Tundra Puzzler 3

HARD LIFE FOR ARCTIC BROWN BEARS

Background Information

The following information *approximates* the reproduction and **mortality** rates in a population of brown bears living in part of Alaska's arctic tundra. (*Actual mortality figures vary widely.*)

Female brown bears (grizzlies) in tundra areas do not begin producing young until they are eight years old, and then have one litter about every four years. Nearly all female bears have their last litter at about age 20, and die of old age after raising that litter.

In northern tundra areas, female bears give birth to two cubs per litter. On average, half of the cubs born are female.

Young bears have poor **survival rates**. About 40 percent of the cubs die before they are four years old.

For a bear population to remain stable or to grow, each female bear must produce at least one female young that survives to breed. This represents one female bear to replace her when she dies.

Bears four years and older usually have good survival rates. On average, only about 2 percent of these bears die each year from sources other than human-caused mortality. Most of these deaths are the result of accidents, disease, and fights among bears.

Because male bears fight more often than female bears, they have a higher death rate. Female bears five years and older outnumber adult male bears three to two.

The number of bears **harvested** by hunters is limited by regulations. Female bears with cubs cannot legally be killed unless in defense of life or property. Regulations allow people to harvest about 3 percent of the brown bears in a tundra population each year.

The combination of natural deaths and legal harvest of bears by humans means that about 20 percent of the adult females die every four years.

The number of bears killed in defense of life or property cannot be controlled by regulations. It can, however, be minimized by changes in human behavior. Brown bears are **omnivores** and are often attracted to garbage, dog food, birdseed, and campsites where food has been prepared. Changes in human behavior can lessen the frequency with which bears come in contact with people and their property.

In northern Alaska, 70 percent of the bears' natural diet is vegetation. They also feed on ground squirrels, marmots, bird eggs, and caribou and scavenge dead animals. They travel over **home ranges** from 60 to 700 square miles (155-1813 km^2) in search of adequate food supplies.

THE PUZZLE

Based on this background, **(a)** how many cubs could a single female brown bear living in an arctic tundra area produce in her lifetime, if she survived a full life span?
(b) How many of these would survive to age four?
(c) To breeding age (eight years)?
(d) What is the maximum number of female young that 100 female cubs could produce given the above mortality rates? *Calculate how many survive each four-year period of their lives to produce a litter of cubs, then multiply that number by the number of cubs produced. Divide by half to find out the number of females.*
(e) How many of these would survive to breeding age?
(f) Considering the given reproduction and mortality (death) rates, would the bear population remain stable, increase, or decrease?
(g) Imagine yourself as a bear biologist in the arctic with this information. Predict how increasing human populations and development may affect brown bear populations.

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What Ecologists Have Learned

Because of the slow reproductive rates of tundra brown bears, their populations grow slowly even under undisturbed circumstances.

In the example given, **(a)** one female will produce eight cubs in her lifetime, four of which will be females.
(b) Only 2.6 of the females will survive four years.
(c) Only two will survive to breeding age.

(d) If you calculate the survival of the 100 female cubs born, you will find that 40 survive to four years, **(e)** 32 to age eight (when they produce 32 female cubs); 27 to age 12, 22 to age 16, and 18 to age 20. By adding up the number of female cubs produced, (remembering that cubs are only produced every four years on average) you should find that 99 female cubs would be produced by each 100 female cubs born.
(f) This is just barely enough to keep the population stable.

(g) Because bears are wide-ranging and are attracted to human settlements, increasing human populations and development inevitably lead to more human-bear encounters. Because human-bear encounters often result in the bear being killed, the consequence of increasing human populations and development in tundra regions of Alaska is an increase in brown bear mortality.

A bear biologist who found the production and mortality rates given in the example would have to conclude that development could lead to a decline in brown bear populations.

BEAR OUTLOOK

Brown bears formerly ranged throughout the lower 48 states south to Mexico. Today, only two small populations remain in the lower 48 states – one in Yellowstone National Park and the other in the mountains around Glacier National Park.

Human development in bear habitat has been the main cause of brown bears disappearing from their formerly extensive range.

Today, harvest regulations help prevent humans from killing too many bears. As wild areas are developed, however, human-bear encounters increase and so does the number of bears killed by humans.

In tundra regions, where bear production is low and where individual bears must travel vast areas to find adequate food, scientists consider it very likely that increasing development will lead to bear population declines.

The information provided in the example is based on research by the Alaska Department of Fish and Game in northern Alaska. However, the actual reproduction and mortality rates of brown bear populations vary considerably from place to place and year to year. In other environments, reproduction rates are higher. Brown bear populations can withstand low levels of human harvest, but small increases in the number of bears killed can cause a population decline.