Habitat Fragmentation
A Bird's-Eye View

Objectives:
Student will be able to:

- recognize that different species respond differently to perturbations in their environment
- work collaboratively to generate possible solutions to the problem of conserving biodiversity in a human-managed ecosystem

Author
Ecology Explorers Education Team, adapted from M Dixon and "Interpreting Landscape Patterns from Organism-based Perspectives," by S. M. Pearson, Chapter 13 in Gergel and Turner (2002. Learning Landscape Ecology, Springer-Verlag)

Time:
60 minutes

Grades:
6-12

Standards
Arizona Science
Personal & Social Perspectives; Life Sciences

NGSS - Core Ideas
Human Impacts; Interdependent relationships in ecosystems; Ecosystem dynamics; Biodiversity and humans

Practices
Using models; Designing solutions

Specific AZ, Common Core, and NGSS standards on page 2.

Background:
Different species of birds use different parts of a habitat. For example in forests, some species prefer the open habitats created by the death of a tree or harvesting of trees. Some species prefer the habitat found in a closed canopy. Some species require large areas for hunting and finding mates. All of these different features of a natural ecosystem can be affected by the amount and pattern of man-made landscape changes. In urban Phoenix, some native desert birds can only be found in the desert outside the city, while others have moved into our city center. As the city expands, the desert retreats. This activity explores the effects of specific pat- terns of urbanization on various bird species.

Materials:
- handouts include: habitat rules for some bird species (exercise 1), Table 1.1, gridded maps of habitats with different amounts of cleared land, gridded maps with different patterns of forest clearing,
- graph paper and
- calculators (if desired)

Rcommended Procedure:

Engagement:
1) Have students brainstorm possible effects of urban development on native Sonoran Desert birds. List on the board.

2) Go over the habitat requirements for the birds in this activity

Exploration:

Exercise 1:
1. Pass out student worksheet

2. Using the gridded landscape maps for Exercise 1, identify and mark all the cells of suitable habitat based on the habitat rules for your species.

3. Count the number of suitable cells and estimate the % of the total desert habitat (or city habitat for Inca Dove) that is still suitable for your species as the desert shrinks. Fill in this information in Table 1.1.

Explanation
4. Discuss results of Exercise 1. Graph the results for each bird and compare the differences. How does this graph relate to extinction rates?

Expansion

Exercise 2:
5) Assuming that 50% of the desert is to be converted into housing, what are the effects of alternative spatial patterns? Follow the directions for exercise two and answer the questions on the worksheet.

Evaluation:
▪Collect and grade worksheets

Standards

Arizona Science Standards
S3-C1-PO4
S3-C1-PO5
S4-C3-PO1

NGSS Core Ideas
ESS3.C: Human impacts on Earth systems
LS2.A: Interdependent relationships in ecosystems
LS2.C: Ecosystem dynamics, functioning, and resilience
LS4.D: Biodiversity and humans

NGSS Practices
Asking questions
Developing and using models
Constructing explanations
Designing solutions
Engaging in argument from evidence
Obtaining, evaluating, and communicating information

NGSS Crosscutting Concepts
Patterns
Cause and effect
Scale, proportion and quantity
Systems and system models
Stability and Change

AZCCRS/ELA Literacy
RST7: Integration of knowledge and Ideas
SL1: Comprehension and Collaboration

AZCCRS/Mathematics
Domains: Number and Quantity, Measurement and Data
Math Practices:
4. Model with mathematics.
8. Look for and express regularity in repeated reasoning.

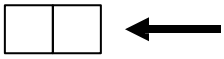
Exercise 1:

Using the gridded landscape maps for Exercise 1, identify and mark all the cells of suitable habitat based on the habitat rules for your species.

Count the number of suitable cells and estimate the % of the total desert habitat (or city habitat for Inca Dove) that is still suitable for your species as the desert shrinks. Fill in this information in Table 1.1.

Habitat "Rules" for different species

Species	Functional Group	Habitat Rules
Le Conte's Thrasher	Interior Desert Species	Desert cells that do not share a border with an urban cells
Black-Throated Sparrow	Area-sensitive Desert Species (small home range)	Desert patches composed of at least 3 connected cells
Rock Wren	Area-sensitive Desert Species (large home range)	Desert patches composed of at least 9 connected cells
Gilded Flicker	Urban Edge Species	Desert cells that share a border with an urban cell
Inca Dove	Urban habitat Species	Urban cells that do not share a border with a desert cell



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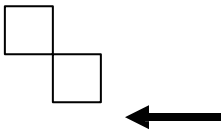

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Table 1.1.

A. # of ur- ban cells	B. # de- sert cells left	Available Habitat											
		Thrasher		BT Sparrow		Wren		Flicker		Inca Dove			
		C. # suit- able cells	D. % of desert cells avail- able (C/B) x100	E. # suit- able cells	F. % of desert cells avail- able (E/B) x100	G. # suit- able cells	H. % of desert cells avail- able (G/B) x100	I. # suita- ble cells	J. % of desert cells avail- able (I/B) x100	K. # suit- able cells	L. % of urban cells available (K/A) x100
10%	90										
20%	80										
40%	60										
60%	40										
80%	20										

Exercise 2.

Assuming that 50% of the desert is to be converted into housing, what are the effects of alternative spatial patterns? Based on what you learned in Exercise 1, rank the relative suitability of each of the Exercise 2 landscapes for your species.

Table 2.1

Clearing Pattern	Rank of Habitat Availability for each Species (1=most available, 6=least available)				
	Thrasher	Sparrow	Wren	Flicker	Inca Dove
A. Checker-board (Uniform)					
B. Random					
C. Dispersed strips					
D. Four areas					
E. Progressive strips					
F. Two areas					

Compare and discuss your results with the class. Which species would have the most available habitat on each map?

Discussion Question:

How would you manage the landscape to best accommodate the habitat requirements of all of the species?

Landscape Maps for Exercise 1

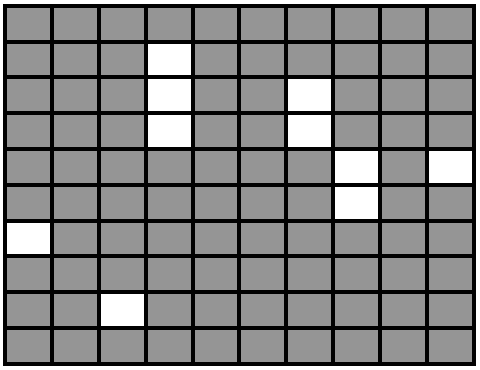
KEY:

Gray cells = desert

White cells = urban

10% = % of desert cleared

10%



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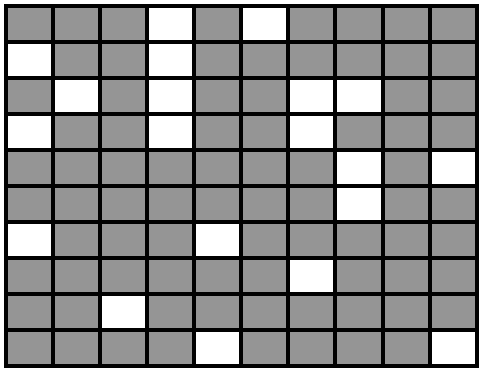

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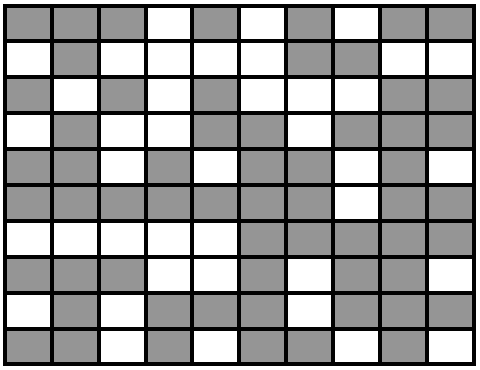

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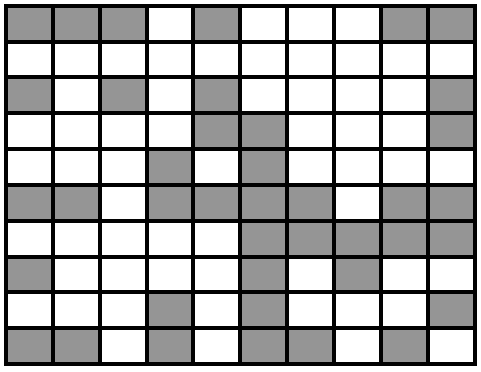

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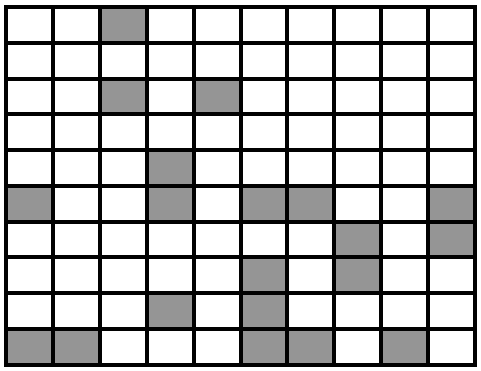
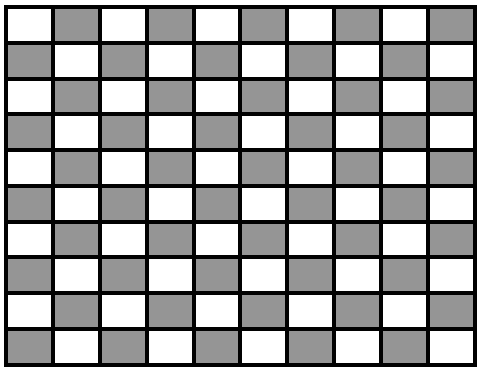


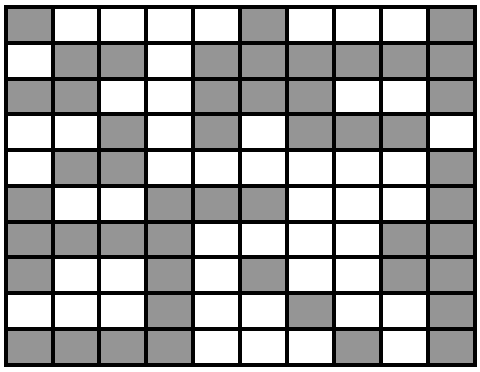
Each of the above landscapes is composed of 100 cells. The progressive placement of clearings was random.

Landscape Maps for Exercise 2

50% A



50% B



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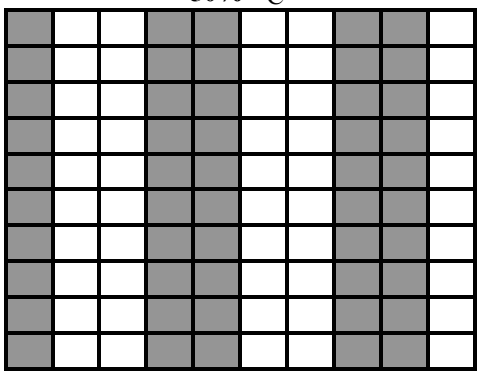

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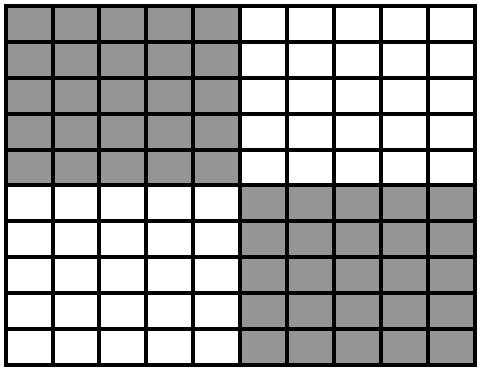

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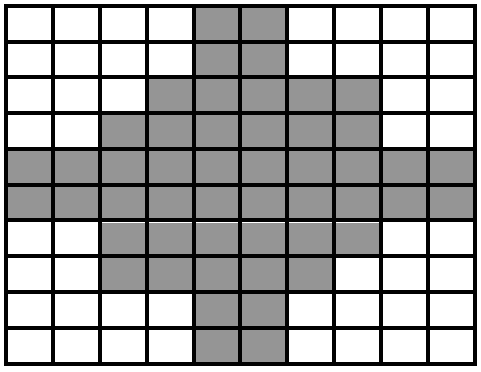

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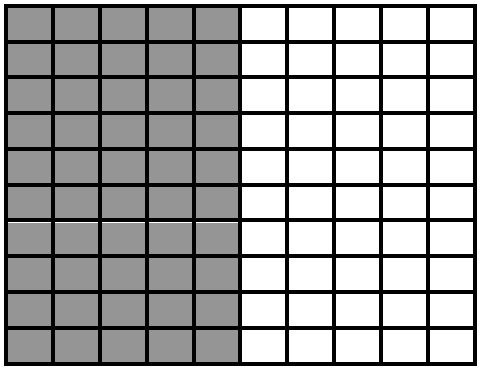

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