



## Abstract

California, due to a lack of rain, has experienced extreme drought over the past several years. We performed a case study to determine the effect of drought on California Chinook salmon (*Oncorhynchus tshawytscha*). We used online databases including Scopus and One-Search. The search terms we used are “drought,” and “salmon,” and “populations,” “chinook salmon,” and “population,” and “California,” and “drought,” and “chinook salmon.” We found that droughts do have adverse effects on Chinook salmon populations such as a lower survival rate when traveling from freshwater to saltwater. We hope our research will raise awareness about the effect of drought on Chinook salmon, and the necessity of managing these populations to prevent further declines and possible extinction.

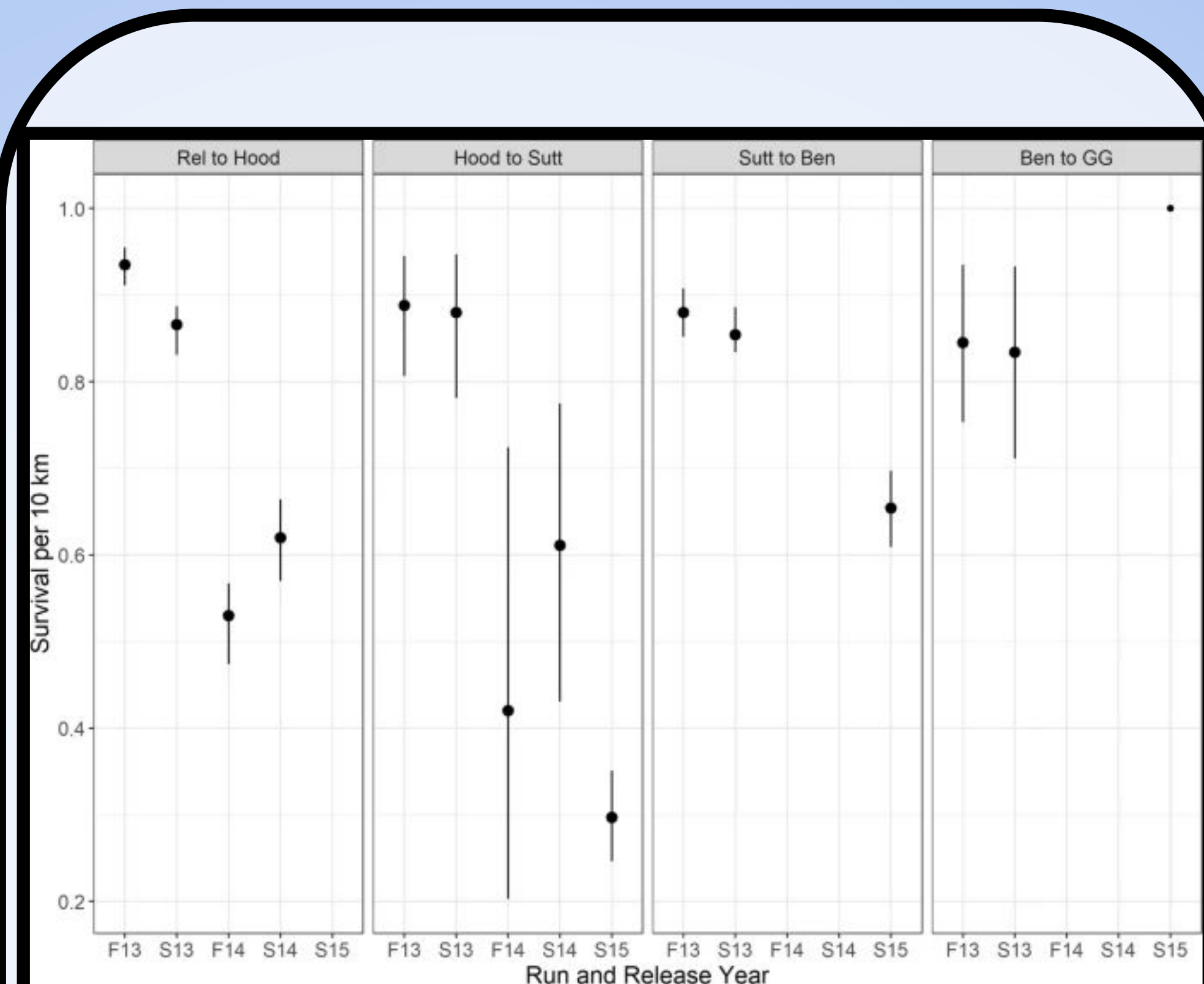
## Materials & Methods

Our data came from Scopus and OneSearch where we used the following search terms: “drought,” and “salmon,” and “population,” “chinook salmon,” and “population,” “California,” and “drought,” and “chinook salmon.”

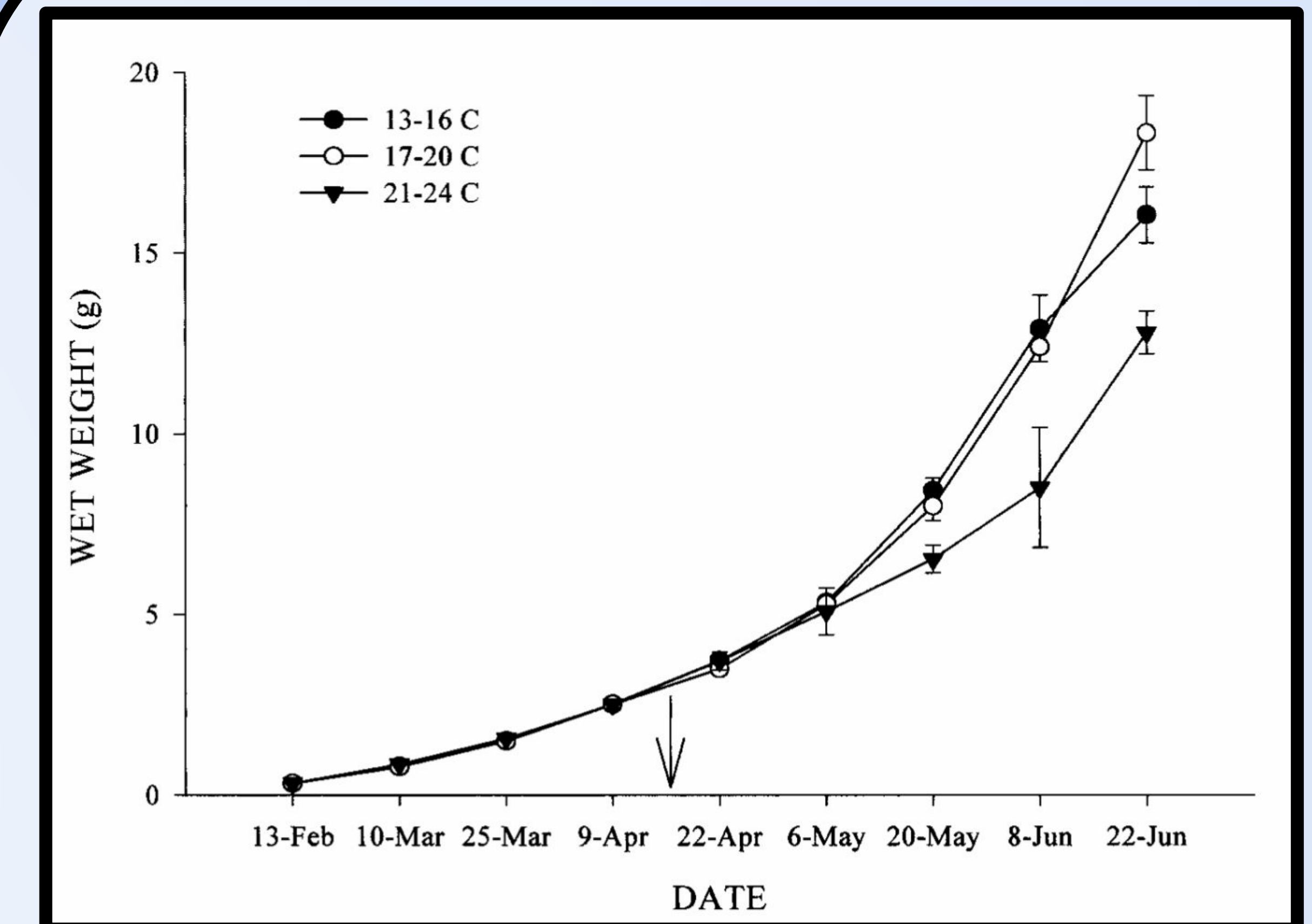
We made sure to stick to papers that examined four main effects of droughts; Stream Flow, Water Temperature, Water Quality, and Competition with Agriculture. As stream flow, water temperature, and water quality, and competition with agriculture are some of the most impactful dynamics that affect salmon populations, all papers selected for inclusion in this study examined these main effects of drought.

## References

- Singer, G. P., Chapman, E. D., Ammann, A. J., Klimley, A. P., Rypel, A. L., & Fangue, N. A. (2020). Historic drought influences outmigration dynamics of juvenile fall and spring-run Chinook Salmon. *Environmental Biology of Fishes*, 103, 543-559. <https://doi-org.sonoma.idm.oclc.org/10.1007/s10641-020-00975-8>
- Dusek Jennings, E., & Noble Hendrix, A. (2020). Spawn Timing of Winter-Run Chinook Salmon in the Upper Sacramento River. *San Francisco Estuary and Watershed Science*, 18(2). <https://doi.org/10.15447/sfews.2020v18iss2art5>
- Bosse, C., Marine, K. R., & Cech, J. J. (2004). Effects of High Water Temperature on Growth, Smoltification, and Predator Avoidance in Juvenile Sacramento River Chinook Salmon., 24 <https://doi.org/10.1577/M02-142>



**Figure 1:** This figure shows the run and release values on a yearly basis, versus the survival rate per 10 kilometers. The regions are from the Sacramento release location to Hood (Rel to Hood), Hood to the Sutter Slough-Sacramento River junction (Hood to Sutt), the Sutter Slough junction to the Benicia Bridge (Sutt to Ben), and from the Benicia Bridge to the Golden Gate Bridge (Ben to GG).



**Figure 2:** This figure shows the correlation between higher water temperature and smaller Chinook salmon in the Sacramento river. This ultimately draws a correlation between droughts and a decrease in Chinook salmon population as smaller fish will lay fewer eggs.

## Discussion

**Significance:** Salmon play an important role in the ecosystem because they are a part of the natural life cycle and bring many nutrients back to freshwater when they return from the marine environment where they spend majority of their adulthood. Salmon are also a valuable part of the economy as a popular source of food, as well as recreational fishing. The efforts to keep salmon populated is very important to our environment because of the benefits salmon provide.

**Future Direction of Research:** Salmon play an important part in watershed ecosystems we know for a fact based on previous research that they add valuable nutrients to the water which keep the watershed healthy and going. From our research it is also known that droughts cause a decrease in the population of salmon which if left unchecked could turn into a massive decline salmon population and in an extreme case even the extinction (or partial extinction) of some salmon species. This is mostly unlikely though as thankfully many conservation efforts and efforts to strengthen the salmon populations against droughts are proving successful. Future research should aim to examine the impacts of increased drought frequency, and how decreasing snowmelt from the mountains effects the long-term health of the salmon population.

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