

`Fire Weather' Featured Laboratory: National Estuarine Research Reserve System

from National Oceanic and Atmospheric Administration & San Francisco State University

Research Background:

In 2018 there were approximately 8,000 wildfires in California, according to the Insurance Information Institute. Most of these fires burned during the dryer Summer and Fall months. During Fall months atmospheric conditions in California can become hot and dry, creating an environment perfect for wildfires. 1 of the 2018 wildfires burned very near the Rush Ranch in Solano County California, approximately 90 kilometers (56 miles) northwest of the Golden Gate Bridge. The fire near Rush Ranch burned more than 4,500 acres. For reference, an acre is slightly larger than a football field. The fire occurred on October 7^h, 2018. Interestingly, there was a fire 5 years prior in the same area. The earlier fire near Rush Ranch occurred on October 4th, 2013 and did approximately the same amount of damage.

The two fires at Rush Ranch provided an excellent opportunity for scientists working at the San Francisco National Estuarine Research Reserve (NERR) to explore weather patterns before, during, and after both Rush Ranch fires. The scientists working at NERR hypothesize a local increase of temperature and decrease of relative humidity (a measurement of the amount of water in the air) coincided with the fires at Rush Ranch. This hypothesis relies on observed temperatures being higher than average and relative humidity being lower than average.

NERR has a weather stations very near where the Rush Ranch fires occurred. The NERR weather station has been recording meteorological data dating back to 2006, before the fires near Rush Ranch. Meteorological data is information regarding weather conditions (temperature, wind speed and direction, relative humidity, and more). The meteorological data from the days before, during, and after the fire will be analyzed to compare temperature and relative humidity at the time of the fires at Rush Ranch. Using the meteorological data recorded at the Rush Ranch we predict temperatures will be higher than average and relative humidity will be lower than average on the days when the fires began.

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Grassland and hills of Rush Ranch. Photo credit Tom Muehleisen.



A helicopter dropping fire suppressant on a controlled burn at Rush Ranch. Controlled burns are used to clear the land of grass, brush, and other vegetation that may contribute to larger fires. Photo credit Tom <u>Muchleisen</u>.

Name___

Scientific Question:

How do temperature and relative humidity change in the days before, during, and after the Rush Ranch fires?

Scientific Data:

Use the data below to answer the scientific question:

	A	В	С
1	Date	Maximum Temperature C°	Relative Humidity % (at max temp)
2	10/1/13	23.9	41
3	10/2/13	23.9	37
4	10/3/13	23.1	16
5	10/4/13	27.2	12
6	10/5/13	28	12
7	10/6/13	28.4	15
8	10/7/13	28.4	14
9			
10			
11	10/4/18	21.9	58
12	10/5/18	25	41
13	10/6/18	28	16
14	10/7/18	28.4	8
15	10/8/18	29.8	18
16	10/9/18	26.2	35
17	10/10/18	21.5	47

The table above list daily maximum temperatures and relative humidity recorded at the Rush Ranch weather station. The relative humidity was recorded at the same time as the daily maximum temperature.

What data will you graph to answer the question?

Independent variable: <u>Time (Days)</u>

Dependent variable: Temperature and Relative Humidity_

Draw your graph below:

1. Identify the periods of day and night in the graph. How does each variable change during the daily cycle? Compare and contrast the graphs from each year.



The temperature recorded by Rush Ranch weather station before, during, and after the 2013 Rush Ranch fire is graphed above. The image of the fire on the graph coincides with the October 4^{th} , 2013 Rush Ranch fire.



The relative humidity recorded by Rush Ranch weather station before, during, and after the 2018 Rush Ranch fire is graphed above. The image of the fire on the graph coincides with the October 7^{th} , 2018 Rush Ranch fire.

Temperature (C°) before, during, and after the 2018 Rush Ranch Fire.



The temperature recorded by Rush Ranch weather station before, during, and after the 2018 Rush Ranch fire is graphed above. The image of the fire on the graph coincides with the *October* 7^{th} , 2018 Rush Ranch fire.

Graphing Level

- A Graph provided, axes labeled and data displayed
- B Axes labels provided, student must graph data
- C Graph not provided, student must label axes and graph data

Name____

Interpret the data:

- 1. A connection between maximum temperature and minimum relative humidity on October 7th, 2018 and October 4th 2013 should be identified.
- 2. The daily cycle of both temperature and relative humidity should be noted, along with changes in that cycle.

Make a claim that answers the scientific question.

Fires occur frequently during Fall months when temperatures are very high and humidity is very low.

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

The maximum temperature and minimum relative humidity on both fire days (October 7th, 2018 & October 4th, 2013) can be seen in the graphs. These maxima and minima are extremes for both local temperature and local relative humidity. Both fires started when there were extreme weather conditions (high temperature and low humidity).

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about.

It appears that during Fall months temperature and relative humidity reach levels that are conducive to generating fire. The data graphed in this project supports that idea by demonstrating the risk of fire associated with above average temperatures and below average humidity.

Your next steps as a scientist:

Science is an ongoing process. What new question do you think should be investigated?

The next step in this process would be to look into the local winds before, during, and after the fires. It would be interesting to see if there were a relationship between temperature, relative humidity, and local wind.

Students can address any meteorological inquiries by using various websites to look up weather stations (locally, regionally, or any scale they like). Students could find weather stations nearest to their home, school, or a park they visit and examine the conditions reported there. Is there fire weather near their home, school, or park?

What future data should be collected to answer your question?

Name_____

Independent variable(s):	Time
Dependent variable(s):	Wind Speed & Wind Direction

For each variable, explain why you included it and how it could be measured.

Wind speed and direction were included because the role that wind played in the fires has not been fully examined. Wind speed and direction are measured and reported by weather stations (like the one at Rush Ranch).

What hypothesis are you testing in your experiment? A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.

We hypothesize that the winds increased in the days leading up to the fire days (October 7th, 2018 & October 4th, 2013). This hypothesis can be tested with review of the meteorological information available from the Rush Ranch weather stations.