



Climate change and PNW Fisheries

*Climate Science on Tap
Schooner Series, 2019*

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What is the climate change impact?



Tolerating the heat!



Managing for Change



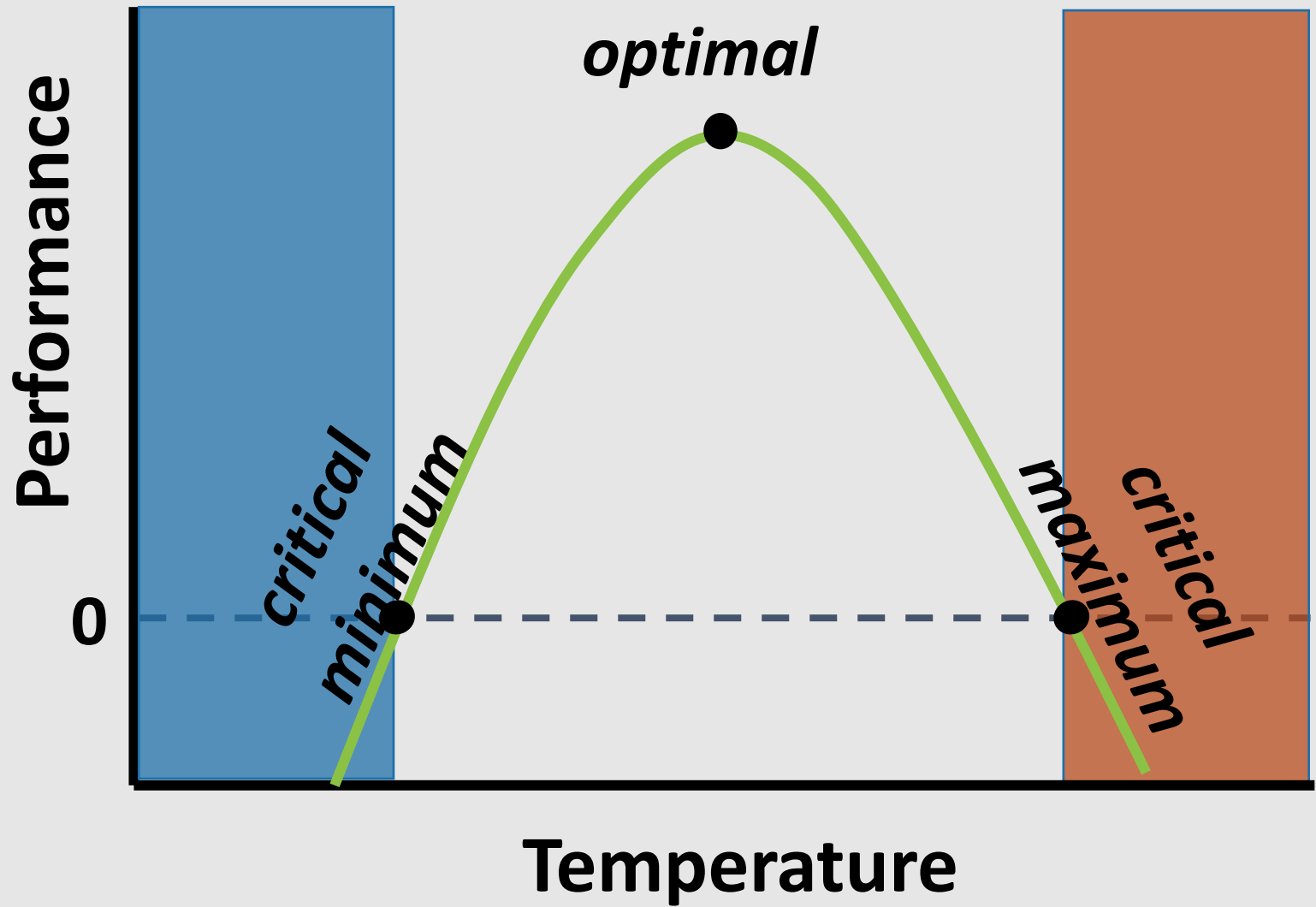
Ocean Acidification

We change how we interact with the environment through space and time



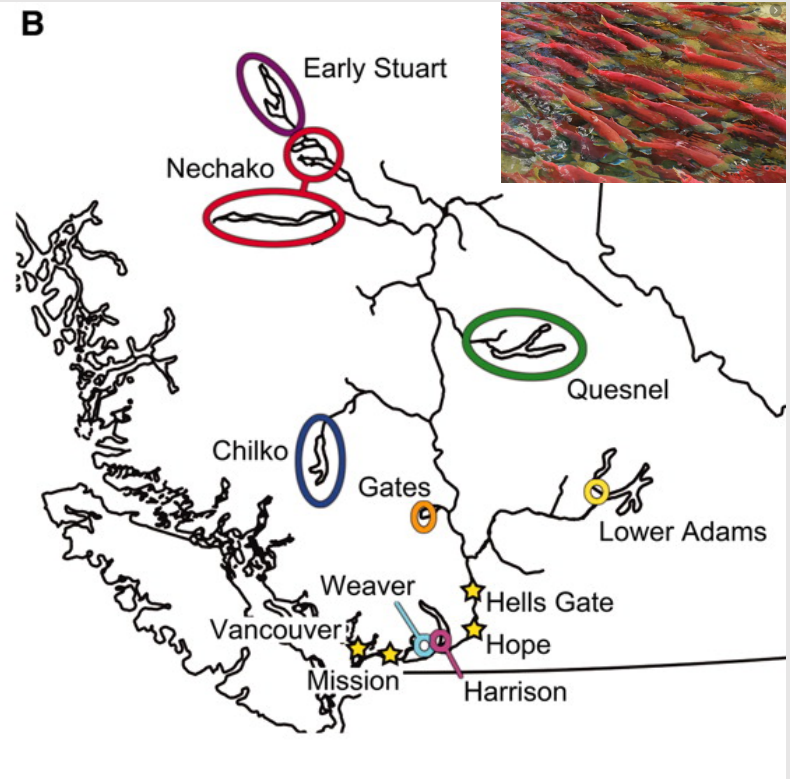
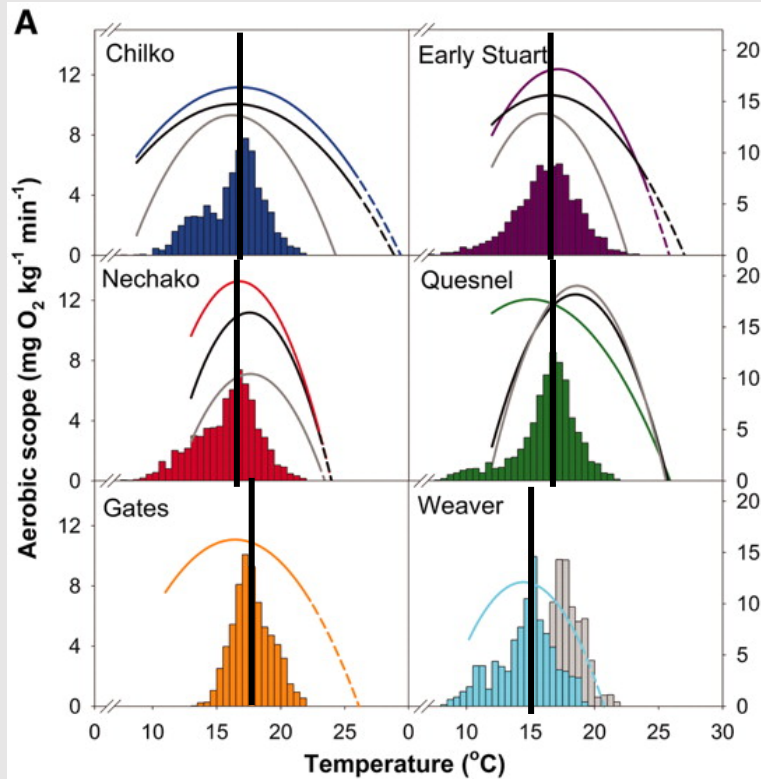
- Work in my office all day with AC
- Commute on the bus
- Exercise late in the evening (or early in the morning)
- Go to the beach

Thermal Tolerance



Thermal Tolerance of Fraser River Sockeye Salmon

Eliaison et al. 2011

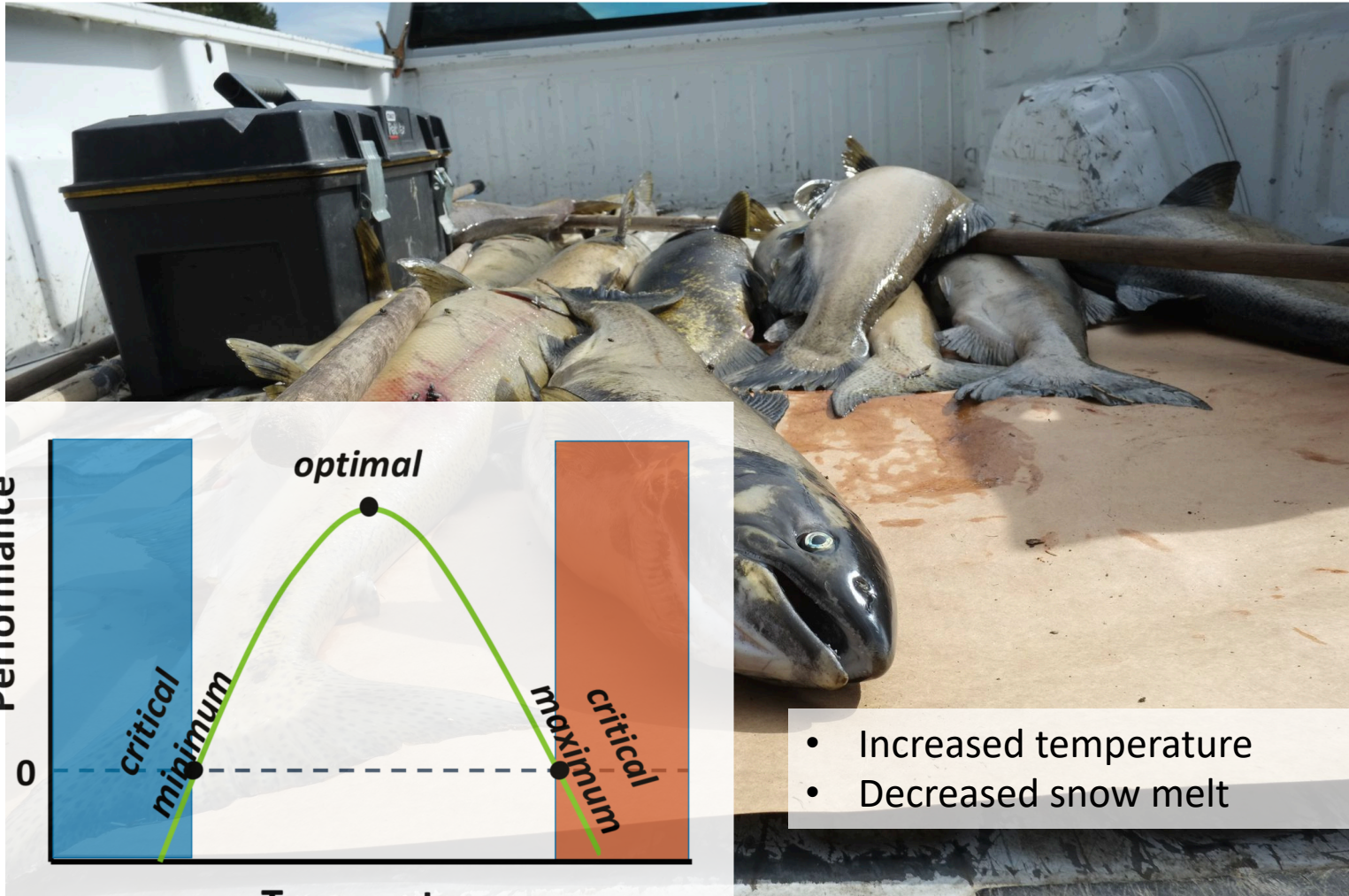


Further from optimal temperature = closer to critical maximum temperature = less energy to spawn/reproduce

Climate change is cooking salmon in the Pacific Northwest

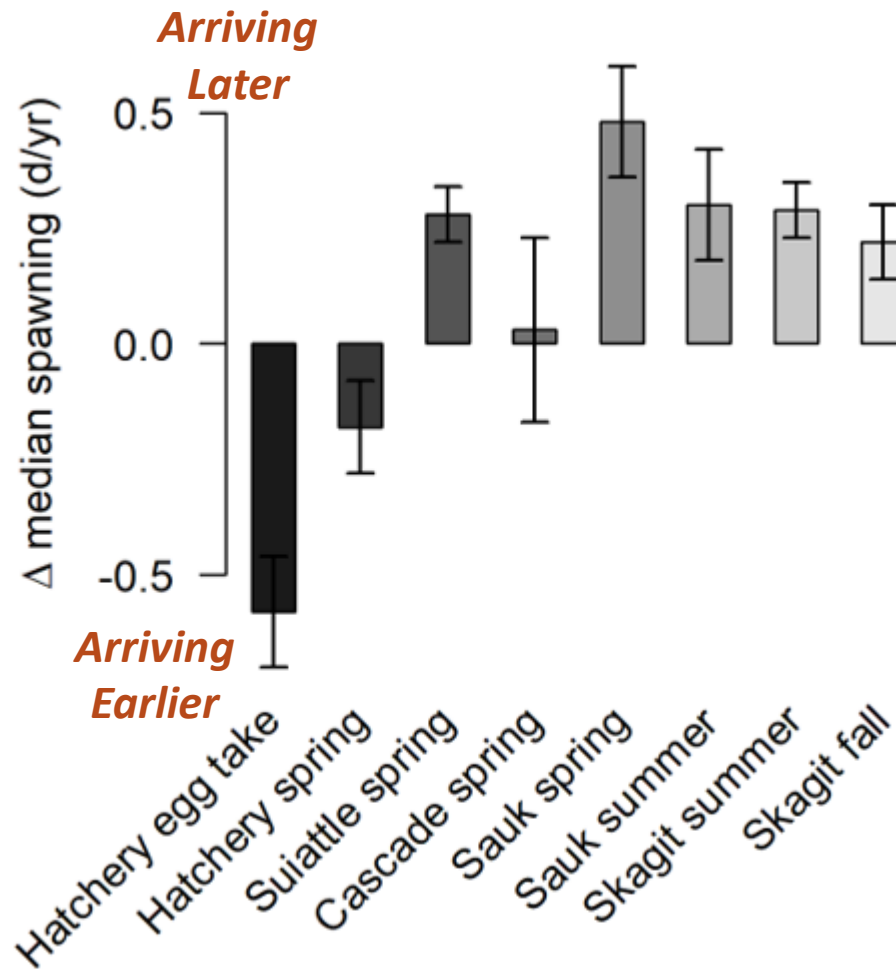
Warmer waters in the Pacific Northwest are killing salmon before they can reproduce.

By Howard Hsu | February 8, 2019



Salmon that have died in Washington's Wallace River before spawning. Howard Hsu

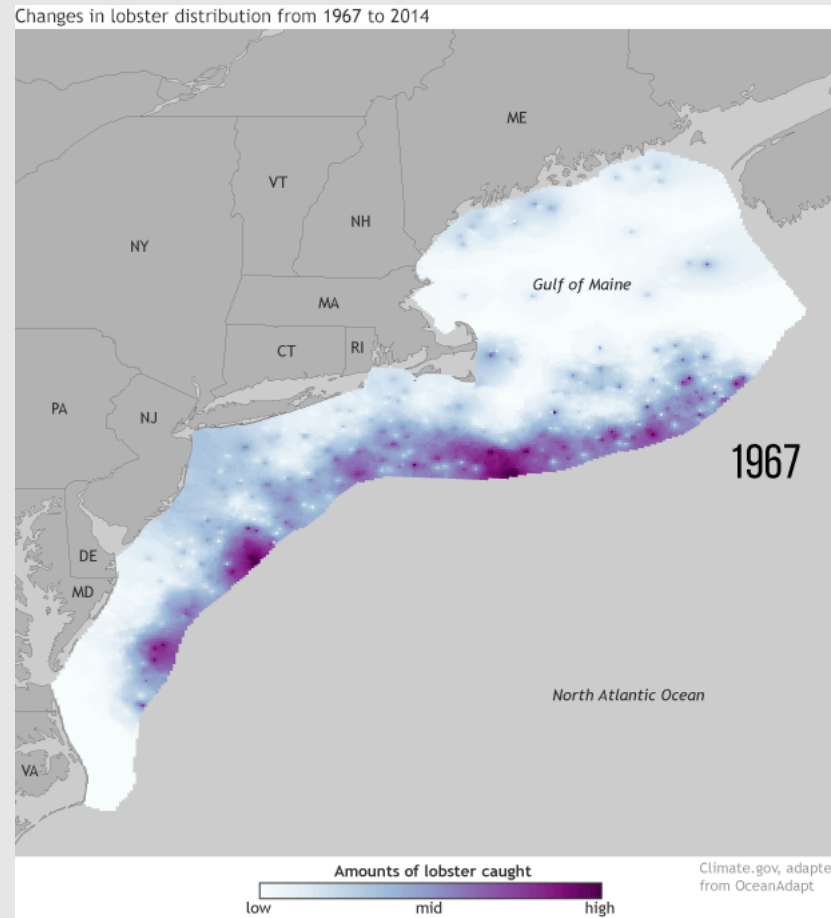
Skagit River Chinook Salmon



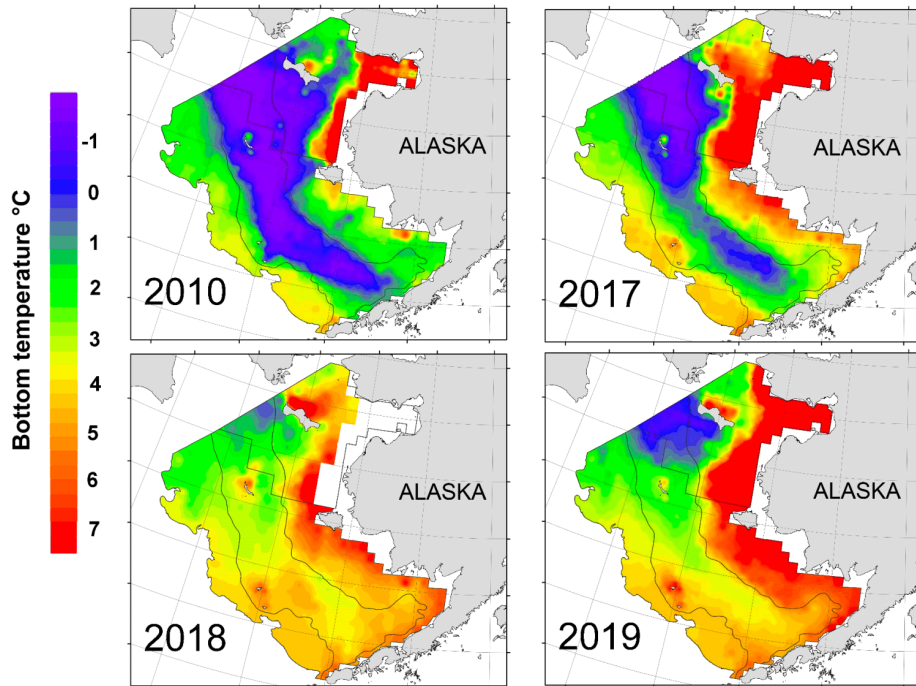
Salmon alter how they interact with the environment through time

So...who gets the fish?

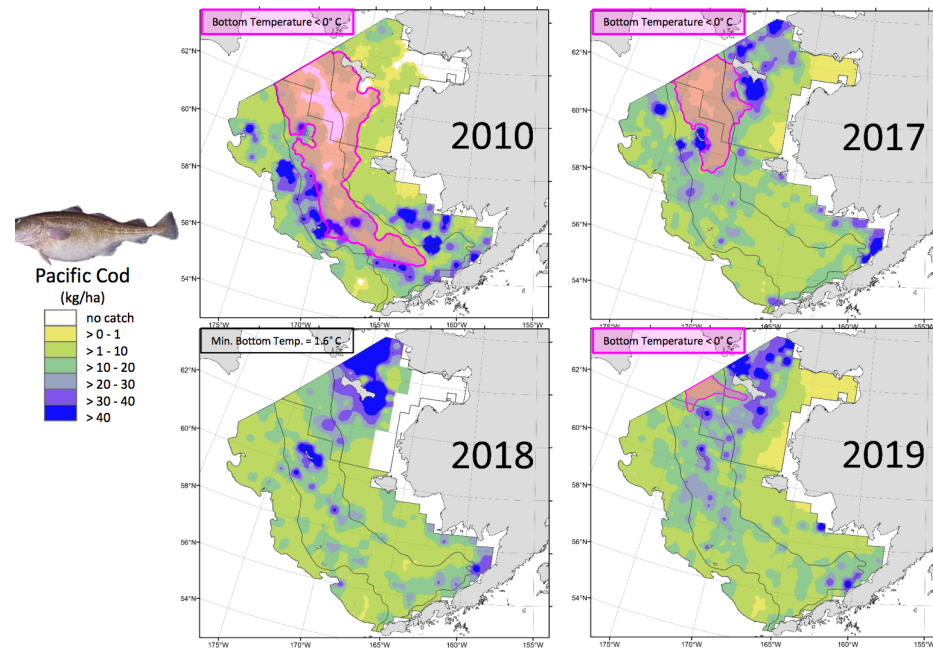
Species such as lobster and summer flounder have been found at higher latitudes during more recent, warmer time periods



Survey bottom temperatures

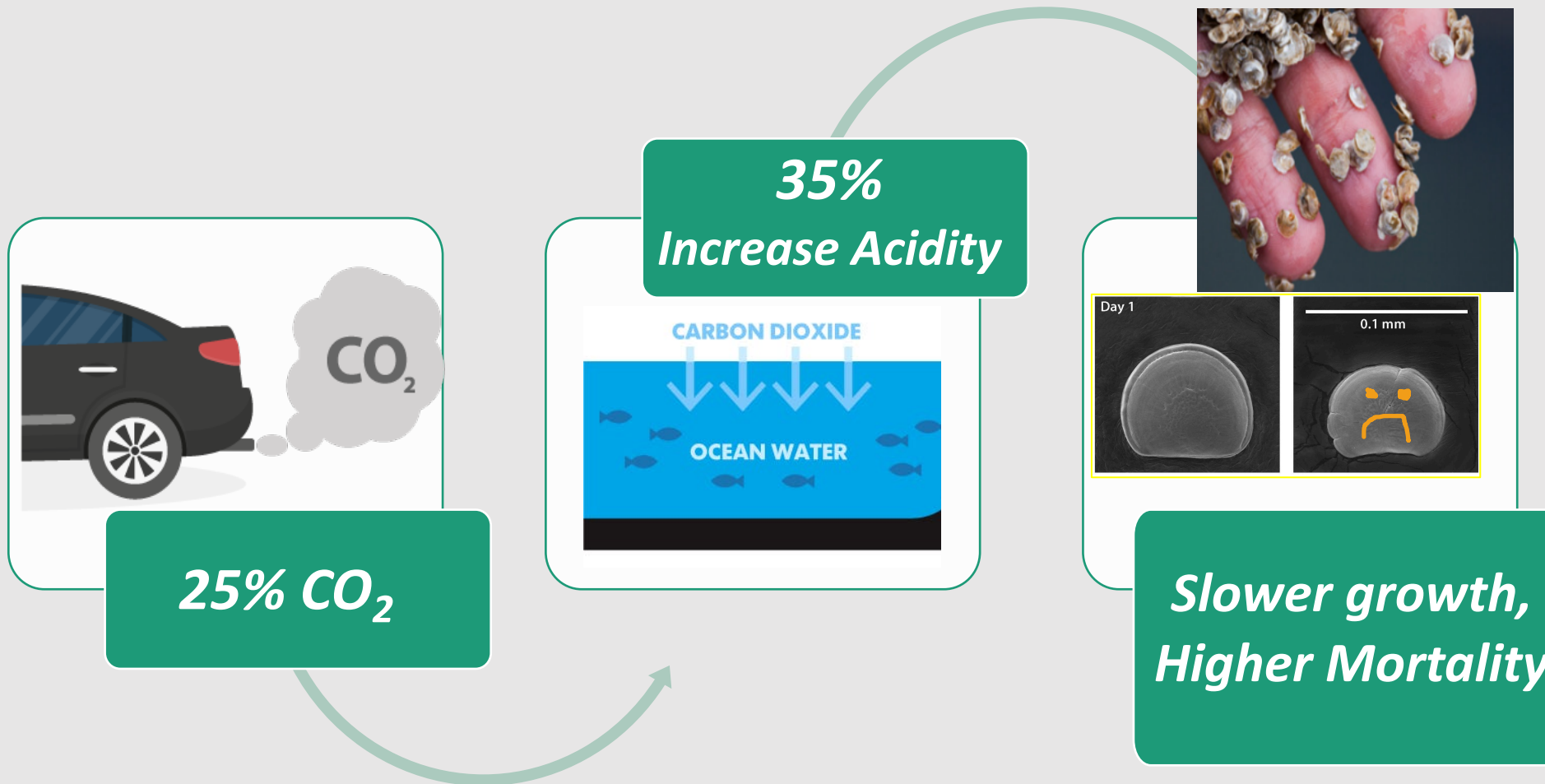


Bering Sea Pacific Cod Distribution



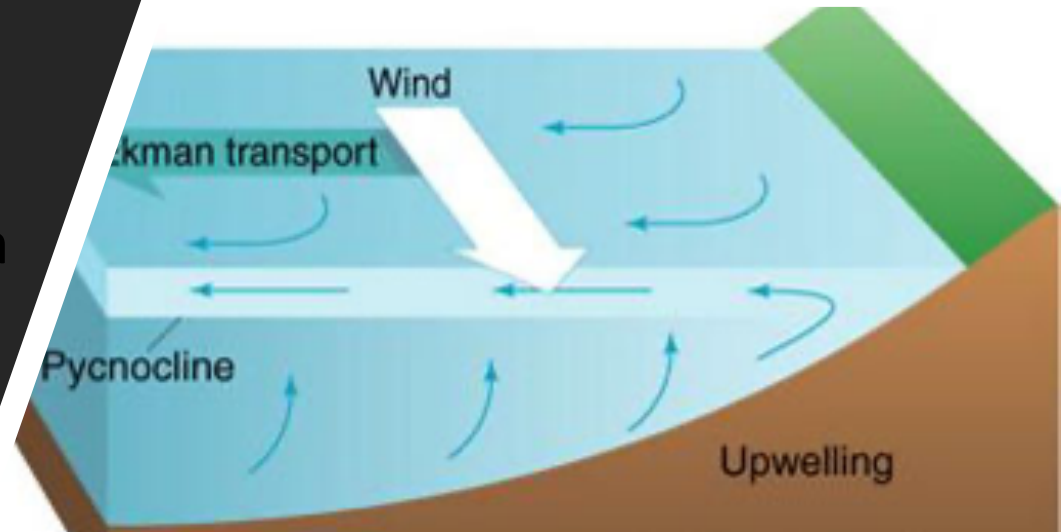
Many species alter how they interact with the environment through time

Ocean Acidification

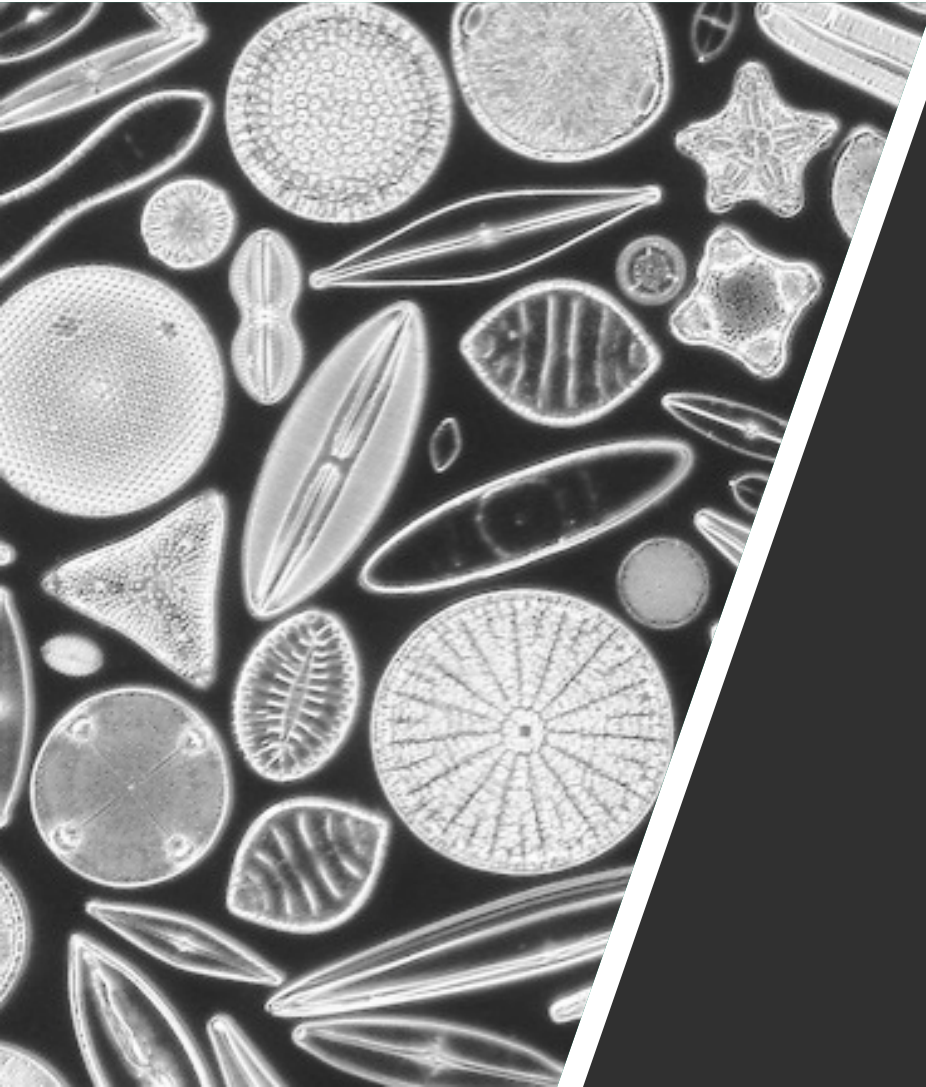


Ocean Acidification: WA

- Runoff of nutrients and decaying organic matter
- Coastal upwelling of CO₂ rich, low pH (high acidity) waters from deep ocean to WA coast
- Emissions of other acidifying gases (nitrogen and sulfur oxides)

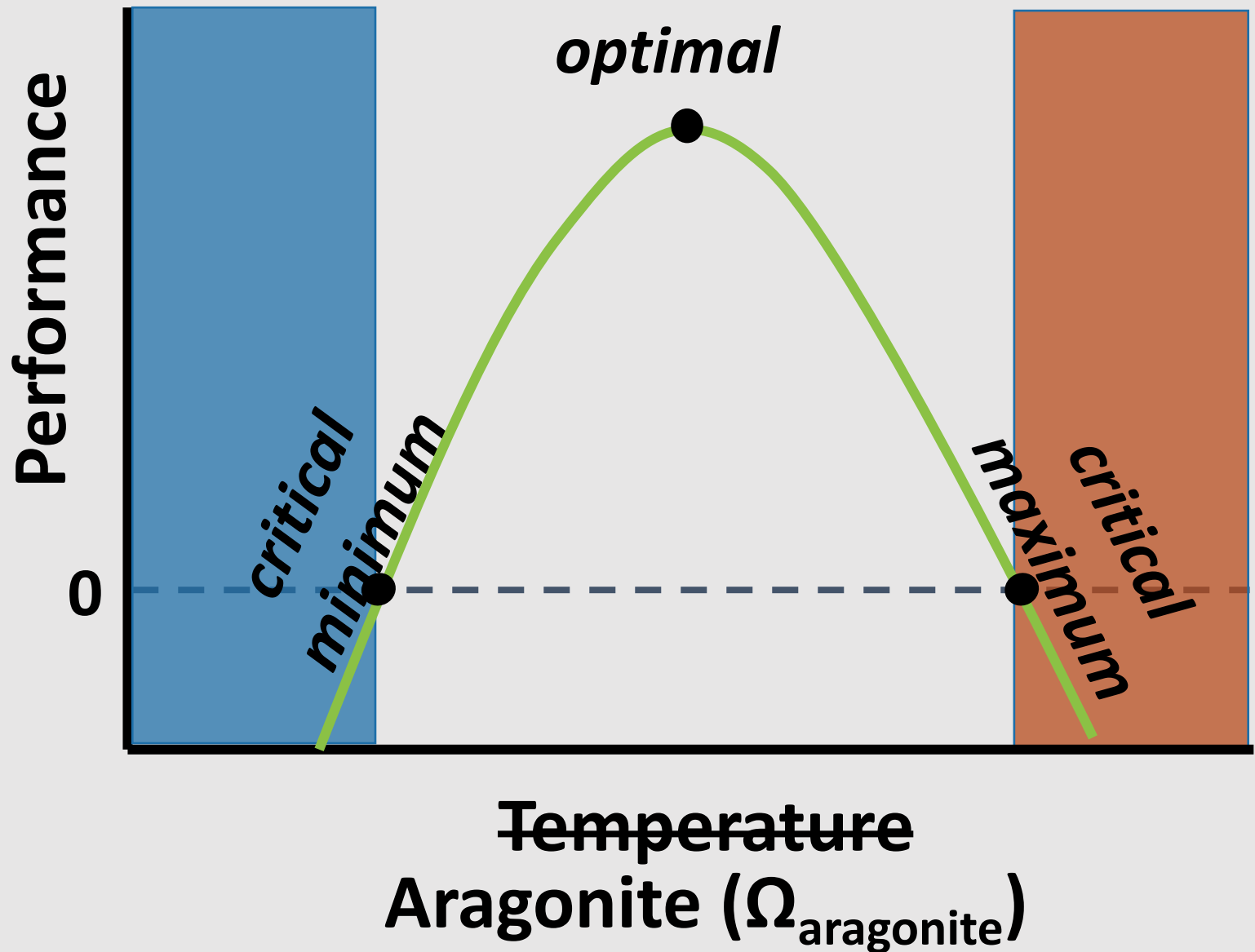


Ocean Acidification in WA... but why does it matter?



- More than 30% of Puget Sound species are calcifiers
 - Oysters, clams, geoduck
 - Sea cucumbers, seaweed, diatoms
- \$270 million annually
- Supports 3,200 jobs
- Important component of subsistence fisheries

Aragonite Tolerance



The State of the Science

- Identify aragonite and thermal tolerance for a range of species
- Identify the breadth of variability in tolerance among individuals
- Understand how tolerance is passed to offspring

Shellfish growers fight to keep species thriving amid rising acid levels in Puget Sound

Growers at Taylor Shellfish farms in Jefferson County are working to keep shellfish alive, by testing water for acid levels and growing algae for them to eat.

What is the climate change impact?



Species modify their use of space and timing



Management must be modified to minimize impacts of change



The PNW is particularly vulnerable to acidification

Shifts in timing: good or bad?



*Small and
Juvenile Fishes*

*Zooplankton
Increase*

*Phytoplankton
Increase*

Upwelling

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Month