Name_____

DATA Nugget

Live fast, die young?

Featured scientists: Kaitlyn Holden (she/her) and Anne Bronikowski (she/her) from Michigan State University

Research Background:

Garter snakes are a common sight across North America, but one small species in Northern California has helped scientists learn a lot about how animals adapt to their environment. Since 1972, a long lineage of scientists has studied these snakes and passed their data down through generations. This long-term dataset allows scientists to ask questions about how replicate populations change over time.

Kaitlyn holding snakes from the lakeshore (right) and mountain (left) snake populations.

These garter snakes live in two very different types of habitats. Some populations live along **lakeshores at low elevations**. These areas have rocky shorelines, warmer temperatures, and steady access to water and food like small fish and frogs. However, these snakes also face more predators. Other populations live in **high-elevation mountain meadows**. These habitats are cooler and covered in grass. Water and food are not always available and can change each year depending on snow and rain. Because these habitats are so different, the snakes in each place experience different challenges.

Over time, these differences have led to the evolution of two distinct ecotypes. **Ecotypes** are groups within a species that have adapted to their local environment. The lakeshore and meadow snakes differ in both their physical traits and their genetics. They also differ in how they grow, reproduce, and survive—traits known as **life history strategies**.

Life history strategies are often described along a spectrum from “fast” to “slow.” Lakeshore snakes have a “fast” life history. They grow quickly, reach adulthood sooner, are larger at adulthood, and produce larger and more frequent litters of offspring. In contrast, meadow snakes have a “slow” life history. They grow more slowly, reach adulthood later, have a smaller body size, and have fewer, less frequent litters.

Name_____

Low Elevation – Lake Snakes

Grow Fast
Large Size
Early Maturation (2 years)
Large Litters (mean = 8)
Short-lived (median = 4 years)

High Elevation – Meadow Snakes

Grow Slow
Small Size
Delayed Maturation (4-5 years)
Small infrequent Litters (mean = 4)
Long-lived (median = 9 years)

Kaitlyn became interested in these snakes after a surprising start to her career. Interested in reptiles since childhood, she originally moved to Texas to join a lab that was studying turtles. Unfortunately, only a few weeks in, the grant money supporting her position fell through - right after she moved from Wisconsin to Texas! Luckily, another researcher invited her to join a lab studying snakes. After earning her Master's degree, Kaitlyn continued this work during her PhD with her collaborator, Anne.

Kaitlyn and Anne wanted to understand how these snake populations are surviving today, especially after years of severe drought in California. They wondered if survival rates had changed over time and whether snakes in lakeshore and meadow habitats survived differently.

To answer these questions, Anne and Kaitlyn wanted to take a fresh look at snake survival rates. They went out into the field to collect their own data, and compared their estimates to over 50 years of prior data collection. Both the historic and current data were collected using the method called **capture-mark-recapture**. In this method, researchers catch snakes, measure traits like size and weight, and give each snake a unique mark before releasing it back into the wild. If a snake is caught again later, scientists can track how it has grown. Not all snakes are recaptured. These data can be used to estimate survival rates, though some snakes may have moved away or avoided being caught.

Because it is hard to know the exact age of each snake, Kaitlyn grouped them into four age classes based on size: **neonates** (newborns), **juveniles**, **young adults**, and **old adults**. She then used statistical models to use her capture-mark-recapture dataset to estimate the probability of survival for each group. Kaitlyn predicted that meadow snakes, with their "slow" life history strategy, would have higher survival rates than lakeshore snakes. She also expected this difference to be greatest in young snakes.

Name_____

Scientific Questions: Does the probability of survival differ between the garter snake ecotypes? Is this true for all age classes?

What is the hypothesis? Find the hypothesis in the Research Background and underline it. A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.

Scientific Data:

Use the data below to answer the scientific questions:

Dataset	Year Marked	Year Recaptured	Ecotype	Age	Probability of Survival	Lower confidence interval (CI)	Upper confidence interval (CI)
Current	2010	2019	High elevation - Meadow	Neonate	0.10		
Current	2010	2019	High elevation - Meadow	Juvenile	0.36	0.28	0.46
Current	2010	2019	High elevation - Meadow	Young Adult	0.67	0.60	0.73
Current	2010	2019	High elevation - Meadow	Old Adult	0.82	0.75	0.88
Current	2010	2019	Low elevation - Lake	Neonate	0.10		
Current	2010	2019	Low elevation - Lake	Juvenile	0.34	0.29	0.41
Current	2010	2019	Low elevation - Lake	Young Adult	0.61	0.61	0.69
Current	2010	2019	Low elevation - Lake	Old Adult	0.62	0.77	0.84
Historic	1978	1988	High elevation - Meadow	Neonate	0.10		
Historic	1978	1988	High elevation - Meadow	Juvenile	0.35	0.24	0.46
Historic	1978	1988	High elevation - Meadow	Young Adult	0.65	0.48	0.73
Historic	1978	1988	High elevation - Meadow	Old Adult	0.81	0.48	0.74
Historic	1978	1988	Low elevation - Lake	Neonate	0.10		
Historic	1978	1988	Low elevation - Lake	Juvenile	0.17	0.13	0.23
Historic	1978	1988	Low elevation - Lake	Young Adult	0.46	0.39	0.54
Historic	1978	1988	Low elevation - Lake	Old Adult	0.73	0.66	0.78

Name_____

What data will you graph to answer the questions?

Independent variable: _____

_____

Dependent variable: _____

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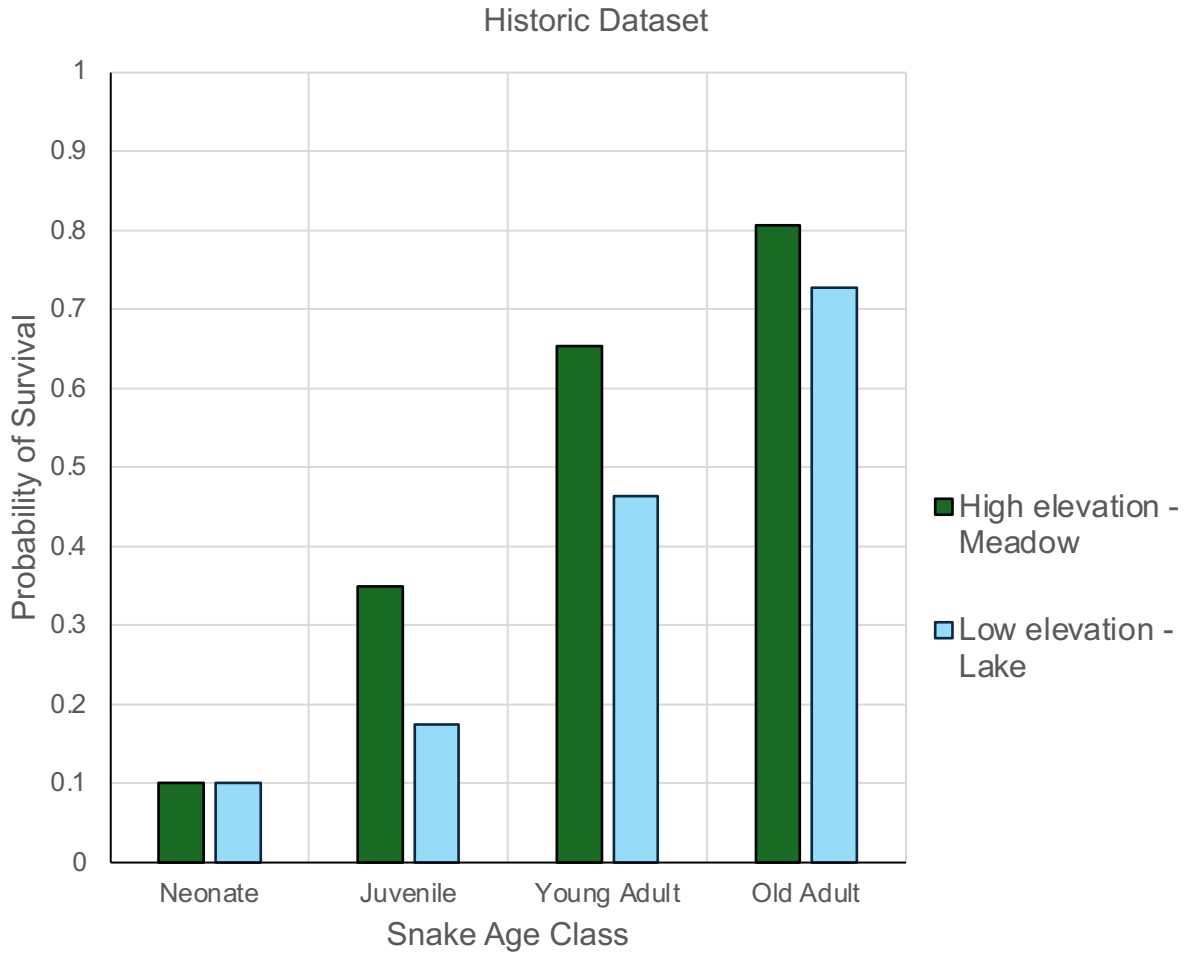
Below is a graph of the data: Identify any changes, trends, or differences you see in your graph. Draw arrows pointing out what you see and write one sentence describing what you see next to each arrow.



Name_____

Interpret the data:

Make a claim that answers the scientific questions - Does the probability of survival differ between the garter snake ecotypes? Is this true for all age classes?

What evidence was used to write your claim? Reference specific parts of the table or graph.

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about the differences between garter snake ecotypes at low and high elevations.

Name_____

Did the data support Kaitlyn's hypothesis? Use evidence to explain why or why not. If you feel the data are inconclusive, explain why.

Your next steps as a scientist: Science is an ongoing process. What new question(s) should be investigated to build on Kaitlyn and Anne's research? How do your questions build on the research that has already been done?