

How Many Bears Can Live in This Forest?

Objectives

Students will (1) define a limiting factor, and (2) describe how limiting factors affect animal populations.

Method

Students become “bears” to look for one or more components of habitat during this physically involved activity.

Materials

Five colors of construction paper (a couple of sheets each of red, yellow, green, blue, and orange) or an equal amount of light poster board or colored tokens; one black felt pen; envelopes (one per student); pencils; one blindfold; five sheets green construction paper (for extension)

Grade Level: 5–8

Subject Areas: Science, Environmental Education, Mathematics

Duration: one 20- to 45-minute session or longer

Group Size: 10 to 45

Setting: outdoors

Conceptual Framework Topic Reference: WPIIA2b, WPIIA2b1, WPIIA2b2

Key Terms: limiting factors, habitat, shelter, cover

Appendices: Simulations, Ecosystem

Background

Black bears are the focus of this activity that illustrates the importance of suitable habitat for wildlife. The activity demonstrates the consequences for a population of bears if one or more habitat components is relatively scarce. When any element or factor in a habitat is inappropriate or exceeds the tolerance range for an animal or population, it directly affects the well-being of the animal(s) and may result in death or population reduction. This factor “limits” the animal or population. Limiting factors may include habitat components such as food, water, shelter, and appropriate space, as well as life history parameters such as disease, predation, and climatic conditions. Limiting factors also may be related to human activity such as development, pollution, and hunting. Populations tend to increase in size until limited by one or more of these factors.

Black bear habitat limits black bear populations, especially through the influences of shelter, food supply, and the social tolerances or territoriality of the animal. Shelter or cover is a prime factor. Black bears need cover—for feeding, hiding, bedding, traveling, raising cubs, and denning. With limits of space, adult bears will kill young bears or run them out of the area. These young bears must keep moving around either until they die or until they find an area vacated by the death of an adult.

When food supplies are reduced by factors such as climatic fluctuations, competition becomes more intense. Some adult bears might temporarily move to seldom-used areas of their home range, sometimes many miles away. They must live on what food is available in the area. These individuals may become thin and in poor

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Number of Cards to Make

Paper Color	Label	Represents	Number of Students in Group						
			10-15	16-20	21-25	26-30	31-35	36-40	41-45
Orange	N-20	Nuts, 20 lbs.	2	3	3	4	5	6	7
Orange	N-10	Nuts, 10 lbs.	8	13	17	21	25	29	33
Blue	B-20	Berries, 20 lbs.	2	3	3	4	5	6	7
Blue	B-10	Berries, 10 lbs.	8	13	17	21	25	29	33
Yellow	I-12	Insects, 12 lbs.	2	3	3	4	5	6	7
Yellow	I-6	Insects, 6 lbs.	8	13	17	21	25	29	33
Red	M-8	Meat, 8 lbs.	2	3	3	4	5	6	7
Red	M-4	Meat, 4 lbs.	8	13	17	21	25	29	33
Green	P-20	Plants, 20 lbs.	2	3	3	4	5	6	7
Green	P-10	Plants, 10 lbs.	8	13	17	21	25	29	33

condition for winter hibernation or, in the case of young bears, be forced from the area by more aggressive adults.

All possible conditions are not covered by the design of the activity. However, by this simple illustration it is possible for students to grasp quickly the essential nature of the concept of "limiting factors"—habitat components that affect the survival of an animal or restrict the numbers or range of an animal population.

Procedure

1. Make a set of 2" x 2" cards from the colored construction paper. Use the chart on this page to determine how many cards of each color to make and what to write on each one.

As shown in the chart, the color of the card determines the type of food it represents:

orange—nuts (acorns, pecans, walnuts, hickory nuts)

blue—berries and fruit (blackberries, elderberries, raspberries, wild cherries)

yellow—insects (grub worms, larvae, ants, termites)

red—meat (mice, rodents, peccaries, beaver, muskrats, young deer)

green—plants (leaves, grasses, herbs)

The number on each card represents the number of pounds of food. For example, a card with the label M-4 represents 4 pounds of meat.

2. The following estimates of total pounds of food needed for one bear for 10 days are used for this activity:

Nuts	20 pounds	(25%)
Berries and fruit	20 pounds	(25%)
Insects	12 pounds	(15%)
Meat	8 pounds	(10%)
Plants	20 pounds	(25%)
	80 pounds	(100%)

NOTE: These figures represent the food of a typical black bear in Arizona. The components of an actual bear's diet will vary between areas, seasons, and years. For example, a bear in the state of Alaska would likely eat more meat (fish) and fewer nuts than a bear in Arizona. One similarity among black bears everywhere is that the majority of their diet is normally made up of vegetable material.

If the teacher follows the table when making the food cards, there should be less than 80 pounds of food per student, so there is actually not enough food in the area for all the "bears" to survive.

It is also possible to include water as a habitat component by making additional squares from light blue paper. To calculate how many water cards to make, multiply the number of students by 1.25 (round to the nearest whole number). For example, for a group of 20 students, make $20 \times 1.25 = 25$ water cards. Divide the water squares into five equal piles (or roughly equal), and mark each group with one of the following letters: R, L, ST, SP, and M. These letters represent all the places where a bear could find water: rivers, lakes, streams, springs, and marshes.

4. In a fairly large open area (e.g., $50' \times 50'$), scatter the colored pieces of paper.
5. Do not tell the students what the colors, initials, and numbers on the pieces of paper represent. Tell them only that the pieces of paper represent various kinds of bear food. Since bears are omnivores—they like a wide assortment of food—and the students should gather different colored squares to represent a variety of food.
6. Have the students write their names on an envelope, which will represent each student's "den site" and should be left on the ground (perhaps anchored with a rock) at the starting line on the perimeter of the field area.
7. Have the students line up on the starting line, leaving their envelopes between their feet on the ground. Give them the following instructions: "You are now black bears. All bears are not alike, just as you and I are not exactly alike. Among you is a young male bear who has not yet found his own territory. Last week he met up with a larger male bear in the big bear's territory and before he could get away, he was hurt. He has a broken leg. (Assign one student as the injured bear and tell him or her to "hunt" by hopping on one leg.) Another bear is a young female who investigated a porcupine too closely and was blinded by the quills. (Assign one student as the blind bear; he or she must hunt blindfolded.) The third special bear is a

mother bear with two fairly small cubs. She must gather twice as much food as the other bears. (Assign one student as the mother bear.)

8. Students must walk into the "forest." Bears do not run down their food; they gather it. When students find a colored square, they should pick it up (one at a time) and return it to their "den" before picking up another colored square. (Bears would not actually return to their den to eat; they would eat food as they find it.)
9. When all the colored squares have been picked up, the food gathering is over. Have students pick up their den envelopes containing the food they gathered and return to class.
10. Explain what the colors and numbers represent. Each color is a kind of food and the numbers represent pounds of food eaten. Ask students to add up the total number of pounds of food they gathered—whether it is nuts, meat, insects, berries, or plant material. Have students write the total weight on the outside of their envelopes.
11. Using a chalkboard, list "blind," "injured," and "mother." Ask the blind bear how much food she acquired. Write the amount after the word "blind." Ask the injured bear and the mother bear how much they acquired and record the information. Ask the other students how much food they found and record each response on the chalkboard. Tell the students each bear needs 80 pounds to survive. Which bears survived? Is there enough to feed all the bears? How many pounds did the blind bear collect? Will she survive? What about the mother bear? Did she get twice the amount needed to survive? What will happen to her cubs? Will she feed her cubs first or herself? Why? What would happen to her if she fed the cubs? What if she ate first? If the cubs die, can she have more cubs in the future, and perhaps richer, years? (The mother bear will eat first and

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the cubs will get whatever, if any, is left. The mother must survive; she is the hope for a continued bear population. She can have more cubs in her life; only one needs to survive for the population to remain static.)

12. If the water squares are included, each student should have picked up at least one square representing a water source or that bear will not survive. Water can be a limiting factor and is an essential component of habitat.
13. Ask students to record how many pounds of each of the five categories of food they gathered. Next, ask each student to convert those numbers into percentages of the total poundage of food each gathered. Provide the students with the background information about black bears so that they can compare their percentages with the typical percentages eaten by black bears in Arizona. Ask students to guess how healthy their bears would be. How do the bears' requirements for a diet seem to compare with the needs of humans for a balanced and nutritious diet?
14. Ask the students to arrive at a class total for all the pounds of food they gathered as bears. Divide the total by the 80 pounds needed by an individual bear (approximately) in order to survive in a 10-day period. How many bears could the habitat support? Why then did only ____ bears survive when your class did this activity? Is that realistic? What percentage of the bears survived? What percentage would have survived had the food been evenly divided? In each case, what percentage would not survive?
15. Ask the students to determine the amount of food tokens that must be added to support all of the bears in this activity. If sufficient food were available for all of the bears, would the population likely increase the following year? Have the students support their answers. Other than food, what factors, natural or human-related, might also limit the growth of the bear population? How would

each of these factors affect the bear population? Could the bear population increase indefinitely if unlimited food were available? Why or why not?

16. Drawing on their discussion, ask the students to try to define the term "limiting factor." Have them suggest examples of limiting factors, cultural and natural, that would be likely to actually influence the survival of other animals and their populations.

Extensions

1. Cut paper or poster board into 2" x 2" squares. Make five squares per student. For example, with a class of 30 students, you would make 150 squares. Divide all the squares into five equal piles and mark the cards in each pile with one of the following letters: B, T, D, H, and F. These represent B = bedding sites, T = travel ways, D = dens, H = hiding cover, and F = feeding sites. For this activity, these terms are defined as follows:

bedding sites: Black bears are usually active in early morning and late evening, and bedded most of the rest of the day and night. Bedding sites are usually in areas of dense vegetation, steep topography, or large trees where the bears feel secure.

travel ways: Bears require corridors of cover (made up of thick vegetation or steep topography) to enable them to travel between areas of food, water, and shelter within their home range.

dens: Black bears use dens as shelter for hibernation from November to April in each year. Bears have been found denning in hollow logs, caves, holes dug into hillsides, under buildings on top of the ground, and even in culvert pipes. Bears often prepare and may use more than one den; they may change dens during the winter because of disturbance or a leaky den. Bears seldom re-use dens from year to year.

hiding cover: Black bears evolved as animals that escape danger from predators and other bears by hiding in thick cover.

feeding sites: Bears often will use areas with less cover than hiding areas or bedding sites for feeding. Feeding sites are, however, often found close to thick hiding cover to allow the bear to quickly escape danger, if necessary.

NOTE: This information is based on actual research data from a study in Arizona. These components of shelter may vary slightly in different parts of North America.

2. In a fairly large open area (e.g., 50' x 50'), scatter the colored pieces of paper.
3. Have the students line up along one side of the area. Tell them that they are to become "bears" for this activity. Review the concept of habitat—that a bear would need shelter, food, water, and space in a suitable arrangement in order to survive. Do not tell the students what the letters on the squares of paper represent. Tell them only that the squares represent one element or component of bear habitat.
4. Direct the students to move as individual "bears" into the area. Each bear must pick up as many of the components of habitat as possible. Some competitive activity is acceptable as long as it is under control. Bears are territorial. Remember that if bears fight, which they seldom do, they can become injured and unable to successfully meet their needs for survival.
5. When the students have picked up all of the squares of paper in the area, have them return to the classroom or be seated in any comfortable area. Ask the students to separate their squares of paper into piles according to the letter on each. Using a chalkboard or large pad for a visual reference, ask the students to predict what the letters on the green cards represent—giving them the clue that each is an element of cover or shelter for a black bear. What kinds of shelter would a bear need? What do those initials represent? Record how many bears acquired at least one of each kind of shelter. How many got only

four kinds? Three? Two? How many got only one kind of shelter? For this activity, only those bears with at least one of each kind of necessary shelter can survive through 1 year.

6. Shelter is a very important part of a bear's habitat. A bear needs shelter in which to search for food and water. Bears also need shelter for traveling through their home range as well as shelter for bedding, hiding, and denning. Ask students why a den is important. (The bear could live from April through October but would not have a secure place to hibernate and might not survive the winter.) Ask the students what would happen if a bear did not have travel ways? (Without travel ways, home ranges become fragmented and bears are not able to reach needed food, water, or other shelter. Without suitable habitat, bears move into marginal habitats and get into trouble with people.)
7. In this activity, how many bears survived? What was a limiting factor for this population of bears? (Shelter.) What other things could possibly become limiting factors? (Water and space—or territory—are two examples.) Could food be a limiting factor for bears? (Yes, however bears are omnivores and can use many sources of food.)
8. Ask the students to summarize what they have learned about the importance of suitable habitat for bears' survival. How are the bears' habitat needs similar to and different from the needs of other animals?

Evaluation

1. Define limiting factor.
 - a. Describe some of the factors that may limit the survival of an animal.
 - b. What might be the consequences to the individual animal and to its population if one of these limiting factors were no longer limiting?