**Hot on the Trail**

**Cottonwood Reproductive Parts in the Albuquerque Bosque**

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Credit: iNaturalist Network

**Research Background:**

Cottonwoods thrive along the Middle Rio Grande, a riparian ecosystem that spans from Cochiti Dam to San Marcial (Crawford et al., 1993). In Albuquerque, the cottonwoods cluster along the river, creating a dense forest that sustains the surrounding native biological communities. These large, canopied trees give the bosque its name. Without them, the ecosystem’s integrity diminishes. For example, cottonwoods provide food and shelter for various bird species, and they support many arthropod populations (Crawford et al., 1993). Porcupines nest in their high branches for protection, and beavers use their woodfall for homes. Cottonwoods also provide leaf litter mulch and shade, increasing the survivability of a variety of plants and organisms living in the surrounding ecosystem. Cottonwood populations have flourished along the river; their large population size can be attributed to their successful reproduction. Cottonwoods reproduce mainly by seeding (Borman, 2002). They are dioecious, producing male and female flowers on different trees (planttalk.colostate.edu). They flower in the spring and release their seeds within small fibers that resemble cotton (Borman, 2002). These small fibers that surround the cottonwood seed allow it to be more easily dispersed by the wind.

Unfortunately, the survival of cottonwoods and the bosque ecosystem that depends on them has been increasingly threatened over the years. Urban development has depleted the river water supply, introduced non-native species to the ecosystem, and confined plants and animal species to restricted locations (Crawford et al., 1993). The Bosque Ecosystem Monitoring Program (BEMP), concerned with the changes occurring along the Middle Rio Grande, started monitoring the bosque ecosystem in 1996 (bemp.org). Since then, BEMP has established thirty-four sites along the Middle Rio Grande, collecting over one million data points annually (bemp.org). University of New Mexico students and professors work with BEMP staff to provide educational activities for students to learn about the riparian ecosystem and methods of data collection (bemp.org). At various sites across New Mexico, students engage in interactive discussions and exercises that deepen their understanding of ecological sustainability and its importance for the Middle Rio Grande (bemp.org).

As a consequence of urban development and advances in technology and industrial practices, the climate has been rapidly changing. One notable factor that has steadily increased is temperature. In the US-Mexico border region, temperature has increased more than 1°C in the last fifty years (Gutzler, 2015). A shift towards higher average temperatures places great pressure on species in the bosque to adapt in order to survive. High temperatures have been shown to shorten the growing season of crop species and to harm their reproductive phases, reducing seed yield (Hedhly et al., 2008). As the climate of the Middle Rio Grande begins to warm, cottonwoods may face greater stress from rising temperatures just as many crop species have experienced. Since cottonwoods can reproduce by seeds, the viability of their seeds is extremely important for cottonwood survival. A change in the timing and frequency of higher temperatures will affect the cottonwood reproductive season, and so, the alterations in timing will place stress on the male and female reproductive process, especially the most sensitive stages. High temperatures can accelerate reproductive part development, and may also affect the quantity of pollen, pollen tube growth rates, seed germination, and dispersal of seeds (Hedhly et al., 2008). Furthermore, germination and seedling growth of cottonwoods have been found to be negatively affected by high temperatures (Farmer and Bonner, 1967). I have chosen to analyze the relationship between cottonwood reproduction and temperature because I am concerned with the effect of increasing temperature on the ability of cottonwoods to cope. A reduction in cottonwood survival will change the biodiversity of the Middle Rio Grande, negatively impacting the wildlife that I find so fascinating and beautiful. I also depend on this ecosystem for recreational use, and so, changes to it will have a lasting impact on my life. Additionally, disruptions in cottonwood reproduction due to temperature could have implications for other plants. Rising temperatures have the potential to negatively influence our food availability which is a concern of mine as I continue forward into an uncertain climate-changing future.

Cottonwood reproduction is sensitive to changes in temperature. Increasing temperatures place greater stress on cottonwoods, negatively affecting their reproductive process. Thus, the amount of cottonwood reproductive parts collected each year at BEMP sites will decrease as annual temperatures increase. Two of the datasets that BEMP collects are cottonwood reproductive parts and temperature. Every BEMP site has ten litterfall tubs located in various areas in the site (bemp.org). Once a month, the litterfall from these tubs is collected, placed in brown bags (labeled with the date, site name, and appropriate letter), and taken to the BEMP lab at the University of New Mexico (bemp.org). The litterfall collected consists of reproductive parts from various plant species as well as other types of litterfall, such as wood and leaves. The litterfall materials are then sorted in the lab. The weight of the litterfall is measured in g/m2, and then it is recorded and entered in the BEMP datasets (bemp.org). The temperature collected for this Data Nugget was provided by temperature analysis from the National Oceanic and Atmospheric Administration (National Centers for Environmental Information). Since only temperature for the Albuquerque area was provided by BEMP, four sites within Albuquerque were chosen. These sites are Alameda, Rio Grande Nature Center (RGNC), Savannah, and Diversion. These are also the sites that provided the most data over a long period. Additionally, the data collected are from 2005 to 2015 as these were the years with the greatest available data for cottonwood reproductive parts collected.

***Scientific Question:***

What is the relationship between temperature and cottonwood reproduction?

***Scientific Data:***

**Use the data below to answer the scientific question:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Cottonwood Reproductive Parts Collected at Each BEMP Site (g/m2) | | | |
| Year | Temperature (°C) | Alameda | RGNC | Savannah | Diversion |
| 2005 | 14.57 | 6.86 | 3.77 | 3.09 | 1.64 |
| 2006 | 14.23 | 9.99 | 2.68 | 2.41 | 2.28 |
| 2007 | 14.19 | 5.94 | 2.06 | 1.30 | 1.50 |
| 2008 | 13.99 | 3.47 | 1.41 | 2.56 | 1.48 |
| 2009 | 14.13 | 3.93 | 2.29 | 1.08 | 2.48 |
| 2010 | 14.45 | 6.36 | 2.75 | 1.30 | 2.17 |
| 2011 | 14.46 | 5.64 | 1.91 | 0.71 | 1.39 |
| 2012 | 15.40 | 2.13 | 1.31 | 0.89 | 1.32 |
| 2013 | 14.11 | 2.66 | 0.99 | 1.10 | 1.43 |
| 2014 | 14.77 | 4.74 | 0.57 | 1.35 | 1.80 |
| 2015 | 14.37 | 7.09 | 1.44 | 2.15 | 3.75 |

*What data will you graph to answer the question?*

Independent variable:

Dependent variable:

***Draw your graph below*:**

***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 graph.*

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

***Your next steps as a scientist:***

*Science is an ongoing process. Did this study fully answer the scientific question?*

*What new questions do you think should be investigated?*

*What hypothesis would you like to test? A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.*

*What data will you graph to answer the question?*

*Independent variable(s):*

*Dependent variable(s):*

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

**References:**

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