

# Examining heat stress in migrating adult Pacific salmon

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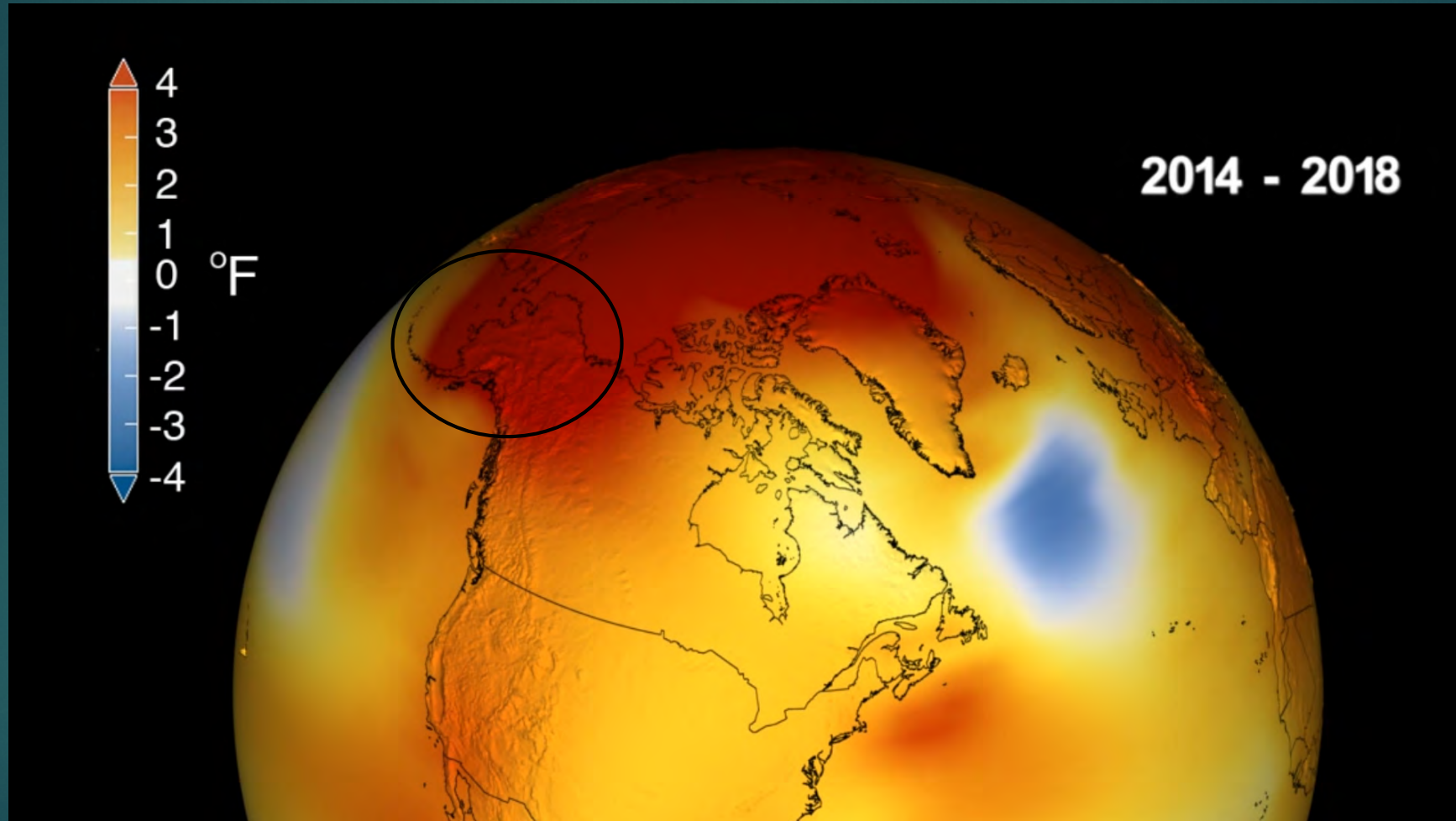


# Hypothesis: Warm Water temperatures are inducing heat stress in Pacific salmon in Alaska





# 2014-2018: Warmest 5 years on record





# Salmon mortality linked to record heat in 2019

## Alaska Heat Wave Hits Yukon-Kuskokwim Delta

By KRYSTI SHALLENBERGER, ALASKA'S ENERGY DESK • JUL 10, 2019



People living in the Yukon-Kuskokwim Delta felt something unusual this past holiday weekend: a heat wave. Temperatures crept close to 90 degrees in many parts of the region, including Bethel, but a malfunctioning thermometer and not enough data could prevent this summer from making it into the record books.



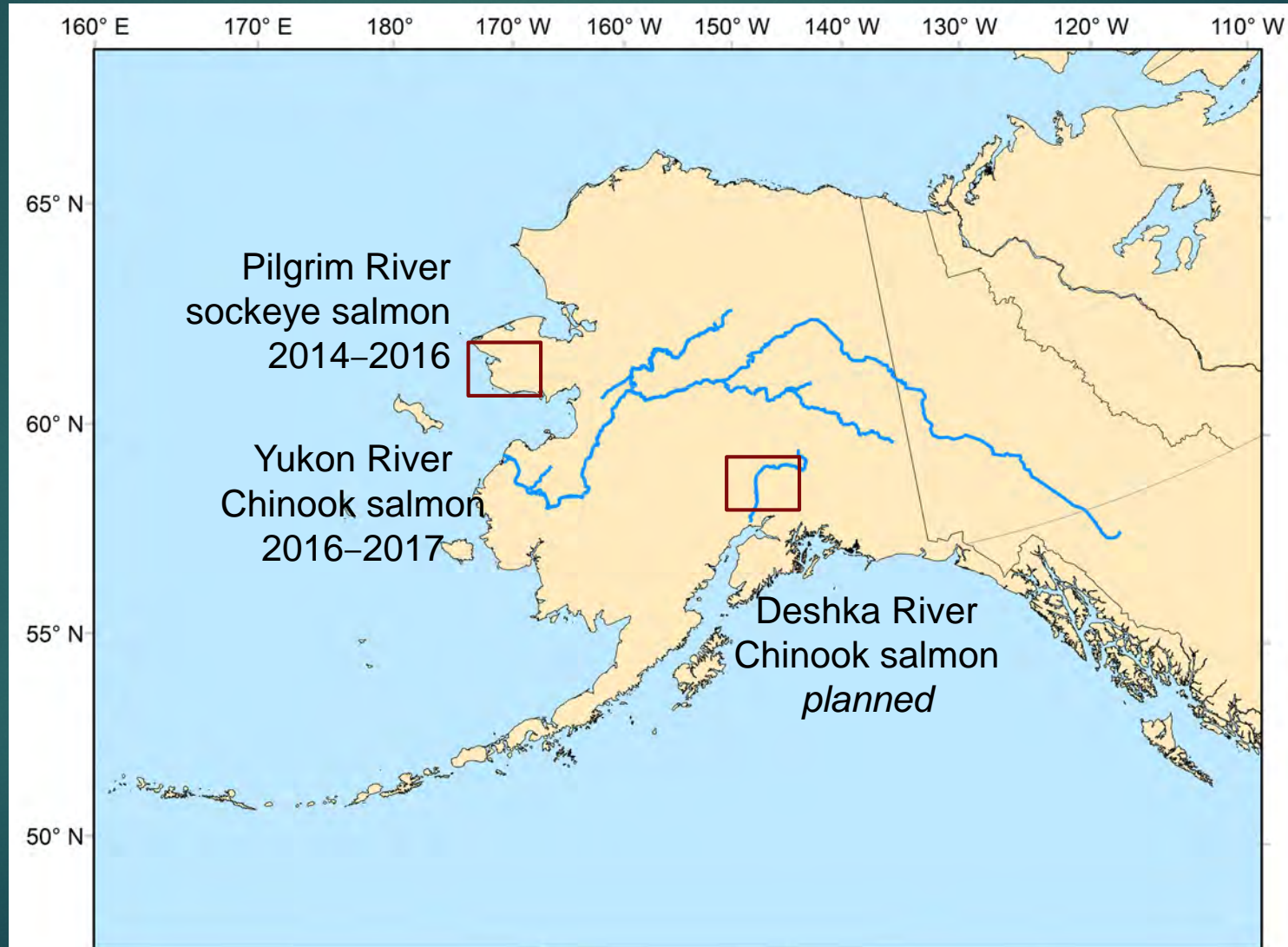
Stephanie Quinn-Davidson, YRITFC





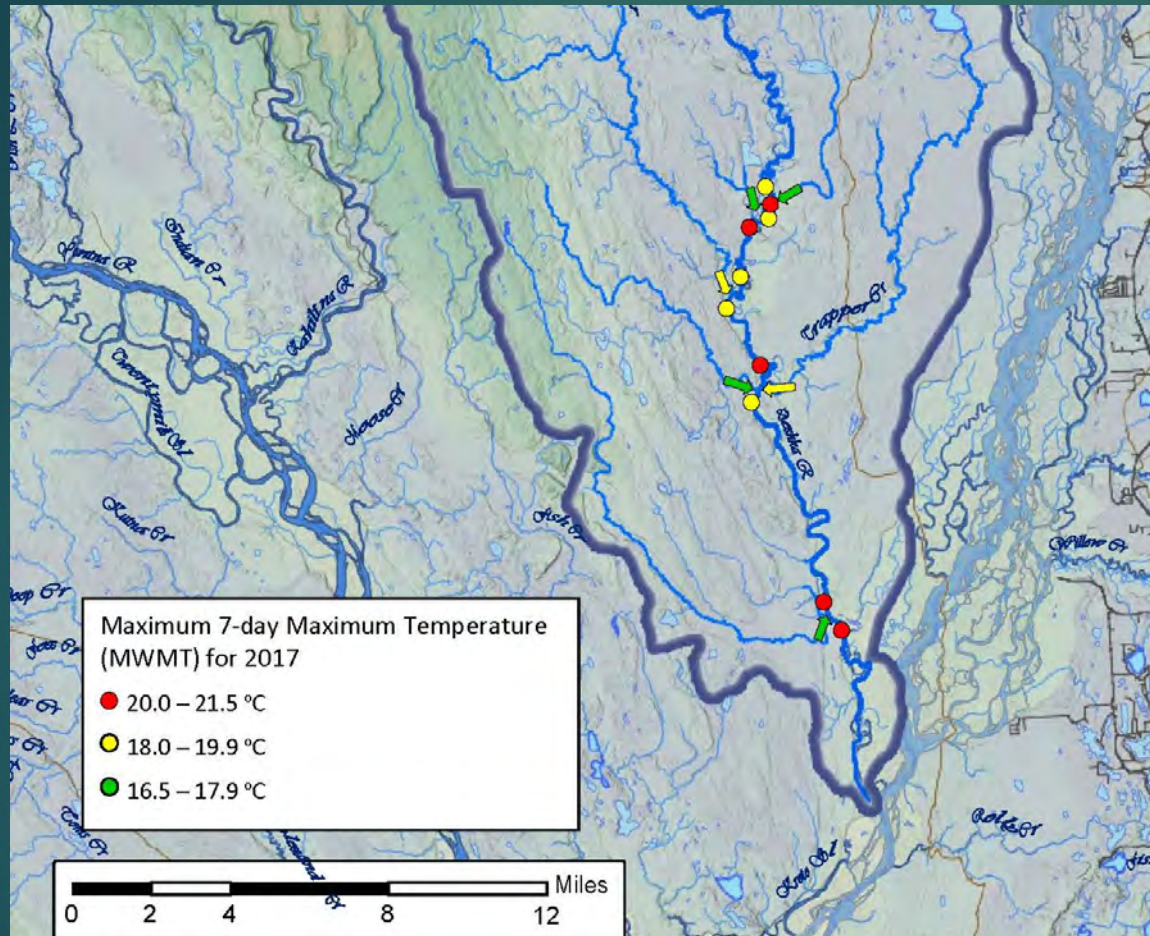


# Pacific salmon heat stress projects





# New Project: Heat stress in juvenile and adult Deshka River Chinook salmon

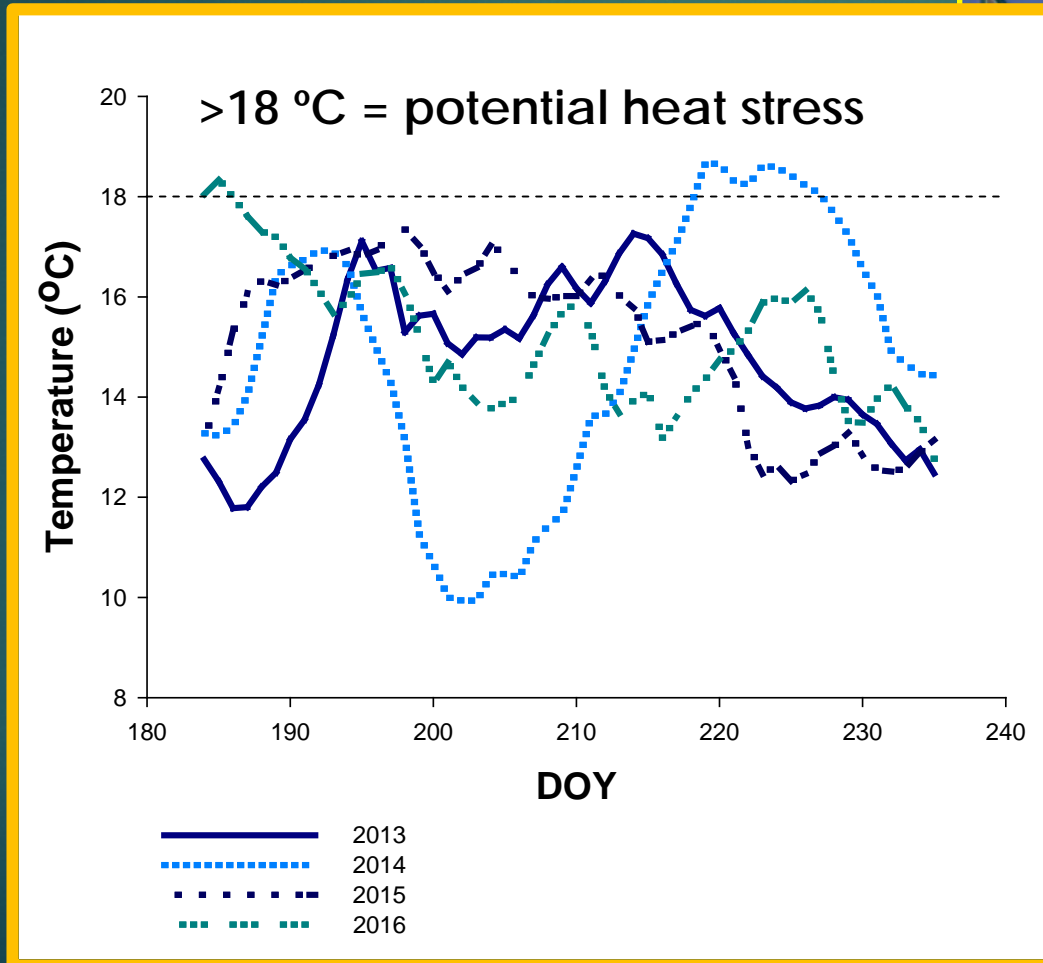
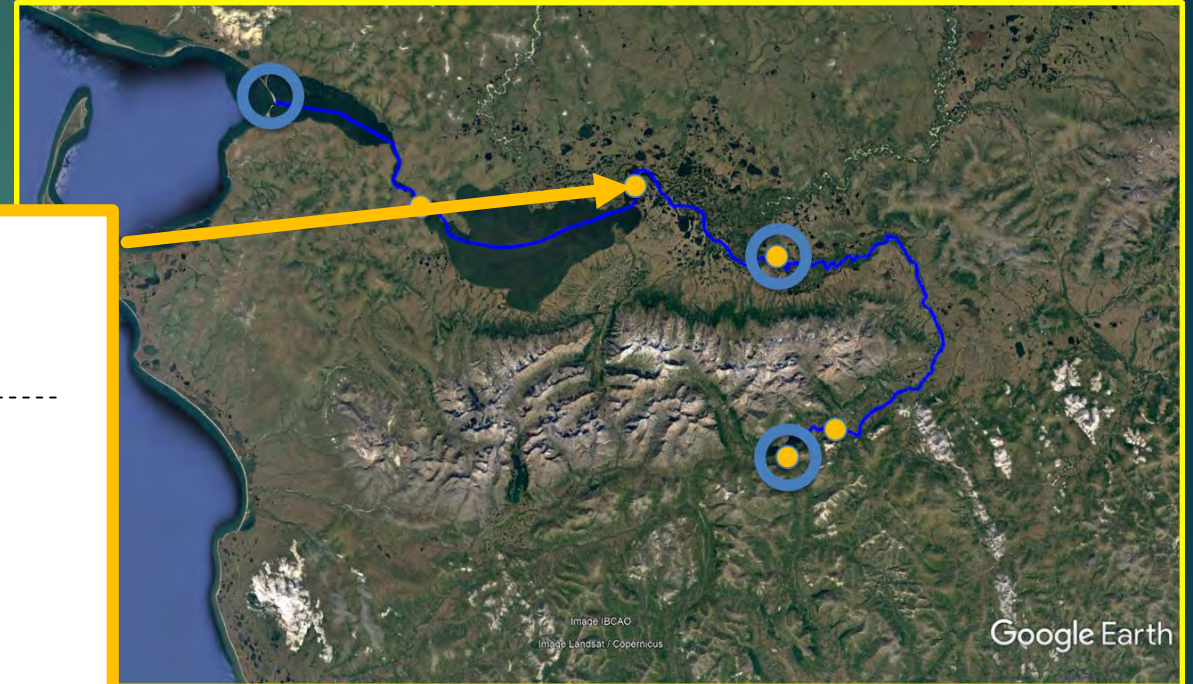


- Juvenile heat stress experiment
- Estimate heat stress rates in juveniles from reaches that differ in temperature
- Estimate heat stress in adults at the weir





# Pilgrim River Sockeye Salmon



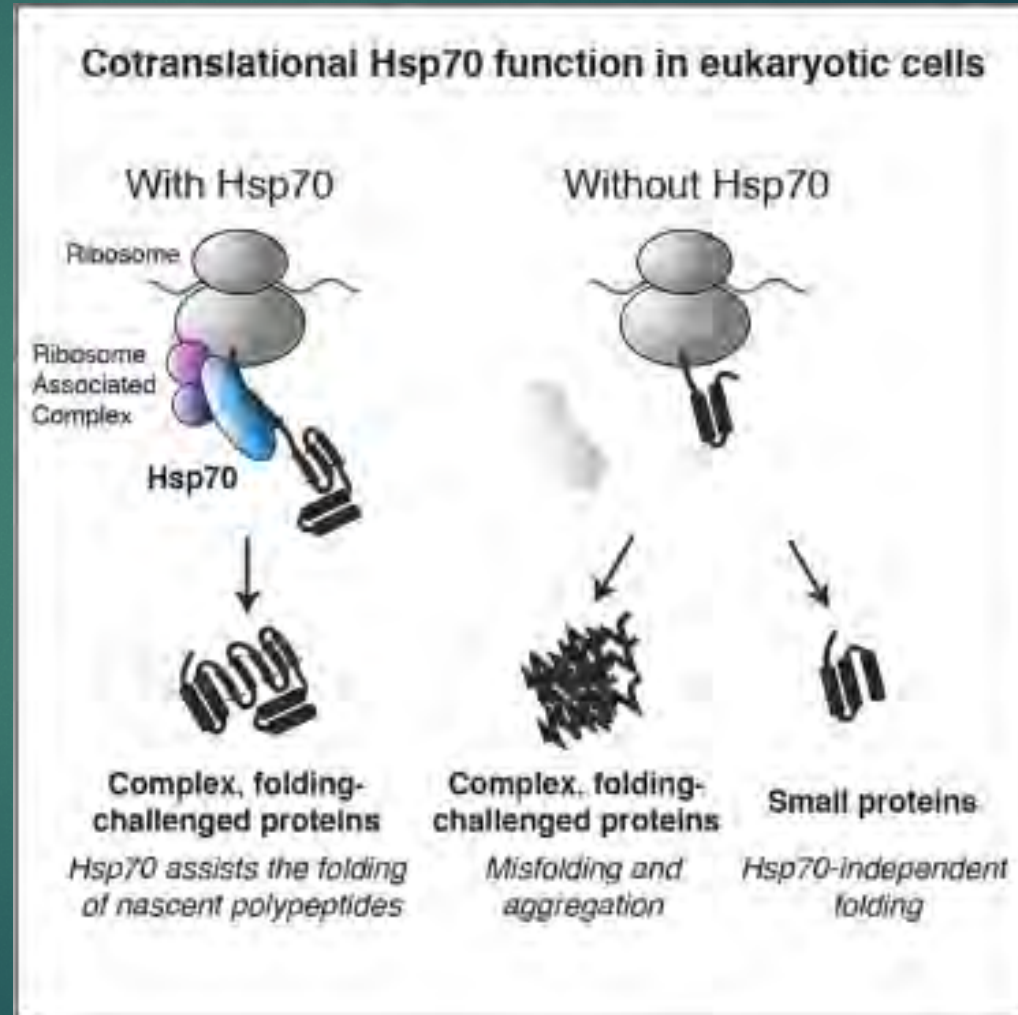
18 °C ~ 65 °F



# Biomarkers of heat stress

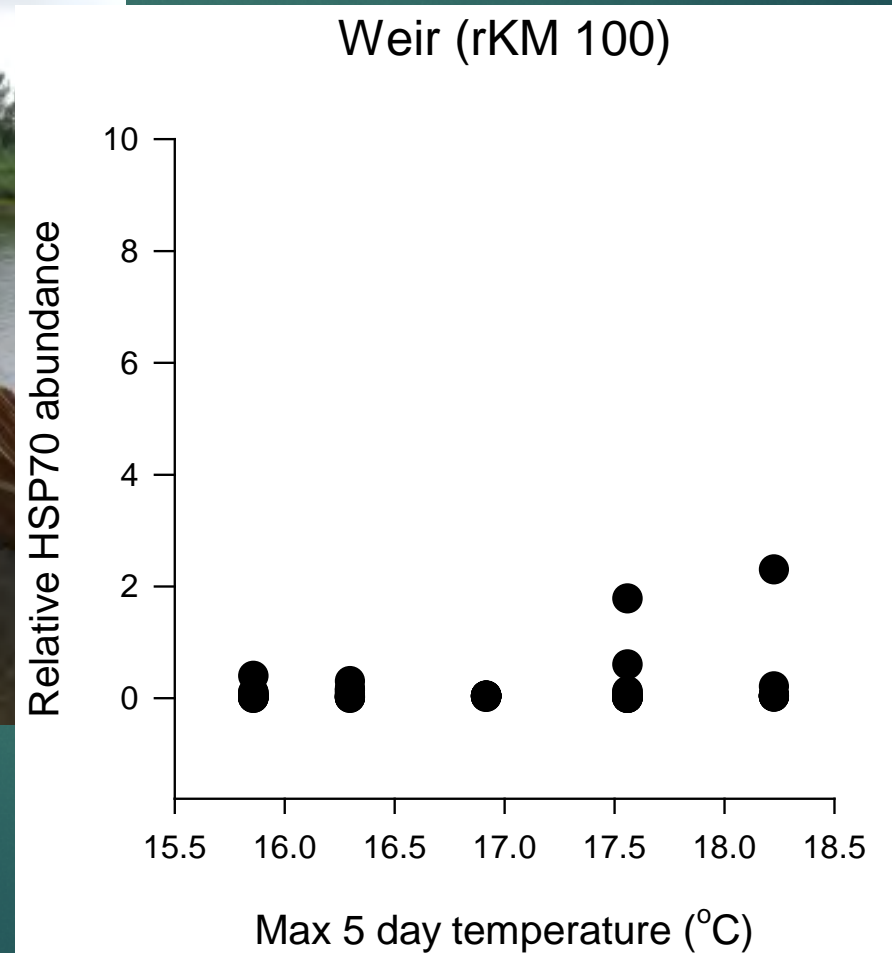
## Heat shock protein 70 (HSP70)

- ▶ Established
- ▶ Response within hours
- ▶ Chaperone that maintains cellular function
- ▶ Measuring relative abundance of HSP70 protein





# Pilgrim River Sockeye Salmon



Heat stress indicated in just 5% of fish (n = 66)

18 °C ~ 65 °F



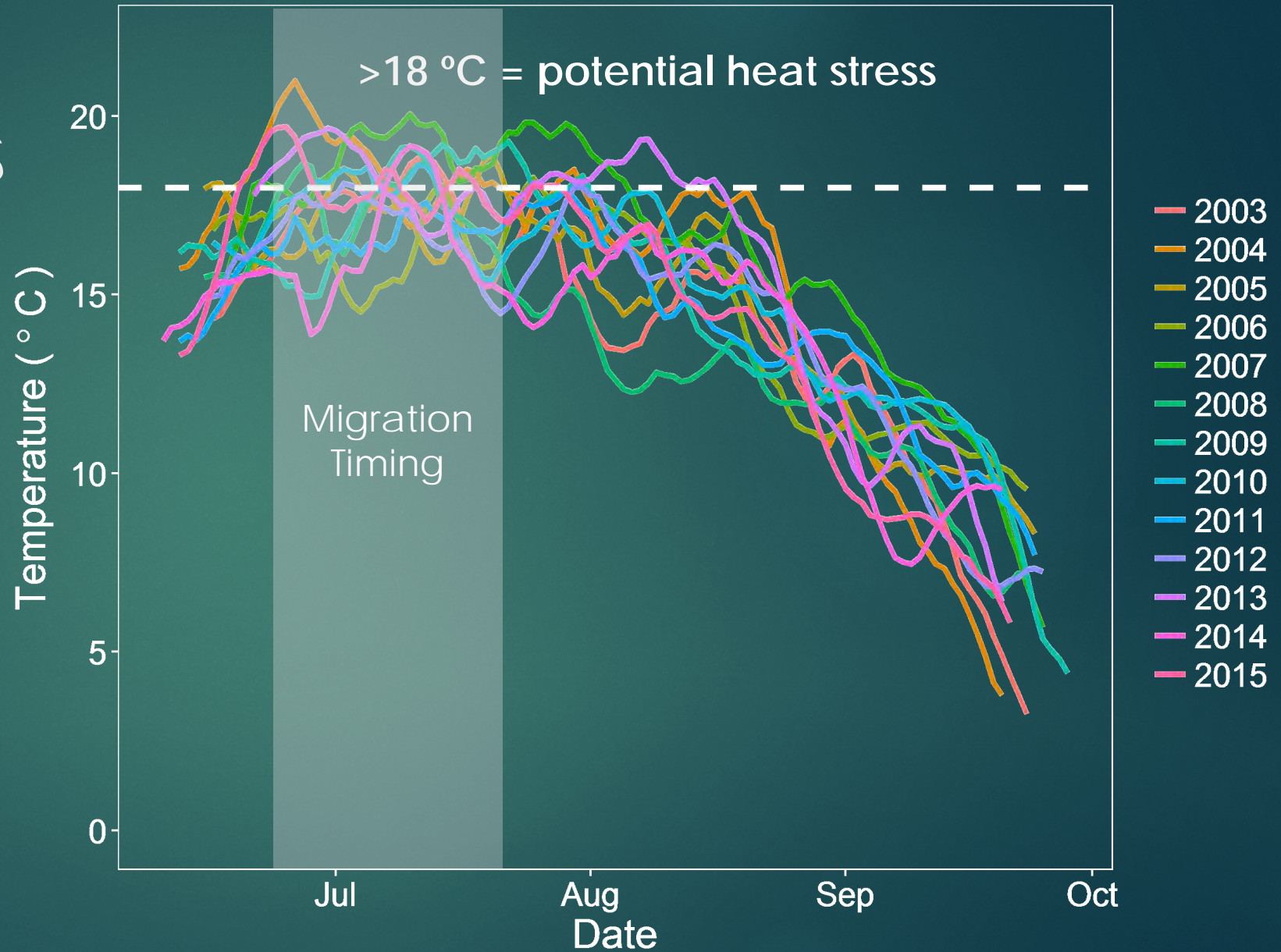
# Yukon River Chinook salmon





# Yukon River Temperatures

21 °C ~ 70 °F  
18 °C ~ 65 °F  
15 °C ~ 59 °F

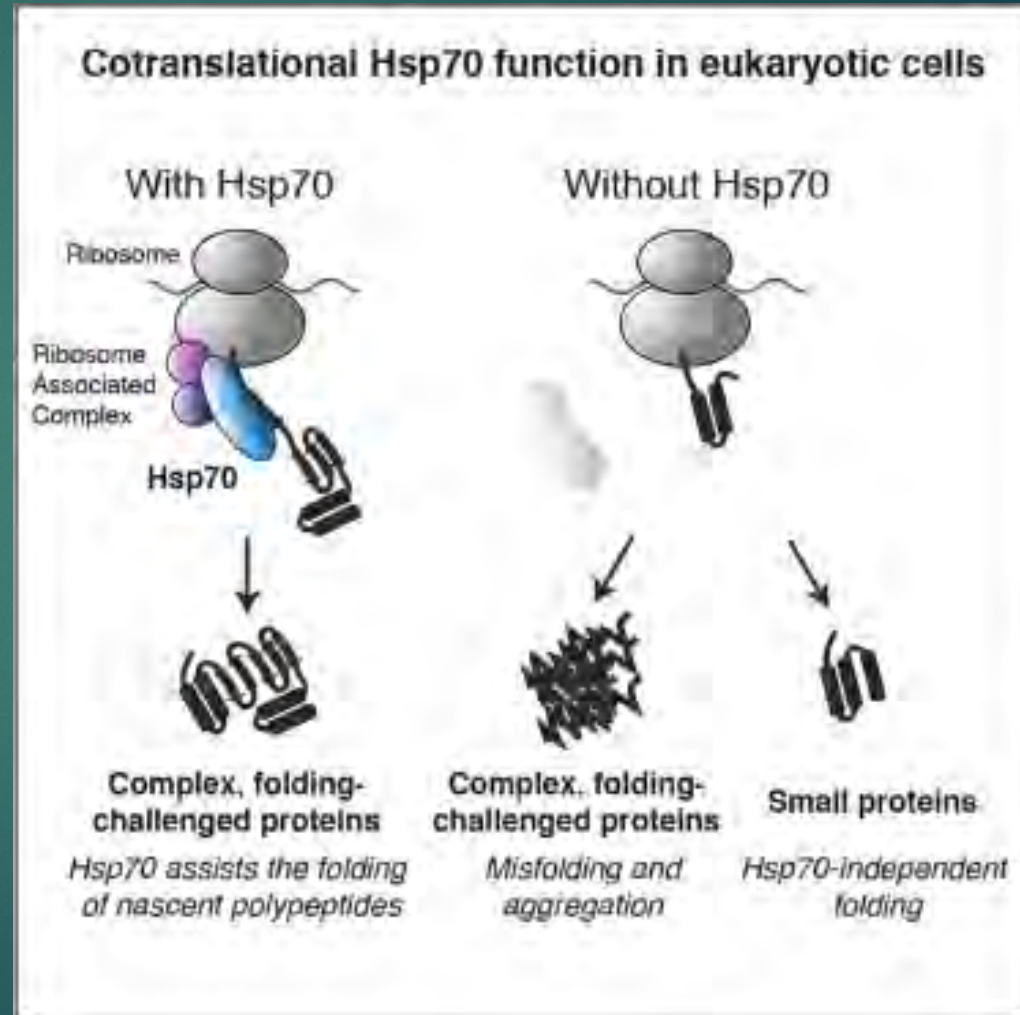




# Yukon River Chinook Salmon Biomarkers

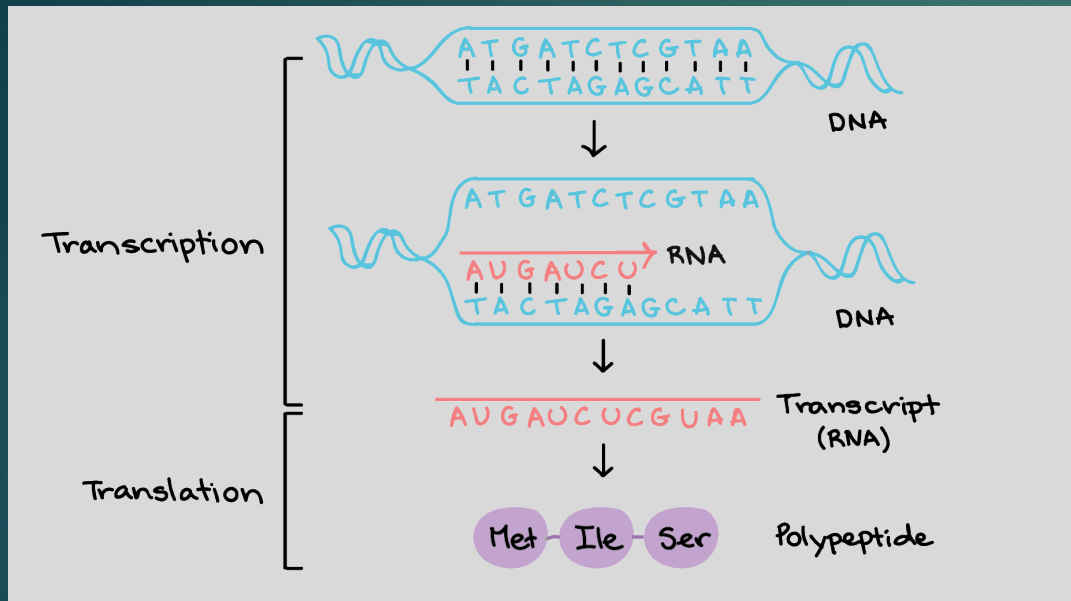
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# Yukon River Chinook Salmon Biomarkers



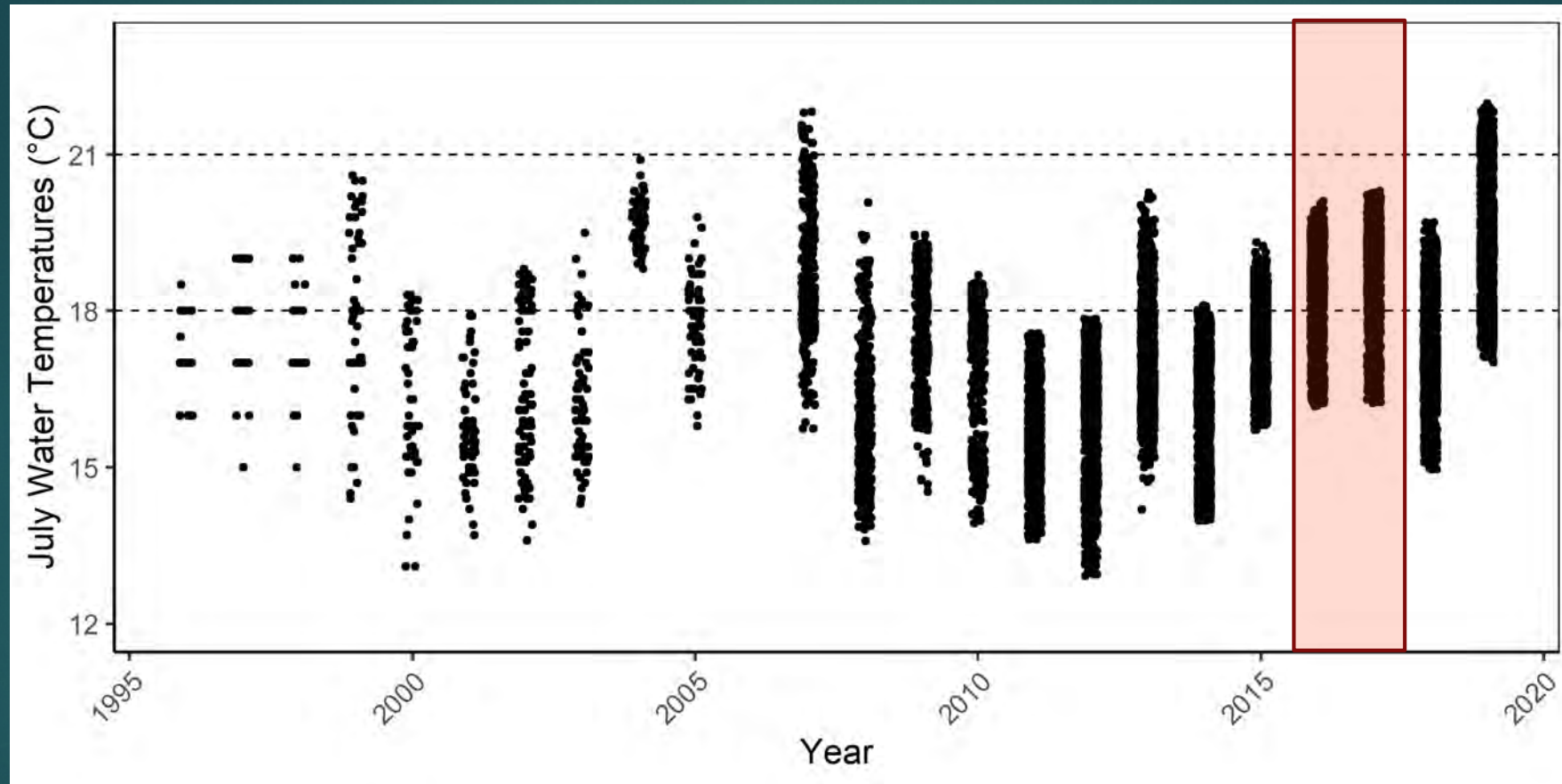
Khan Academy

## Gene transcription panels

- ▶ Response within hours
- ▶ Potential to understand mechanisms leading to mortality
- ▶ Measuring mRNA of specific genes including HSP70



# Yukon River Water Temperatures



~21 °C / 70 °F =  
mortality

>18 °C / 65 °F =  
potential heat  
stress



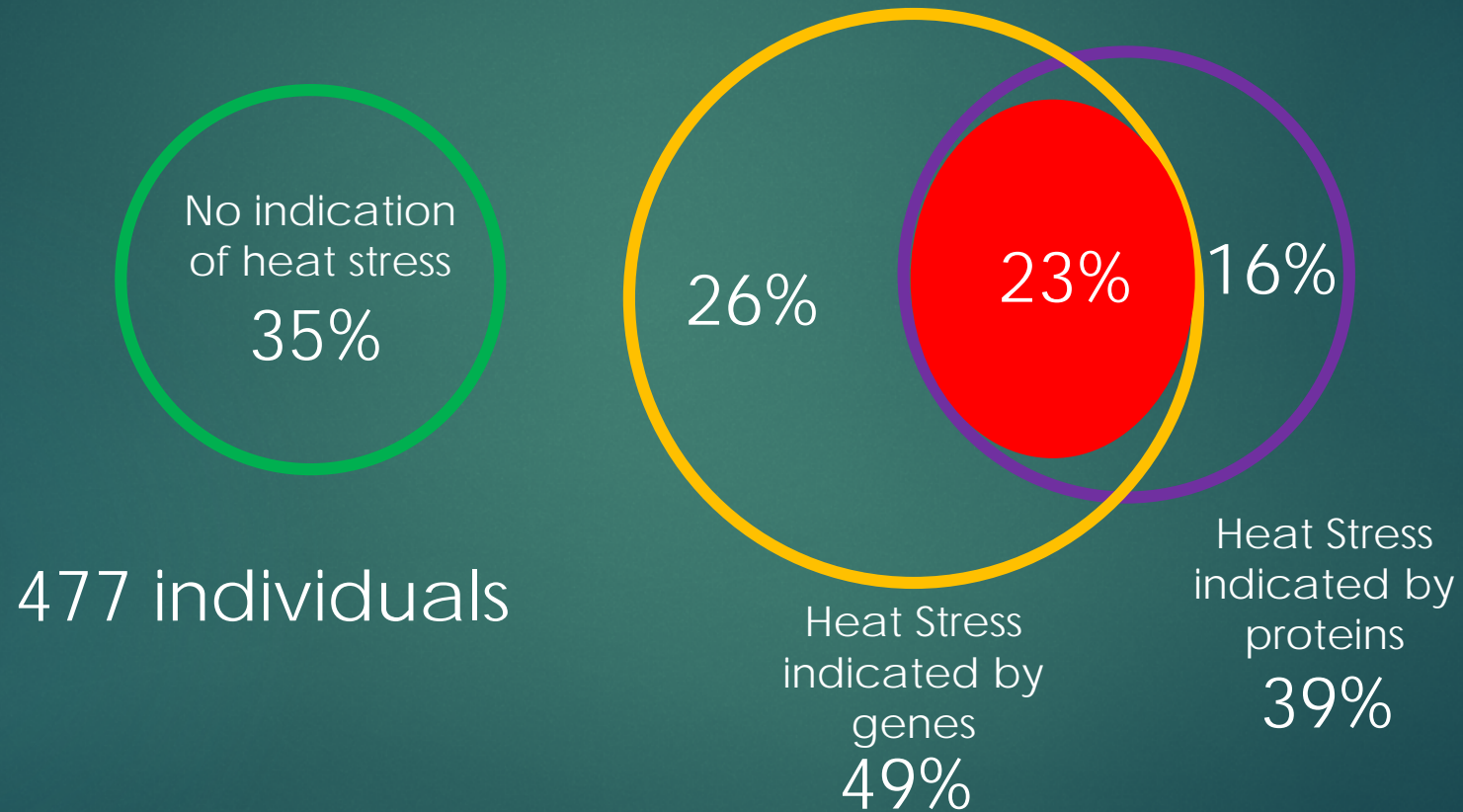
# Muscle biopsy & live release of 500 fish in 2016 and 2017 across the watershed



Preliminary Information-Subject to  
Revision. Not for Citation or Distribution



# Overall 65% of 2016-2017 Yukon River Chinook salmon sampled had some indication of heat stress





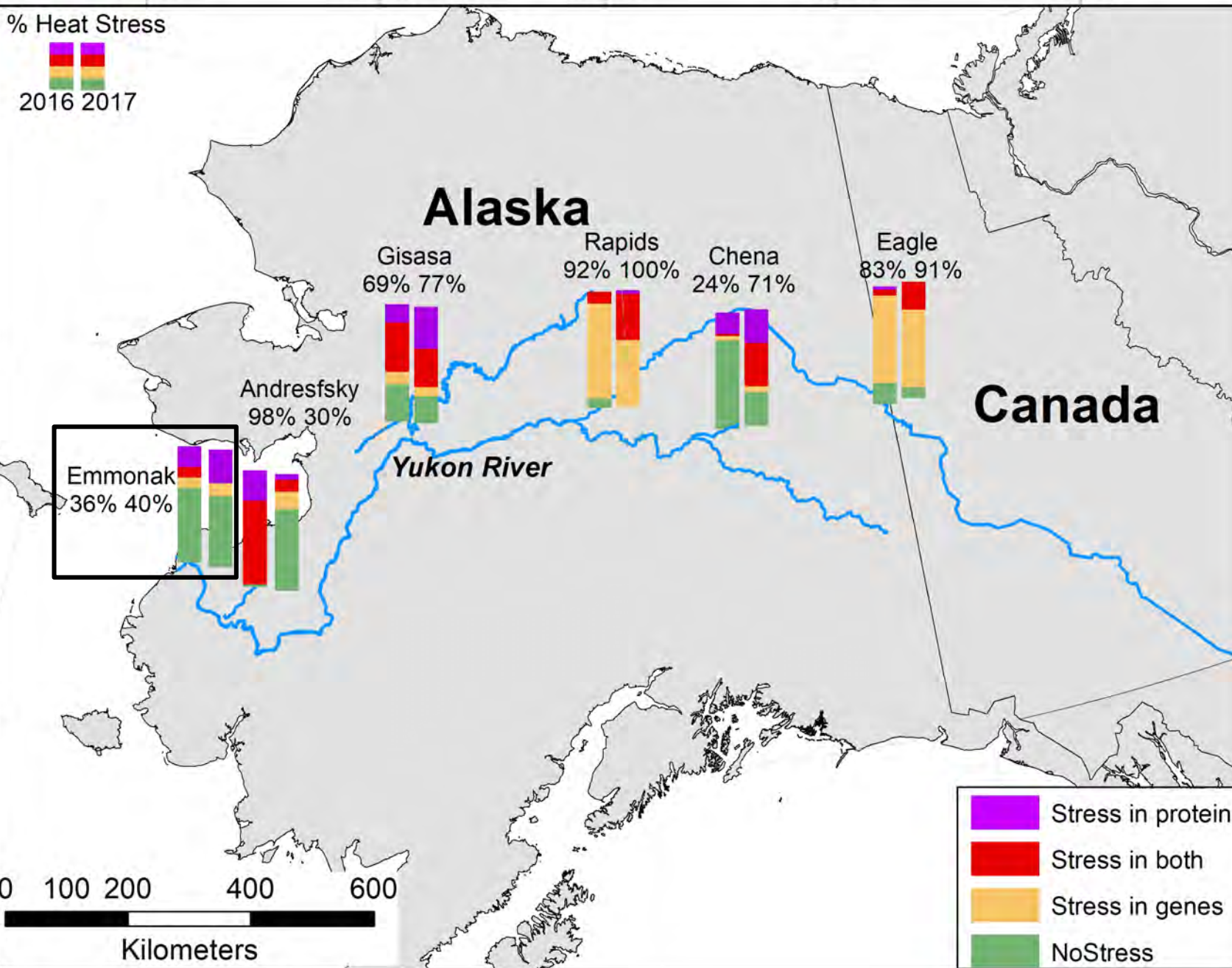
170° W

160° W

150° W

140° W

130° W



Preliminary Information- Subject to Revision. Not for Citation or Distribution





# Heat stress in Pacific salmon



Pilgrim River Sockeye salmon

- ▶ Cool water generally  $< 18\text{ }^{\circ}\text{C}$  /  $65\text{ }^{\circ}\text{F}$
- ▶ Little evidence of heat stress
  - ▶ 5% Heat stress from HSP70



Yukon River Chinook salmon

- ▶ Warm water often  $18 - 21\text{ }^{\circ}\text{C}$  /  $65 - 70\text{ }^{\circ}\text{F}$
- ▶ Strong evidence of heat stress
  - ▶ 39% Heat stress from HSP70
  - + 26% Heat stress from genes
  - = 65% Heat stress total



# Deshka River was $>27$ °C in 2019!!



## PRESS RELEASE

**FOR IMMEDIATE RELEASE:**

July 10, 2019

**MORE INFORMATION:**

Sue Mauger, Science Director (907.399.2070)  
Brandon Hill, Chief Creative Officer (207.632.0861)

### HEAT WAVE HITS COOK INLET SALMON STREAMS

*Climate Crisis Sends Stream Temperatures Off the Charts*

HOMER, AK— As Alaskans suffer through the smoke, haze and danger of a record-breaking heat wave, Alaska's salmon are suffering too. On July 7<sup>th</sup>, stream temperatures topped 81.7 °F (27.6 °C) in the Deshka River, a major salmon stream on the west side of Cook Inlet in the Mat Su Valley.

"We've been tracking stream temperatures in non-glacial systems across the Cook Inlet watershed since 2002," said Sue Mauger, Cook Inletkeeper's Science Director. "But this is a first – we've never seen stream temperatures above 76 degrees Fahrenheit."



# Thanks to...

- ▶ Arctic Yukon Kuskokwim Sustainable Salmon Initiative
- ▶ Rampart Rapids subsistence fishing community
- ▶ Community of Pilot Station
- ▶ ADF&G Test fishery crews and FWS weir crews in 2016 and 2017
- ▶ Norton Sound Economic Development Corporation field crews in 2014-2016
- ▶ 2018 Pilot Station Sonar Crew

