

Why Are the Quail Disappearing? A Claim-Evidence-Reasoning Case

Learning target: I can use population data to decide which kind of interaction explains a decline, support the claim with specific evidence, and use the pattern of that interaction to predict what will happen next and what a manager should do.

Claim, evidence, reasoning

About 45 min

Individual

MS-LS2-2 · assesses

writing

data analysis

Standards connections

MS-LS2-2 (assesses): Students construct an explanation that identifies a predatory interaction from data, rules out competition and parasitism with evidence, and uses the known pattern of predation to predict the outcome of a management action; this is the explanation-that-predicts the PE asks for, applied to one ecosystem with a comparison to others in the reasoning.

Purpose: assess · **Time:** about 45 minutes · **Format:** individual

Answers with reasoning

The scenario

Pine Hollow Preserve is a 2,000-hectare area of oak woodland and grassy slopes in the California foothills. It was set aside partly to protect a population of mountain quail, a ground-nesting bird that eats seeds and berries. Six years ago the preserve's biologist, Dr. Okafor, started a yearly survey. In the first year, a few red foxes were seen on the preserve for the first time; red foxes are not native to this part of California and probably came from animals released or escaped decades ago elsewhere in the state. Quail numbers have fallen every year since. The preserve's board wants to know why, and what to do. Three explanations are on the table: **(1)** the foxes are eating the quail (predation); **(2)** ground squirrels, which also eat seeds, are taking the quail's food (competition); **(3)** feather lice, which live on the quail and feed on their skin and feathers, are weakening the birds (parasitism). The dataset below is a teaching dataset invented for this case; the numbers are realistic but were not measured on a real preserve.

Pine Hollow Preserve yearly survey (teaching dataset)

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

Year	Quail counted	Red foxes (adults on cameras)	Ground squirrels counted	Fall seed supply (kg per hectare)	Quail carrying feather lice (%)
1	420	2	600	31	12
2	400	3	610	29	14
3	390	8	590	33	11
4	300	14	620	30	13
5	210	18	600	32	12
6	150	20	610	31	14

Simulated data for teaching. Quail and squirrels are counted on fixed survey routes; foxes are counted from camera traps; seed supply is measured in fall; lice are checked on captured quail.

Two more field notes — Note A: In years 5 and 6, the biologist examined 40 fox droppings; quail feathers were found in 24 of them. Note B: Quail nests on the ground were monitored with cameras in year 6; of 30 nests, 19 were raided, and foxes were recorded at 17 of the raided nests.

Warm-up: organize the evidence

1. Which columns changed a lot over the six years, and which stayed about the same? Give the first-year and sixth-year values for each column you name.

Answer: Changed a lot: quail fell from 420 to 150; foxes rose from 2 to 20. Stayed about the same: ground squirrels (600 to 610, always between 590 and 620); seed supply (31 to 31 kg/ha, always 29-33); quail with lice (12% to 14%, always 11-14%).

Why: The dataset was built so that only the two columns involved in predation move; the competition and parasitism columns are flat within normal variation.

Also acceptable: Accept 'roughly steady' with the range given.

- Quail and foxes identified as changing with values
- Squirrels, seed and lice identified as flat with values

2. Calculate the percent change in quail from year 1 to year 6, and the number of foxes in year 6 compared with year 1 as a ratio (year 6 ÷ year 1). Show your work.

Answer: Quail: $(150 - 420) \div 420 \times 100 = -270 \div 420 \times 100 = -64$ percent (a 64% decrease). Foxes: $20 \div 2 = 10$, so there are 10 times as many foxes in year 6 as in year 1.

Why: $-270/420 = -0.643$. The fox ratio is exact.

Also acceptable: Accept -64.3% or 'fell by about 64%'. Accept 'ten times more foxes'.

3. For each of the three explanations, name the column (or field note) that tests it, and say whether that evidence supports or weakens the explanation.

Answer: Predation: tested by the fox column and Notes A and B; foxes rose from 2 to 20 as quail fell, quail feathers were in most fox droppings and foxes were recorded at most raided nests, so the evidence supports it. Competition: tested by the squirrel and seed columns; squirrels stayed about 600 and seed stayed about 31 kg/ha, so the shared resource did not shrink and the competitor did not grow, which weakens it. Parasitism: tested by the lice column; the share of quail with lice stayed at 11-14%, so the parasite load did not rise, which weakens it.

Why: Each explanation has a column that would have moved if it were true; only the predation columns moved.

Also acceptable: A student who notes that a steady lice percentage of a shrinking population means fewer infected birds overall is reasoning carefully.

- Correct column or note for each explanation
- Correct support/weaken judgment for each with a value

4. From Note A, calculate the percent of fox droppings that contained quail feathers. From Note B, calculate the percent of raided nests where a fox was recorded.

Answer: Note A: $24 \div 40 \times 100 = 60$ percent of droppings contained quail feathers. Note B: $17 \div 19 \times 100 = 89$ percent of raided nests had a fox recorded.

Why: $24/40 = 0.60$; $17/19 = 0.895$, rounds to 89% (or 90%).

Also acceptable: Accept 89% or 90% for Note B.

Your argument

Answer: Claim: The quail decline is best explained by predation: red foxes (+) are eating mountain quail (–), especially their eggs and chicks at ground nests. Evidence: (1) Quail fell from 420 to 150, a 64% drop, over the same six years that foxes rose from 2 to 20, ten times as many; the two columns move in opposite directions, which is the predation fingerprint. (2) Quail feathers were in 60% of fox droppings (24 of 40), so foxes are eating quail. (3) Foxes were recorded at 89% of raided nests (17 of 19), so foxes are destroying nests, which cuts the number of new quail. (4) Ground squirrels stayed at about 600 and seed supply stayed at about 31 kg/ha, so the competitor did not increase and the shared food did not shrink; this rules out competition. (5) The share of quail with lice stayed at 11-14%, so parasite load did not rise; this rules out parasitism.

Reasoning: In predation, the predator gains and the prey loses, and when a new predator population grows, its prey population falls, as seen with carnivores and their prey in ecosystems everywhere. The data match that pattern exactly: the predator went up tenfold and the prey went down by two-thirds, and the diet and nest evidence show the link directly. Competition would have left a different fingerprint: either more squirrels or less seed, and neither happened. Parasitism would have shown a rising share of infected quail, and it did not. The same thing would be expected on any preserve where a new ground predator arrives and finds a ground-nesting bird, because the cause-and-effect link, more predators meaning more prey eaten, does not depend on which species are involved; that is why foxes, cats and rats introduced to islands have reduced ground-nesting birds in many places.

Why: This is the solved model response. Full credit needs a claim naming both species with symbols, at least four evidence items with numbers and their rule-in/rule-out role, and reasoning that uses the predation pattern, explains the missing fingerprints of the other two interactions, and generalizes to another ecosystem.

Also acceptable: A student who adds that quail in constant danger may nest less often (a fear effect) is extending the claim correctly. A student who claims competition because 'squirrels are more numerous than quail' has confused size of population with change in population and should not get credit for the claim.

- Claim names predation, red fox (+) and mountain quail (–)
- At least four evidence items with numbers from the table or notes
- Each evidence item states what it supports or rules out
- Reasoning uses the predation pattern (predator up, prey down)
- Reasoning explains why competition and parasitism do not fit
- Reasoning predicts the same pattern in another ecosystem with a new predator

After the argument

5. The board can afford one action: trap and remove foxes, put out extra seed, or treat quail for lice. Recommend one, predict what the quail and fox numbers will do over the next three years if your claim is right, and describe one possible side effect on another species in the preserve.

Answer: Recommend trapping and removing foxes, because the evidence points to predation. Prediction if the claim is right: fox numbers fall quickly as they are removed; quail stop falling within a year and begin to rise over the following two years as more nests succeed, perhaps back toward 300-400 if removal continues. Possible side effects: with fewer foxes, mice and ground squirrels (which foxes also eat) may increase and compete harder with quail for seeds; or another predator such as a coyote or bobcat may fill the gap. Extra seed would not help because seed is not short; lice treatment would not help because lice did not rise.

Why: The recommendation must follow from the claim and the prediction must use the pattern (remove predator, prey recovers). A side effect shows awareness that interactions ripple.

Also acceptable: A student who recommends fox removal plus nest protection (fencing or cages) is giving a stronger plan. A student who chooses extra seed must argue from evidence; the table gives none.

- Recommendation matches the claim
- Prediction for quail and foxes over three years
- A plausible side effect on a third species

6. Describe one result from next year's survey that would make you doubt your claim, and explain why.

Answer: Examples: foxes are removed but quail keep falling at the same rate (the predator was not the main cause); fox droppings next year contain no quail feathers (foxes are not eating quail); the lice percentage jumps to 40% (parasitism now matters); seed supply crashes (competition for food now matters). Any of these would mean another cause is at work.

Why: The item checks that the student can state in advance what evidence would overturn the claim.

Also acceptable: Accept 'quail recover even though foxes were not removed' as a doubting result.

- A specific future result
- An explanation of why it conflicts with the claim

Scoring rubric

Criterion	4 • Exemplary	3 • Proficient	2 • Developing	1 • Beginning
Claim	Names predation and both species, with the correct + and – effect on each, in one clear statement.	Names predation and the fox-quail pair but omits or muddles the effect symbols.	Names predation without the species, or names a species pair with the wrong interaction.	No claim, or a claim unrelated to the data.
Evidence	Four or more specific pieces of evidence with numbers, including at least one that rules out competition and one that rules out parasitism.	Four pieces of evidence, but one lacks a number or does not say what it supports or rules out.	Two or three pieces of evidence, or evidence that only supports the claim without ruling anything out.	Evidence missing, invented, or contradicted by the table.

Reasoning	Uses the predation pattern explicitly, explains the missing fingerprints of competition and parasitism, and predicts the same pattern in another ecosystem with a new predator.	Uses the predation pattern and explains why one other explanation fails, but does not generalize to other ecosystems.	Restates the evidence without naming the pattern, or names the pattern without linking it to the numbers.	No reasoning, or reasoning that misreads the data (for example, treating a large squirrel count as evidence of competition).
Scientific language and accuracy	Uses predation, predator, prey, competition, parasitism and population correctly; percent and ratio calculations are correct.	Terms mostly correct; one minor slip in a term or a rounding error.	Several terms used loosely (for example, parasite for predator), or a calculation error that affects the argument.	Scientific language absent or consistently wrong.

Teacher notes

The dataset and field notes are simulated. They were built so that predation is the only explanation whose fingerprint appears: the predator column rises tenfold while the prey falls 64%, the diet and nest notes confirm the link, and the competition and parasitism columns are flat. Mountain quail are a real California ground-nesting bird and non-native red foxes are a real conservation concern for ground-nesting birds in parts of the state, but no real preserve or survey is being described. Common error: students treat the large squirrel count (about 600) as proof of competition; the question is whether the competitor or the shared resource changed, and neither did. If students ask whether foxes will crash after the quail, use the extension: red foxes are generalists, so the predator-prey loop may not swing back on its own, which is the conservation reason for intervening.

Scaffold offered to students: Fingerprint table before writing

On scrap paper, make three rows labeled predation, competition and parasitism. For each row, write what you would **expect** to see in the data if that explanation were true: for predation, a predator rising while prey falls and prey remains in the predator's diet; for competition, the competitor rising or the shared resource shrinking; for parasitism, the share of infected quail rising. Then write what the table actually shows next to each expectation. The row where expectation and data match is your claim; the rows where they do not match are evidence against the other explanations.

Extension: The predator-prey loop, interrupted

If foxes depend mostly on quail, the predator-prey pattern says the fox population should crash after the quail crash. But red foxes also eat mice, insects, fruit and garbage. Write a paragraph explaining why a predator with many food sources can keep its numbers high even as one prey species disappears, what that means for the quail if nobody intervenes, and why conservation scientists worry more about this situation than about a specialist predator.