

Twenty-Nine Reindeer: Boom and Crash on St. Matthew Island

Learning target: I can use evidence from a passage and a data table to explain how a limiting resource allowed a population to boom, then caused it to crash, and why a carrying capacity is not a fixed number.

Reading with evidence

About 40 min

Individual

MS-LS2-1 · practice

MS-LS2-4 · supports

reading

writing

data analysis

Standards connections

MS-LS2-1 (practice): Students interpret real population counts alongside a description of the resource (winter lichen) that limited the herd, and explain the effects of abundant and then scarce resources. The data are few, so this builds the practice rather than fully assessing it.

MS-LS2-4 (supports): The reindeer's grazing changed the island's lichen cover, a biological component, and that change affected the population. Students read about this chain here; they argue from it later in the chapter.

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

Answers with reasoning

Twenty-Nine Reindeer

[1] St. Matthew Island sits alone in the Bering Sea, over 300 kilometers from the Alaska mainland. It is roughly 50 kilometers long, treeless, cold and windy, and no one lives there. During the Second World War the United States Coast Guard ran a small radio navigation station on the island. In 1944, to give the crew an emergency food supply, the Coast Guard shipped in 29 reindeer, 24 females and 5 males, and set them loose. Soon after the war ended the station was closed, the crew left, and the reindeer stayed behind with the whole island to themselves.

[2] For a reindeer, the island looked like a feast. In summer there were grasses, sedges and willows. In winter, when snow covered the ground, there was something even more important: a thick carpet of lichen, a slow-growing partnership of fungus and algae that reindeer dig for and eat through the cold months. Lichen is the resource that gets reindeer through an Arctic winter, and on St. Matthew Island, which had never had reindeer before, the lichen mat had been building up for centuries. There were no wolves or bears on the island, and no hunters. Every resource a reindeer needs was abundant, and nothing was eating reindeer.

[3] The herd did what populations do when a needed resource is abundant: it grew. A biologist who visited in 1957 counted about 1,350 animals, and he noted that they were fat and healthy, heavier on average than reindeer on the mainland. In 1963 a survey counted about 6,000 reindeer. In nineteen years, 29 animals had become six thousand. But the same biologist saw something worrying on that visit. Across much of the island the lichen carpet was cropped short, trampled and broken. Six thousand

mouths were taking lichen far faster than lichen can grow back, and the animals were already thinner than they had been in 1957.

[4] Here is the key idea. The island's summer food was still plentiful, so during the warm months there was no shortage. The winter food, lichen, was the resource that ran short first. Scientists call the resource that runs out first the limiting resource, because it, not the other resources, sets the limit on how many animals the area can support. For the St. Matthew reindeer, the limiting resource was winter lichen, and by 1963 the herd had grown past what the lichen could feed.

[5] The winter of 1963 to 1964 was unusually severe, with deep snow that made the remaining lichen even harder to reach. Thousands of animals that were already thin could not find enough to eat. When the biologist returned in the summer of 1966, he counted 42 reindeer: 41 females and a single male, all in poor condition. The population had fallen by more than 99 percent in about three years. The crash was not caused by a disease or a predator. It was caused by a resource shortage that the herd itself had created, made worse by a hard winter.

[6] The story also shows that an area's carrying capacity, the number of animals its resources can keep supporting over time, is not carved in stone. Before the reindeer arrived, the island's deep lichen mat could probably have fed a much smaller herd for many years if the herd had stayed near that size. But lichen grows only a few millimeters a year, and the overgrazed mat could not recover quickly. After the crash, the island could support far fewer reindeer than it could have in 1944, because the limiting resource itself had been damaged. With only one male left, the tiny herd never recovered, and by the 1980s there were no reindeer on St. Matthew Island at all.

[7] Ecologists still use this island as a clear example of what happens when a population grows without a check: a boom, an overshoot past the carrying capacity, and a crash. In most places, predators, disease, competition from other species and migration slow a population down before it climbs so high. On St. Matthew none of those brakes existed, so the only brake left was the resource itself, and that brake came on all at once. The numbers tell the story: 29, 1,350, 6,000, 42.

Reindeer counts on St. Matthew Island (real counts, rounded as reported)

Year	Reindeer counted	Notes from the surveys
1944	29	24 females and 5 males released by the Coast Guard
1957	about 1,350	Animals fat and heavier than mainland reindeer; lichen still deep in most places
1963	about 6,000	Lichen cropped and trampled over much of the island; animals thinner
1966	42	41 females and 1 male, all in poor condition, after the severe winter of 1963-64

These are the counts reported by the wildlife biologist who studied the herd; the 1957 and 1963 figures are survey estimates.

Questions: cite the passage

1. According to paragraphs 1 and 2, why were the reindeer brought to the island, and what three things made the island a good place for a reindeer population to grow? Give the paragraph numbers.

Answer: They were brought as an emergency food supply for the Coast Guard station crew (paragraph 1). The island was good for growth because food was abundant (summer plants and, especially, a centuries-old lichen mat for winter), there were no predators (no wolves or bears), and there were no hunters (paragraph 2).

Why: Paragraph 1 gives the reason for the introduction; paragraph 2 lists abundant resources and the absence of predators and hunters.

Also acceptable: Accept 'no one lived there' as the no-hunting point, and 'the lichen had been building up for centuries' as the abundant-food point.

- Emergency food for the crew
- Three favorable factors: abundant food/lichen, no predators, no hunting
- Paragraph numbers given

2. Using the table, calculate how many times larger the 1963 population was than the 1944 population. Round to the nearest whole number and show your division.

Answer: $6,000 \div 29 \approx 206.9$, so the 1963 population was about 207 times larger than in 1944.

Why: Straight division of the two counts. Because 6,000 is an estimate, 'about 200 times' is an acceptable rounding if the division is shown.

Also acceptable: Accept 207 or 'about 200 times' with the division shown.

3. Paragraph 4 says lichen, not summer grass, was the limiting resource. Explain in your own words what makes a resource 'limiting,' and quote the words from paragraph 4 that define it.

Answer: A limiting resource is the one that runs out first, so it decides the maximum population even when every other resource is still plentiful. Quote: 'the resource that runs out first the limiting resource, because it, not the other resources, sets the limit on how many animals the area can support.'

Why: Students should capture both parts: it runs short first, and it alone sets the ceiling.

Also acceptable: A student who explains it as 'the weakest link' in the reindeer's needs has the idea.

- Runs short first
- Sets the limit even though other resources are abundant
- Quote or close paraphrase from paragraph 4

4. Between 1957 and 1963 the herd grew from about 1,350 to about 6,000. Calculate the average increase in reindeer per year over those six years. Show your work.

Answer: $(6,000 - 1,350) \div 6 \text{ years} = 4,650 \div 6 = 775$ reindeer per year on average.

Why: The subtraction gives the total increase; dividing by the six years between the surveys gives the average yearly increase. The real growth was not steady (it was faster as the herd got bigger), which is why the answer is an average.

Also acceptable: Accept 'about 780 per year' if the student rounds the estimates; accept 7 years (664 per year) only if the student explains counting both 1957 and 1963 inclusively, and then correct the convention.

5. Paragraph 5 says the crash had two causes working together. Name both, give evidence from paragraphs 3 and 5 for each, and explain why the severe winter alone would probably not have caused such a huge crash if the herd had been small.

Answer: Cause 1: the herd had overgrazed its limiting resource. Evidence: by 1963 the lichen carpet was 'cropped short, trampled and broken' and the animals were 'already thinner' (paragraph 3); the shortage was one 'the herd itself had created' (paragraph 5). Cause 2: the severe winter of 1963-64 with deep snow made the little remaining lichen even harder to reach (paragraph 5). A small herd would have had plenty of lichen per animal and would have gone into winter fat, so even with deep snow most animals could have found enough or lived off their body reserves; the winter was deadly because the herd was already far past what the lichen could feed.

Why: Full credit needs both causes, evidence for each from the right paragraphs, and the reasoning that the winter's effect depended on the herd size relative to the resource.

Also acceptable: A student who frames it as 'the winter was the trigger, the overgrazing was the cause' is reasoning well.

- Names overgrazing of lichen and the severe winter
- Evidence from paragraph 3 and paragraph 5
- Explains that a small herd would have had enough lichen per animal

6. Paragraph 6 argues that carrying capacity 'is not carved in stone.' Using the lichen's growth rate, explain why the island could support fewer reindeer after the crash than before the reindeer arrived.

Answer: Lichen grows only a few millimeters a year, so once the deep mat was cropped and trampled it could not rebuild for many years. The carrying capacity depends on how much lichen is available each winter; with a damaged, thin mat, far fewer reindeer could be fed through a winter than when the mat was centuries deep in 1944.

Why: The point is that the limiting resource itself was reduced, so the capacity fell. Carrying capacity tracks the resource supply, not the land area.

Also acceptable: Accept 'the reindeer ate the capital, not just the interest' or similar if explained.

- Cites the slow lichen growth
- Links damaged lichen to a lower number of animals that can be supported

7. Paragraph 7 lists four 'brakes' that usually slow a population before it overshoots. Name them, and state which ones were missing on St. Matthew Island according to the passage.

Answer: The four brakes are predators, disease, competition from other species, and migration. The passage says the island had no wolves or bears (no predators) and no other large grazers are mentioned (no competing species), and because it is an isolated island the reindeer could not migrate. It does not say disease was present; the crash 'was not caused by a disease.'

Why: Paragraph 7 lists the brakes; paragraphs 2 and 5 supply the evidence that predators, competition and migration were absent and disease was not the cause.

Also acceptable: Accept 'all four were missing' if the student notes the passage says disease did not cause the crash.

- All four brakes named
- Correctly identifies which were missing with passage evidence

8. In many classroom experiments, a population of yeast or duckweed grows quickly, slows, and then levels off at a steady number. The reindeer did not level off; they overshoot and crashed. Using evidence from at least two paragraphs, explain what was different about the reindeer's situation, and what the island story teaches about the difference between a resource being **abundant now** and a resource being **renewed as fast as it is used**.

Answer: In a jar of yeast or a tub of duckweed, the population runs short of a resource that is used up at about the same rate it becomes available (space, light, or a steady food supply), so growth slows gradually and levels off near the carrying capacity. The reindeer were living on a stored supply: the lichen mat had been 'building up for centuries' (paragraph 2) but 'grows only a few millimeters a year' (paragraph 6). Because the stored supply was huge, the herd kept growing as if the resource were unlimited, past the number the yearly lichen growth could support; by 1963 the lichen was 'cropped short, trampled and broken' (paragraph 3). When the stored supply ran out, the population fell far below the old level instead of leveling off. The lesson: a resource that is abundant right now can still be a limiting resource if it is not renewed as fast as it is used, and a population that grows on a stored supply will overshoot and crash rather than settle.

Why: This is the synthesis item. Full credit requires evidence from two or more paragraphs, the contrast between leveling off and overshoot, and the stored-versus-renewed distinction.

Also acceptable: A student who adds that the absence of predators removed the other brakes (paragraph 7) is giving a strong additional reason.

- Evidence from at least two paragraphs
- Contrasts gradual leveling with overshoot and crash
- Explains the difference between a stored supply and a renewed supply

Teacher notes

The passage is just under 700 words. The history is real and taken from the published study of the herd by wildlife biologist David Klein (Journal of Wildlife Management, 1968): 29 reindeer (24 females, 5 males) released in 1944; about 1,350 in 1957; about 6,000 in 1963; 42 (41 females, 1 male) in 1966 after the severe 1963-64 winter; heavy lichen depletion observed in 1963; the herd gone by the 1980s. The 1957 and 1963 figures are survey estimates, so answers rounded to 'about 200 times' or 'about 780 per year' are fine when the work is shown. Lichen growth of a few millimeters per year is a typical figure for reindeer lichens. Avoid the older textbook story of the Kaibab deer, which is historically disputed; St. Matthew is the better-documented case. Students sometimes conclude that 'carrying capacity' was 6,000 because that was the peak; use q6 and q8 to correct this: the peak was an overshoot, and the sustainable number was lower and fell further after the damage.

Scaffold offered to students: Track the numbers and the resource together

On scrap paper draw a two-row timeline: 1944, 1957, 1963, winter 1963-64, 1966, 1980s. On the top row write the reindeer count at each date. On the bottom row write one or two words about the lichen at that date (deep, cropped, buried by snow, damaged). Most of the questions ask you to connect the top row to the bottom row, so having both in front of you makes the answers easier to find.

Extension: Could it have been managed?

Suppose the Coast Guard had kept a crew on the island and wanted the herd to last for a century. Using the passage's numbers, propose a target herd size and a rule for how many reindeer to remove each year, and explain how you would use measurements of the lichen mat (not just counts of reindeer) to decide whether the target is too high. Then explain in a paragraph why counting the limiting resource is often a better early warning than counting the population.