of birds in a forest does not decrease after a clearcut, it's time to figure out why! Using the packet of information from the real scientists about your species, discover as much as you can about whether they live in clearcuts or mature forests—and why. Just as we like to live in a house because we don't like being wet or cold, animals choose where they live because they like things about the sites. Using the information in your packet, you will be able to figure out not only how your species responds to clearcuts, but also

why they respond that way. What they like to eat, how they move, where they build their homes, what temperatures they like, and lots of other things help them choose whether or not to live in a clearcut!

Using the sources in your packet, investigate:

1. How your species respond to clearcuts.
2. Why they respond that way.

When everyone is done investigating their species, you are going to share your discoveries with the class. So, take good notes below to help you remember everything that is important!

Questions

Species name _____

How does your species respond to clearcuts? (*Hint: Does its population increase, decrease, or stay the same?*)

Where does it live in the forest? Are the things it needs to make its home available in clearcuts?

What does it eat? Is there lots of food for it in clearcuts?

What kind of environment does it need? Is this environment similar or different from clearcuts?

(*Hint: Think about things like water, moisture, cover, sunlight, and temperature.*)

What are the TOP THREE reasons your species likes or doesn't like to live in clearcuts?

1. _____
2. _____
3. _____

BIG MANAGEMENT DECISIONS IN THE BOARDROOM!

The Great Clearcut Controversy LESSON PLAN 3

In this lesson, students participate in a mock boardroom activity where they use the engineering design process and information learned in Lessons 1 and 2 to create the best management plan for a forest in southern Indiana.

Estimated Time

1 Hour

Procedure

1. Review Teacher Information on timber harvesting and forest management, if needed. Arrange desks or tables into a circle or semicircle.
2. Review Lesson 1 and 2 with students. Ask:
 - What did we discover in Lesson 1?
 - What questions did we still have at the end of Lesson 1 that we answered in Lesson 2?
 - In two sentences, can someone summarize what we learned in Lessons 1 and 2?
3. Ask students:
 - Does anyone know what a boardroom is?
 - Does anyone know what happens in boardrooms?
4. Explain that boardroom meetings frequently occur when important business decisions have to be made by representatives from several companies. Each company wants to make sure that they meet their goals in the business deal, but the companies have to all work together to come up with mutually beneficial solution. If one company's representative asks for too much, the other representatives will not agree to the deal and then nothing happens.
5. Ask students:
 - Do you think things like this ever happen to decide how to manage forests or other ecosystems?
 - Is there ever money involved in natural resources management decisions?
6. Develop the following scenario: Farmer Rachel (the teacher) has a large forest in southern Indiana that she wants to harvest, because she needs money to buy a new truck. She is worried that cutting down all the trees might hurt the animals in her forest. Luckily, she heard there was a classroom of experts on how different animals in her forest respond to clearcuts! She's invited your class to join her in a boardroom to help her decide how to manage her forest. She needs you to represent the species that you researched and help her make a management decision that will make her AND all of the forest animals happy!
7. Have each group outline the type of management their species wants and why. Make sure you are really convincing and advocate well for your species, because you don't want them to die in her forest!
8. Students should realize that different people are advocating for different management strategies and that they need to come to a compromise. Have them work together to come to consensus on a management plan that everyone can agree on.
9. The teacher, acting as Farmer Rachel, should guide the discussion to varying degrees. As the students work through this process ask:
 - What is the problem you are all trying to solve?
 - What makes this a hard problem to solve?
 - What are some possible solutions?
 - Why is the solution you agreed on the best?
 - What are the tradeoffs and constraints you considered?
10. As needed, Farmer Rachel (the teacher) can remind students that she needs to make money by harvesting some trees.
11. Have students present their plan to Farmer Rachel (the teacher) and convince her why it is the best. They should settle on some form of management that creates a variety of habitats within the forest, but exactly what they envision may vary. It may help them to draw a map of the plan on the board to clarify their thoughts. To extend the discussion, Farmer Rachel can tell them she wants to do another harvest in 10 years and one more in 20 years. What do the students think would be the best plan for these harvests?
12. *Final project (optional):* Tell students that just like Farmer Rachel needs to make decisions about how to manage her personal forest, public agencies like the Indiana Department of Natural Resources (IDNR) and the U.S. Forest Service also have to decide how to manage their forests for multiple goals.
 - Demonstrate what they have learned in this unit by writing a letter to the Indiana State Forester describing how they think that the IDNR should manage the state forests in Indiana.
 - Go over the directions on the Letter to *Indiana State Forester* assignment and rubric with students (*Supplementary Material G*).

Required Materials

Letter to Indiana State Forester Assignment/Rubric (*Supplementary Material G*, if using assessment)

Supplementary Material A	Additional vocabulary (PDF)
Supplementary Material B.....	How do bird communities change after clearcuts? Presentation (PowerPoint and PDF)
Supplementary Material C	The Hardwood Ecosystem Experiment Overview (PDF)
Supplementary Material D.....	Species cutouts (PDF)
Supplementary Material E.....	Clearcut poster (PDF)
Supplementary Material F.....	Species information packets (PDF)
Northern short-tailed shrew	
Eastern chipmunk	
Indigo bunting	
Ovenbird	
Timber rattlesnake	
Northern slimy salamander	
Indiana bat	
Eastern red bat	
Supplementary Material G.....	Final assignment and rubric (PDF)

To download a zip file that includes all of these Supplementary Materials, go to: <http://purdue.ag/clearcutsm>
The file will immediately download when you click on it.