

Patches and Passages: Modeling Habitat Loss and Fragmentation

Learning target: I can use a grid model of a landscape to tell habitat loss apart from habitat fragmentation, predict which species can survive, and design a wildlife crossing that reconnects habitat.

Diagrams and models

About 45 min

Individual

MS-LS2-4 · practice

MS-LS2-5 · practice

visual modeling

independent practice

Name

Date

Period

Directions

Figures 1 and 2 are a model of Oak Valley, an invented valley in California. Each square stands for 1 square kilometer. Rows are numbered 1 to 6 from the top and columns 1 to 6 from the left. Oak, Grass and Creek squares are habitat; Houses, Farm and Freeway squares are not. Squares that touch along an edge are connected; squares that touch only at a corner are not. Figure 3 gives each species' needs in this model. Answer Part A by reading the maps, then build your own model in the drawing box, then answer Part C.

You will need: This worksheet, Pencil, Colored pencils (optional), Ruler

The model

Figure 1: Oak Valley in 1950 (model map, 1 square = 1 km²)

Oak	Oak	Oak	Grass	Grass	Oak
Oak	Oak	Creek	Grass	Oak	Oak
Grass	Oak	Creek	Oak	Oak	Grass
Grass	Oak	Creek	Oak	Oak	Oak
Oak	Oak	Creek	Grass	Oak	Oak
Oak	Grass	Creek	Grass	Oak	Oak

All 36 squares are habitat. The creek runs north to south through column 3.

Figure 2: Oak Valley today (model map, 1 square = 1 km²)

Oak	Oak	Oak	Houses	Houses	Oak
Oak	Oak	Creek	Houses	Oak	Oak
Freeway	Freeway	Freeway	Freeway	Freeway	Freeway
Farm	Farm	Creek	Oak	Houses	Houses
Farm	Oak	Creek	Grass	Houses	Houses
Farm	Grass	Creek	Grass	Oak	Houses

Houses, farm fields and a freeway now cover part of the valley. The creek still flows under the freeway through a narrow pipe that animals do not use.

Figure 3: What five Oak Valley species need in this model

simulated data

Bobcat A pair needs at least 10 connected habitat squares of any type. Does not cross the freeway.	Grasshopper sparrow Needs at least 4 Grass squares inside one connected habitat patch (the Grass squares do not have to touch each other). Nests on the ground in open grassland.	California newt Needs a Creek square and at least 2 Oak squares in the same patch. Breeds in water, lives on land.
Acorn woodpecker Needs at least 3 Oak squares in one patch. Flies over houses and roads easily.	Western fence lizard Needs at least 1 Oak or Grass square. Rarely moves more than a few hundred meters.	

Teaching values invented for this model. The species are real California animals, but real habitat needs vary from place to place.

The real version — Freeways surround the Santa Monica Mountains near Los Angeles. Biologists who track mountain lions there found that very few lions cross U.S. Highway 101, and the population has very low genetic diversity. Earlier research found that the same freeway also limited the movement of genes in bobcats and coyotes. A wildlife bridge over Highway 101 at Liberty Canyon in Agoura Hills, planted with native plants, is scheduled to open in late 2026 to connect the mountains with wild land to the north.

Part A: Read the maps

1.

Count the habitat squares in Figure 1 and in Figure 2. What percent of Oak Valley's habitat has been lost? Show the calculation.
-
2.

How many separate habitat patches does Figure 2 have? Give the size of each patch in km² and describe where each one is (for example, 'northwest corner').
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3.

Use Figure 3 to decide whether each species can live in Oak Valley in 1950 and today. For 'today', name the patch or patches where it can live, or write 'none'.

1950: can it live here? (yes/no)	Today: which patch or patches?
Bobcat	
Grasshopper sparrow	
California newt	
Acorn woodpecker	
Western fence lizard	

4.

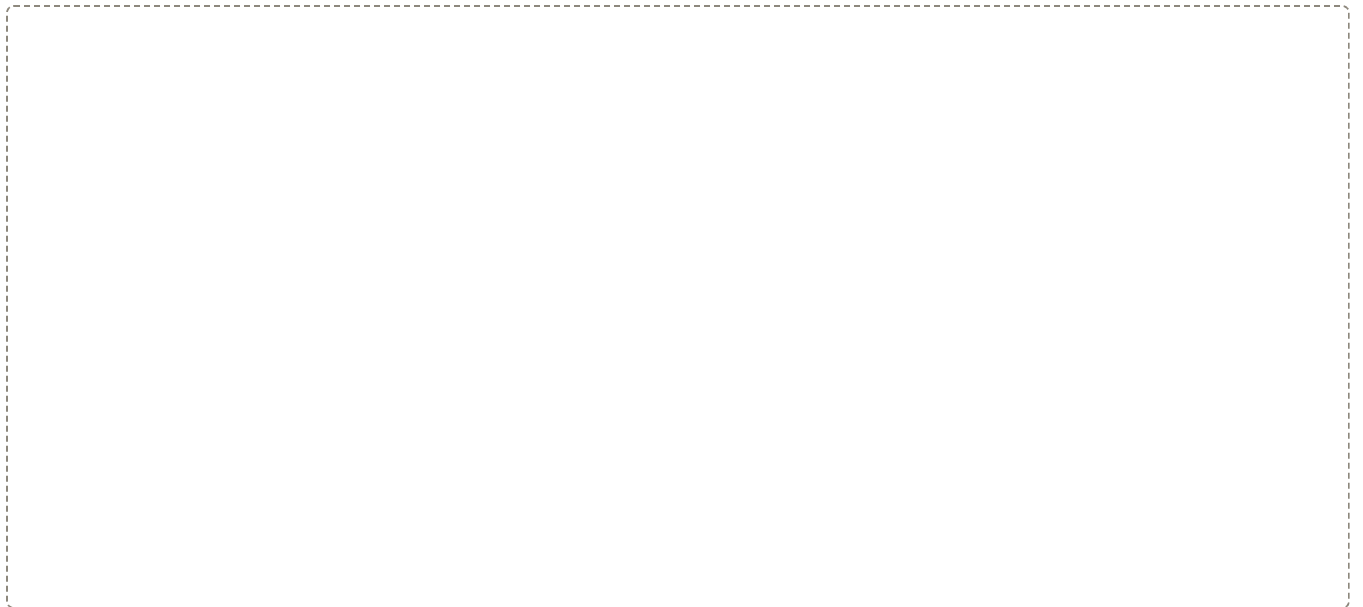
Oak Valley still has 18 habitat squares today, and a bobcat pair needs only 10. Explain why bobcats cannot live there anyway. Is their problem caused mainly by habitat **loss** or by habitat **fragmentation**? Use numbers from the map.
-
5.

Is the grasshopper sparrow's problem caused mainly by habitat loss or by fragmentation? Count the Grass squares in 1950 and today to support your answer.
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6. The fence lizard can still live in every patch. Explain why biologists might still worry about the lizards in the small northeast patch over many generations, even though none are dying from a lack of habitat today.

Part B: Build your model

-  Draw today's map as a 6-by-6 grid (you may abbreviate: O = Oak, G = Grass, C = Creek, H = Houses, F = Farm, W = Freeway). Add ONE wildlife crossing, a bridge over the freeway or a large tunnel under it, in the square where it helps the most. A crossing is not habitat: it only joins the habitat on its two sides. Shade every square that is now part of one connected patch with the crossing, draw arrows to show where animals can move, label the crossing, and write the size of every patch. Then circle any Farm squares the town could restore to grassland, and label them 'restore'.



Part C: Test your design

7. Where did you put your crossing (row and column)? What is the size of the largest connected patch after you add it? Does it meet the bobcat's need? Show how you added the patch sizes.

8. Which species gain from your crossing, and which do not? For any species the crossing does not help, explain why, and say whether restoring the Farm squares you circled would help it. Give the new number of Grass squares in that patch.

9. Explain why only one square in row 3 makes a useful crossing in this model. What does that tell real engineers about choosing where to build a wildlife bridge?

10. Name **two** ways the real Santa Monica Mountains differ from this grid model, and explain how each difference could change the model's predictions.

Counting patches without getting lost

Put your finger on one habitat square and lightly number it 1. Number every habitat square that touches it along an edge, then every square that touches those, until you cannot go further: that is patch 1. Pick a habitat square that has no number yet and start patch 2. When every Oak, Grass and Creek square has a number, count how many squares share each number. Check that the patch sizes add up to the total from q1.

One crossing or two?

The town can afford a second crossing next year, or it can use the same money to restore four Farm squares to grassland. Using the model and Figure 3, decide which choice protects more species, and explain your reasoning. Then propose a sixth species with a need you invent, such as 'needs 6 Oak squares in one patch', that would change your decision, and explain why.