CLIMATE CHANGE AND TROUT IN WESTERN MONTANA

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Climate Data

	1980-1997	1998-2014
Average temperature for months of July, August, and September	75° F	77.1° F
Instances/Years in which average temperature for July, August, and September was recorded above 75° Fahrenheit	7 Instances	14 Instances
Average July Temperature	77.1° F	81.2° F
Average September Temperature	68.4° F	69.7° F
Average August Temperature	79.5° F	80.2° F
Average difference in temperature from August to September	11.1° F	10.5° F

Framing Question

- How will climate change impact aquatic ecosystems and socio-economic processes in temperate and semi-arid regions such as Western Montana? How applicable are these findings across other regions with differing ecological or socio-economic processes?

Abstract

In this project I assess climate change vulnerability for native and non-native non-anadromous salmonids (salmonids that do not migrate to saltwater) in Western Montana, separating threats and benefits that may occur for individual species. It is important to note that this project relies on an assemblage of secondary resources for information and data. I then assess the impact that these changing populations will have on 1) the ecological health of the region, and 2) the sport-fishing culture and industry in the region. I then discuss both the applicability of these findings, as well as the larger implications. Ultimately, projected climate change will lead to two scenarios (see below). The applicability of these findings, however, will vary from region to region depending on both climate and socio-economic processes that are present across different regions, highlighting the complexity of the interplay between climate change, aquatic ecosystems, and environmental problems as a whole.

Precipitation Data

	1970-1992	1993-2014
Instances where total precipitation in months of July, August, and September was above 4 inches	15 instances	8 instances
Average precipitation of July, August, and September combined	5 inches	3.8 inches
Average precipitation in July	1.8 inches	1.4 inches
Instances in which precipitation fell below one inch in July	5 instances	12 instances
Average precipitation in September	1.7 inches	1.4 inches
Instances in which precipitation fell below one inch in September	8 instances	7 instances

Scenario 1: Long-Term

In *Scenario 1*, western Montana experiences a decrease in future trout populations as a whole. This is experienced as a result of the warming trends that are expected to continue far into the future (see table below). Temperature is expected to warm so much that it is not favorable for any species of trout.

Ecosystem Impacts

- Spike in aquatic insect population, resulting in a decrease in aquatic vegetation that acts as important habitat for many species
- Decline of large predators such as brown bears and large birds of prey
- However, human efforts geared towards improving aquatic ecosystems may increase as a result of the decline of charismatic species such as trout… they have a vested interest in trout.

Impacts on Sport Fishing Industry

- Negative impacts on fly-fishing industry that relies heavily on trout populations in western Montana
- A shift to focusing on warm-water species of fish in Western Montana

References: 1) Bear, Beth, Thomas McMahon, and Alexander Zale. 2005. *Thermal Requirements of Westslope Cutthroat Trout*. Final Report. 2) Elton, C.S. 1958. The ecology of invasions by animals and plants. 3) Fraley, J.J., and Shepard, B.B. 1989. Life history, ecology and population status of migratory bull trout (Salvelinus confluentus) in the Flathead Lake and river system, Montana. 4) Fridley, J.D. 2001. The influence of species diversity on ecosystem productivity: how, where, why? 5) McMahon, Thomas, Alexander Zale, Frederic Barrows, Jason Selong, and Robert Danehy. 2007. "Temperature and Competition between Bull Trout and Brook Trout: A Test of the Elevation Refuge Hypothesis." 6) Muhlfeld, Clint C., and Brian Marotz. 2005. "Seasonal Movement and Habitat Use by Subadult Bull Trout in the Upper Flathead River System, Montana." 7) Wenger, Seth J., Daniel J. Isaak, Charles H. Luce, Helen M. Neville, Kurt D. Fausch, Jason B. Dunham, Daniel C. Dauwalter, et al. 2011. "Flow Regime, Temperature, and Biotic Interactions Drive Differential Declines of Trout Species under Climate Change."

Conclusion

- Ultimately, it is important to keep in mind that impacts of climate change will vary from region to region, and these findings are not applicable everywhere!
- For example, an aquatic ecosystem that houses warm-water species of fish may indeed benefit from warmer temperatures and changing precipitation patterns.
- Regions with differing socio-economic statuses may also be impacted in a different matter (i.e. in Nepal, economic impacts will be felt on the individual level, as entire livelihoods will be threatened).

http://www.rampapish.com/photo-detail.php?image=131

Scenario 2: Short-Term

Scenario 2 is predicted to occur in the much more near future, as it experiences a decrease in bull trout populations (due to alternating precipitation and temperature patterns) that results in a lack of competition for other species (i.e. rainbow trout). As a result, in *Scenario 2*, we can actually expect an increase in rainbow trout populations

Ecosystem Impacts

- Low levels of ecological diversity, as large population of rainbow trout have ability to outcompete any other predator species.
- Loss of the *insurance effect* that is experienced with a more diverse ecosystem.
- Allows for conditions favorable to invasive species, as a result of a greater amount of vacant niches.

Impacts on Sport Fishing Industry

- Micro-economy of fly fishing may initially benefit, as most fishermen are okay with catching rainbow trout, and fishing for bull trout is illegal.
- An increased harvest of rainbow trout could even help balance the ecosystem as a whole.