

The Ten-Year Puzzle: Hares, Lynx and a Pattern That Almost Repeats

Learning target: I can explain, with evidence from a passage, why predator and prey populations rise and fall in a lagged pattern and why that pattern is a useful tool rather than a fixed law.

Reading with evidence

About 40 min

Individual

MS-LS2-2 · practice

reading

writing

Standards connections

MS-LS2-2 (practice): The passage shows one predator-prey pattern, explains the cause-and-effect behind it and then shows the same shape in other ecosystems with different species. Citing that evidence builds toward explaining and predicting patterns of interaction across ecosystems.

Purpose: build · **Time:** about 40 minutes · **Format:** individual

Answers with reasoning

The Ten-Year Puzzle

[1] For more than a century, fur-trading companies in northern Canada kept records of the pelts trappers brought in each year. The ledgers were meant for business, but ecologists later realized they were a treasure: a year-by-year count, stretching back into the 1800s, of how many Canada lynx were being caught. Plotted on a graph, the numbers did not wander randomly. They rose and fell in waves, with a peak roughly every ten years. The animal the lynx depends on, the snowshoe hare, showed the same kind of waves.

[2] The two species are tightly linked. A snowshoe hare is a rabbit-like animal of the northern forests that eats twigs, buds and bark through the long winter. Hares breed fast: a female can raise several litters in one summer. A Canada lynx is a medium-sized cat whose huge furry paws work like snowshoes. Hares make up most of its diet. When hares are everywhere, lynx eat well and raise more kittens. When hares are scarce, lynx kittens starve and adult lynx may not breed at all.

[3] Put those facts together and the waves make sense. Hares increase first. A year or two later the lynx population catches up, because it takes time for well-fed lynx to raise kittens and for those kittens to grow into hunters. Now there are many lynx and they eat hares faster than hares can replace themselves, so the hare population crashes. With little food, the lynx population crashes next, again a year or two behind. With few lynx left, the surviving hares begin to multiply, and the whole sequence starts over. Each peak in the predator follows a peak in its prey. Ecologists call that delay a lag.

[4] It would be tidy to call it a law, but the waves are not identical. Some peaks are tall and some are small. The spacing is 'about' ten years: sometimes eight, sometimes eleven. Lynx are not the only thing pushing hares down. At the top of a wave, hares have eaten so many twigs and buds that food runs short, and hares that live in constant fear of predators raise fewer young. Hard winters, disease and other predators such as great horned owls and coyotes all add their push. The cycle is a pattern produced by several causes acting together, not a clock.

[5] In the 1980s and 1990s, a team of ecologists in the Kluane region of the Yukon tested which causes mattered most. On some large forest plots they built fences that kept out lynx and other mammal predators. On other plots they put out extra food for hares all year. On a few plots they did both. Extra food alone roughly tripled the number of hares. Fencing out predators alone roughly doubled it. Doing both together raised hare numbers to about eleven times the level on untreated plots. Yet on every plot, even with fences and feeders, the hare population still cycled. Food and predation together drive the waves, and neither one alone explains them.

[6] This story matters far beyond the Yukon because the shape keeps turning up. In the meadows of northern Europe, voles and the owls that hunt them rise and fall in waves a few years apart, with the owls lagging behind. On an island in Lake Superior, wolves and moose have been tracked for decades, and the wolf numbers tend to follow the moose numbers, though disease, ticks and harsh winters bend the pattern. The species are different, the cycle lengths are different, but the lagged rise-and-fall is the same.

[7] That is why ecologists treat the predator-prey pattern as a tool. If they know a predator depends mostly on one prey, they can predict that the predator's numbers will trail the prey's, and they can warn a park manager that a prey crash will be followed by a predator crash. What they cannot do is promise the exact year or the exact size of the next peak, because weather, food and disease always have a vote. A pattern that repeats across ecosystems is powerful evidence that the same cause-and-effect links are at work everywhere. It is not a guarantee that any single ecosystem will behave on schedule.

Questions: cite the passage

1. According to paragraph 1, where did the long-term lynx data come from, and what did ecologists see when they graphed it?

Answer: The data came from fur-trading company records of how many lynx pelts trappers brought in each year, going back into the 1800s. When graphed, the numbers rose and fell in waves with a peak roughly every ten years.

Why: Paragraph 1 gives both the source (pelt records) and the finding (regular waves, about ten years apart).

Also acceptable: Accept 'business records of pelts.'

- Names fur or pelt records
- Describes waves or peaks about every ten years

2. Suppose hares in one forest peaked in 1990 and the cycle followed the pattern in paragraphs 1 and 3 exactly. In what year or years would you expect the lynx peak, and how many hare peaks would you expect between 1990 and 2030? Show your reasoning with numbers from the passage.

Answer: Lynx peak: paragraph 3 says the lynx catches up 'a year or two later,' so 1991 or 1992. Hare peaks: paragraph 1 says a peak roughly every ten years, so from 1990 to 2030 is 40 years, $40 \div 10 = 4$ cycles, giving peaks in 1990, 2000, 2010, 2020 and 2030. That is 5 peaks if you count both ends, or 4 new peaks after 1990.

Why: The lag and the spacing both come from the passage. Either 4 or 5 is acceptable if the counting rule is stated. The word 'exactly' in the prompt removes the irregularity for this calculation; q4 brings it back.

Also acceptable: Accept 1991-1992 for the lynx peak. Accept 4 or 5 hare peaks with the counting explained.

3. Explain the **lag** in your own words. Use paragraph 3 to say what has to happen inside the lynx population before its numbers can rise.

Answer: The lag is the delay between a change in the prey and the matching change in the predator. Before lynx numbers can rise, well-fed lynx have to raise kittens and those kittens have to grow into hunters, which takes a year or two; so the lynx peak comes after the hare peak.

Why: Full credit needs the idea that the predator's increase depends on reproduction and growth, which take time.

Also acceptable: Accept 'lynx have to breed and the young have to grow before they count as hunters.'

- Defines lag as a delay between prey change and predator change
- Mentions raising kittens or kittens growing up

4. Paragraph 4 says the cycle is 'not a clock.' Quote one sentence from that paragraph that supports this, and list two causes other than lynx that push hare numbers down.

Answer: Possible quotes: 'the waves are not identical'; 'The spacing is about ten years: sometimes eight, sometimes eleven'; 'The cycle is a pattern produced by several causes acting together, not a clock.' Other causes: food running short at the top of a wave, fear of predators reducing the number of young, hard winters, disease, other predators such as great horned owls and coyotes.

Why: Any one supporting sentence plus any two non-lynx causes earns full credit.

Also acceptable: Close paraphrase of the quote is acceptable if the paragraph number is given.

- A quoted sentence from paragraph 4 about irregularity or multiple causes
- Two causes other than lynx

5. In the Kluane experiment (paragraph 5), what happened on the plots with extra food only, with fences only, and with both? Include the numbers.

Answer: Extra food only: hare numbers roughly tripled (about 3 times). Fences only (predators kept out): roughly doubled (about 2 times). Both together: about eleven times the number on untreated plots. On all plots the hares still cycled.

Why: The three results and their numbers are stated in paragraph 5; the 'still cycled' observation is needed for q6.

Also acceptable: Accept '×3, ×2, ×11.'

- Three treatments with the correct multipliers
- Mentions that the cycle continued

6. The hares on the fenced-and-fed plots still cycled. Explain what that result tells ecologists about the cause of the waves, and why a scientist could not have learned it from the fur records alone.

Answer: It tells ecologists that food and predation each matter, that together they matter far more than either alone, and that even removing both does not stop the cycle, so other causes (such as fear effects, weather or disease, from paragraph 4) also drive the waves. The fur records only show that lynx and hare numbers go up and down together; they cannot show which cause produces the waves. Only an experiment that changes one thing at a time on real plots can separate the causes.

Why: The answer should connect the experimental result to cause-and-effect and contrast an observed pattern (records) with a controlled test (plots).

Also acceptable: A student who says the records are 'correlation, not cause' has the key idea.

- States that both food and predation drive the waves
- States that the continued cycling points to additional causes
- Explains that records show a pattern but cannot isolate a cause

7. Paragraph 6 gives two other ecosystems. Name the predator and prey in each, and state the one feature all three ecosystems share.

Answer: Northern Europe: owls (predator) and voles (prey). Island in Lake Superior: wolves (predator) and moose (prey). Shared feature: in all three the predator's rise and fall lags behind the prey's rise and fall.

Why: Paragraph 6 names both pairs and states that the lagged rise-and-fall is the same even though species and cycle lengths differ.

Also acceptable: Accept 'the predator follows the prey' for the shared feature.

- Both pairs named with roles
- Lagged rise-and-fall identified as the shared feature

8. The passage calls the pattern 'a tool' but 'not a guarantee.' Using evidence from at least two different paragraphs, explain what a park manager **can** predict from the pattern and what they **cannot**.

Answer: Can predict: that a predator which depends mostly on one prey will rise and fall after the prey does (paragraph 3, paragraph 7), so a prey crash will be followed by a predator crash, and that this holds in other ecosystems with different species (paragraph 6). Cannot predict: the exact year of the next peak or its exact size, because the spacing varies (paragraph 4: sometimes eight, sometimes eleven years) and weather, food and disease 'always have a vote' (paragraph 7).

Why: Full credit needs evidence from at least two paragraphs and a clear split between the direction-and-order of changes (predictable) and timing-and-size (not predictable).

Also acceptable: A student who frames it as 'the pattern predicts the order of events, not the calendar' has the idea.

- Something the manager can predict, with a paragraph cited
- Something the manager cannot predict, with a paragraph cited
- Evidence from at least two different paragraphs

Teacher notes

The passage is about 690 words. The historical and scientific content is real: the Hudson's Bay Company pelt records are the classic source for the roughly ten-year lynx cycle; lynx peaks trail hare peaks by about one to two years; and the Kluane Lake experiments (Yukon, 1980s-1990s) found that food addition roughly tripled hare density, predator exclusion roughly doubled it, and the two together raised it about elevenfold

while the cycle continued. The multipliers are rounded; do not present them as exact. The passage deliberately states that the textbook's smooth, regular waves are an idealization: real cycles vary in height and spacing and have several causes. The Lake Superior island is Isle Royale, where the textbook's account also simplifies; the passage names ticks, disease and winters as bending the pattern. If students ask what 'fear' has to do with breeding, say that stressed hares produce fewer and smaller litters, a result from the same research program.

Scaffold offered to students: Mark the four stages first

In paragraph 3, underline the four stages of the cycle in order: hares up, lynx up, hares down, lynx down. Write the numbers 1 to 4 in the margin beside each. Questions 2, 3 and 6 all depend on seeing that the lynx stages come after the hare stages. For question 5, draw a quick three-column table (food, fences, both) and copy the number from the passage into each column before you write.

Extension: Design the next experiment

The Kluane team tested food and predators. The passage also says that hares living in fear raise fewer young, and that hard winters matter. Choose one of those two causes and design a fair test for it on forest plots: what you would change, what you would keep the same, what you would count, and how long you would run it. Then explain in two sentences why a ten-year cycle makes this kind of experiment slow and expensive.