Hubbard Brook Environmental Literacy Program
Data Inquiry Activities

Is Forest Management for the Birds?	
Summary	This is a five-part lesson that explores the impacts of different forest management methods on bird abundance and species diversity.
Subject areas	Biology, ecology, environmental science; Assumes students have some prior knowledge of biodiversity.
Skill level	Advanced middle school- high school
Objectives	• Students will compare and contrast the impacts of clearcutting, group selection, and no harvesting on forest succession. • Students will analyze and interpret data. • Students will determine effects of different methods of harvesting and successional stage on various bird species. • Students will integrate what they have learned about forest management, succession, and birds to justify their management recommendations for the forest.
NH Science Framework Standards	• SPS1:11:1.1- Making observations and asking questions. • SPS1:11:4.1- Representing and understanding results of investigations. • SPS3:11:2.8-Analyze global, social, cultural, political, economic and environmental linkages. • LS3:11:1.3- Analyze the aspects of environmental protection, such as ecosystem protection, habitat management, species conservation, and environmental agencies and regulations; and evaluate and justify the need for public policy in guiding the use and management of the environment.
Time	5 class periods of 50 minutes in length, plus homework time for essay in part 5

Materials	**Part 1** • *Saving Songbirds* DVD (optional) • Gough, G.A., Sauer, J.R., Iliff, M. Patuxent Bird Identification Infocenter. 1998. Version 97.1. Patuxent Wildlife Research Center, Laurel, MD. • Cornell University's All About Birds. • NH Public Television's *Junior Wildlife Journal: New Hampshire Birds* • Birds of North America (by subscription, excellent) • *Forest Succession and Wildlife*, Pennsylvania Dept. of Conservation and Natural Resources. • Foss, Carol R. ed, *Atlas of Breeding Birds in New Hampshire*. Published by Arcadia for Audubon Society of New Hampshire, 1994. • Hunt, Pam. 2009. *State of New Hampshire Birds. A report submitted to the NH Fish & Game Department*, pages 34-47. • Rodewald, Amanda D. *Managing for Forest Songbirds*, Extension Fact Sheet, Ohio State University W-6-2001. **Part 2** • Slideshow *Signs of Forest Succession in Maine* (ME Audubon) • Rodewald, Amanda D. *Managing for Forest Songbirds*, Extension Fact Sheet, Ohio State University W-6-2001. • *Forest Succession and Wildlife*, Pennsylvania Dept. of Conservation and Natural Resources. **Part 3** • USDA *Northeastern Forest Regeneration Handbook*, pages 33-35, 38. • Rodewald, Amanda D. *Managing for Forest Songbirds*, Extension Fact Sheet, Ohio State University W-6-2001. **Part 4** • Table 1 (embedded in Student Handout) **Part 5** • Table 1 (embedded in Student Handout)
Assessment	Student handouts, graph, and essay. Answer keys included.

Teacher's Notes

Part 1. Bird Habitat Concept Map/Poster: What habitat does my bird prefer?

- The *Saving Songbirds* DVD (available from www.nhptv.org) is a good introduction to this unit.
- Students are asked to develop a concept map based on their bird. Start by writing down the names of the most abundant birds from Table 1 on notecards, one bird per card. Have students pick a bird from a box when they enter class, this will be their bird to research. A student example is provided in the answer key.
- A list of resources for students to use when researching their bird for the concept map is included in the student handout for Part 1.
- *The Theory Underlying Concept Maps* contains information on creating and using concepts maps as teaching and evaluation tools. A condensed version of *The Theory Underlying Concept Maps* is found at https://www.msu.edu/~luckie/ctools/ .

Part 2. Forest Succession

- You may want to introduce this part by showing the PowerPoint *Signs of Forest Succession in Maine* (ME Audubon).
- Provide students with copies of Costello's Table 1.
- Students should continue focusing on the bird they researched for Part 1. Have students form groups of three, ideally each student representing a bird preferring a different successional stage. The group can answer lesson questions together. At the end of the lesson, have the groups share their conclusions with the rest of the class.

Part 3. Forest Management—Comparison of Methods

Students work in groups of three to learn about three types of forest management and how they affect bird habitat.

Part 4. Graphing and Interpreting Costello Results

Students work in groups of three to create a bar graph using data in Table 1, to compare the abundance of three birds for three differently managed areas.

Part 5. Forest Management Planning for Bird Biodiversity

Students continue to examine Costello's data to evaluate the impact of different forest management methods on songbird diversity and conclude with an essay that recommends forest management techniques for the White Mountain National Forest in NH.

Additional Resources

Costello, Christine, Mariko Yamasaki, Peter J. Pekins, William B. Leak, Christopher D. Neefus, *Songbird response to group selection harvests and clearcuts in a New Hampshire northern hardwood forest*, Forest Ecology and Management 127 (2000) 41-54

DeGraaf, Richard M.; Yamasaki, Mariko, Options for managing early-successional forest and shrubland bird habitats in the northeastern United States, Forest Ecology and Management. 185: 179-191. (2003)

North American Bird Conservation Initiative, U.S. Committee, 2009. The State of the Birds, United States of America, 2009. U.S. Department of Interior: Washington, DC. 36 pages. *(Read about status of birds in major US habitats.)*

Silvicultural Principles For New Hampshire Forest Types, Leak, William and E. Snyder, New Hampshire Timber Harvesting Council, June 2011. (*See chapters on silvicultural principles and silvicultural systems.)*

Is Forest Management for the Birds?   Name _____
How Does Forest Management Affect Bird Abundance: A Five-Part Lesson

Student Introduction
Christine Costello and her colleagues wanted to understand how songbirds are affected by different types of timber harvesting in the White Mountains of New Hampshire. She and other scientists investigate forest ecology and wildlife habitat at the Bartlett Experimental Forest, located within the White Mountain National Forest.

Key Questions:
- Is timber harvesting good or bad for bird populations?
- How does it affect the number of species in the forest?
- Do various methods of harvesting affect birds in different ways?
- Clearcutting has become a controversial practice. Is it better or worse for bird diversity than other harvesting methods? Why?
- If you were in charge, how would you manage the forest for the birds?

To answer these questions, the researchers designed and conducted a five-year field study. They conducted breeding bird surveys in clearcut stands, group selection stands, and uncut stands (the clearcut and group cut stands were 1-5 years old at the onset of the study). Getting up before dawn, they visited 108 survey points four times each field season, May-July. What did they find out?
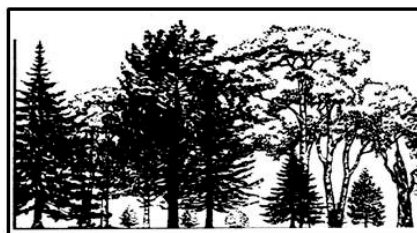
Some different methods of forest management
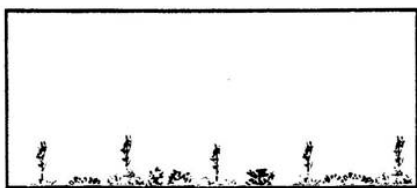
Clearcut in a hardwood stand

Group selection cut in a hardwood stand

Uncut, mature mixed hard and softwood forest

Images taken from Silvicultural Principles For New Hampshire Forest Types, Leak, William and E. Snyder, New Hampshire Timber Harvesting Council, June 2011.

Part 1. Bird Habitat Concept Map/Poster: What habitat does my bird prefer?

Based on your research (use **Resources** listed below), draw a detailed concept map depicting the elements important to your bird's preferred habitat, including:

- Food
- Predators
- Forest management history
- Nesting sites
- Vegetation structure (vertical and horizontal structure)
- Successional stage

Your concept map should include:

☐ whether your bird is a neotropical (long distance) migrant, a short distance migrant, or year-round resident

☐ your bird's habitat preferences during migration and at its destination

☐ a photo of the bird in the middle of the map, in its preferred habitat bubble

☐ bubbles around important factors

☐ arrows or linking words to show the influence of that factor on the quality of the habitat

☐ arrows to connect the bubbles that affect each other (indirect effects)

☐ photos or drawings to illustrate your map/poster

☐ new elements added to your rough draft as you proceed through these lessons

Resources

- Gough, G.A., Sauer, J.R., Iliff, M. Patuxent Bird Identification Infocenter. 1998. Version 97.1. Patuxent Wildlife Research Center, Laurel, MD.
- Cornell University's All About Birds.
- NH Public Television's *Junior Wildlife Journal: New Hampshire Birds.*
- *Forest Succession and Wildlife*, Pennsylvania Dept. of Conservation and Natural Resources.
- Hunt, Pam. 2009. *State of New Hampshire Birds. A report submitted to the NH Fish & Game Department*, pages 34-47.
- Rodewald, Amanda D. *Managing for Forest Songbirds*, Extension Fact Sheet, Ohio State University W-6-2001.

Part 2. Forest Succession   Name _____

Ms. Costello and colleagues found that many bird species they studied show preferences for habitats created by certain forest management practices. These management practices can change the species composition and successional stage of the forest. Form a group of 3 students to answer these questions. Use **Resources** section at end of lesson for more information.

1. Use your textbook or **resources** to define forest succession:

2. Using your textbook and other resources, such as Rodewald and *Forest Succession and Wildlife,* describe habitat differences in these successional stages by completing the chart below (to learn which bird species occupy the various successional stages, see Costello Table 1).

Successional stage	Approximate tree age	Plant species	Light level	Moisture level	Vegetation structure	Bird species
Early						
Late						

3. Using Costello's Table 1, name a bird that is a habitat generalist. _____
   What do you think this means?

4. See Hunt p.32 to complete the table below.

Your bird species	Population Status	Why?

Resources for Part 2

- Slideshow *Signs of Forest Succession in Maine* (ME Audubon)
- Rodewald, Amanda D. *Managing for Forest Songbirds*, Extension Fact Sheet, Ohio State University W-6-2001.
- Hunt, Pam. 2009. *State of New Hampshire Birds. A report submitted to the NH Fish & Game Department*, pages 34-47.
- *Forest Succession and Wildlife*, Pennsylvania Dept. of Conservation and Natural Resources.

Name _____

Part 3. Forest Management—Comparison of Methods

Now we are ready to learn about some different types of forest management and how they affect bird habitat. Work in a group of 3 to research the three forest management methods.

1. In the table below compare and contrast a clearcut, group cut stand, and no cutting. Consider impacts on vegetation, structure, food, and nest sites. Also consider human impacts such as income, scenery, and recreation (see USDA **Resources** below).

    a) Definition of a clearcut:

    b) Definition of a group cut stand:

    c) Definition of an uncut or mature forest:

	Advantages	*Disadvantages*
Clearcut		
Group Cut Stand		
Uncut Mature Forest		

2. Using your group members' research about your three birds and the forest management methods, <u>predict</u> how and why different methods of forest management would affect the quality of the bird's habitat. Use specific details from your readings (see **Resources** below).

Predicted Impact of Forest Management Method on Habitat Quality for Your Birds

Management Method	Bird 1	Bird 2	Bird 3
Clearcut			
Group Cut Stand			
Uncut			

Resources for Part 3:
- USDA *Northeastern Forest Regeneration Handbook*, pages 33-35, 38.
- Rodewald, Amanda D. *Managing for Forest Songbirds*, Extension Fact Sheet, Ohio State University W-6-2001.

Part 4. Graphing and Interpreting Costello Results

1. Remain in a group of three. Each group should have an expert on a bird that prefers early successional habitat, a habitat generalist, and a mid-late successional habitat bird that you researched in Part 1. Working with your group, use the data in Table 1 to develop a bar graph comparing the abundance of your three birds for the three forest management methods. Hint: put # individuals observed (abundance) on y-axis. Sketch the layout for your graph here.

2.   a. Interpret the results you see in your graph. For which forest management methods are the three species most abundant? Complete the following chart.

Your Group's Bird Species Names	Successional stage preferred by species	Forest management method(s) preferred, where species is most abundant

    b. Can you explain why each species was more abundant in a particular type of managed forest?

3. Look back at your prediction for your birds' habitat preferences made in Part 3 Question 2. Were your predictions correct? Why or Why not? Add this knowledge to your concept map from Part 1.

4. From your examination of the data, explain some advantages to being a generalist.

5. Which species is (are) most vulnerable to habitat loss? Why?

6. Now, trade graphs with a neighboring group. From the graphs alone, predict which bird prefers which habitat type. How did you know? Discuss your answers with your group.

Name _____

Part 5. Forest Management Planning for Bird Diversity

Now, let's find out what Ms. Costello and her colleagues discovered about the impact of forest management methods on songbird diversity. Table 1 compares songbird abundance under three types of forest management:
- Clearcuts (approx. 20-30 acre) areas in which all trees were cut)
- Group cut stands (approx. ¼ acre. -2 acre) small clearcuts, surrounded by mature forest)
- Mature uncut forest (trees of all sizes and ages, no recent harvesting activity)

1. Using Table 1, enter data for *species* (not individual abundance) below:

Species Recorded	*Clearcuts*	*Group Cut Stands*	*Mature uncut forest*
# species recorded here			
# species ONLY found here			
# species NOT found here			

2. Which of the three management techniques maximizes songbird species diversity? (Hint: which has the highest number of species recorded?) Explain your answer using the data.

3. If the White Mountain National Forest managers employ group cut stands instead of clear cuts, what will be the impact on bird diversity (# of species recorded)?

4. Hypothesize why some early successional birds are absent from the group cut stands.

5. Now look at the rows of data for the individual species.
    a. Which species might disappear from the White Mountains if clearcutting were discontinued? (Hint: which species occur only in clearcuts?)

    b. What habitat category do these birds fall under, or what do all these birds have in common?

6. In this study, there were no bird species found only in mature forest. However, do you think there is value in allowing tracts of forests to remain uncut? (Hint: are there other wildlife, plant or insect species that might depend on uncut mature forest habitat? Can you think of any other reasons for preserving tracts of forest and allowing them to grow old?)

7. How abundant were your three species in the three types of cuts? Can you explain why?

8. Now, let's return to the key questions posed at the beginning of these lessons. Look at the bird abundance data in Table 1. Abundance is a count of individual birds. Find the boldface numbers that represent the number of individual birds counted for each Successional Group in each of the three forest management types. Now fill in the summary table below with the **boldface** Costello data presented in Table 1.

Summary of # individual birds observed (abundance) in different management types

Successional Type Preferred	Clearcut	Group Cut Stand	Mature/Uncut
Early successional birds			
Generalist birds			
Mid-late successional birds			
TOTAL			

9. Is timber harvesting good or bad for bird abundance? Why? Explain with data.

10. How does timber harvesting affect the number of bird <u>species</u> in the forest (bird diversity)? Explain with data from question 1 in part 5. How is this different from bird abundance?

11. Do various <u>methods</u> of harvesting affect birds in different ways? Explain with data from summary table above.

12. Clearcutting has become a controversial practice. Is it better or worse for bird diversity than other harvesting methods? Why?

13. If you were the Forest Supervisor for the White Mountain National Forest, what forest management technique(s) would you plan for and why? Use your Table comparing and contrasting forest management techniques to help you answer this question. What might be the tradeoffs between bird diversity and other goals? Please write a five paragraph essay using the Costello data and your other research to support your proposed forest management plan. Outline your essay below before you begin to write it.

Have you ever been in a National Forest?

These forests are owned and managed by the federal government to conserve water, forests, wildlife, and recreational resources. Unlike the national parks, national forests can be harvested under the supervision of professional foresters. One of America's 155 national forests is the White Mountain National Forest in New Hampshire and Maine. Find the national forest closest to you at http://www.fs.fed.us/recreation/map/state_list.shtml.

Table 1. Number of songbird observations recorded in clearcut, group selection stands and mature stands during breeding bird surveys on the White Mountain National Forest; 1992-1996 (Costello, unpublished data*).

Early successional birds	Clearcut	Group Cut Stand	Mature	Grand Total
Alder Flycatcher	64	0	0	64
American Goldfinch	10	2	4	16
Black and White Warbler	34	7	5	46
Cedar Waxwing	56	14	2	72
Common Yellowthroat	318	66	0	384
Chestnut-sided Warbler	848	262	0	1110
Dark-eyed Junco	88	12	0	100
Eastern Bluebird	5	0	0	5
Eastern Towhee	9	0	0	9
Magnolia Warbler	4	10	0	14
Mourning Warbler	144	49	0	193
Nashville Warbler	8	0	0	8
Indigo Bunting	84	0	0	84
Gray Catbird	4	2	0	6
Olive-sided Flycatcher	5	0	0	5
Song Sparrow	7	0	0	7
Tree Swallow	108	0	0	108
White-throated Sparrow	180	15	0	195
Total No. Observations	**1976**	**439**	**11**	**2426**
Total No. Species	**18**	**10**	**3**	**18**

Forest Generalists	Clearcut	Group Cut Stand	Mature	Grand Total
American Redstart	108	263	256	627
American Robin	11	5	0	16
Black-capped Chickadee	9	53	29	91
Blue Jay	4	27	5	36
Canada Warbler	7	2	0	9
Downy Woodpecker	3	6	11	20
Hairy Woodpecker	5	19	25	49
Northern Flicker	8	0	3	11
Purple Finch	4	4	0	8
Red-eyed Vireo	18	359	563	940
Rose-breasted Grosbeak	17	39	21	77
Red-breasted Nuthatch	0	12	3	15
Swainson's Thrush	20	37	43	100
Yellow-bellied Sapsucker	7	57	35	99
(continued on next page)				

Forest Generalists, continued	Clearcut	Group Cut Stand	Mature	Grand Total
Yellow-rumped Warbler	4	22	15	41
Winter Wren	5	13	6	24
White-breasted Nuthatch	0	20	31	51
Total No. Observations	**230**	**938**	**1046**	**2214**
Total No. Species	**14**	**15**	**13**	**17**

Mid to late successional birds	Clearcut	Group Cut Stand	Mature	Grand Total
Blue-headed Vireo	0	68	50	118
Blackburnian Warbler	0	63	46	109
Brown Creeper	0	2	3	5
Black-throated Blue Warbler	6	259	162	427
Black-throated Green Warbler	0	217	135	352
Evening Grosbeak	2	2	20	24
Eastern Wood Pewee	6	14	33	53
Golden-crowned Kinglet	0	5	0	5
Hermit Thrush	5	81	44	130
Least Flycatcher	0	12	132	144
Northern Parula	5	0	2	7
Ovenbird	2	324	278	604
Pileated Woodpecker	0	3	7	10
Scarlet Tanager	2	72	88	162
Veery	21	44	37	102
Wood Thrush	0	13	19	32
Total No. Observations	**49**	**1179**	**1056**	**2284**
Total No. Species	**9**	**16**	**16**	**16**

Grand Total No. Obs	**2255**	**2556**	**2113**	**6924**
Grand Total No. Species	**41**	**41**	**32**	**51**

* Two years of this data set were published in Costello, Christine, Mariko Yamasaki, Peter J. Pekins, William B. Leak, Christopher D. Neefus, "Songbird response to group selection harvests and clearcuts in a New Hampshire northern hardwood forest," Forest Ecology and Management 127(2000)41-54.

ANSWER KEY

Part 1. Bird Habitat Concept Map/Poster: What habitat does my bird prefer?
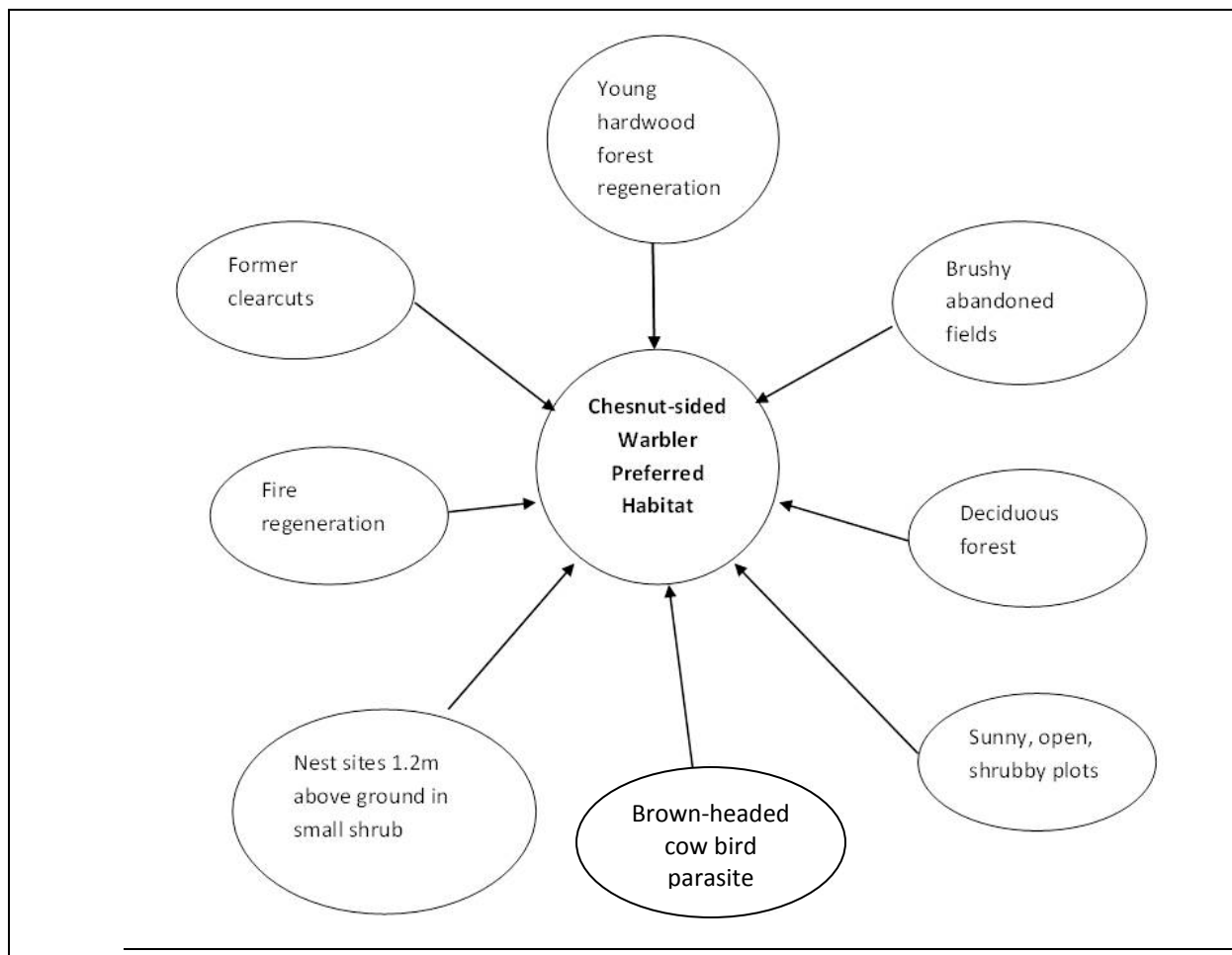
Part 2. Forest Succession

1. Use your textbook or **resources** to define forest succession:
   Succession is a typical series of changes in the species composition and structure of an ecological community over time. This succession of species and growing conditions follows a disturbance to the site such as a windstorm, fire, or timber harvest.

2. Using your textbook and other resources, such as Rodewald and *Forest Succession and Wildlife,* describe habitat differences in these successional stages by completing the chart below (to learn which bird species occupy the various successional stages, see Costello Table 1).

Early successional habitat is characterized by mosses, grasses, herbaceous plants, shrubs, and fast growing seedlings of shade intolerant, pioneer tree species such as poplars, white and gray birch, and white pine. Plants must tolerate high levels of light and fluctuating levels of moisture. Birds that prefer early successional habitat include the gray catbird, eastern towhee, and field sparrow (see Rodewald article).

Mid-successional habitat is characterized by pioneer trees that are successively replaced by more shade-tolerant herbs and tree seedlings that are able to take hold in the darker understory.

Late successional habitat hosts mature trees that thrive in moist, shady conditions including hemlock, American beech, and certain lichens. Mature forest birds include the Red-eyed Vireo and Wood Thrush.

3. Using Costello's Table 1, name a bird that is a habitat generalist. _____
What do you think this means?

A habitat generalist such as the American Redstart can be found in forest stands of various ages and successional stages.

4. See Hunt p.32 to complete the table below.

Answers will vary, depending on the student's bird. For example…The population of the Merlin is increasing. It is a canopy nesting bird in the spruce-fir and hardwood forests. This could mean that there are sufficient mature forests providing large canopy trees needed by the Merlin in order for it to increase its population.

Part 3. Forest Management—Comparison of Methods

1. In the table below compare and contrast a clearcut, group cut stand, and no cutting. Consider impacts on vegetation, structure, food, and nest sites. Also consider human impacts such as income, scenery, and recreation (see USDA **Resources** below).
   a) Definition of a clearcut:

A clearcut is a form of even-aged management that either removes all trees from an area at the same time or in some cases all trees down to a certain diameter (ex: all trees with a diameter greater than 2 inches). It allows intense sunlight to reach the forest floor. In the Costello study, clearcuts were areas exceeding 20 acres in which all trees were removed.

   b) Definition of a group cut stand:

A group selection cut is a form of uneven aged management that removes small groups of trees creating openings/patches that range from 1/10 ac to 2 acres in size. The newly cut openings/patches are surrounded by older forest age classes. A group selection stand consists of both the openings/patches and the surrounding older forest that will be harvested during the next cutting cycle 10 to 20 years later. Sunlight is intense in the center of group cut openings, but the edges are partially shaded by surrounding trees.

c) Definition of an uncut or mature forest:

A mature forest has not been cut recently, probably for many decades. For the most part, trees are large and the canopy is closed. There can be signs of human disturbance, such stone walls, old foundations, ski trails, hiking trails, etc.

	Advantages	*Disadvantages*
Clearcut	*Simplest and most economical harvesting method, enables shade-intolerant species to regenerate, removes diseased or unwanted species, creates early successional habitat*	*Unattractive for recreationists, removes opportunity for timber income for many decades, can destroy habitat for species needing mature forest conditions, can expose soil to erosion and degrade aquatic habitat*
Group Cut Stand	*Enables some regeneration of shade-intolerant species, provides less disruption to the habitat and scenic character of the forest, can allow periodic harvests in an area to provide habitat diversity for plants and animals, provides both early and late successional habitat*	*Cut areas may be too small to allow significant regeneration of early successional species, and there are higher management costs than for clear-cut. Group selection cut openings may not be big enough for some early successional species, if species has territory requirements that are larger than 2 acres or if species avoids edges.*
Uncut Mature Forest	*Maintains highest water quality and habitat needed by certain species requiring standing dead trees and accumulation of organic matter on forest floor, highest recreational value*	*Low habitat diversity, provides little income to landowner*

2. Using your group members' research about your three birds and the forest management methods, <u>predict</u> how and why different methods of forest management would affect the quality of the bird's habitat. Use specific details from your readings (see **Resources** below).
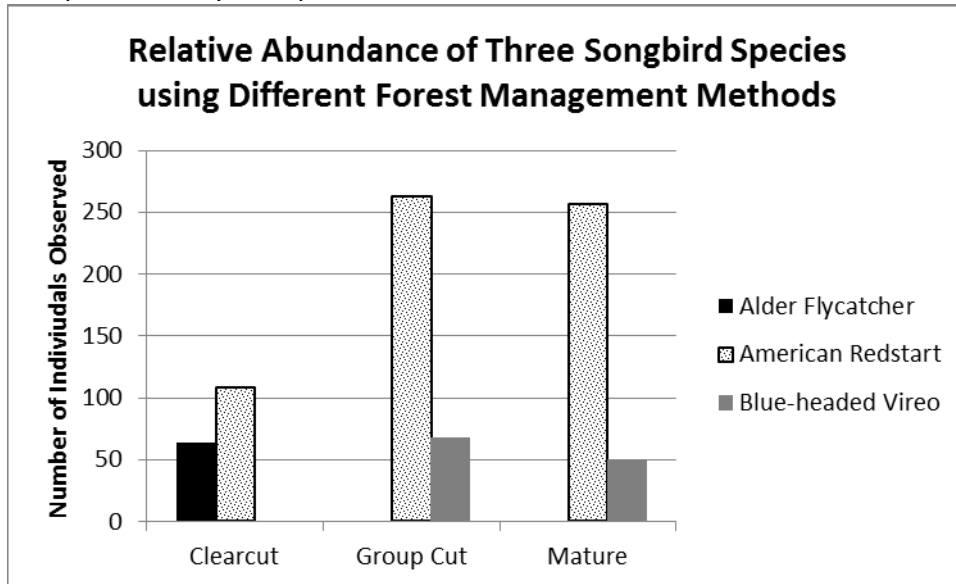
Predicted Impact of Forest Management Method on Habitat Quality for Your Birds

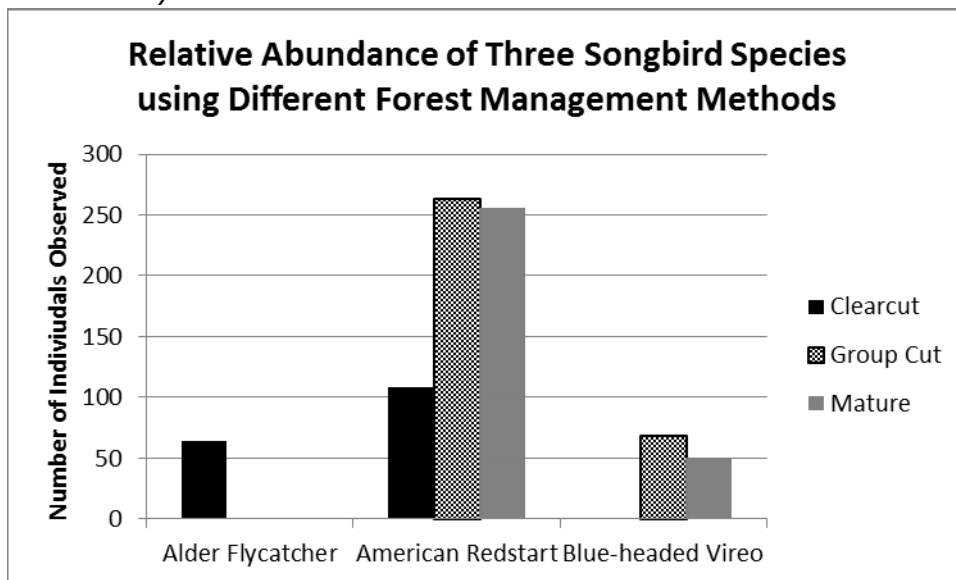| Management Method	Bird 1 Ex: Blue-headed vireo	Bird 2 Ex: Alder flycatcher	Bird 3 Ex: American redstart
Clearcut	My bird would not prefer a clearcut because it lives in the canopy of mature forests and cutting down the trees would eliminate its habitat.	The Alder flycatcher likes to live in open, shrubby areas. Therefore, clearcutting would be beneficial since it regenerates this type of habitat.	The American redstart likes second growth woods and shrubby habitat. We predict that it will be found in recently clearcut areas.
Group Cut Stand	This would be better for my bird than a clearcut because a group cut stand also contains mature forest for nesting and feeding.	The group cut stand method does not provide enough light for early successional species to get established. Also, group cut stand openings may not be large enough for some early successional species, such as the alder flycatcher, if species has territory requirements that are larger than 2 acres or if species avoids edges.	We predict that this could be the best habitat for American Redstarts since it will have second growth forest in past cuts and shrubby habitat in recent cuts.
Uncut	This type of management will provide my bird with its preferred habitat of mid to late successional forest.	Alder flycatchers are seldom found in uncut mature forest, according to the Costello data. This is not a good habitat management method for them.	We predict that the redstart will be found here but won't be as abundant, since the forest will be older and less open.

Part 4. Graphing and Interpreting Costello Results

1. Remain in a group of three. Each group should have an expert on a bird that prefers early successional habitat, a habitat generalist, and a mid-late successional habitat bird that you researched in Part 1. Working with your group, use the data in Table 1 to develop a bar graph comparing the abundance of your three birds for the three forest management methods. Hint: put # individuals observed (abundance) on y-axis. Sketch the layout for your graph here.

One possible way to represent these data:

Relative Abundance of Three Songbird Species using Different Forest Management Methods

- Alder Flycatcher
- American Redstart
- Blue-headed Vireo

Another way:

Relative Abundance of Three Songbird Species using Different Forest Management Methods

- Clearcut
- Group Cut
- Mature

2. a. Interpret the results you see in your graph. For which forest management methods are the three species most abundant? Complete the following chart.

Your Group's Bird Species Names	Successional stage preferred by species	Forest management method(s) preferred, where species is most abundant
Alder Flycatcher	Early	Clearcutting
American Redstart	Generalist	Most abundant in group cut stand; uncut not far behind.
Blue Headed Vireo	Mid to Late	Group cut stand

b. Can you explain why each species was more abundant in a particular type of managed forest?

3. Look back at your prediction for your birds' habitat preferences made in Part 3 Question 2. Were your predictions correct? Why or Why not? Add this knowledge to your concept map from Part 1.

"Our predictions for the Alder flycatcher were correct. We predicted that it would prefer early successional habitat and this is where it was found exclusively.
The observations made by the Costello researchers make sense for the alder flycatcher. Clearcutting creates the early successional habitat that they need."

"The American redstarts were observed in all three management regimes, but not as often in the early successional habitat. We predicted that they would prefer group cut stand habitat, and they did, but they were nearly as abundant in the mature forest. This was a surprise."

"The Blue-headed vireo was found most often in the group cut stands, which we did not predict. We expected them to be more abundant in the mature areas than the group cut stands since they like to search for food in mid-levels of the forest."   [Note: statistically speaking, the difference between the number of Blue-headed vireo found in the group cut stand (68) was not significant compared to the number found in the mature forest (50)].

4. From your examination of the data, explain some advantages to being a generalist.
A generalist has the advantage of being able to survive in a variety of habitats. If a forest is altered through management, succession, or natural disaster, generalists can adjust their feeding habits and still reproduce.

5. Which species is (are) most vulnerable to habitat loss? Why?
The specialists are most vulnerable to habitat loss since they cannot easily adapt to other habitats or food sources. For example, in an area where there are extensive mature forests and

little harvesting, there may not be sufficient early successional habitat to sustain population of specialists like the Alder flycatcher.

6. Now, trade graphs with a neighboring group. From the graphs alone, predict which bird prefers which habitat type. How did you know? Discuss your answers with your group.
Answers will vary.

Part 5. Forest Management Planning for Bird Diversity

1. Using Table 1, enter data for <u>species</u> (not individual abundance) below:

Species Recorded	Clearcuts	Group Cut Stands	Mature uncut forest
# <u>species</u> recorded here	41	41	32
# <u>species</u> ONLY found here	8	1	0
# species NOT found here	10	10	19

2. Which of the three management techniques maximizes songbird species diversity? (Hint: which has the highest number of species recorded?) Explain your answer <u>using the data</u>.
Clearcuts and group cut stands tied for the greatest diversity of songbird species, since 41 species were found in each, which was more than that for mature (32) forests. Also, only 10 species were <u>not</u> found in clearcuts and group cut stands out of the total of 51 species observed. If all the forest was mature, 19 species would not be found, a much lower level of diversity.

3. If the White Mountain National Forest managers employ group cut stands instead of clear cuts, what will be the impact on bird diversity (# of species recorded)?
Diversity might decline in the WMNF if group cut stands rather than clearcuts were employed. There are 8 early successional birds that were found in clearcuts but not in group cut stands. We can predict that diversity would probably be reduced by these 8 species. There was only one species, the golden-crowned kinglet, which occurred only in a group cut stand.

4. Hypothesize why some early successional birds are absent from the group cut stands.
Perhaps the smaller openings (¼-2 acres) in the group cut stands are not large enough to support the habitat requirements of feeding and nesting for some early successional birds. Also, "edge effects" might play a role (some birds avoid edges, and smaller openings have a higher edge to interior ratio).

5. Now look at the rows of data for the individual species.
a. Which species might disappear from the White Mountains if clearcutting were discontinued? (Hint: which species occur only in clearcuts?)

*The species that might disappear if clearcutting were discontinued include: alder flycatcher, eastern bluebird, indigo bunting, olive-sided flycatcher, eastern towhee, Nashville warbler, song sparrow and tree swallow. These species were found only in clearcuts. (This is a significant finding in light of population trends in New Hampshire and the Northeast. The **State of NH Birds** (Hunt, Pam. 2009. [State of New Hampshire Birds. A report submitted to the NH Fish & Game Department](#)) says that a disproportionate number of early successional birds are in clear and persistent decline.)*

b. What habitat category do these birds fall under, or what do all these birds have in common?
They are all early successional birds. It is important to note that early successional birds can be found in areas besides clearcuts. Areas that have experienced disturbance, such as beaver meadows, burned over areas, and hurricane damaged stands, also provide early successional habitat. However, some of these natural disturbances are no longer allowed to persist. For example we put out fires quickly, we trap beavers if their work interferes with human zones, etc.

6. In this study, there were no bird species found only in mature forest. However, do you think there is value in allowing tracts of forests to remain uncut? (Hint: are there other wildlife, plant or insect species that might depend on uncut mature forest habitat? Can you think of reasons for preserving tracts of forest and allowing them to grow old?)
Old growth is rare in New Hampshire, but there aren't any wildlife species in this state that are completely dependent upon it. However, there are wildlife species that are more commonly associated with older stands and large diameter trees such as the barred owl and the northern goshawk (these birds are not surveyed in the same way as songbirds). Species such as this may experience population declines if we did not leave enough mature forest. There are also certain lichens and insects that are more abundant in older forest stands.   Other reasons for allowing preserving tracts of forest include aesthetics, preservation of genetic diversity and continued research on the value of old growth.

7. How abundant were your three species in the three types of cuts? Can you explain why?
Answers will vary.

8**.** Fill in the summary table below with the **boldface** Costello data presented in Table 1.
Summary of # individual birds observed (abundance) in different management types

Successional Type Preferred	*Clearcut*	*Group Selection Cut*	*Mature Forest*
Early successional birds	*1976*	*439*	*11*
Generalist birds	*230*	*938*	*1046*
Mid-late successional birds	*49*	*1179*	*1056*
TOTAL	*2255*	*2556*	*2113*

9. Is timber harvesting good or bad for bird abundance? Why? Explain with data.
Timber harvesting does not appear to negatively affect bird abundance. From the table above abundance is slightly more in the clearcut area, but there is not a big difference between the clearcut (2255 birds), group selection cut (2556 birds) or mature forest areas (2113 birds).

10. How does timber harvesting affect the number of bird <u>species</u> in the forest (bird diversity)? Explain with data from question 1 in part 5. How is this different from bird abundance?
While the bird abundance data showed a small difference across management types, bird diversity data does show that forest management methods in the study area can increase species diversity. The clearcut and group areas seemed to promote greater bird diversity, with 41 species of birds being found there, as compared to 32 species that were found in mature forests. In addition, the clearcut area contained 8 species of birds that were only found in clearcuts. The group selection cuts contained only one species exclusive to this area, and mature forest contained no species found exclusively there.

11. Do various <u>methods</u> of harvesting affect birds with different successional stage preferences in different ways? Explain with data from summary table above.
It appears that different methods of harvesting affect the types and numbers of birds that reside in these areas. Clearcut areas contained a much greater number of early-successional birds. While group selection areas also contained a number of early-successional birds, both group selection cuts and mature forest contained a much greater number of generalist and mid-late successional birds than did clearcut areas.

12. Clearcutting has become a controversial practice. Is it better or worse for bird diversity than other harvesting methods? Why?
According to Costello's data the clearcut areas in the White Mountain National Forest of NH (20-30 acres in size) better support early successional bird diversity than the group selection cuts. Possible explanations for this include: clearcut areas give rise to early successional forest vegetation across more of the cut area, which supports early successional bird species; some birds have territory requirements exceeding two acres; and because "edge effects" might play a role (some birds avoid edges, and smaller openings have a higher edge to interior ratio). However, other bird species require mature or uncut forests. A variety of forest management practices is important for bird diversity as a whole.

13. If you were the Forest Supervisor for the White Mountain National Forest, what forest management technique(s) would you plan for and why? Use your table comparing and contrasting forest management techniques to help you answer this question. What might be the tradeoffs between bird diversity and other goals? Please write a five paragraph essay using the Costello data and your other research to support your proposed forest management plan. Outline your essay below before you begin to write it.
Answers will vary.