Name_____

DATA Nugget

Mangroves on the move

Featured scientists: Candy Feller from the Smithsonian Environmental Research Center and Emily Dangremond from Roosevelt University

Research Background:

All plants need nutrients to grow. Sometimes one nutrient is less abundant than others in a particular environment. This is called a **limiting nutrient**. If the limiting nutrient is given to the plant, the plant will grow in response. For example, if there is plenty of phosphorus, but very little nitrogen, then adding more phosphorus won't help plants grow, but adding more nitrogen will.

Candy (right) and Emily (left) measure the height of a black mangrove growing in the saltmarsh.

Saltmarshes are a common habitat along marine coastlines in North America. Saltmarsh plants get nutrients from both the soil and the seawater that comes in with the tides. In these areas, fertilizers from farms and lawns often end up in the water, adding lots of nutrients that become available to coastal plants. These fertilizers may contain the limiting nutrients that plants need, helping them grow faster and more densely.

One day while Candy, a scientist, was out in a saltmarsh in northern Florida, she noticed something that shouldn't be there. There was a plant out of place. Normally, saltmarshes in that area are full of grasses and other small plants—there are no trees or woody shrubs. But the plant that Candy noticed was a mangrove. **Mangroves** are woody plants that can live in saltwater, but are usually only found in tropical places that are very warm. Candy thought the closest mangrove was miles away in the warmer southern parts of Florida. What was this little shrub doing so far from home? The more that Candy and her colleague Emily looked, the more mangroves they found in places they had not been before.

Candy and Emily wondered why mangroves were starting to pop up in northern Florida.

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Previous research has shown nitrogen and phosphorus are often the limiting nutrients in saltmarshes. They thought that fertilizers being washed into the ocean have made nitrogen or phosphorus available for mangroves, allowing them to grow in that area for the first time. So, Candy and Emily designed an experiment to figure out which nutrient was limiting for saltmarsh plants.

For their study, Candy and Emily chose to focus on black mangroves and **saltwort** plants. These two species are often found growing together, and mangroves have to compete with saltwort. Candy and Emily found a saltmarsh near St. Augustine, Florida, in which they could set up an experiment. They set up 12 plots that contained both black mangrove and saltwort. Each plot had one mangrove plant and multiple smaller saltwort plants. That way, when they added nutrients to the plots they could compare the responses of mangroves with the responses of saltwort.

To each of the 12 plots they applied one of three conditions: control (no extra nutrients), nitrogen added, and phosphorus added. They dug two holes in each plot and added the nutrients using fertilizers, which slowly released into the nearby soil. In the case of control plots, they dug the holes but put the soil back without adding fertilizer.

A black mangrove growing in northern Florida.

Candy and Emily repeated this process every winter for four years. At the end of four years, they measured **plant height** and **percent cover** for the two species. Percent (%) cover is a way of measuring how densely a plant grows, and is the percentage of a given area that a plant takes up when viewed from above. Candy and Emily measured percent cover in 1x1 meter plots. The cover for each species could vary from 0 to 100%.

Scientific Questions: What is the limiting nutrient for mangroves and saltwort? Is the same nutrient limiting to both species?

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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Scientific Data:

Use the data below to answer the scientific questions:

Plot	Treatment	Mangrove height (cm)	Saltwort height (cm)	Mangrove % cover	Saltwort % cover
1	Control	69	28	36	29
2	Control	80	32	47	22
3	Control	90	34	60	15
4	Control	108	41	68	9
5	Nitrogen	93	41	63	18
6	Nitrogen	105	46	78	6
7	Nitrogen	112	48	89	3
8	Nitrogen	124	51	94	0
9	Phosphorus	71	23	40	24
10	Phosphorus	81	31	55	22
11	Phosphorus	83	32	64	11
12	Phosphorus	87	38	68	12

		Mean mangrove height (cm)	Mean saltwort height (cm)	Mean mangrove % cover	Mean saltwort % cover
Means	Control				
	Nitrogen				
	Phosphorus				
SE	Control	8.3	2.7	7.1	4.3
	Nitrogen	5.8	2.3	4.5	2.7
	Phosphorus	4.4	2.5	3.9	2.7

**Standard error (SE) tells us how confident we are in our estimate of the mean and depends on the number of replicates in an experiment and the amount of variation in the data. When there is lower replication and higher variation, SE bars are large. A large SE means we are not very confident, while a small SE means we are more confident.*

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What data will you graph to answer the questions?

Independent variable(s): _____

_____

Dependent variable(s): _____

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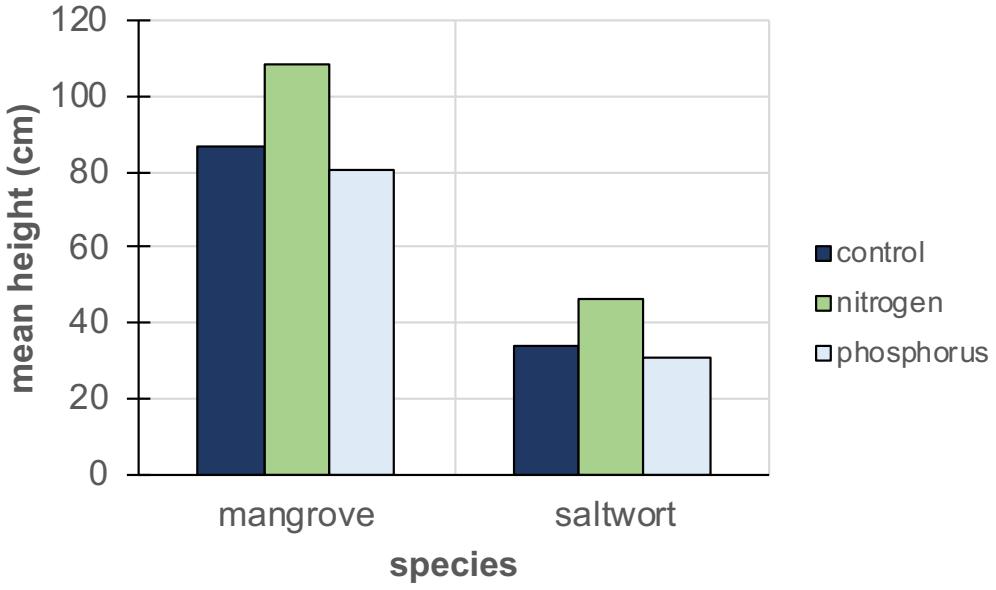
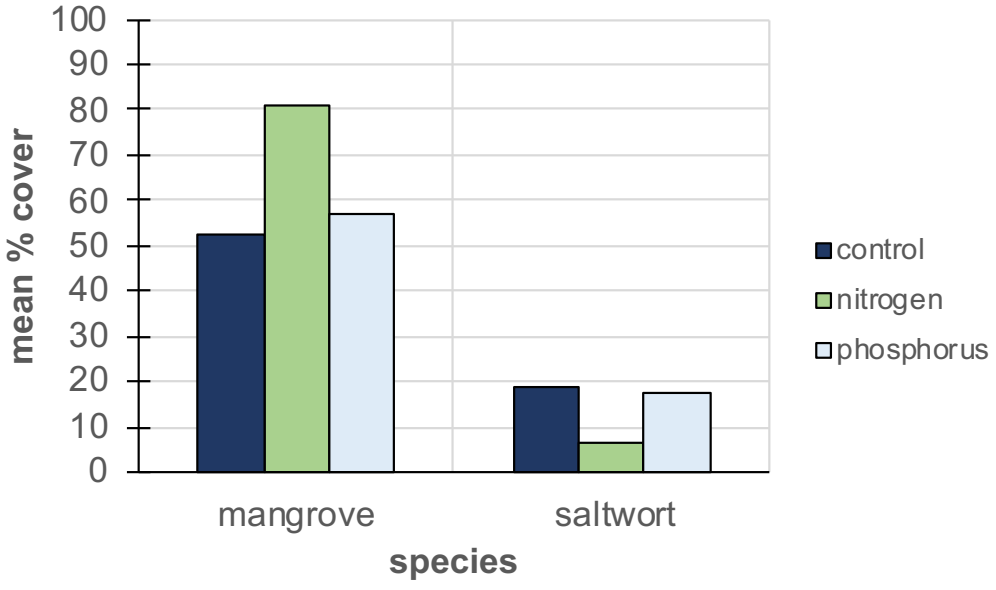
Below are graphs of the data: Identify any changes, trends, or differences you see in your graph(s). Draw arrows pointing out what you see, and write one sentence describing what you see next to each arrow.





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Interpret the data:

Make a claim that answers each of the scientific questions.

What evidence was used to write your claims? Reference specific parts of the tables or graph(s).

Explain your reasoning and why the evidence supports your claims. Connect the data back to what you learned about how limiting nutrients affect plant growth.

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Did the data support Candy and Emily's 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 do you think should be investigated? What future data should be collected to answer your question?