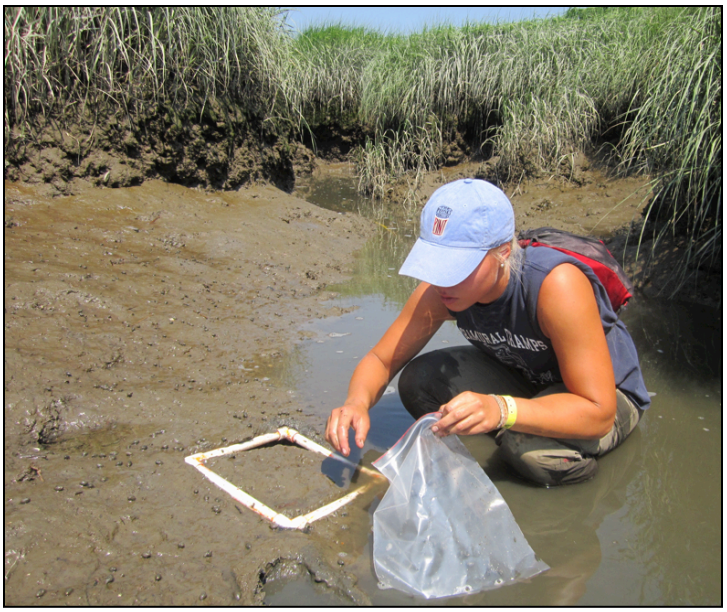
Name_____

DATA Nugget

The mystery of Plum Island Marsh

Featured scientist: Harriet Booth from Northeastern University

Research Background:



Harriet counting and collecting mudsnails in a 0.25m^2 quadrat. Harriet is in a mudflat at low tide.

Salt marshes are among the most productive coastal ecosystems. They support a diversity of plants and animals. Algae and marsh plants use the sun's energy to make sugars and grow. They also feed many invertebrates, such as snails and crabs, which are then eaten by fish and birds. This flow of energy through the food web is important for the functioning of the marsh. Also important for the food web is the cycle of matter and nutrients. The waste from these animals, and eventually their decaying bodies, recycle matter and nutrients, which can be used by the next generation of plants and algae. Changes in any links in the food chain can have cascading effects throughout the ecosystem.

Today, we are adding large amounts of fertilizers to our lawns and agricultural areas. When it rains, these nutrients run off into our waterways, ponds, and lakes. If the added nutrients end up in marshes, marsh plants and algae can then use these extra nutrients to grow and reproduce faster. Scientists working at Plum Island Marsh wanted to understand how these added nutrients affect the marsh food web, so they experimentally fertilized several salt marsh creeks for many years. In 2009, they noticed that fish populations were declining in the fertilized creeks.

Fertilizer does not have any direct effect on fish, so the scientists wondered what the fertilizer could be changing in the system that could affect the fish. That same year they also noticed that the mudflats in the fertilized creeks were covered in mudsnails, far more so than in previous years. These mudsnails eat the same algae that the fish eat, and they compete for space on the mudflats with the small invertebrates that the fish also eat. The scientists thought that the large populations of mudsnails were causing

the mysterious disappearance of fish in fertilized creeks by decreasing the number of algae and invertebrates in fertilized creeks.

A few years later, Harriet began working as one of the scientists at Plum Island Marsh. She was interested in the mudsnail hypothesis, but there was yet no evidence to show the mudsnails were causing the decline in fish populations. She decided to collect some data. If mudsnails were competing with the invertebrates that fish eat, she expected to find high densities of mudsnails and low densities of invertebrates in the fertilized creeks. In the summer of 2012, Harriet counted and collected mudsnails using a quadrat (shown in the photo) and took cores down into the mud to measure the other invertebrates in the mudflats of the creeks. She randomly sampled 20 locations along a 200-meter stretch of creek at low tide. The data she collected are found below and can help determine whether mudsnails are responsible for the disappearance of fish in fertilized creeks.

View of a mudflat at low tide in the Plum Island Marsh, Massachusetts.

Scientific Question: Is there any evidence that mudsnails are causing the decline in fish populations through their effects on invertebrate populations?

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.

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Draw a food web for the creek ecosystem:

1. Include **algae**, **snails**, **invertebrates**, and **fish** in your food web. Write out the name of each species and put a box around it.
2. Add arrows to connect the boxes. Arrows represent the interactions between the players in the ecosystem. For example, you can use arrows to show who eats who, or to show competition between different species. Use the direction of the arrow to show the direction of the relationship.
3. Once you have drawn your arrows, label them with the type of interaction. For example, label an arrow with the words "eaten by" if the arrow connects a species to the species that consumes it.
4. As your final step, draw a box labeled "**fertilizer**" and draw and arrow to show where fertilizer enters the food web.

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Scientific Data:

Use the data below to answer the scientific question:

Year	Creek Type	Habitat	Density of Mudsnails (snails/m^2)	Density of Invertebrates (invertebrates/m^2)
2012	Fertilized	Mudflat	16	1462
2012	Fertilized	Mudflat	0	0
2012	Fertilized	Mudflat	32	4972
2012	Fertilized	Mudflat	16	0
2012	Fertilized	Mudflat	0	3802
2012	Fertilized	Mudflat	0	0
2012	Fertilized	Mudflat	0	0
2012	Fertilized	Mudflat	160	5556
2012	Fertilized	Mudflat	0	0
2012	Fertilized	Mudflat	144	1462
2012	Control	Mudflat	0	0
2012	Control	Mudflat	16	0
2012	Control	Mudflat	16	0
2012	Control	Mudflat	48	0
2012	Control	Mudflat	0	0
2012	Control	Mudflat	0	1169
2012	Control	Mudflat	0	292
2012	Control	Mudflat	16	2047
2012	Control	Mudflat	0	0
2012	Control	Mudflat	0	292

	Average Snail Density (snails/m^2)	Average Invertebrate Density (invertebrates/m^2)
Fertilized Mudflats		
Unfertilized Control Mudflats		

What data will you graph to answer the question?

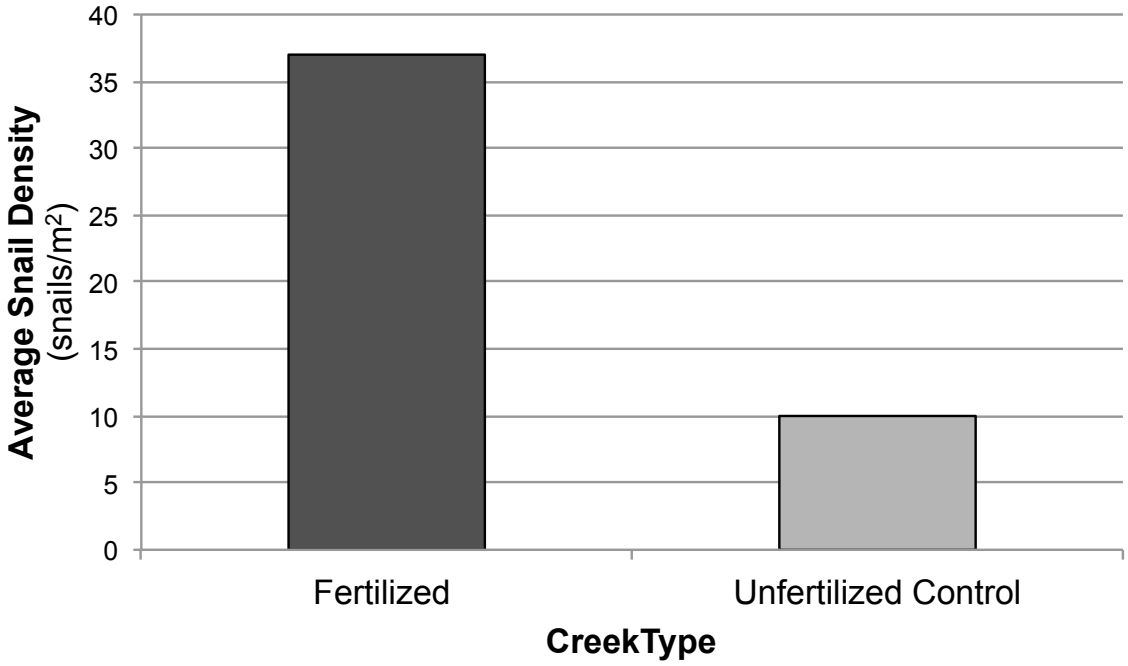
Independent variable: _____

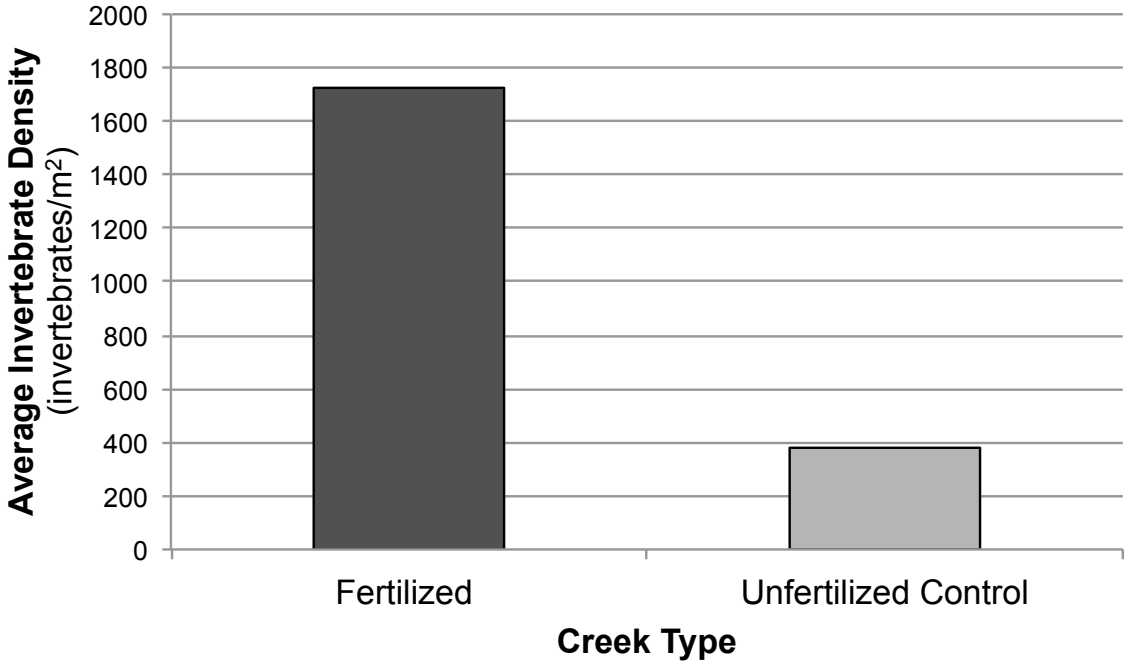
Dependent variables: _____

_____

Name_____

Below are graphs 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.





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Interpret the data:

Make a claim that answers the scientific question.

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

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about the salt marsh food web and how fertilizer may affect the system.

Did the data support Harriet's "mudsnail hypothesis"? Use evidence to explain why or why not. If you feel the data was inconclusive, explain why.

Your next steps as a scientist: Science is an ongoing process. What new question(s) should be investigated to build on Harriet's research? What future data should be collected to answer your question(s)?