Population Limits Lab

Name _____

Date _____

Period _____

mrsajdak.com/populations · Low-write · © Ryan Sajdak · CC BY-NC-SA 4.0

No population grows forever. A **limiting factor** is anything that keeps a population from growing bigger. Find the limits in four real cases.

☐ I can use a pond model's numbers to tell exponential (J-curve) growth from logistic (S-curve) growth.

☐ I can use the St. Matthew Island reindeer numbers to explain overshoot and a population crash.

Part 1. Duckweed pond (Tab 1)

SEP 5 Using Math · CCC Scale and Quantity

Set each row, then press **Skip to the end**. **Your runs** keeps the numbers.

CLUE: A **J** curve keeps shooting up. An **S** curve rises, then levels off.

1. Write the numbers. Circle J or S.

Settings	Plants on day 10	Plants on day 30	Curve
Limits OFF · 200 m² · normal			**J S**
Limits on · 200 m² · normal			**J S**
Limits on · 400 m² · normal			**J S**
Limits on · 200 m² · fertilizer runoff			**J S**

2. With limits on at 200 m², the plants level off near _____. This is the _____.

WORD BANK carrying capacity · range of tolerance · overshoot

Example: density = plants ÷ area. 600 plants ÷ 100 m² = 6 plants per m².

Day 30 density: _____ plants ÷ 200 m² = _____ plants per m².

READ FIRST. In the lab, find the **Learn It** box under the graph and read it. Then answer 3 and 4.

3. A bigger pond and fertilizer runoff both raised the top number. So the limits were _____ and _____. **WORD BANK** space · nutrients · sunlight hours · predators

4. Turn on **Early frost** . It kills 6 of every 10 plants, crowded or not. Frost is:
☐ density-dependent ☐ density-independent

I know because frost hurts the plants the same whether the pond is _____.

Part 2. Reindeer island (Tab 2, St. Matthew)

SEP 4 Analyzing Data · CCC Stability and Change

Press **Run**. Watch the island, the reindeer line and the lichen line. Black dots are the real counts.

5. Write the model's numbers under the real counts.

Year	1957	1963	1966
Real count	1,350	about 6,000	42
Model			

Example: 1,000 reindeer ÷ 100 = 10 times the carrying capacity of 100.

6. Highest count _____ ÷ carrying capacity _____ = _____ times too many.

7. Lichen left in 1963: _____%. Uncheck **The hard winter** . Reindeer in 1966: _____.

Hard winter back on. Check **Wolves on the island** . The curve is: ☐ J ☐ S Lichen left in 1990: _____%.

READ FIRST. In the lab, find the **Learn It** box under the graph and read it. Then answer 8 and 9.

8. Growing past the carrying capacity is called _____. It happened because the island had lots of stored lichen and no _____. **WORD BANK** overshoot · logistic growth · predators · snow

9. With no hard winter, did it still crash? ☐ yes ☐ no Real limit: ☐ the winter ☐ the food Food is:
☐ density-dependent ☐ density-independent

With wolves the lichen lasts, because wolves keep the herd _____ the carrying capacity.

WORD BANK above · below · equal to

☐ I can use survival numbers to find a range of tolerance and say why too much or too little limits.

☐ I can match survivorship curves to r- and K-selected species and say which is most at risk.

Part 3. Trout tanks (Tab 3)

SEP 3 Investigating · CCC Cause and Effect

Every tank starts with 20 brook trout. Only the pH is different. Run all 30 days.

10. Write how many trout are alive in each tank on day 30.

pH	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
Alive													

CLUE: Optimum range = all 20 lived. Zone of stress = some died. Zone of intolerance = none lived.

11. Optimum range: pH _____ to _____. No trout lived at pH _____ and pH _____.

READ FIRST. In the lab, find the **Learn It** box under the graph and read it. Then answer 12 and 13.

12. Why is this good evidence that pH **caused** the deaths? Tick one.

☐ Only the pH was different. Everything else was the same.

☐ There were a lot of tanks.

☐ Trout are the state fish.

13. Some Adirondack lakes are about pH 4.8 from acid rain. Brook trout there will:

☐ thrive ☐ mostly die ☐ not change

My data: at pH 4.5, _____ lived, and at pH 5.0, _____ lived.

Part 4. Life strategies (Tab 4)

SEP 4 Analyzing Data · CCC Patterns

Run **Survivorship**, then **Recovery**. Use the **Life facts** box too.

14. Write the three numbers now. Circle the last two columns after the Learn It box.

Species	Alive at 10%	Alive at 50%	Years to recover	Curve type (circle)	Circle
Black bears				late · constant · early	r K
American robins				late · constant · early	r K
Yellow perch				late · constant · early	r K

READ FIRST. In the lab, find the **Learn It** box under the graph and read it. Then circle the last two columns and answer 15.

CLUE: r-selected = many young, little care. **K-selected** = few young, lots of care.

15. A disease kills most of all three in one year. Most likely to go extinct:

☐ black bears ☐ robins ☐ yellow perch

Because it took _____ years to recover, and each mother has only _____.

Wrap it up

SEP 7 Argument from Evidence · CCC Stability and Change

16. Claim: No population can grow forever.

Evidence 1: In the pond, the duckweed stopped at about _____ plants.

Evidence 2: On St. Matthew Island, the reindeer went from _____ to _____.

Reasoning: Both populations ran out of _____.

WORD BANK resources (space, food) · time · predators · eggs

NYSSLS: building toward HS-LS2-1, HS-LS2-2 and HS-LS2-6 (DCI LS2.A; LS2.C). Environmental Science, Chapter 5, Lesson 5.3: What Limits the Growth of Populations? SEP = Science and Engineering Practice, CCC = Crosscutting Concept.