

Climate Impacts on Fisheries and Marine Life

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Background

- The maximum safe upper limit of CO₂ concentration in the atmosphere is 350 ppm
 - After this limit, severe weather conditions become much more frequent, keeping our planet livable becomes much more difficult
 - Ppm (parts per million) means there is one molecule of carbon dioxide for every million molecules of dry air
 - The world passed this threshold in 1988. Any guesses as to what our level is now?
- Alaska is experiencing climate change at an accelerated rate compared to the rest of the planet
 - Average temp. Increase from 1969-2018 in Southeast: 1.8°C
 - Average temp. Increase from 1969-2018 on the North Slope: 4.6°C

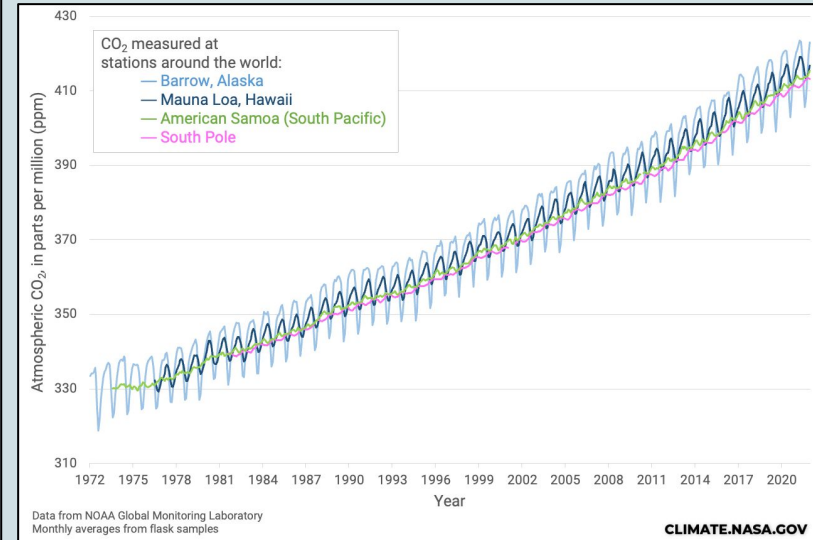


Photo: NOAA

Glacial Melt

- The salmon use chemical cues that's sent is specific to their stream to find their way back.
- As the climate warms, the glaciers and snowpack in Alaska that feed these rivers decrease.
- The melting glaciers disrupt the trail and make the salmon unable able to find their stream and unable to spawn.
- Melting glaciers causes sporadic flooding which causes high turbidity, making fish stressed and confused.

Less than 1% of salmon make it from the egg to adulthood, these factors decrease

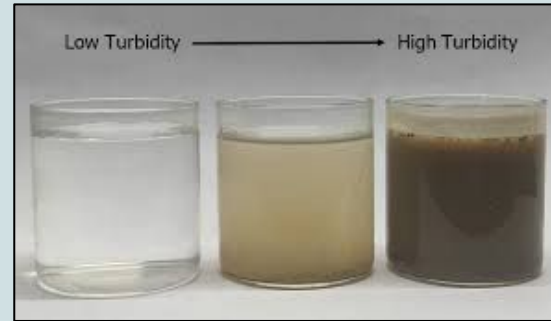


Photo by Esri Developer



Photo by the Alaska Beacon

Mendenhall glacier, Áak'w T'áak Sí't', Juneau, AK.

Left: July 2025

Right: October 2025

On the left, the glacier still touches the lake. In only a few months, the glacier has retreated from its creation, the Mendenhall lake.



Wetlands

- Freshwater ecosystems (lakes, rivers, wetlands, ponds) are warming because of rising air temperature
- Water temperature changes to adapt to seasonal and annual air temperature patterns
- Wetlands are especially vulnerable because they:
 - Have large surface areas
 - Hold water longer
 - Sometimes lack stream inputs
- Copper River Delta and Yakutat Forelands are critical habitat for juvenile salmon
 - Salmon use rivers/streams for migration and rearing
 - Salmon use wetlands/ponds for foraging and developing before heading to the ocean
- Wetlands help filter sediment and nutrients and protect salmon streams and estuaries
- There is a strong positive correlation between air and water temperature
- RCP: Representative Concentration Pathways (future emission scenarios, adopted by the IPCC)
 - RCP 4.5: Emissions peak ~2040s, then steady and decline
 - RCP 8.5: “business as usual”, emissions continue rising



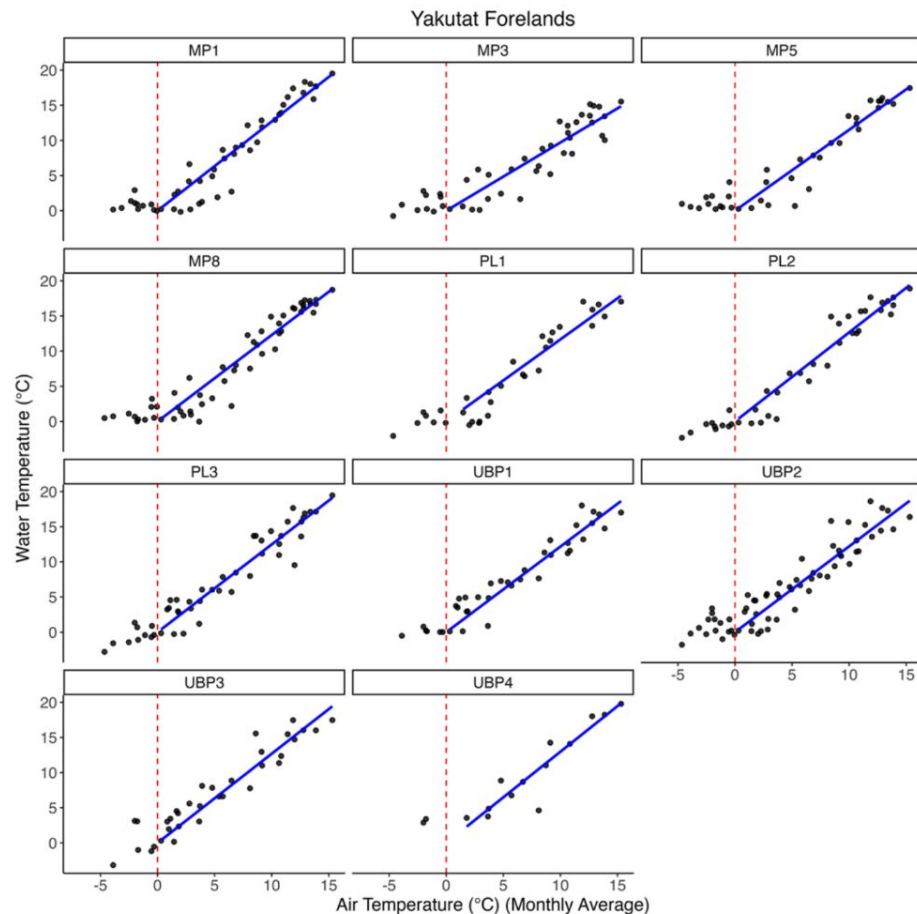
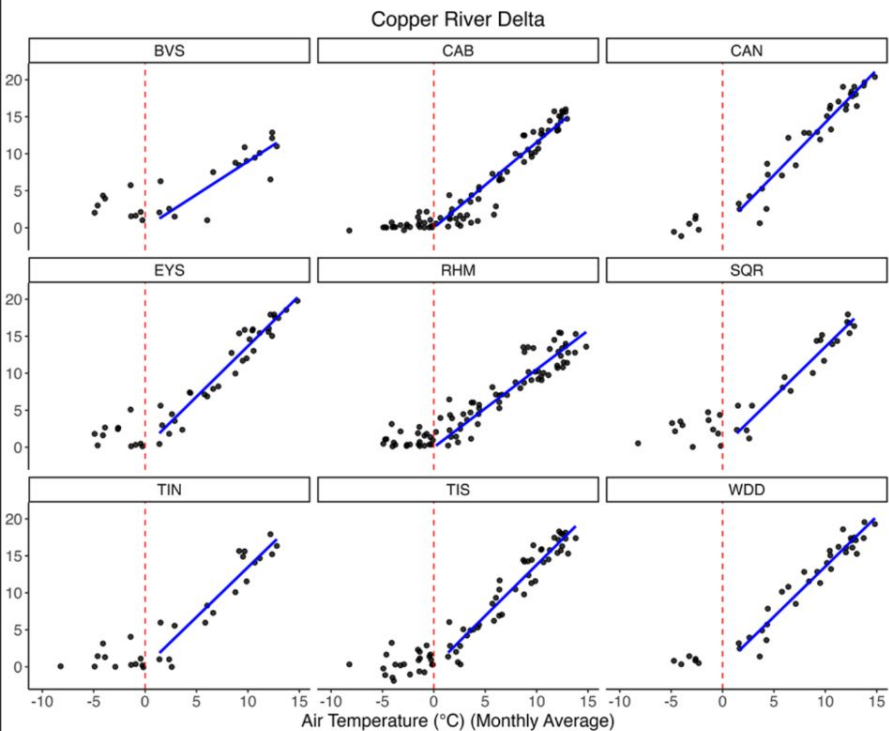
Copper River Delta, Cordova, AK, 2025.

<https://alaskapublic.org/news/alaska-desk/2026-01-23/wetlands-are-warming-as-fast-as-the-atmosphere-thats-bad-news-for-salmon>



Yakutat Forelands Wetlands, Yakutat, AK, 2011.

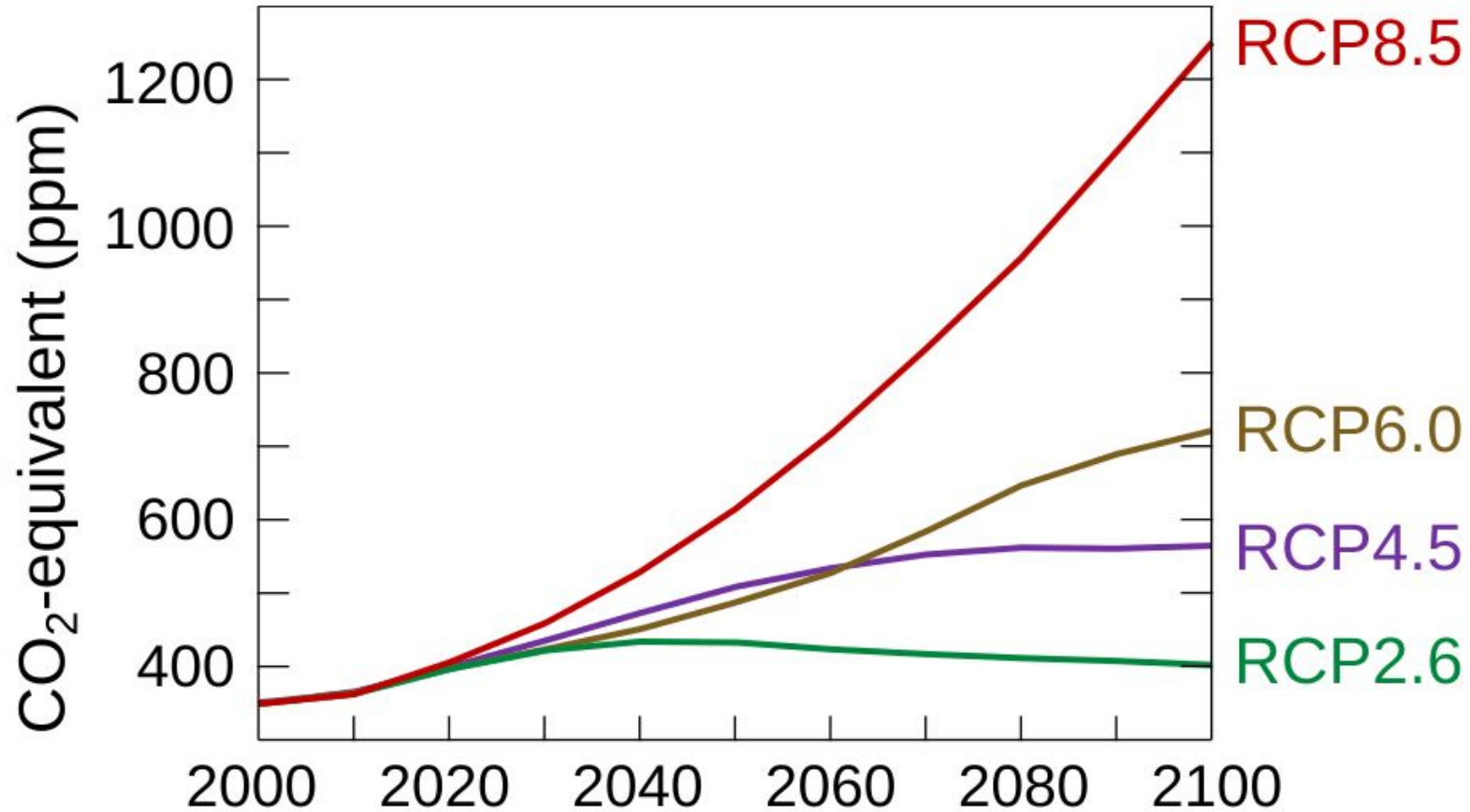
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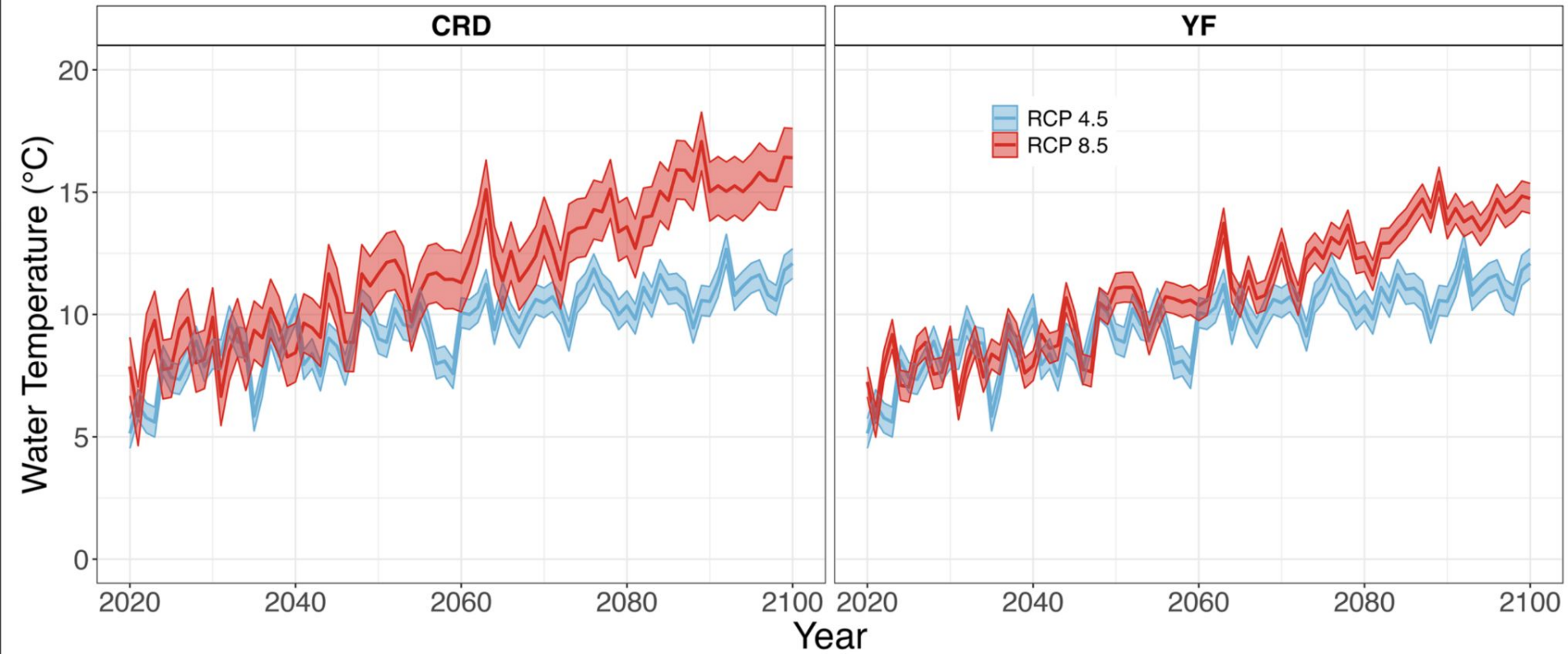


Relationship between water temperature of the 20 ponds and NWS air temperature

<https://www.researchgate.net/publication/399763049> Freshwater subarctic wetlands are vulnerable to future thermal stress from climate warming

IPCC Representative Concentration Pathways





RCP 4.5 and 8.5 scenarios in the Copper River Delta and Yakutat Forelands

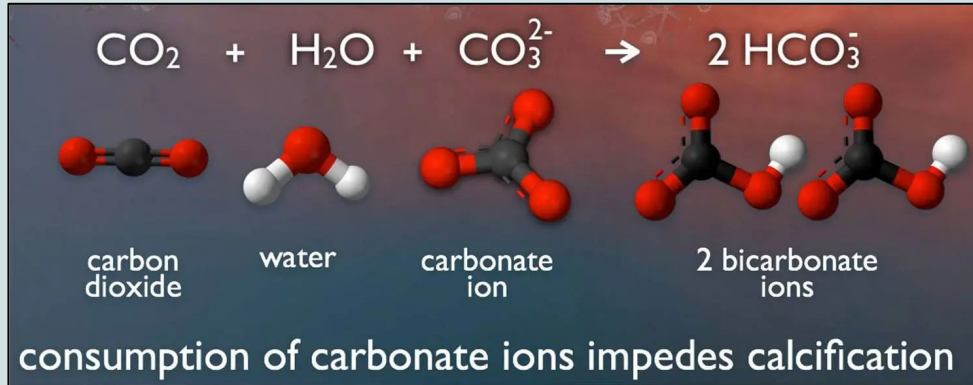
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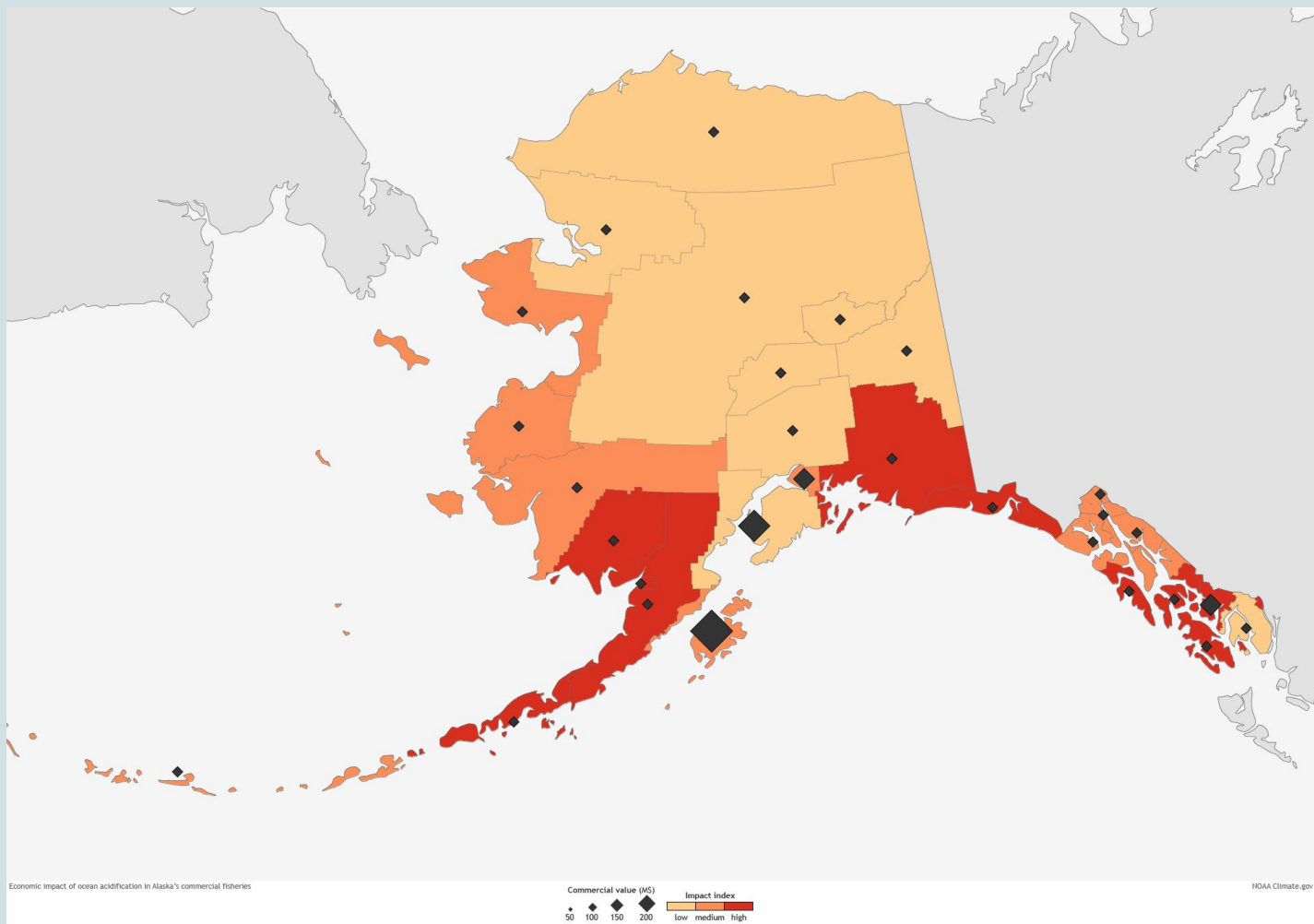
What This Means for Salmon

- All ponds are expected to warm in both locations under both scenarios
 - By 2100, RCP 4.5:
 - CRD: +7.3°C
 - YF: +6.3°C
 - By 2100, RCP 8.5:
 - CRD: +11°C
 - YF: +9.7°C
- Impacts on Salmon
 - Coho salmon temperature limits:
 - Growth stops at ~20°C
 - Lethal range: 23-25°C
 - ~20°C is the widely accepted threshold for most Pacific Salmon species
- The CRD has a greater overall chance of exceeding the 20°C than the YF
- Potential Salmon Responses
 - Changing migratory patterns or spawning timing
 - Taking advantage of cooler streams/areas of the Ocean
 - However, rapid warming may exceed their ability to adapt.

Ocean Acidification

- At least one quarter of carbon dioxide released by the burning of coal, oil and gas dissolves into the ocean, causing ocean acidification.
- Throughout the past 200 years, the ocean has absorbed 525 billion tons of carbon dioxide from the atmosphere, presently around 22 million tons per day. In just this time period, the ocean has become 30% more acidic.
- This acidification has huge effects on ocean ecosystems and marine wildlife. The pH of the water in some areas is so high that the shells of some marine animals are dissolving.





Ocean Acidification Impact (Commercial Value). Photo by NOAA.

Bioaccumulation

Bioaccumulation is when pollutants and heavy metals end up accumulating in animals from their environment. Here is how it impacts Alaska:

- It threatens the subsistence lifestyle of Alaska native people.
- PFAS, or forever chemicals, accumulate in Alaskan staple foods, like salmon.
- “Rusting” in important rivers.
- Fish in Alaska reach dangerously high levels of pollutants sooner than expected due to warming waters.
- Endangers salmon, a large contributor to Alaska’s economy.
- Contributes to the ever-growing microplastic issue.

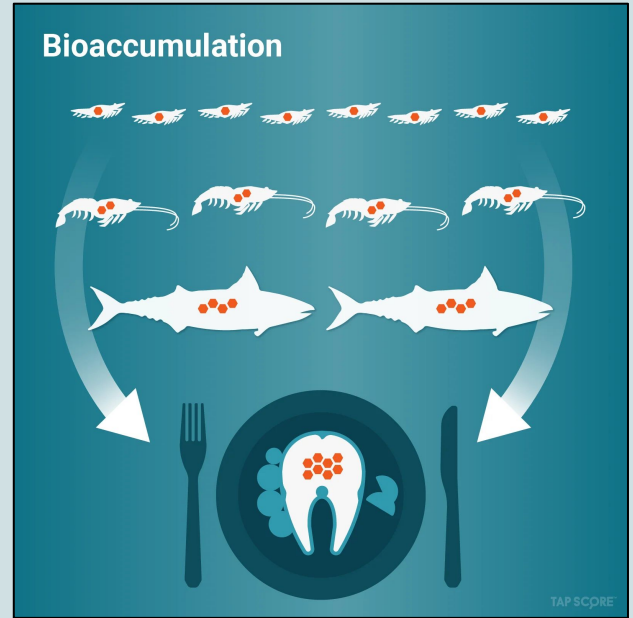


Photo by Tap Score

Trawling and Bycatch

- Bycatch in Alaska can harm salmon rears. From the Pollock industry alone millions of Chinook and Chum, including 729,000 from rivers in western and interior Alaska.
- Trawling can lead to seafloor deformation, including damaging coral reef ecosystems. Corals can be damaged even at low intensity trawls. These impacts only worsen the decline in corals to do ocean acidification and warming water temperatures.

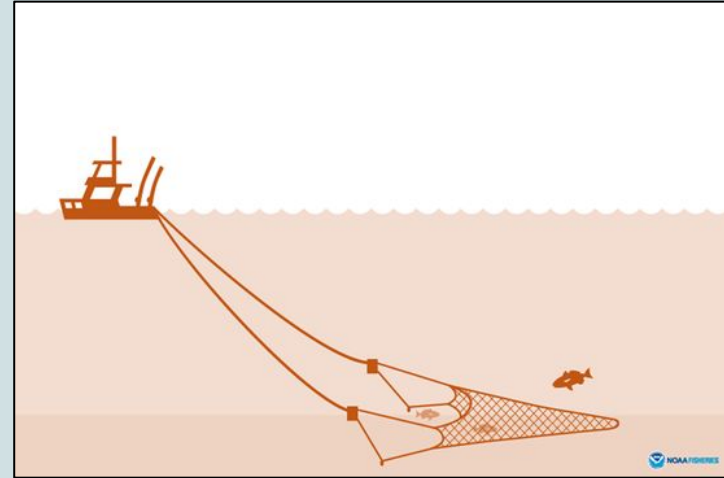


Photo by NOAA



Photo by ADFG

Tradition and Nutrition

- The Tlingit view the land, sea, and all living things as relatives
- Traditional role: stewards of the land and sea
- Modern role: guardians of the land and sea
 - Focuses on protection and preservation, not ownership
- Áak'w T'áak Sít' is a deeply sacred site to the Tlingit people
- Jason Amundson of UAS found that the glacier receded 148ft per year (1998-2020)



Photo: Costa Bella Travel



Photo: The Nature Conservancy

- Glacier melting leads to
 - Loss of culturally significant landscapes
 - Erosion of tlingit history and rights
- Climate change impacts:
 - Cultural erasure
 - Threaten ceremonial traditions and identity
 - Damage homes and traditional lands

Economy



Photo by The Seattle Times



Photo by Raincoast Conservation Foundation

- The seafood industry employs 58,700 people and produces more than \$5 billion in economic activity in Alaska each year.
- Data from a 2021-2023 estimate from the NOAA stated that the Alaska seafood industry suffered a 50% profit decline, resulting in a net loss of \$1.8 billion.
- As our climate warms, our fishing economy will decline. The best way to protect these jobs and livelihoods is to take preventative measures against the further warming of our climate.

How we can Protect our Fish

- Preserving the biodiversity of our ocean will protect the food chain, leading to healthier fish and larger pockets for Alaska.
- Prioritizing cleaner fuel, or renewable energy use and development to reduce the amount of carbon dioxide in the atmosphere, and delay warming will keep our water oxygen-rich and at a balanced pH.
- Salmon must be able to withstand stressors like rising water temperatures caused by climate change during spawning season.
 - Temporary solutions include creating cold water refuges, which are resting areas where the temperature is cooler than the main river, to aid upstream migration and minimize stress of migrating salmon.
- Composting and using the compost in your home garden can prevent and reduce waste runoff into rivers and streams
 - This protects waterways from fertilizer and chemicals running into Salmon habitats.



Photo by World Bank Blogs



Photo by International Fish and Game Association

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