Warming of the rivers and the effect on salmon

Executive Summary

In recent years we have started to see the effects of climate change in a more drastic way. Before the iconic symbol of climate change were the polar bears and the arctic ice melting. Now we don't only have to hear about polar bear to see what is happing because it's happening in our own state

and we are able to see it firsthand. Droughts, floods, and heat waves are some of the effects of climate change that we have experienced. Last year we saw the drastic impact that it had on salmon in the Pacific Northwest. The winter of 2015 brought the lowest snowpack at near zero. The low level of snowpack was the major factor for the loss of nearly half of the expected salmon to return last year. Warm water temperature not only means harm to salmon's immune system but makes salmon an easy target for diseases. Many of the disease have come from salmon that have been cultivated in hatcheries. If diseases weren't enough they still have to go through numerous dams that make it nearly impossible to reach their spawning grounds.

Introduction

The Columbia River is one of the world's largest hydropower systems. There are fourteen dams on the main stem of the Columbia River and over 450 dams throughout the entire Columbia River basin. The Columbia River has support system to some of the greatest salmon and steelhead runs. Unfortunately the sizes of salmon and steelhead runs have drastically decreased. Salmon have dwindled. In 1991, the federal government declared the first salmon in the Pacific Northwest, Snake River sockeye as endangered (Goldfarb, 2015).

The Columbia River serves as the beginning of a long journey for all salmon in the Pacific Northwest. In the summer of 2015 it turned into a kill zone due to the high water temperatures. At Bonneville Dam in mid-July were at an average of 72˚F (Dolce, 2015) when the usual temperature for that time of year is 65˚. "These aren't record temperatures, just record early temperatures for a record long time", Rawding said. Prolonged water temperatures above 68 degrees are lethal for cold-water fish like salmon and trout.

Disease

"We've got a number of dead fish. Some of them are from disease. Some of them look like they've been ravaged by lamprey," says USFWS fish biologist Steve Gough, who has been overseeing fish sampling on the Klamath (Burns, 2015). Ceratanova is naturally present in major river systems throughout the Northwest. All it needs is two hosts to complete its life cycle: the tiny, nearly invisible Polychaeta worm and the Chinook salmon together with warm waters.

Unhealthy Chinook withCeratanova


Healthy Chinook salmon

Ceratanova is when fish are under stress due to elevated temperatures, crowding, columnaris may attack the fish and cause disease. columnaris is bacteria that enters fish through gills, mouth, or small wounds, and is prevalent where conditions may be stressful due to overcrowding or low dissolved oxygen levels in the water column (Aukes, 2006). Infected animals with gill or cutaneous lesions serve as a source of infection (GLFC) . In

hatcheries with open water supplies, any species of infected fish in the water supply may serve as a reservoir of infection for the disease. (htt1)

The ideal temperature for salmon to thrive is between 40˚F to 50˚F, when water is warmer than the usual temperature it is physiologically unsuitable for salmon. Warm water temperature increases a fish's metabolism burning essential energy at a faster rate. Because they are using essential energy at the beginning of their journey salmon are put under stress to look for food, prolonging the time to reach spawning grounds which could be crucial.

Hatcheries

Many of hatchery fish are contaminated by many infections and bacteria that when released carry infectious pathogens and affect the wild salmon. Because hatchery fish have more resistance to the infections they carry they only have the stress of adapting to warm waters. One of the most common diseases in large-scale fish farming is infectious salmon anaemia (ISA). Symptoms include pale gills and swimming near the surface gulping for air. In its more insidious form, fish may develop it without showing any signs of illness, even maintaining a normal appetite until they suddenly die. Some of the problems include the use of non-native stocks, the development of non-competitive behaviors, and over-stocking

fish beyond the natural carrying capacity of the environment at the expense of wild native fish. Many think that we should just increase the amount of salmon that hatcheries release every run. While it sounds like a solution to the problem all we would be doing is putting a Band-Aid on a bullet wound. If we do produce more fish we do not know how many would actually come back as adults. David Noakes a fish biologist OSU believes that if we push more fish into the rivers we would "create a big flush of food for hawks, cormorants, seals, fox and numerous other predators. If you drop a bunch of candy in the street, kids will show up to eat it."

However, as wild fish runs become threatened with extinction, hatcheries are also proving to be a valuable tool for saving wild native runs.

Dams

Dams are one of the causes of the salmon crisis. Salmon need cool water to survive. Dams heat up the river by decreasing river flow and creating huge reservoirs that soak up the sun. Compounding the dam problem, last year's low snowpack coupled with hot water temperatures were straining salmon runs. Salmon runs struggle to cope with the harsh realities of dams, poor water management, and climate change. Dams are just another stress factor it's not only increasing water temperatures but making it a much harder journey. Fish ladders and even water-filled fish elevators have been built to try to improve

the survival of adult salmon and steelhead as they return upriver, it makes them burn unnecessary energy. About 55% of the spawning habitat that was available to salmon is permanently blocked by dams (Harrison, 2008). Because dams are blocking the flow of water they create reservoirs that cause its water temperatures to rise to lethal levels. One of the efforts that have been made is to install Salmon ladders to allow fish to travel up river. According to John Waldman, a professor of biology at Queens College "For one species, American shad, less than 3 percent of the fish made it past all the dams in these rivers to their historical spawning reaches." But according to Teresa Scott Dams prevent passage, ladders allow passage. Ladders themselves do not prevent passage.

Migration blocked

Longer-term climate change, driven by emissions from fossil fuels, also raises concerns for the fate of salmon as they return to freshwater to spawn. Snowpacks were forecasted to decline, putting rivers more at risk of lower flows and higher temperatures.

"It's just like boiling water in a kettle. When you have less water in there, it gets hotter, faster," said Ritchie Graves, a NOAA Fisheries supervisory biologist (Berton, 2015).

Last year, spring chinook arrived in freshwater well before intense heat pushed river temperatures past 70 degrees (Jazeera, 2015) Now, many of the wild fish are holding in cool

deep pools in higher elevation drainages and will spawn later in the year when water temperatures to have eased.

Of the more than 1,100 dams, Bonneville Dam on the Lower Columbia River is where most are struggling as they try to make their way past a network of dams that create slack pools with large volumes of water exposed to the sun (DOE). As water temperatures increase, a number of negative effects on salmon arise. Direct biological impacts on salmon include physiological stress, increased depletion of energy reserves, increased susceptibility and exposure to disease and disruptions to breeding efforts. Such direct impacts on the biology of salmon may potentially lead on to further, less direct impacts. For example, as the developmental rate of salmon is directly related to water temperature, it is possible that increasing temperatures could cause the more rapidly developing juveniles to enter the ocean before time.

Snow pack

Much of Washington's water supply is stored in snow pack and glaciers that melt into rivers. As this stored snow recedes to higher elevations, less will be available to feed rivers. Too much water runoff (melted snow) through early spring when it's not needed will not help in summer when it is needed. Less snow means that glaciers are not replenished. Downstream effects include changes in timing of peak fresh water flows, power output, fish migration,

and water availability in the dry summer season. As peak rivers flows shift to earlier in the spring, salmon rearing, migration and spawning are negatively affected.

Low flows in spring and summer result in warmer water which holds less oxygen and stresses fish. Increased summer stream temperatures may exceed tolerable limits for cold water fish. Changing temperatures in lakes, Puget Sound, and the coastal ocean could decrease food for fish.

Reference

- http://www.fishyfarmacy.com/articles/columnaris.html

  (Aukes, 2006)

- http://www.seattletimes.com/seattle-news/environment/snowpack-drought-has-salmon-dying-in-overheated-rivers/

  (Berton, 2015)

- http://www.opb.org/news/article/salmon-killing-parasite/

  (Burns, 2015)

- https://fortress.wa.gov/ecy/publications/documents/94016.pdf Inventory of dams in WA state report by department of ecology

  (DOE)

- https://weather.com/news/news/snowpack-cascades-west-northwest

  (Dolce, 2015)

- http://www.glfc.org/pubs/SpecialPubs/sp83_2/pdf/chap23.pdf

  Great Lakes Fishery Commission (GLFC) PDF file

  https://www.hcn.org/issues/46.21/the-great-salmon-compromise

  (Goldfarb, 2015)

- https://www.nwcouncil.org/history/DamsImpacts

  (Harrison, 2008)

- http://america.aljazeera.com/articles/2015/7/27/half-of-columbia-rivers-sockeye-salmon-dying-due-to-heat.html

  (Jazeera, 2015)

- Personal email to contact Teresa Scott Drought coordinator for Washington Department of Fish and Wildlife.