Analysis of Groundwater Impacts on Fish in the Cosumnes River

Rhitishah Yuva Raju, Mentors: Nathan Hatch and Amy Yoder

EnvironMentors-**AggieMentors**

University of California Davis /Mira Loma High School

Introduction

California is currently in a crisis due to the lack of groundwater. During the drought, groundwater was heavily relied on and the rate of groundwater usage is not sustainable in the near future. Governor Jerry Brown signed a three-bill legislative packet that created SGMA, a body of experts working to fix our groundwater issues. Due to these conditions, research on the potential effects of managed aquifer recharge is much needed. The Cosumnes River is unique because, it is the only river where a levee was removed to look at the effects of flooding on groundwater. It is unique because it is the only major river in California without a dam. This study looked into the effects of levee removal on groundwater and fish count. This is important because, if removal of levees lead to more groundwater through the process of floodplain aquifer recharge, and it in turn benefits the ecosystem (specifically the fish) and humans. Then, levee removal will be proven to be efficient.

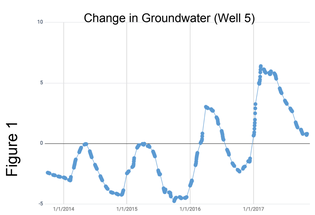

Figure 1

This graph explicates the changing levels of groundwater from 2014 to 2017 in the Cosumnes River for Well 5.

This is a map of the Cosumnes River and MW 5 was the area where groundwater measurements were taken. Map from Amy Yoder, UC Davis.

Background Information

Groundwater is the water that percolates and is absorbed by geological minerals in the ground. Once absorbed, the water joins the water body that is held through sand, clay, and soil in the ground. Groundwater is recharged through rain, snow, ice, rivers, and floodplains. This liquid seeps into the ground through the cracks and crevices and through soil and dirt. Groundwater also works to recharge lakes, rivers, and wetlands. The greater amount of groundwater the higher the water table elevates. Groundwater supplies 51% of America's drinking water for the entire American population and 99% of the rural population.Groundwater is also used to grow crops, specifically, 64% of groundwater is used for irrigation. If substances on the ground are permeable, harmful pollutants can contaminate the groundwater supply.

Surface water is water that collects on the surface of the ground. Surface water can seep into the ground. In rivers, surface water seeps into the ground and recharges the groundwater. When the groundwater is sufficient, then the water table rises. This can lead to increased groundwater. This allows fish to swim upstream in rivers along the Cosumnes River. The most common way to measure groundwater is through wells along the Cosumnes River, groundwater is measured in meters. The Cosumnes River sometimes goes dry during the summer which makes it difficult for fish to swim upstream to their spawning grounds.

Abstract

This research project aims to figure out if levee removal has a positive or negative effect on the ecosystem, specifically the fish and aquifer recharge.

If a levee is removed positive groundwater recharge may occur through the floodplain, because the river will naturally flow onto the floodplain during flood events, allowing the flood waters to rest on the floodplain and infiltrate the subsurface. In the long term, this recharge can help sustain perennial flows in the channel, which can be beneficial for the fish. However, the flood events can negatively impact fish by allowing them to become stranded on the floodplain when water levels are high. Through the use of excel analyses and fieldwork data collection, the effects of levee removal on groundwater levels and fish populations in the Cosumnes River will be explored.

Hypothesis

An increase in surface water increases the habitat availability for the fish in the Cosumnes River because, more flooding allows the river to connect to downstream water sources thus, resulting in more habitat for the fish. Additionally, an increase in surface water also increases groundwater, because, the ground has more water to absorb raising the water table.

Materials and Methods

1. The Data Staging process was completed. Data was obtained for multiple years from 2012 to 2016. The years of 2014 and 2016 were systematically selected. 2014 was the year before the levee was removed and 2017 was two years after the levee removal.
2. Data from well 5 was collected and analyzed in Excel and in R (data analytical software). The fish count was collected by placing nets out in the floodplain after rains and then, the fish count was taken the following day. The groundwater data was collected from pressure transducers in Well 5. They were set to record in 15 minute intervals. After, the data was downloaded from the transducer and saved to an excel file.
3. First, a graph was created with all the groundwater data from the 2014 water year up till the 2017 water year. The graph is on the left panel.
4. Then, a graph was created the 2014 water year, with two axes. Groundwater measurements in meters from Well 5 was on the primary axis and the secondary axis had fish count.
5. Finally, the differences between the fish in the Cosumnes river and the groundwater amount were analyzed.

Results

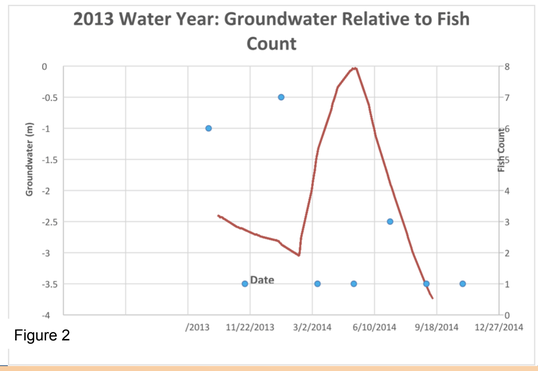

Figure 2

This graph has the groundwater level in meters on the primary axis and fish count on the secondary axis. This data is important because, it was before the levee was removed. This is before flooding was allowed to occur to recharge groundwater. Summers were hot and often the rivers would dry up and fish could not swim upstream resulting, in their eventual death. However, in this graph the lower the groundwater the more fish there were. Until, the fish count plateaued.

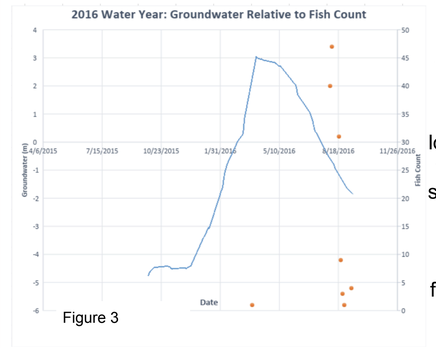

Figure 3

There is a clear relation between groundwater and fish count. During low groundwater periods, there was no fish in the studied area. When there was an increase in groundwater, a significant increase in fish count was observed.

Conclusion

The interconnectivity of groundwater and surface water will result in similar groundwater and fish count trends. This is because of the reliance of fish on surface water and correlation between high groundwater levels and high surface water levels.

In the end, my hypothesis was proven to be correct. Groundwater and surface water are interconnected to the health of a ecosystem which, was represented as fish count in this study.

In Figure 2, it can be observed that the fish count was lower before the groundwater was increased through levee removal and flooding.

From Figure 3, it can be observed that there is a relation between groundwater and fish count. When the groundwater is lower, then there are fewer fish. On the contrary, when groundwater is high there is an increase in fish population. This demonstrates the interconnectivity between groundwater and surface water. When there is a minimal amount of groundwater this impacts the surface water and the water in the river. There is less water for the fish to live in, thus, resulting in the decline in fish population. More ground water is a probable benefit for the fish, because there will be more surface water for them to live in, leading to an increase in fish populations. When there is more surface water, then, groundwater recharge is possible.

3 References:

California, State of. *Edmund G. Brown Jr.* www.water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management.

"Sustainable Groundwater." *Water in the West*, 19 Apr. 2018, waterinthewest.stanford.edu/programs/sustainable-groundwater.

"What Is Groundwater." *The Groundwater Foundation*, www.groundwater.org/get-informed/basics/groundwater.html.

Acknowledgements

Thank you to Ms.Pia Van Benthem for providing the researchers with the opportunity to conduct this study. Thank you to the data scientists and my mentors.