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DATA Nugget

The prairie burns with desire

Featured scientist: Stuart Wagenius from the Chicago Botanic Gardens

Written by: Harrison Aakre

Research Background:

Fire plays a crucial role for prairie habitats across North America. Native Americans have long observed that lush and green pastures grow after a wildfire. In many areas, it is part of current and historical native culture to imitate this natural process by deliberately burning the prairie in a controlled way. This land management practice has many benefits, such as helping native grasses form seeds, thinning out plants, and enhancing habitat for prairie animals. By using controlled fires to cultivate these areas, Native Americans increase the availability of food and connect to the environment and their cultural traditions.

Stuart showing an *Echinacea* flower setting seed.

Some land management agencies plan prescribed burns to increase the health of prairie ecosystems. However, fire is still suppressed in many North American prairies due to the possible damage to human development. In these areas, scientists have observed that fire suppression contributes to local plant species extinctions, but we do not know why.

Stuart is a scientist interested in how fire can help prairie plants. In the late 1990s, Stuart was in central Minnesota searching for prairie plants in the *Echinacea* **genus**. The prairie was ablaze with flowers, so he had no difficulty finding plenty of plants. He tagged each plant so that he could study them again in the future. However, when he returned the following year, the field had almost no flowers! He kept returning to this same field. A few years later he found the site was again filled with flowers. That year there had been a prairie fire. Visually seeing the impacts of fire on the landscape is a memory he will not forget.

Stuart became interested in learning more about how fire affects the reproduction of native prairie plants. He knew that *Echinacea* plants grow in many places, but they have a hard time making seeds. This genus cannot self-pollinate, meaning they must be

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fertilized with pollen from a genetically different plant. *Echinacea* plants are also dependent on insects, such as bees, to pollinate them.

Researchers in the field collecting data on *Echinacea.*

In 1996, a research team started collecting data on *Echinacea* plants in a large research site in Minnesota. This prairie site had a schedule for **prescribed burns**, or controlled fires that are started by experts to manage the land. These burns would happen every 4-6 years during the spring.

The team established a set of plot locations that they visited each summer. They searched for and mapped the location of all flowering *Echinacea* plants within these plots. They took measurements on each *Echinacea* plant – whether it was flowering, and the distance to its second closest *Echinacea* neighbor.

Echinacea flower

Stuart decided to take a new look at this long-term dataset. He had two ideas for how fire might be helping *Echinacea* plants. First, fire might help all the plants get on the same schedule and make flowers at the same time. This **synchrony**, or flowering at the same time, could help pollen get from one flower to another. Second, fire might remove competing plants from the area, opening up bare ground for new seeds to establish. This would allow *Echinacea* plants to be closer to one another, again making it easier for pollen to move between flowers.

With these data, Stuart could compare years with and without prescribed burns to see whether fire helped *Echinacea* flowering. To look at whether fire decreased the space between blooming *Echinacea* plants, he looked at the distance between a focal plant and its second-closest neighbor. To see whether fire increased the synchrony of flowering, Stuart used the data to calculate the proportion of *Echinacea* plants that were in bloom during the summer sampling period.

Scientific Question: How does fire affect the flowering synchrony and distance between *Echinacea* plants?

What is the hypothesis? Find the two hypotheses in the Research Background and underline them. 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 question:

Location	Year	Burned or Unburned	Average distance to second nearest flowering *Echinacea* (m)	Proportion of plants in flower
west	1996	burned	1.9	0.69
west	1997	unburned	2.8	0.12
west	1998	unburned	14.5	0.05
west	1999	unburned	3.6	0.18
west	2000	unburned	4.1	0.11
west	2001	burned	2.4	0.61
west	2002	unburned	6.7	0.10
west	2003	unburned	2.9	0.09
west	2004	unburned	4.1	0.14
west	2005	unburned	2.3	0.16
west	2006	unburned	4.2	0.13
west	2007	burned	1.6	0.59
west	2008	unburned	3.1	0.16
west	2009	unburned	3.0	0.20
west	2010	unburned	2.0	0.31
west	2011	unburned	3.7	0.21
west	2012	burned	1.7	0.41
west	2013	unburned	2.8	0.18
west	2014	unburned	4.0	0.16
west	2015	unburned	3.3	0.30
west	2016	burned	1.8	0.64

What data will you graph to answer the question?

Independent variable(s): _____

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Dependent variable(s): _____

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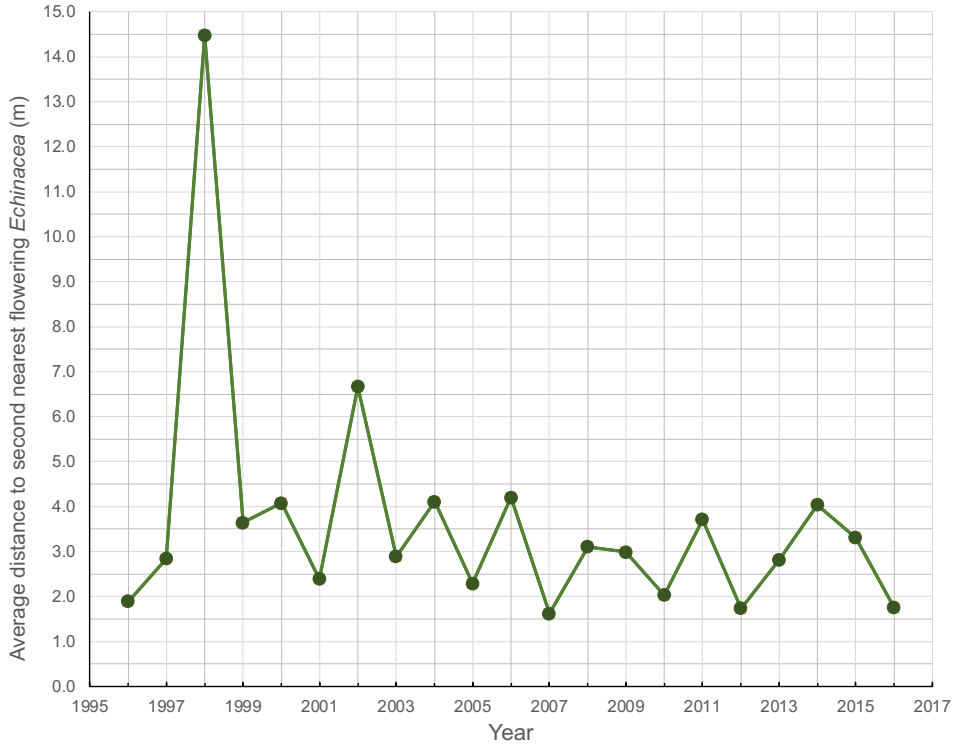
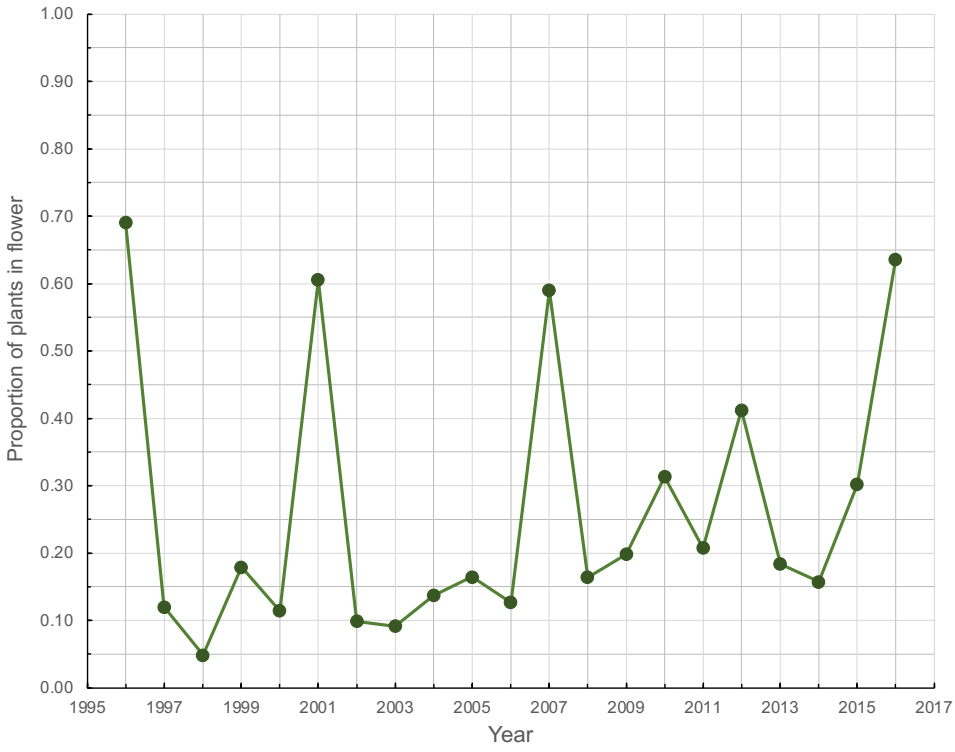
Draw your graph(s) below: Identify any changes, trends, or differences you see in your graphs. Draw arrows pointing out what you see and write one sentence describing what you see next to each arrow.





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Interpret the data:

Make a claim that answers the scientific question - How does fire affect the flowering synchrony and distance between *Echinacea* plants?

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

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about the reproductive needs of *Echinacea.*

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Did the data support Stuart's hypotheses? 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 Stuart's research? How do your questions build on the research that has already been done?