Deshka River temperature monitoring and salmon studies

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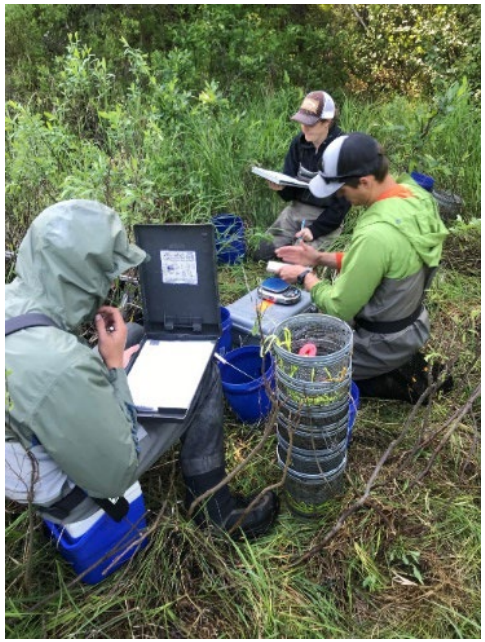

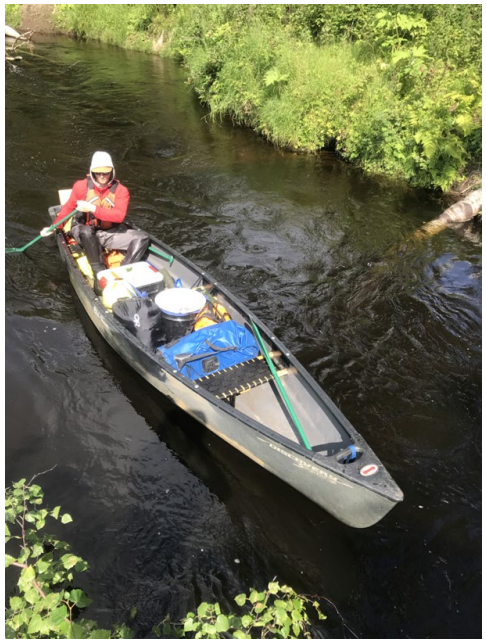

Acknowledgments

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Mat-Su salmon PARTNERSHIP

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ALASKA DEPARTMENT OF FISH AND GAME

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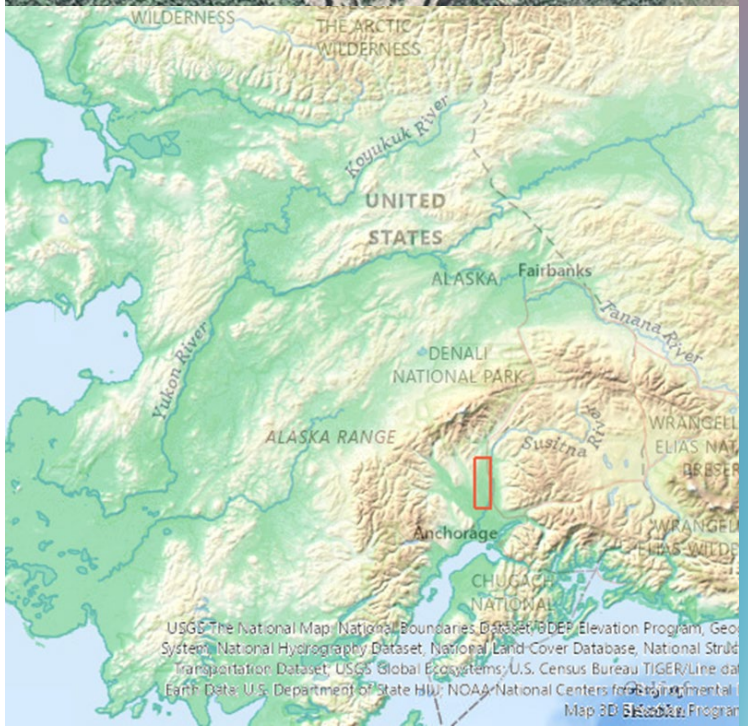
Why the Deshka?

- Historically productive Chinook and Coho salmon producer
  - Chinook fishery restricted/closed 8 of the 10 last years
- The water gets <u>warm</u>
- Road-accessible model system for understanding warm, lowland streams across Alaska
- Interagency interest
  - Mat-Su Salmon Habitat Partnership Strategic Plan – *initial funding*
    - NFHP Water to Watch, 2022
  - Climate change priority in USFWS Regional Strategic Intent
  - Alaska Freshwater Temperature Action Plan
  - Possible ESA listing for GOA Chinook



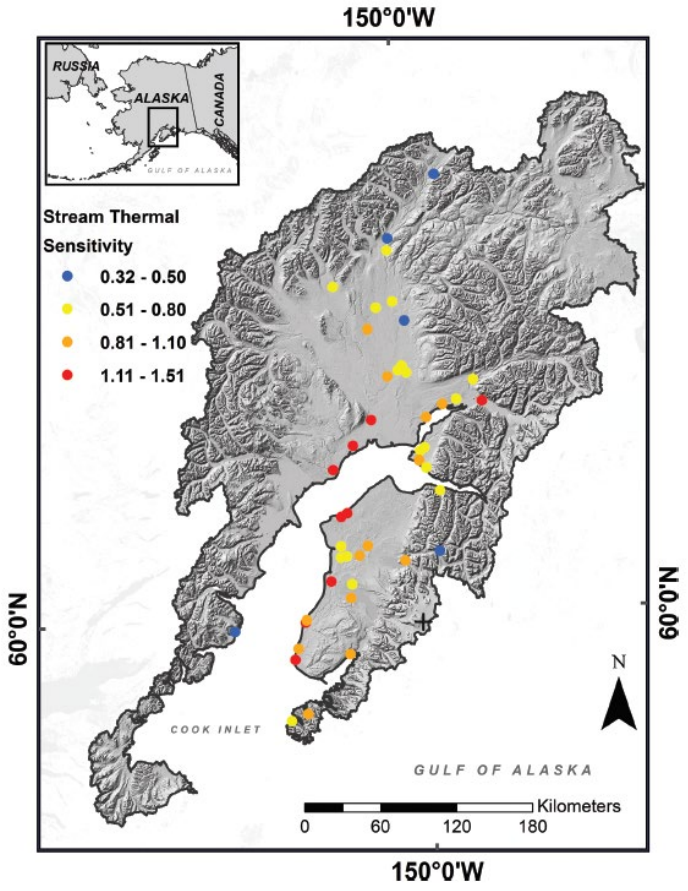
Warm streams are warming fastest

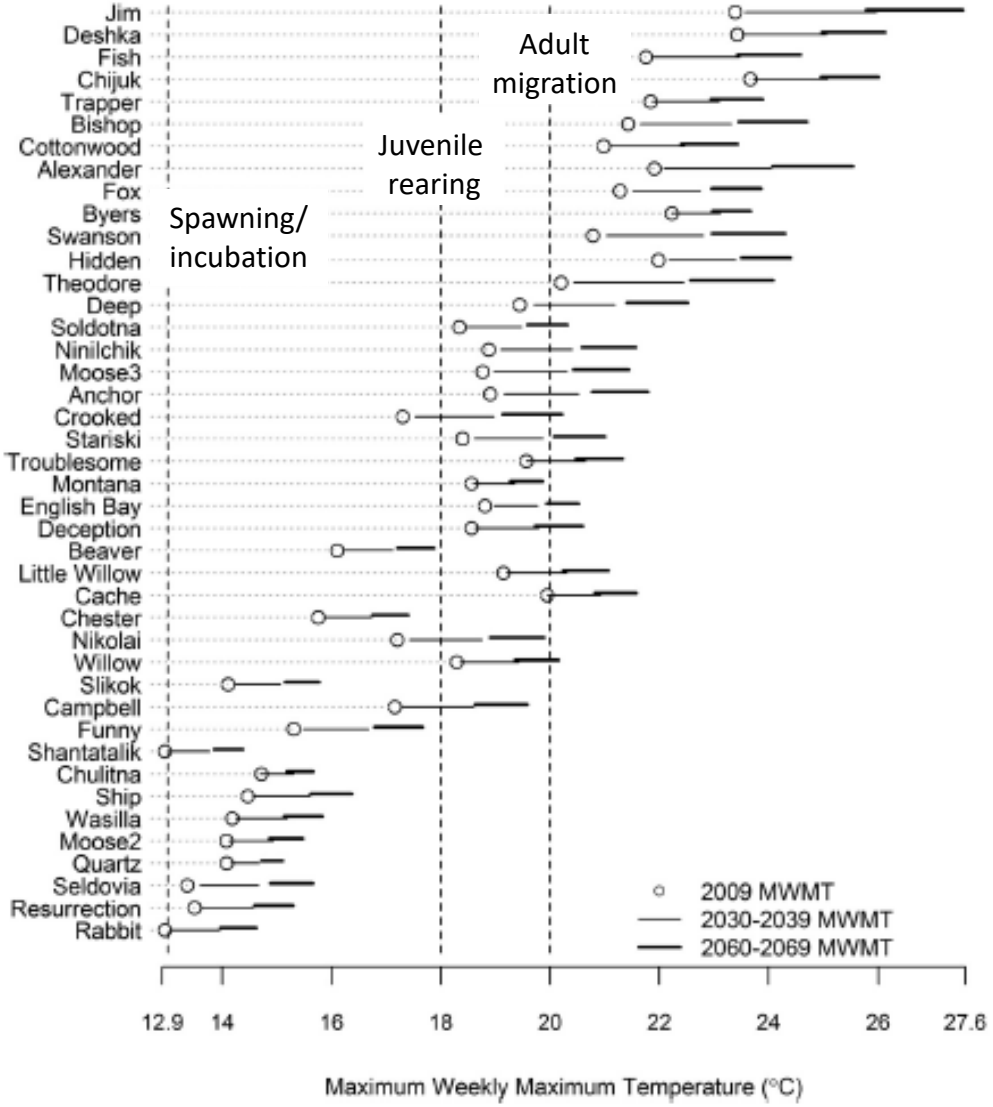
NRC Research Press

ARTICLE

Summer temperature regimes in southcentral Alaska streams: watershed drivers of variation and potential implications for Pacific salmon

Sue Mauger, Rebecca Shaftel, Jason C. Leppi, and Daniel J. Rinella





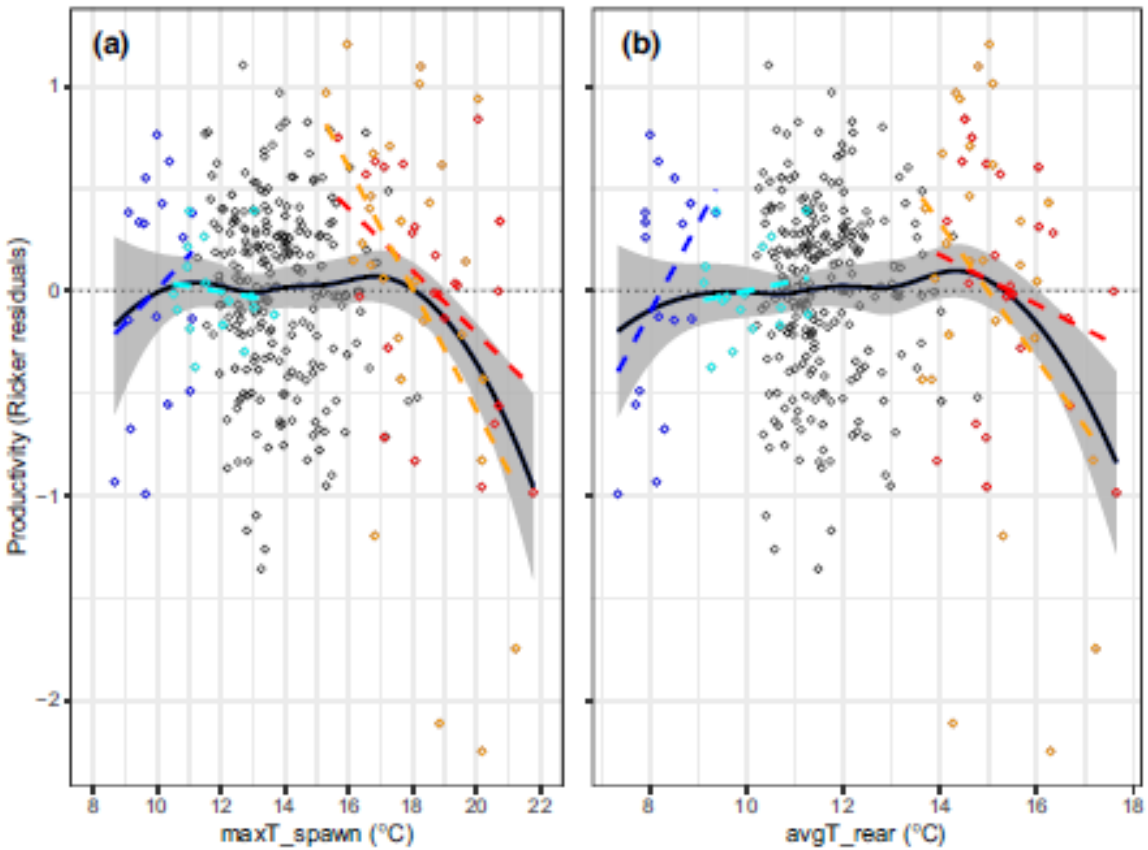
Warm water correlates with low productivity for Deshka Chinook

PRIMARY RESEARCH ARTICLE

Global Change Biology WILEY

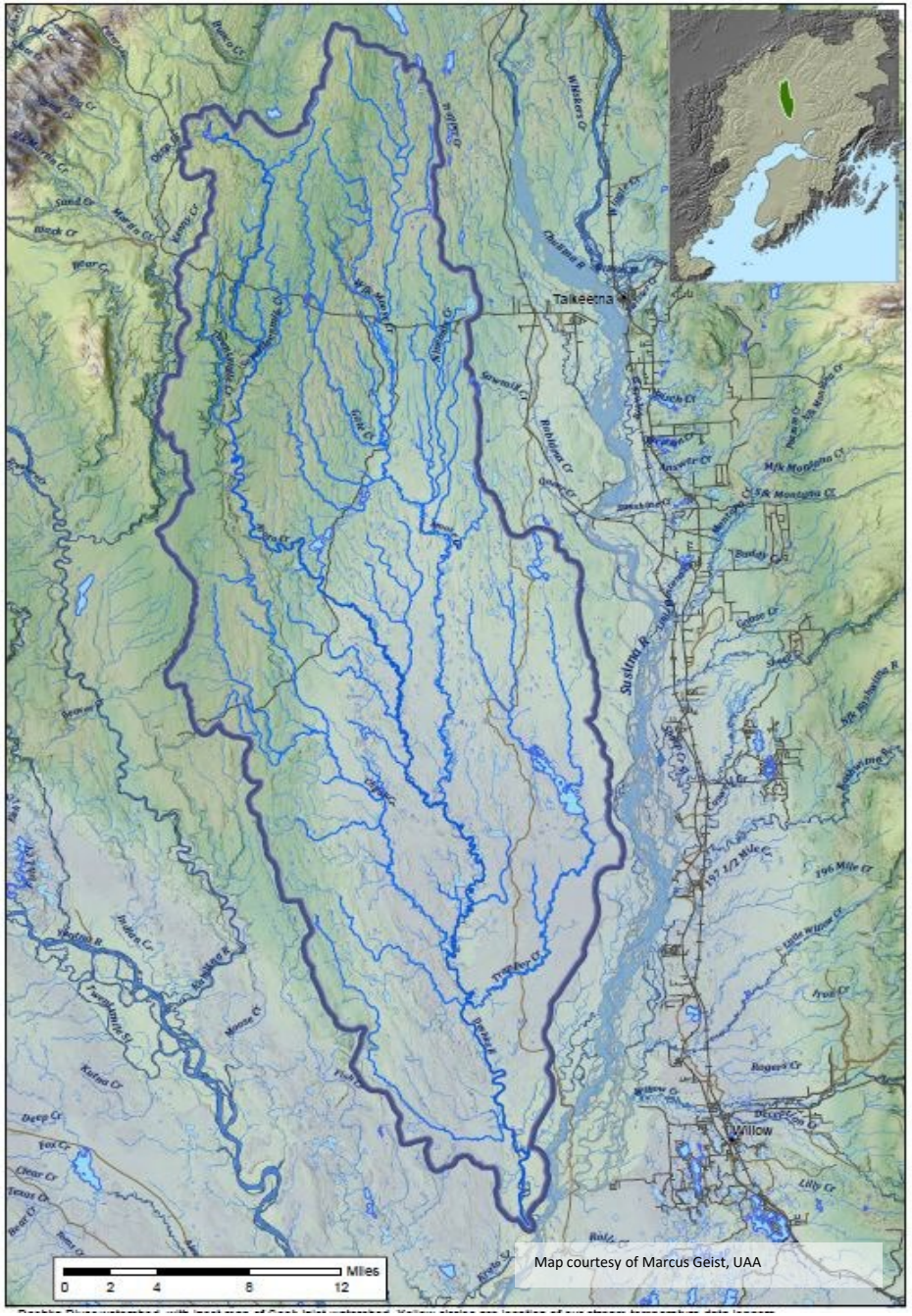
Watershed-scale climate influences productivity of Chinook salmon populations across southcentral Alaska

Leslie A. Jones[1] | Erik R. Schoen[2] | Rebecca Shaftel[1] | Curry J. Cunningham[3] | Sue Mauger[4] | Daniel J. Rinella[5] | Adam St. Saviour[6]



Temperature monitoring and salmon studies in the Deshka River

Two core components:
1. Temperature network
2. Juvenile salmon surveys



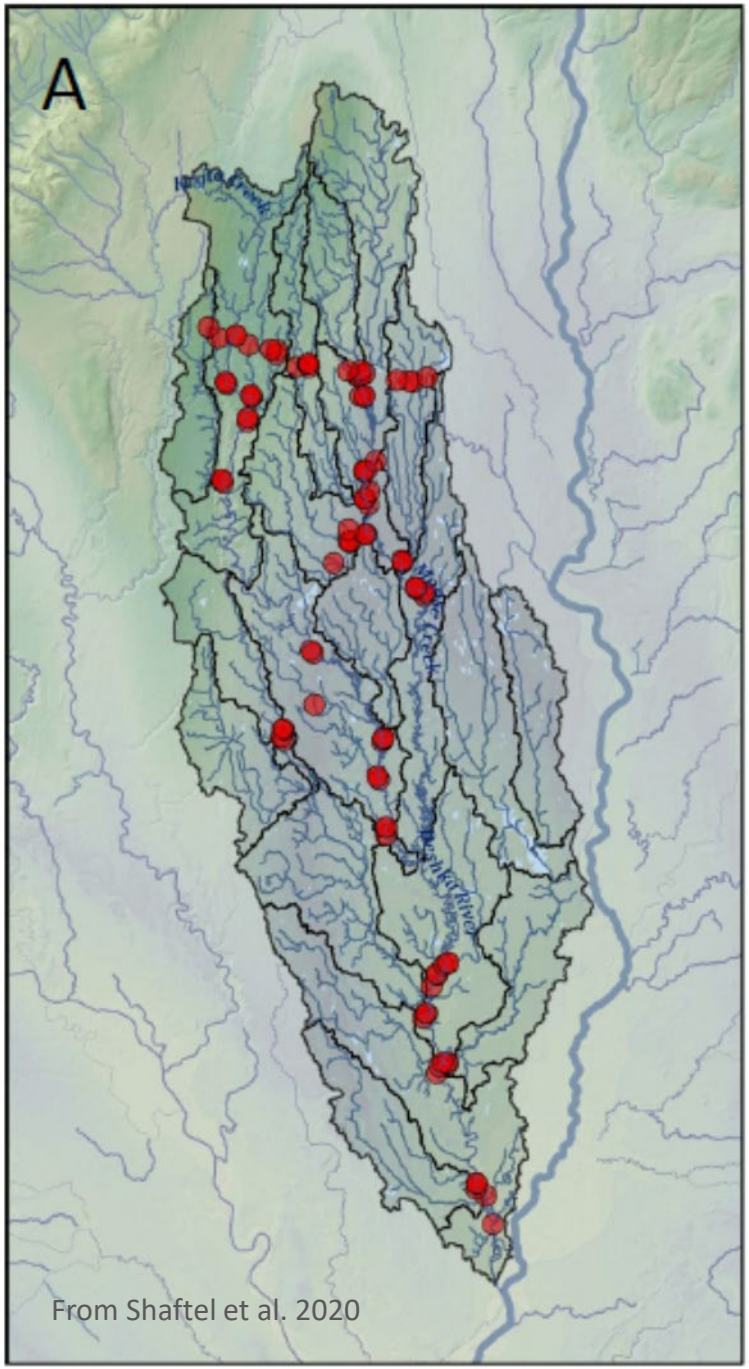
Temperature network

Objectives

- Build a watershed-scale model to characterize current, past, and future thermal conditions across the watershed
- Provide site-specific temperature data for fish studies

Methods

- Log temperature year-round at 82 sites
  - Focused mainly on tributary junctions
  - 2017 – present (n = 23 million)
- Modeled with Bayesian spatial stream network design
  - Current, hindcasting, forecasting



Juvenile salmon surveys

Objectives

- Estimate how temperature influences:
  - Growth rates
  - Distribution and relative abundance
- Forecast changes in the abundance and distribution of thermally suitable habitat
  - Spawning
  - Rearing
- Determine if juvenile salmon abundance can help forecast the size of future runs

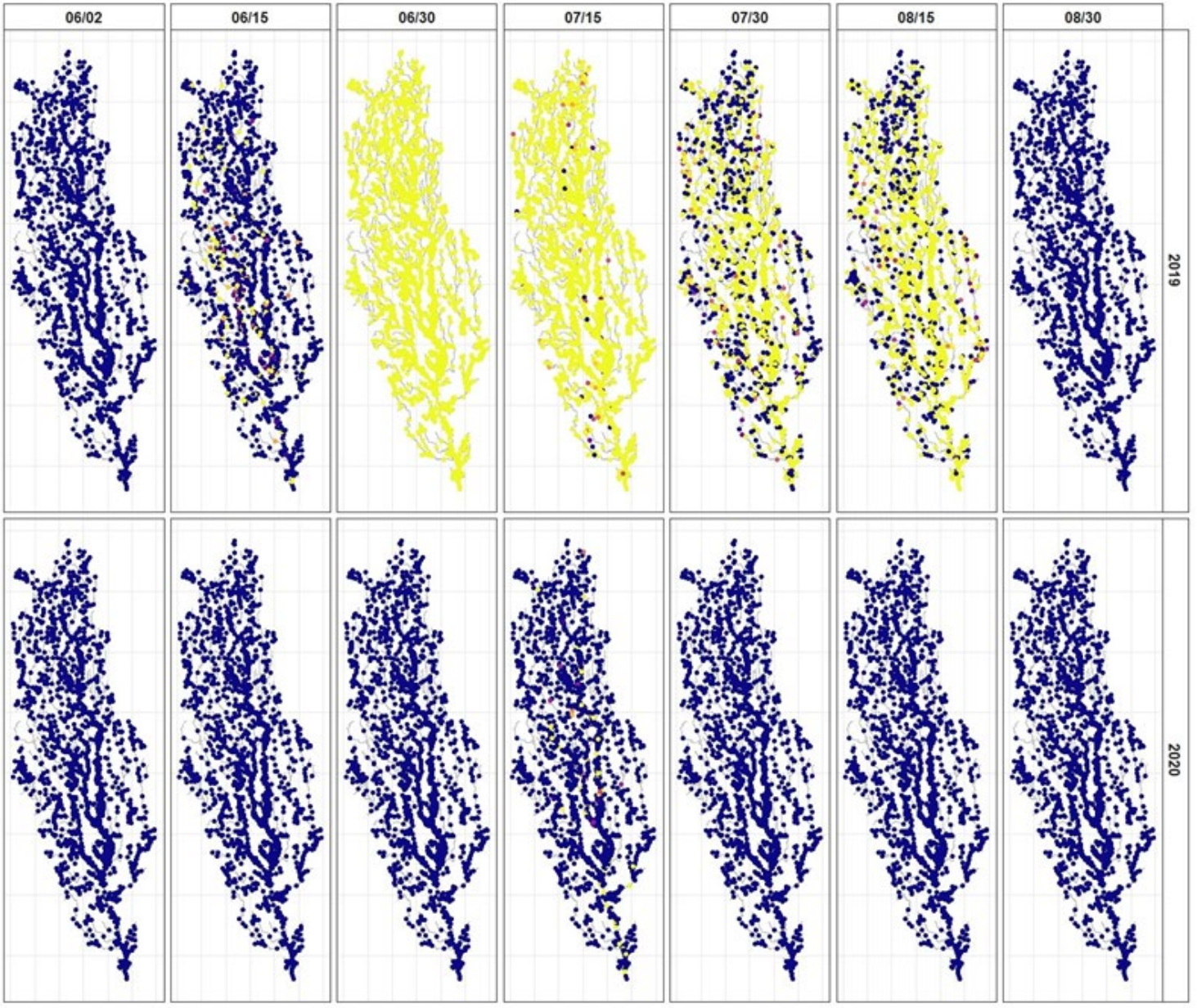
Methods

- Sample juvenile Chinook and coho across the growing season
  - 82 sites, same as temperature network
  - 2019 - 2024 (n = 10,000+)
  - 10 minnow traps/site; 1-hour soak
  - Trap-scale depth, flow, cover
  - Salmon length & weight
  - Otoliths, stomachs, and body composition from subsample

Some questions:

- What is the distribution of thermally suitable habitat in a ‘normal’ vs warm year?
  - Rearing (<18°C)
  - Spawning and incubating (<13°C)
- Are juvenile salmon showing signs of heat stress?
- Is warm water impacting juvenile salmon growth?
- How are Chinook spawners coping with warm water?
- How many juvenile salmon are pike eating? Will it get worse?

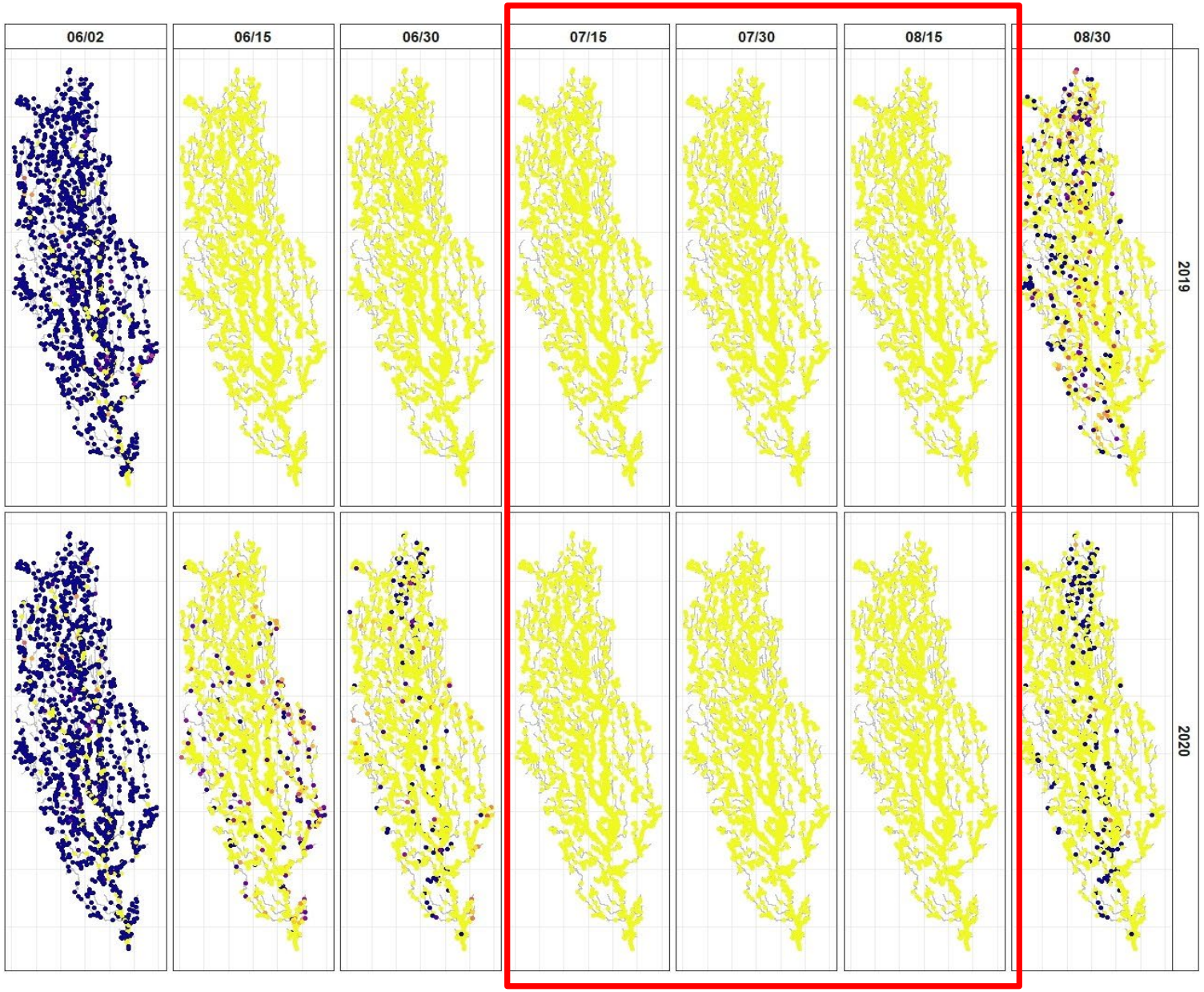
Distribution of thermally-suitable rearing habitat?



Warm year 2019

'Normal' year 2020

Distribution of thermally-suitable spawning habitat?



Warm year 2019

'Normal' year 2020

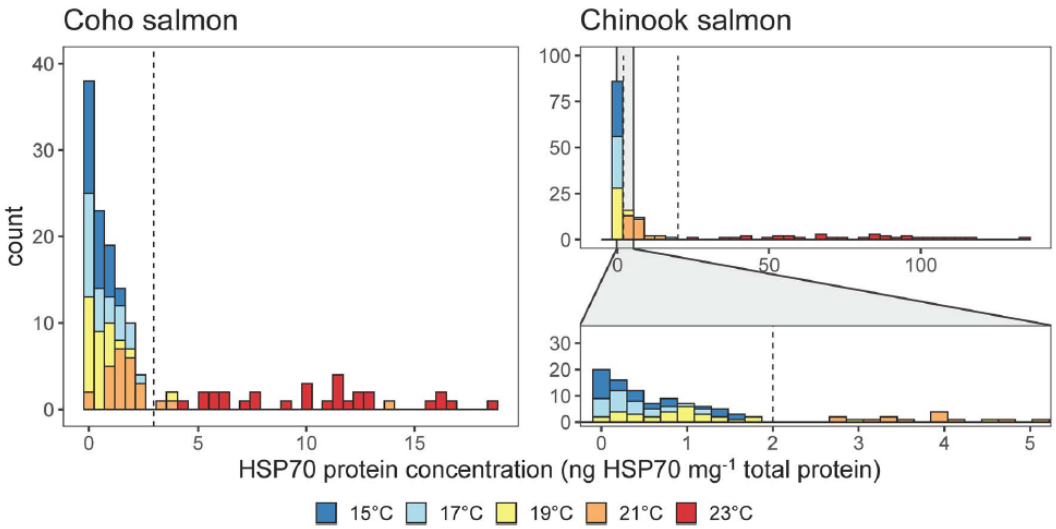
Are juvenile salmon showing signs of heat stress?

- Collaboration with USGS, SSP/QRP funding
- Lab study to identify temperature thresholds
  - Chinook = 21°C
  - Coho = 23 °C

Conservation Physiology
Volume 11 • 2023
10.1093/conphys/coad092
SEB
Research article

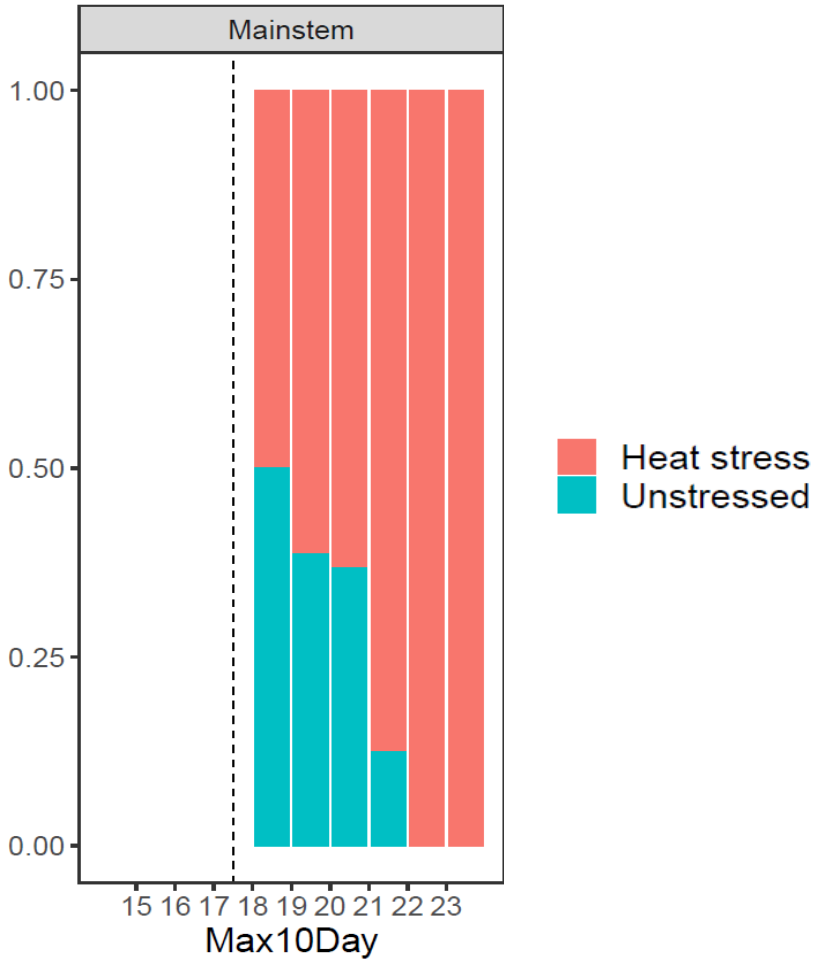
Differential heat shock protein responses in two species of Pacific salmon and their utility in identifying heat stress

Vanessa R. von Biela[1,*], Amy M. Regish[2], Lizabeth Bowen[3], Ashley E. Stanek[1], Shannon Waters[3], Michael P. Carey[1], Christian E. Zimmerman[1], Jonathon Gerken[4], Daniel Rinella[4] and Stephen D. McCormick[2]



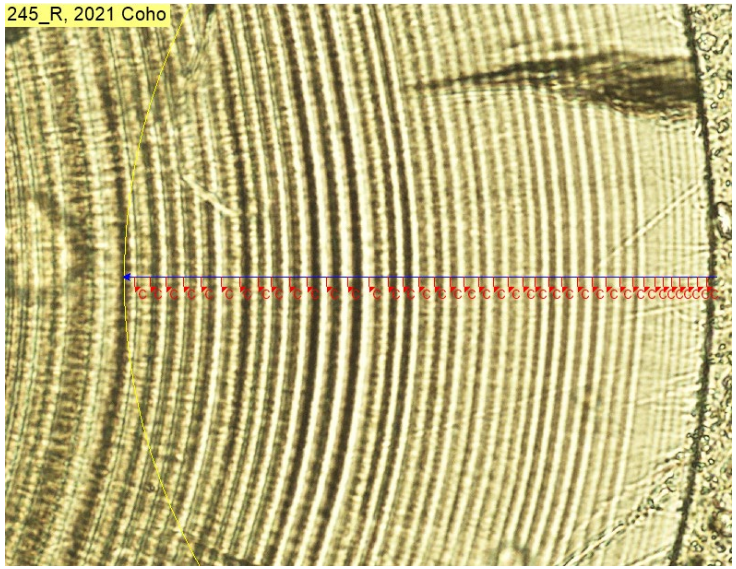
Are juvenile salmon showing signs of heat stress?

- Collaboration with USGS, SSP/QRP funding
- Data from wild Deshka salmon show similar thresholds
- Manuscript describing patterns and prevalence is forthcoming



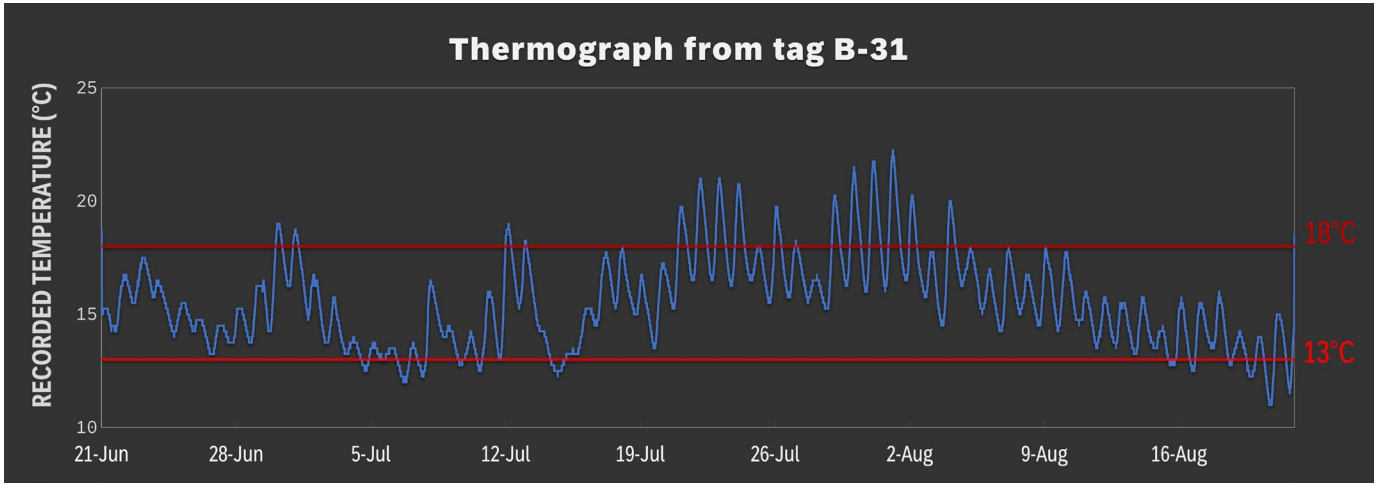
Is warm water impacting juvenile salmon growth?

- John Hermus' UAF thesis, funded by SSP-QRP
- Collaboration with USGS, UAF
- Growth measured by otolith daily growth increments
- Effects of heat stress on growth will also be modeled



How are Chinook spawners coping with warm water?

- Opportunistic carcass surveys
- Temperature-archival radio tagging
  - Collaboration with ADF&G and USGS
  - 80% tag recovery rate
    - 2023: 40 of 49 tags
    - 2024: 38 of 49 tags
  - Mike Johnson's UAF grad program funded by SSP/QRP
  - See Mike and Bailey's poster for more info



How many juvenile salmon are pike eating? Will it get worse?

- Ben Rich's UAF thesis (submitted to Global Change Biology)
- Fewer salmon are consumed as populations decline
- Northern Pike consume 200,000 – 2M juvenile salmon annually
- Bioenergetics scenarios forecast 6 – 12% increase in consumption in future decades

Next steps

- Continue temperature network and carcass surveys indefinitely
- Complete analyses & manuscripts
  - Prevalence and patterns of heat stress in juvenile salmon
  - Projections of thermal habitat change
  - Influence of temperature on juvenile salmon growth rates
  - Influence of temperature on juvenile salmon distribution and relative abundance
- Finish graduate research projects
  - John Hermus – Effects of temperature vs heat stress on growth rates
  - Mike Johnson – Characterizing the thermal experience of spawners
- Develop annual indices of juvenile salmon abundance (2018 to 2023 brood years) and determine if they are useful for forecasting the size of future runs (2029)

Photo: Franklin Dekker USFWS


Thank you!