# Freshwater drivers influence Chinook salmon productivity in southcentral Alaska

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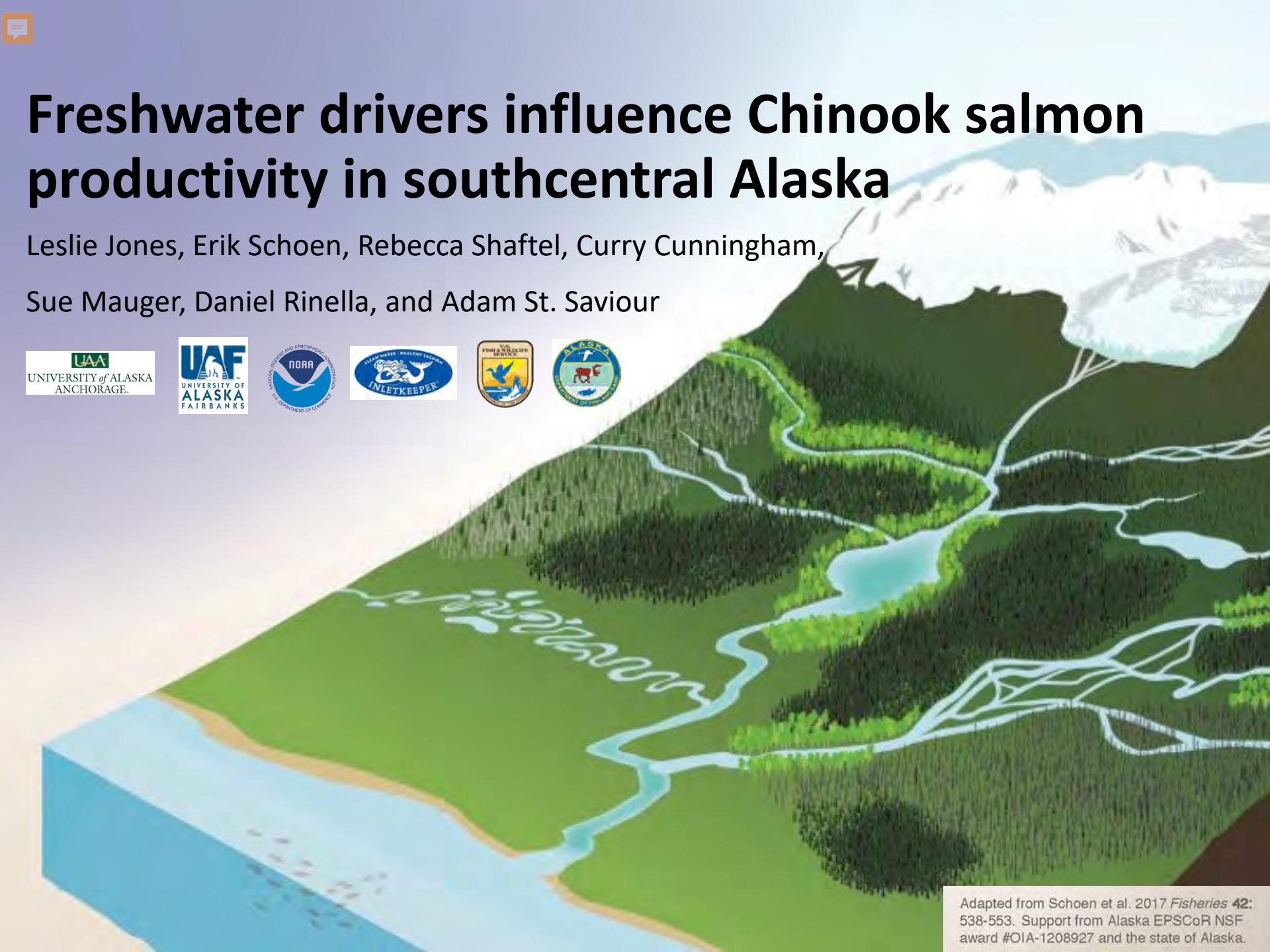
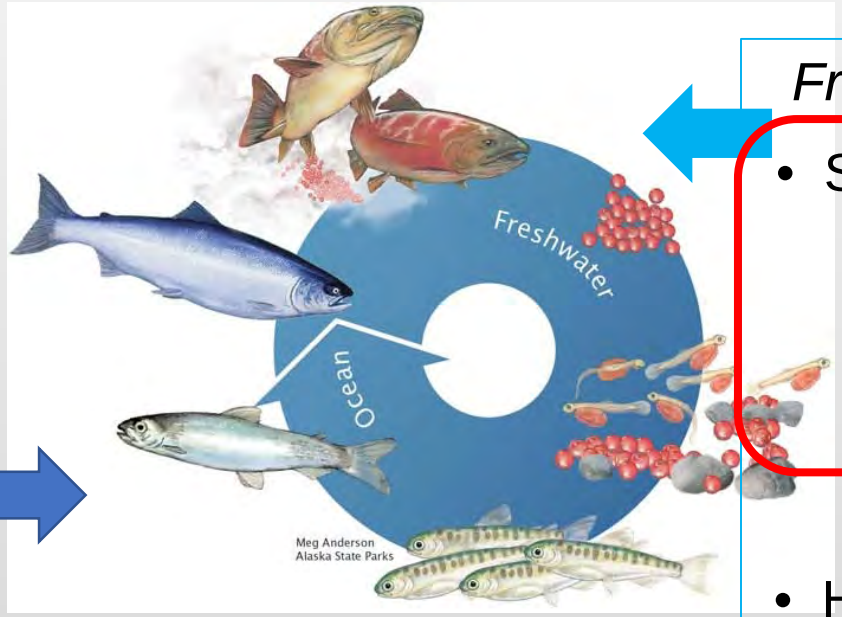


Adapted from Schoen et al. 2017 *Fisheries* **42:** 538-553. Support from Alaska EPSCoR NSF award #OIA-1208927 and the state of Alaska.

# Chinook salmon populations in Cook Inlet have experienced periods of declines during last decade

*Ocean conditions*

- Ocean climate
- Competition with pink salmon
- Predation
- Bycatch




*Freshwater conditions*

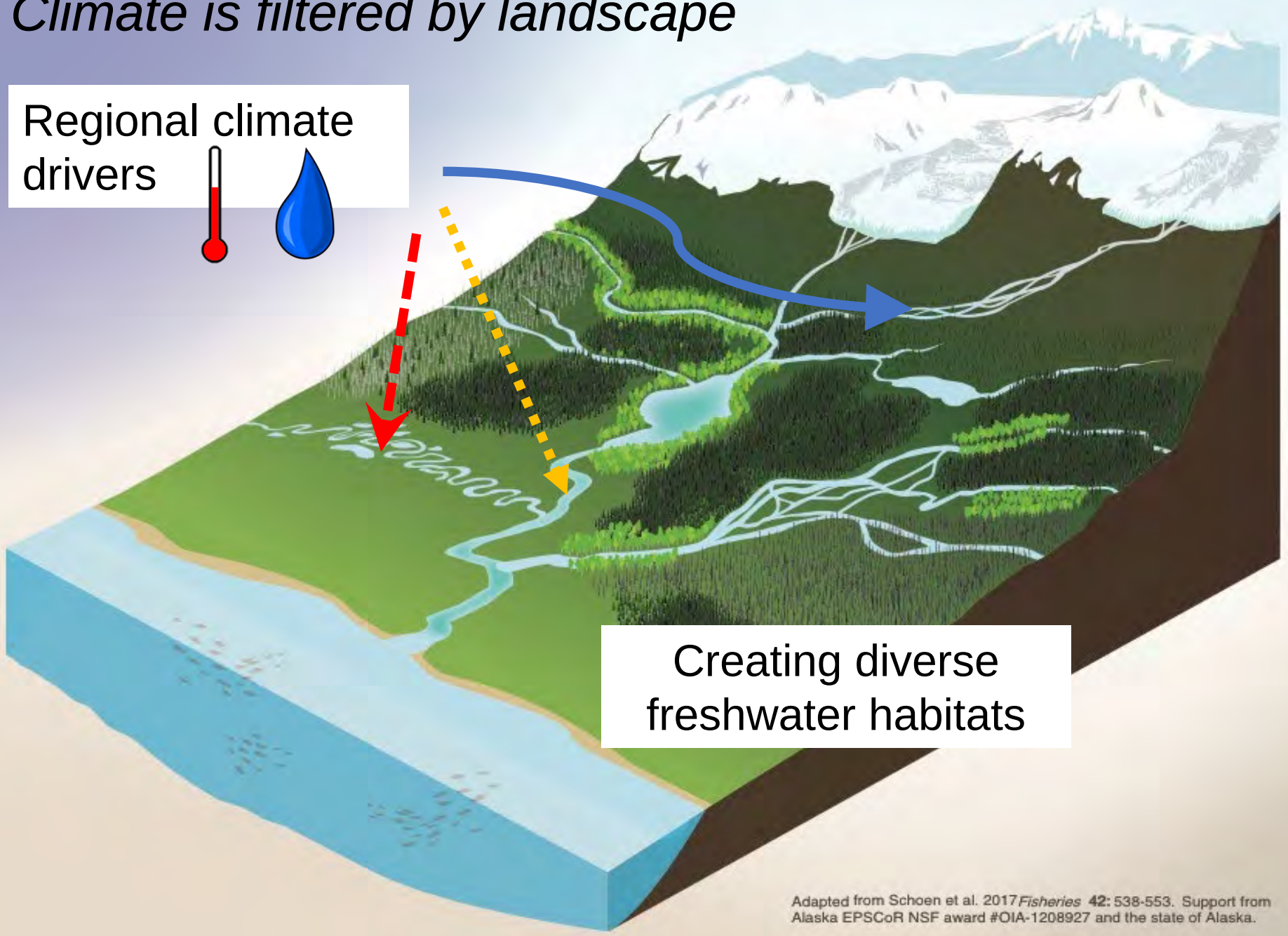
- Spawner abundance
- Warming stream temperatures
- Precipitation
- Invasive species
- Human development

A prominent viewpoint: "Salmon declines are due to problems in the ocean"

Can we rule out freshwater processes as important drivers of Chinook salmon productivity?

# *Climate is filtered by landscape*

Regional climate drivers



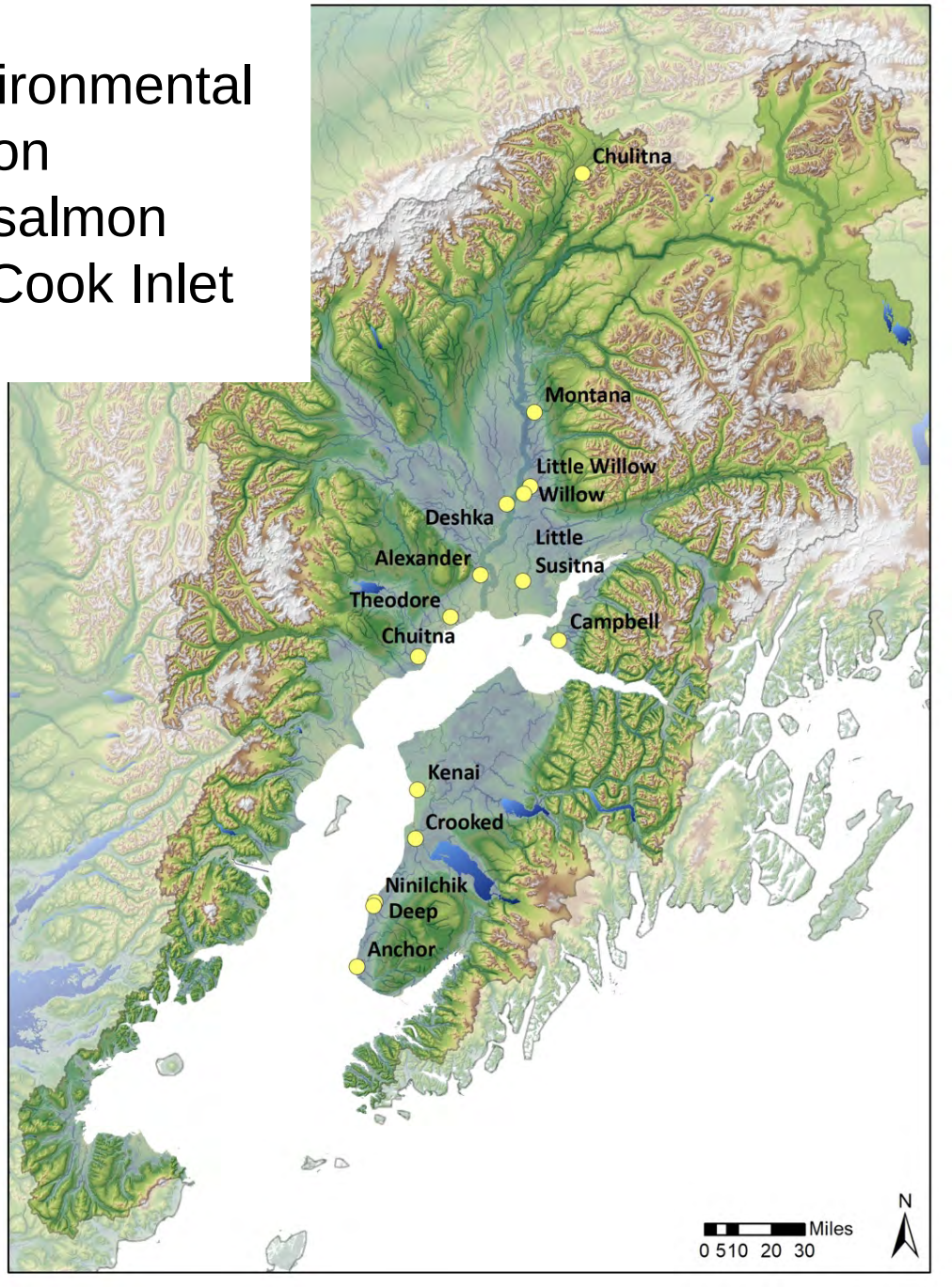
Creating diverse freshwater habitats

Adapted from Schoen et al. 2017 *Fisheries* **42:** 538-553. Support from Alaska EPSCoR NSF award #OIA-1208927 and the state of Alaska.

Objective

To estimate environmental effects on
15 Chinook salmon populations in Cook Inlet

1. What **environmental conditions** did each population experience in each brood year?
2. How has the **productivity** of each population changed over time?
3. How were environmental indicators **correlated** with salmon productivity?



Objective 1

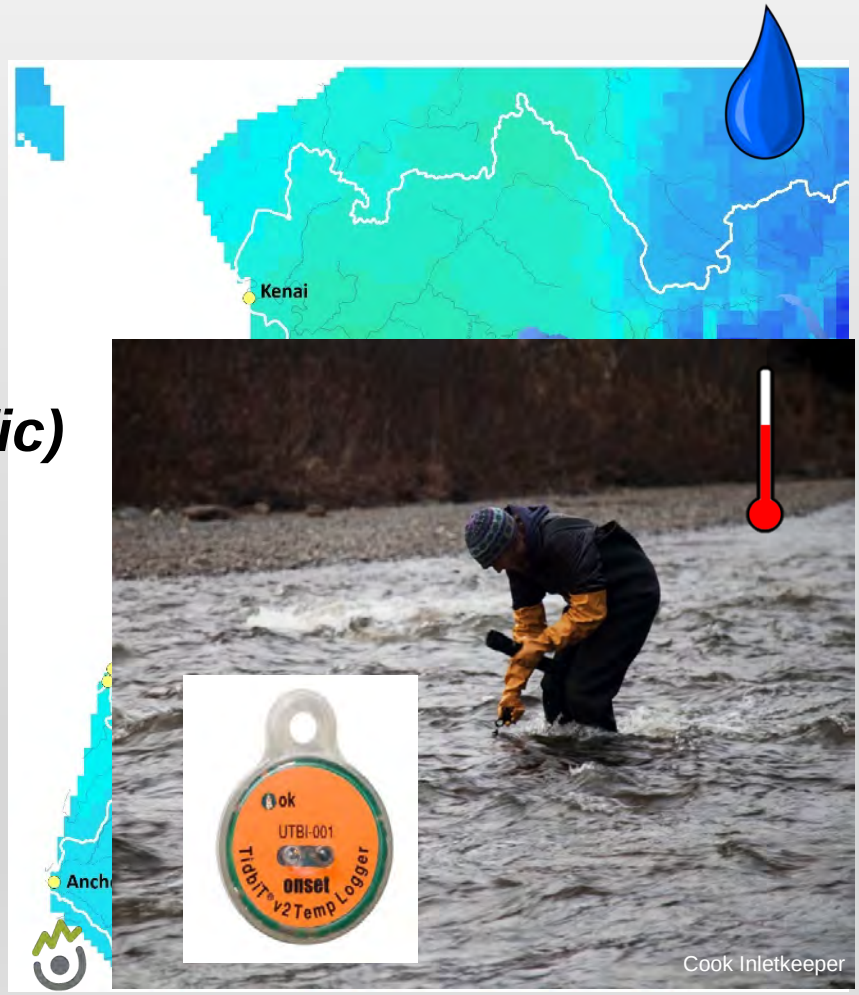
# What **environmental conditions** did each population experience in each brood year?

## *Regional Indicators*

- River ice breakup timing
- Ocean conditions (NPGO)
- Little Susitna discharge gage

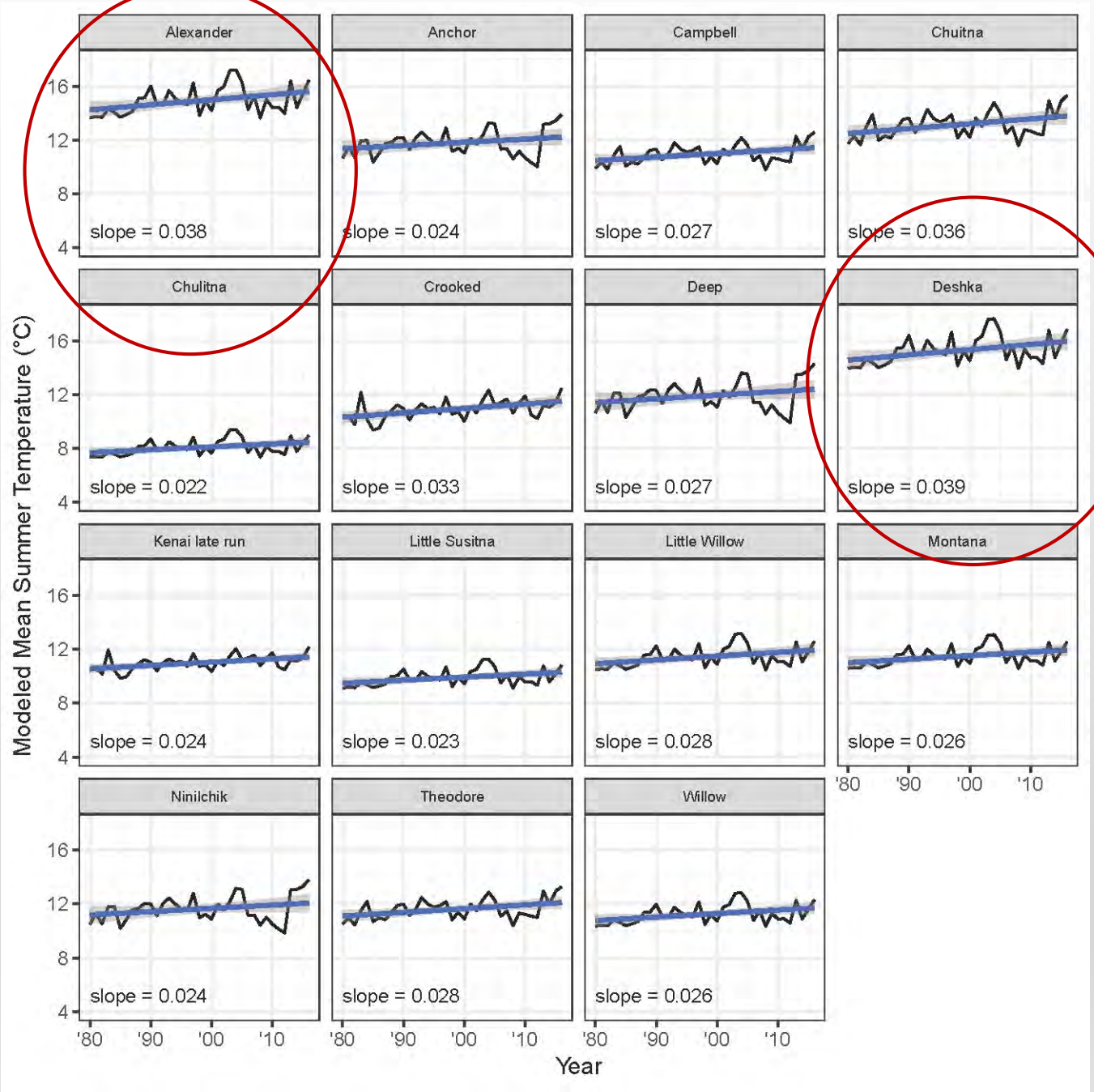
## *Watershed indicators (site-specific)*

- Precipitation
  - Spatially-explicit climate data
  - Summarized for each watershed
- Stream temperature
  - Site-specific
  - Modeled temperatures for period 1980-2015



Objective 1

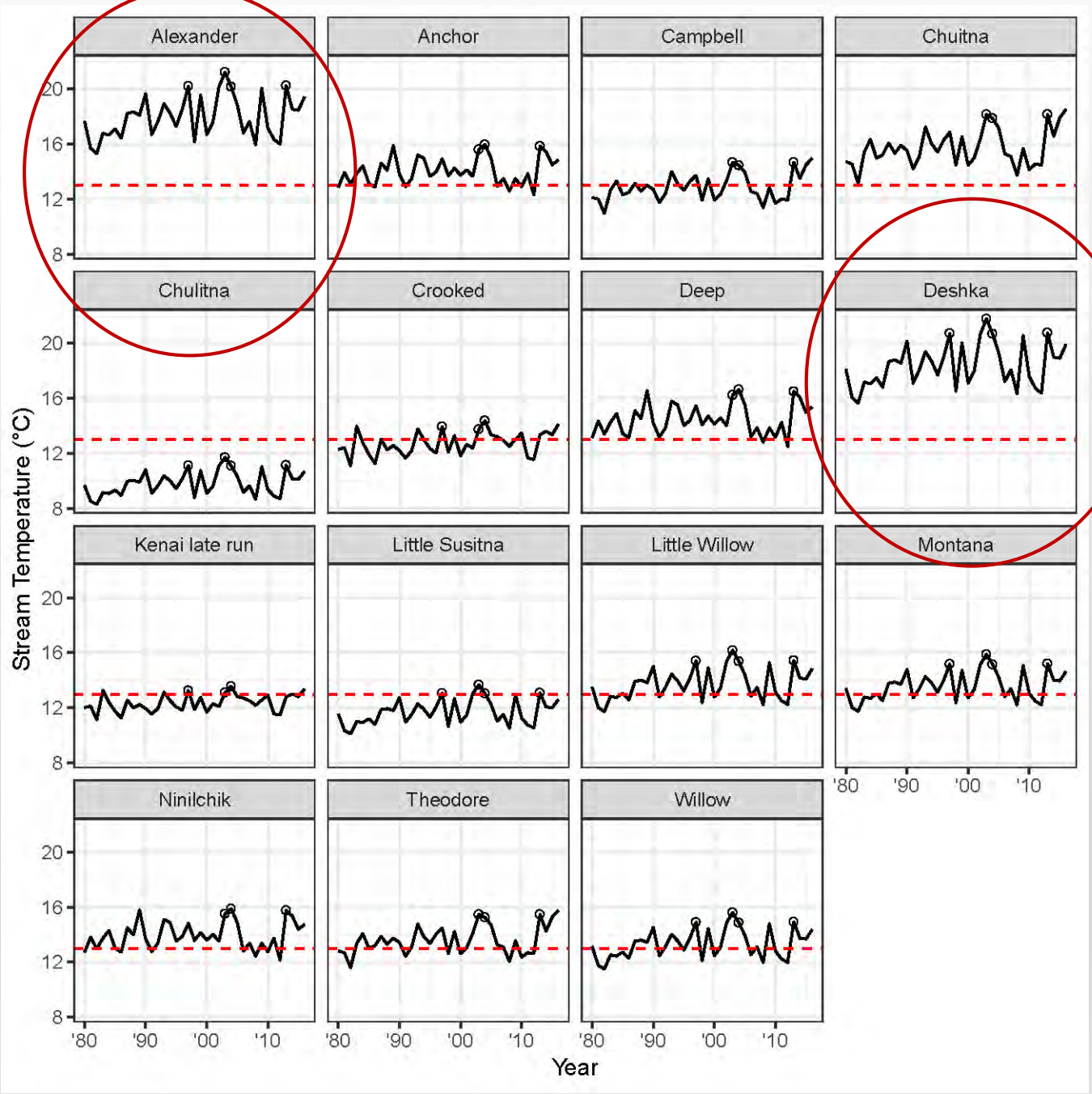
Mean summer temperatures from 1980 - 2015



Objective 1

Maximum weekly stream temperatures during spawning period

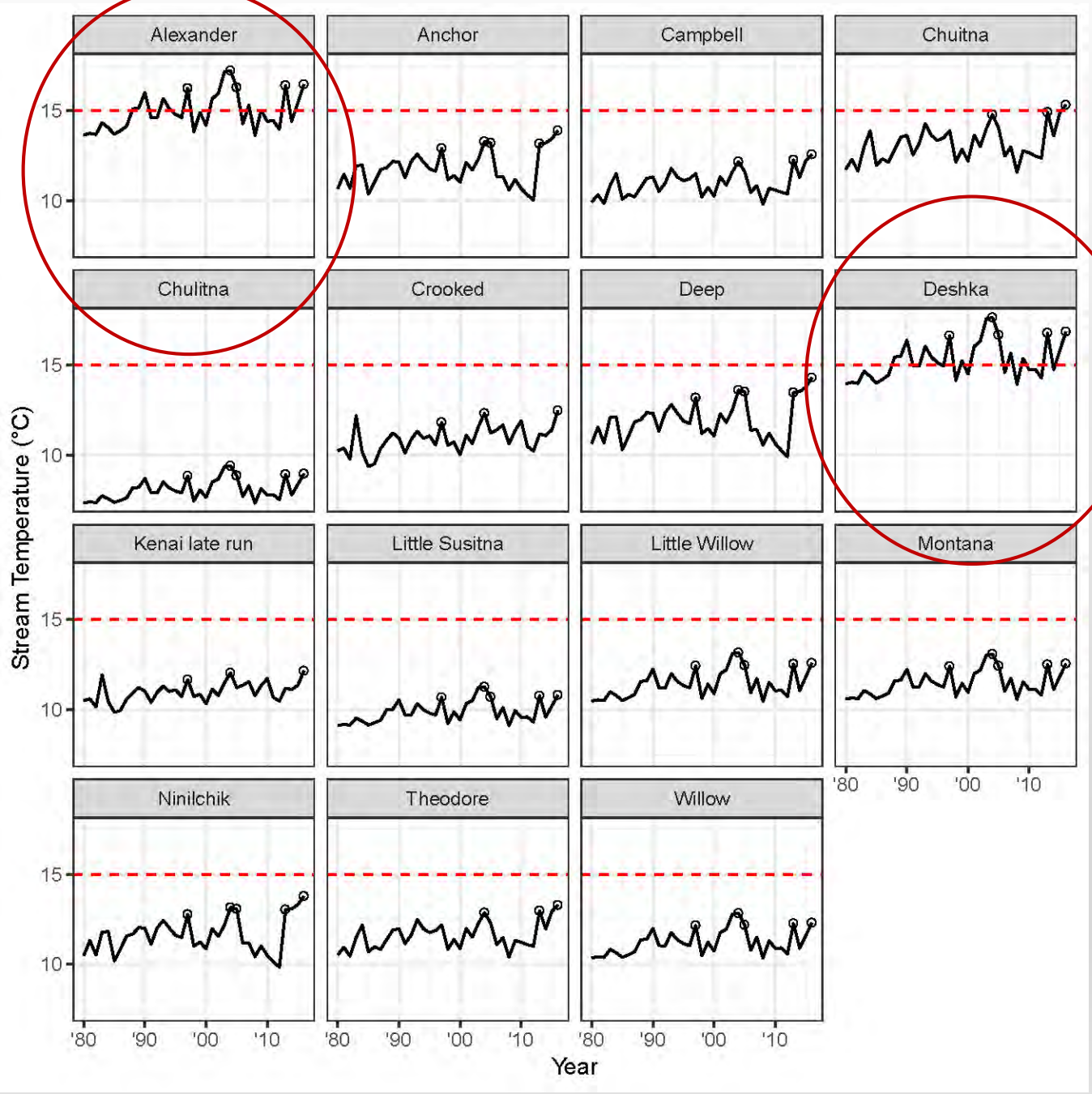
July - August



Objective 1

Average weekly stream temperatures during summer growing period

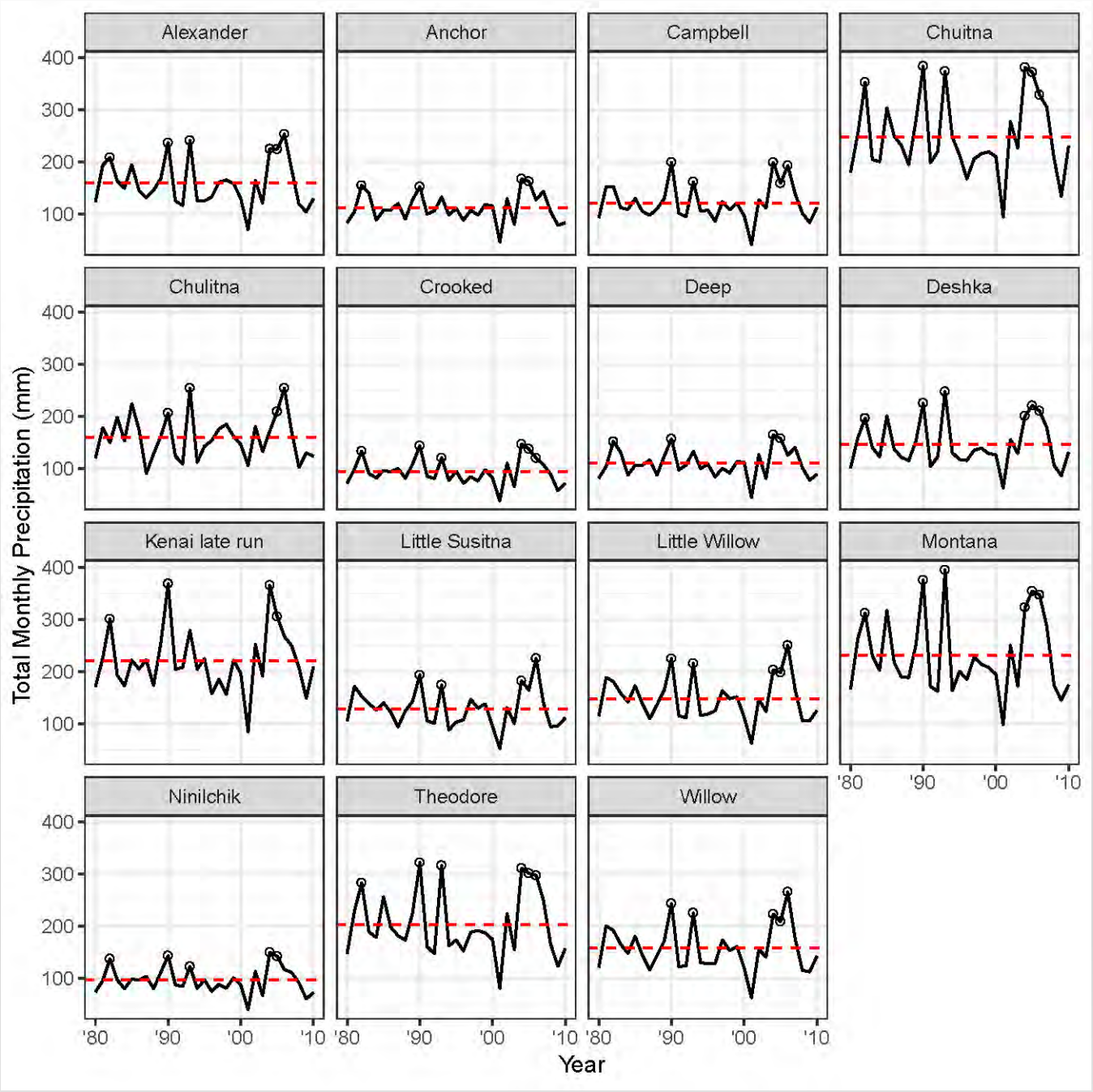
June - August



Objective 1

Maximum monthly precipitation totals for spawning period

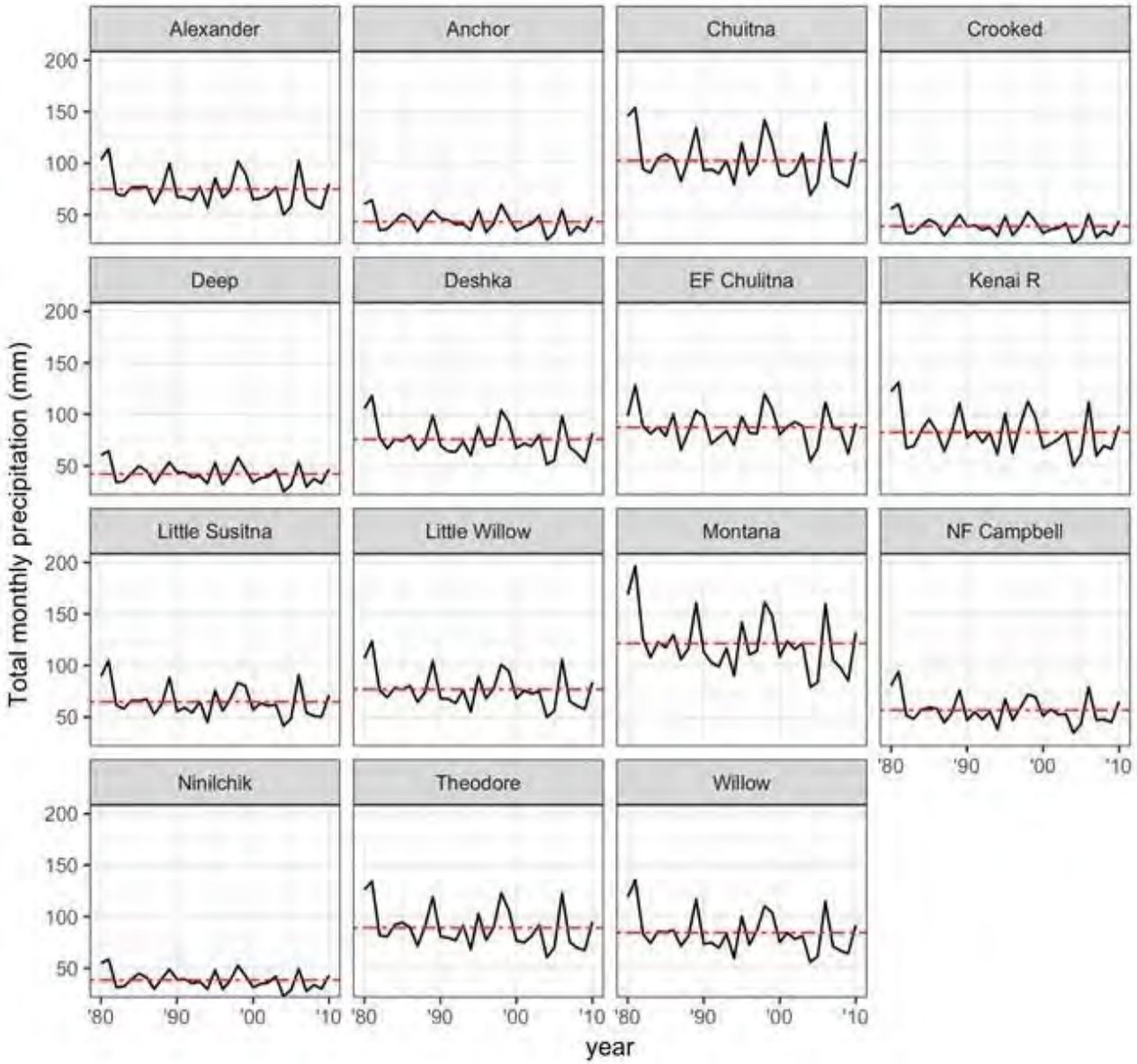
August - November



Objective 1

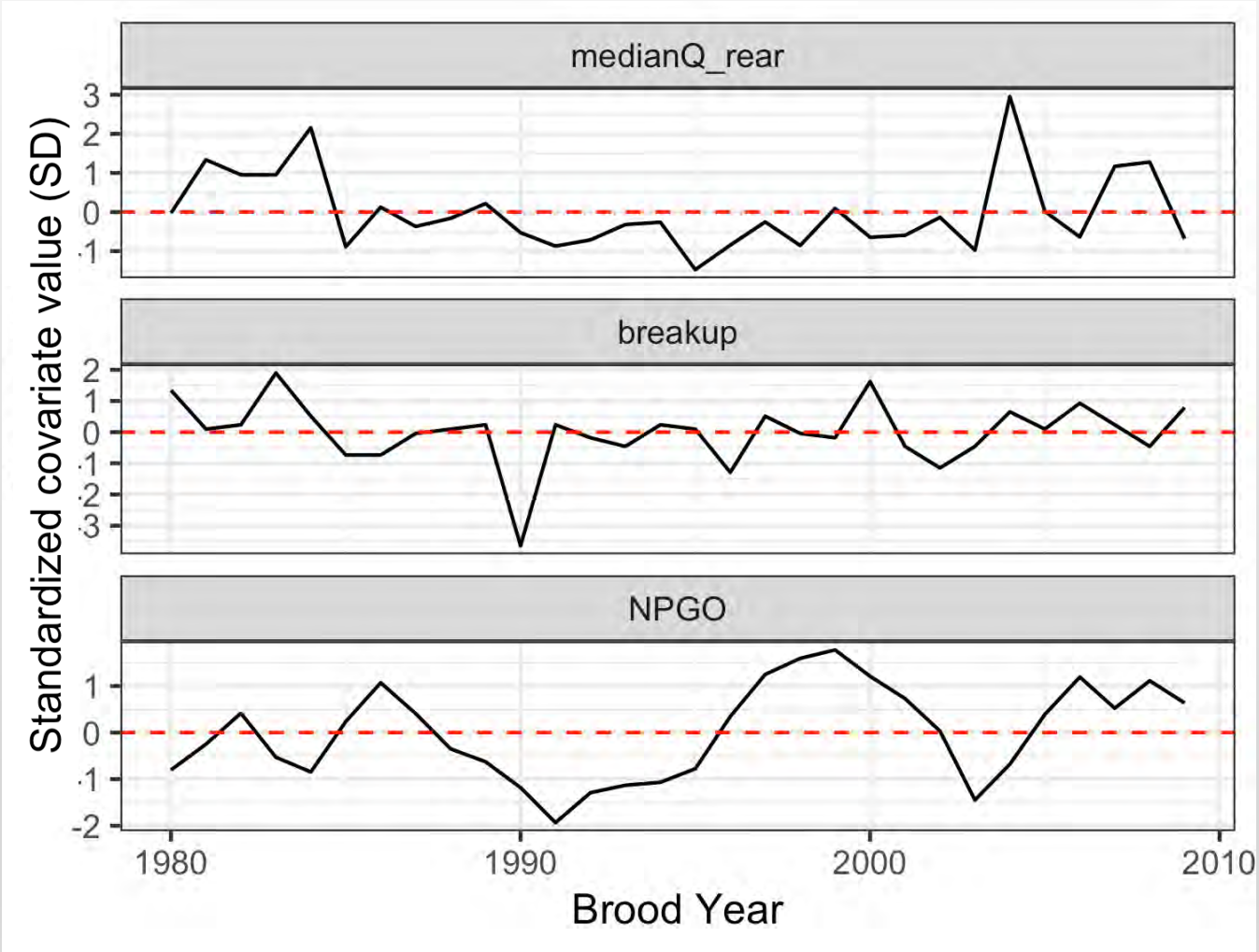
Average monthly precipitation totals for growing period

August - November



Objective 1

# Regional Indicators



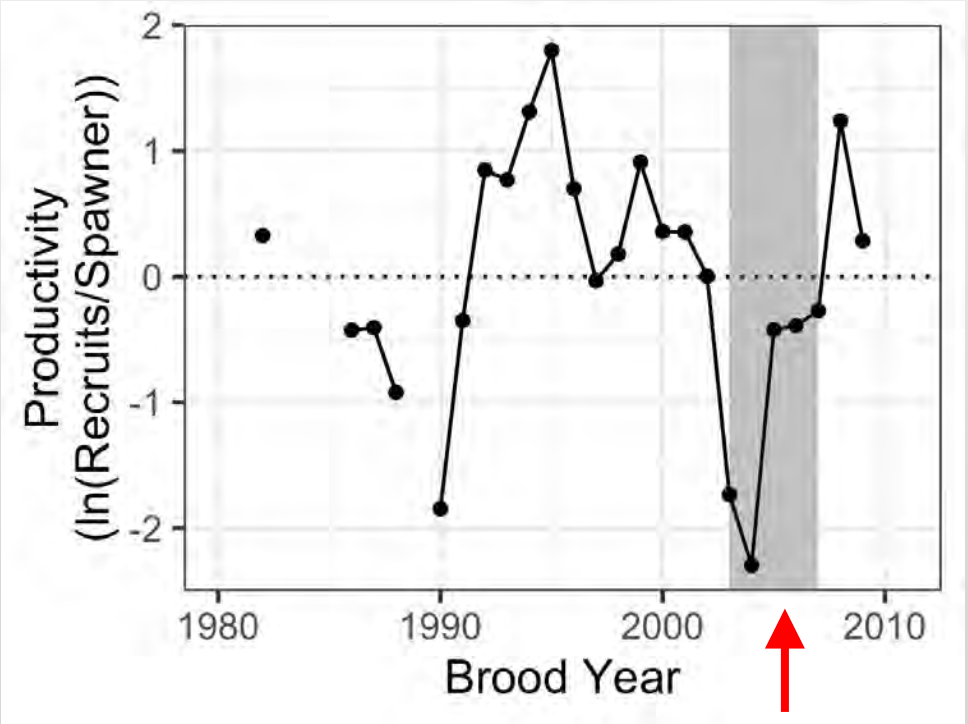
Objective 2

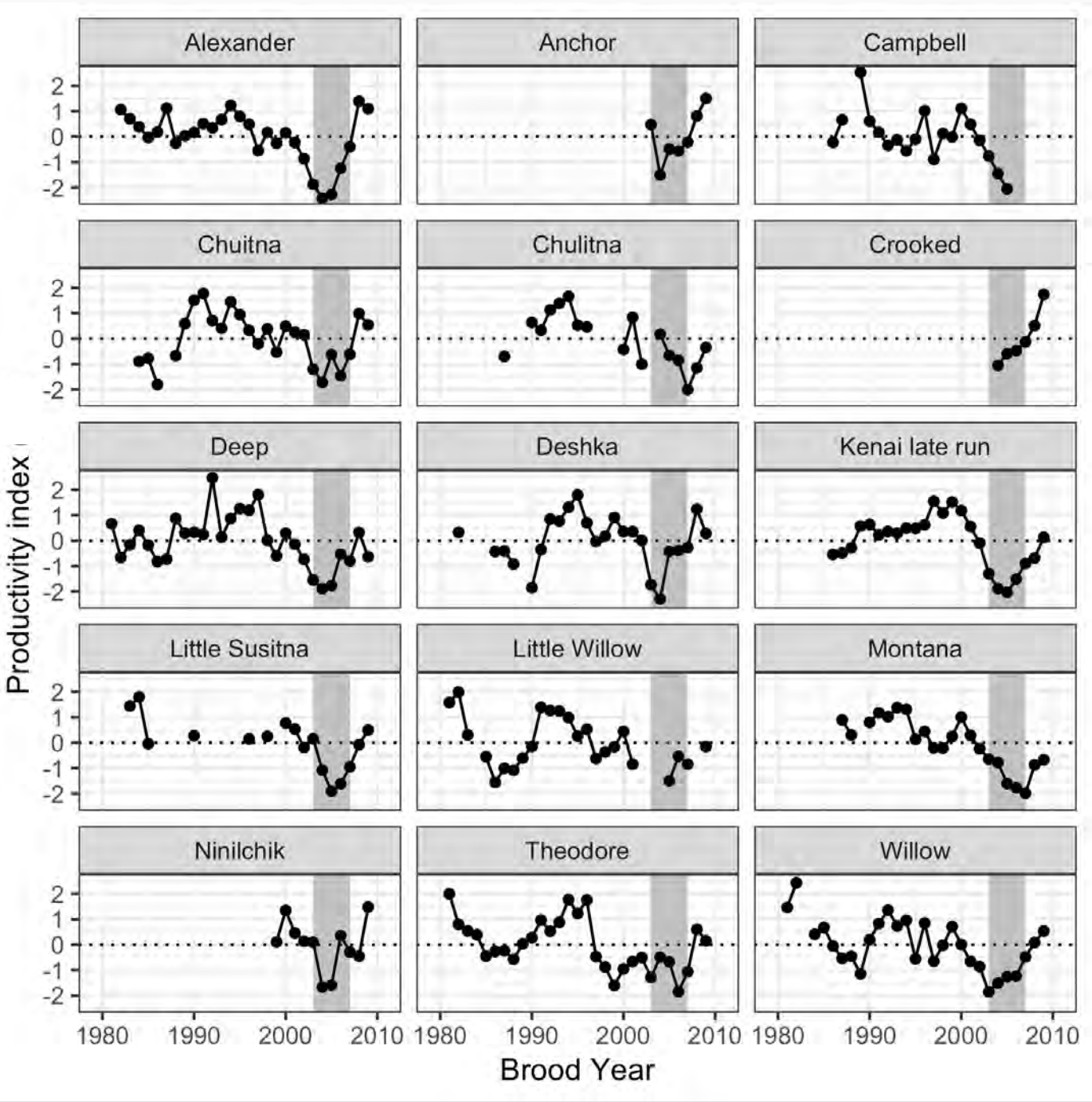
# How has the **productivity** of each population changed over time?

- Compiled ADF&G data
- Filled missing age data
- Estimated an index of brood year productivity accounting for density dependence:

  ln(Recruits/Spawner)

Deshka River






Objective 2

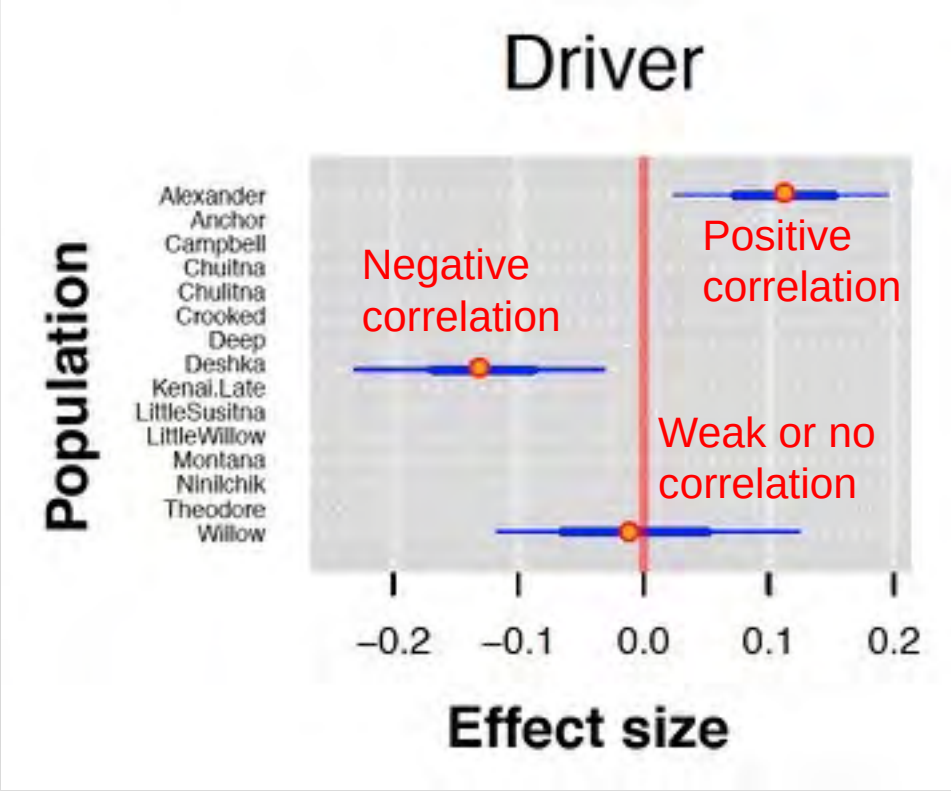
13 of 15 populations experienced their lowest productivity during 2003-2007

Objective 3

# How were environmental conditions **correlated** with salmon productivity?

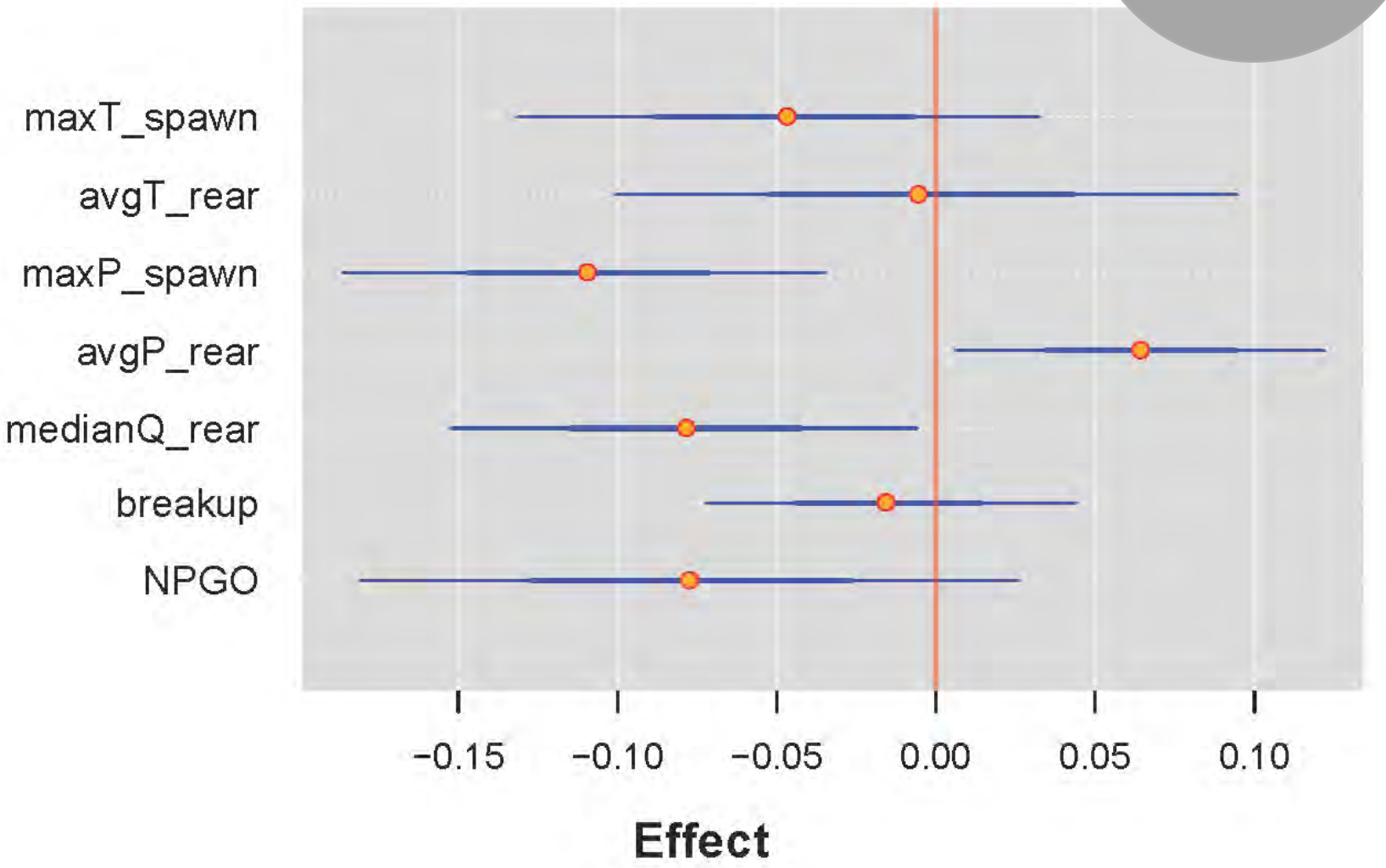
## Hierarchical Bayesian stock-recruit model

- Identify broad regional trends
- Quantify diversity or coherence in how local populations respond to environment

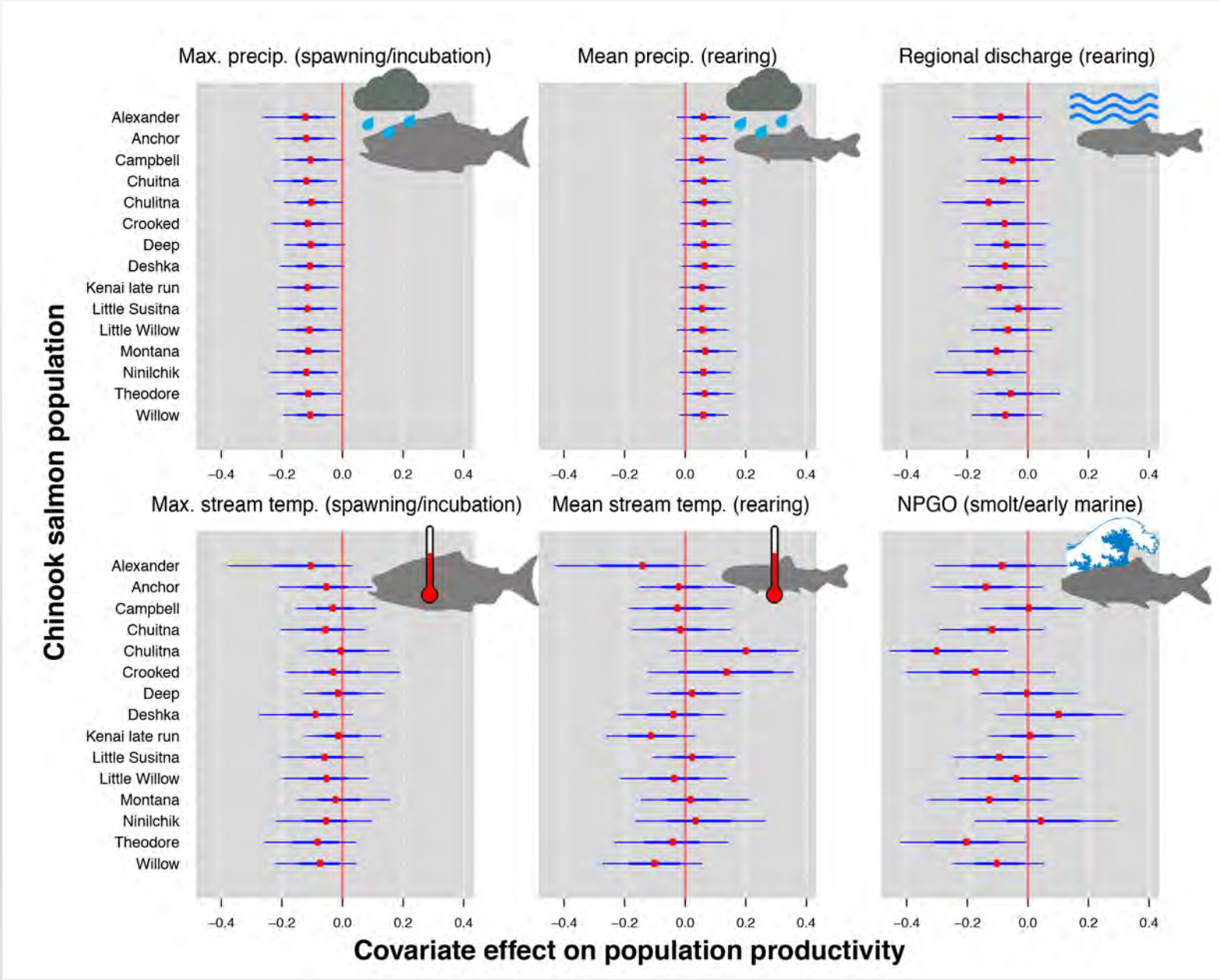


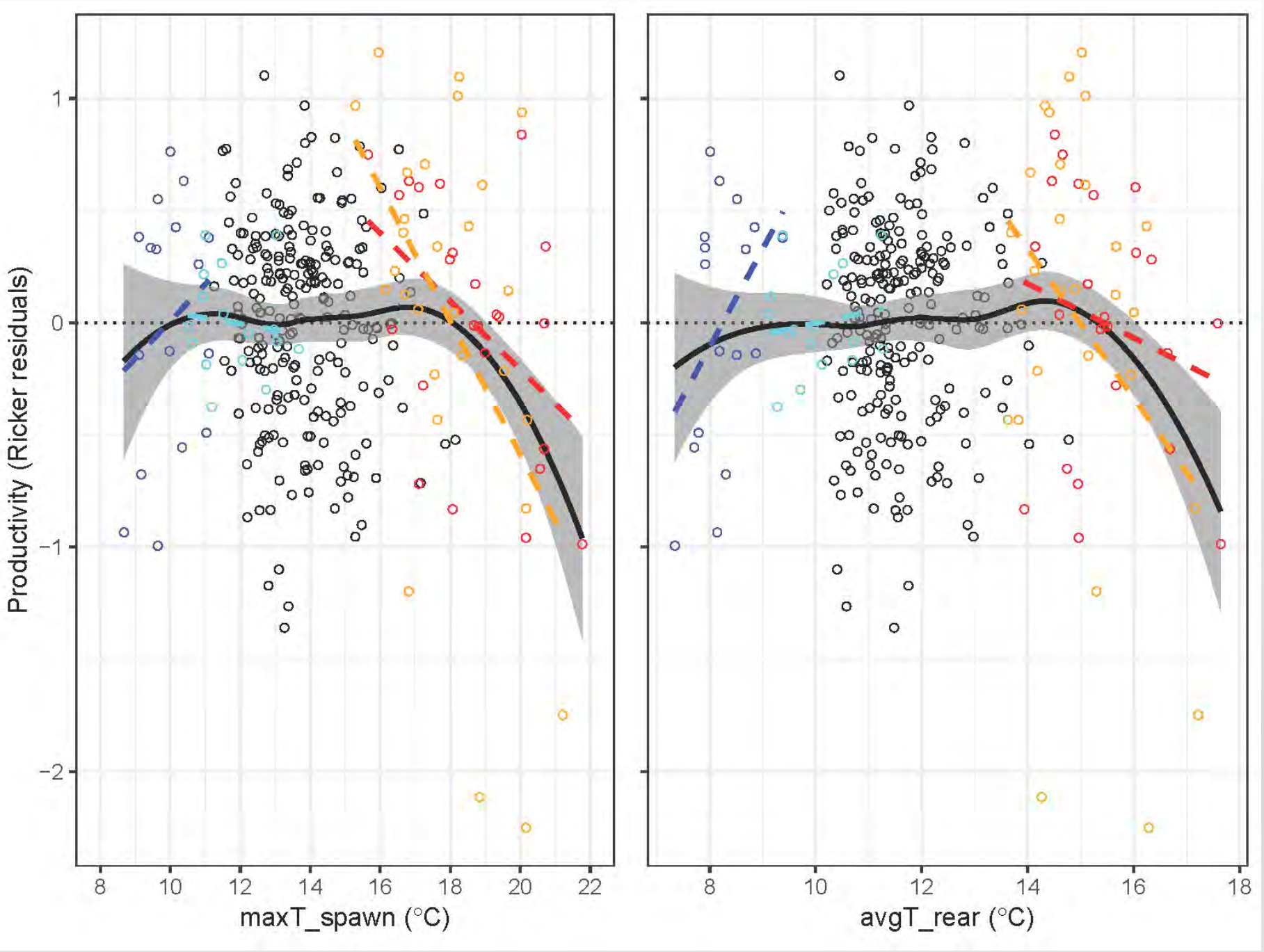
# Regional Effects

Objective 3

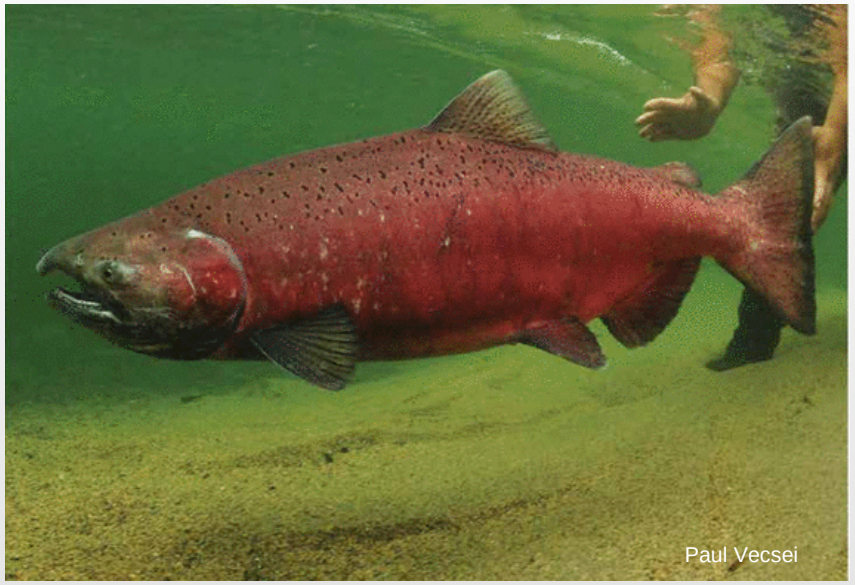


# Population-Specific Effects




Productivity (Ricker residuals)
1
0
−1
−2
8
10
12
14
16
18
20
22
maxT_spawn (°C)
8
10
12
14
16
18
avgT_rear (°C)

# Conclusions

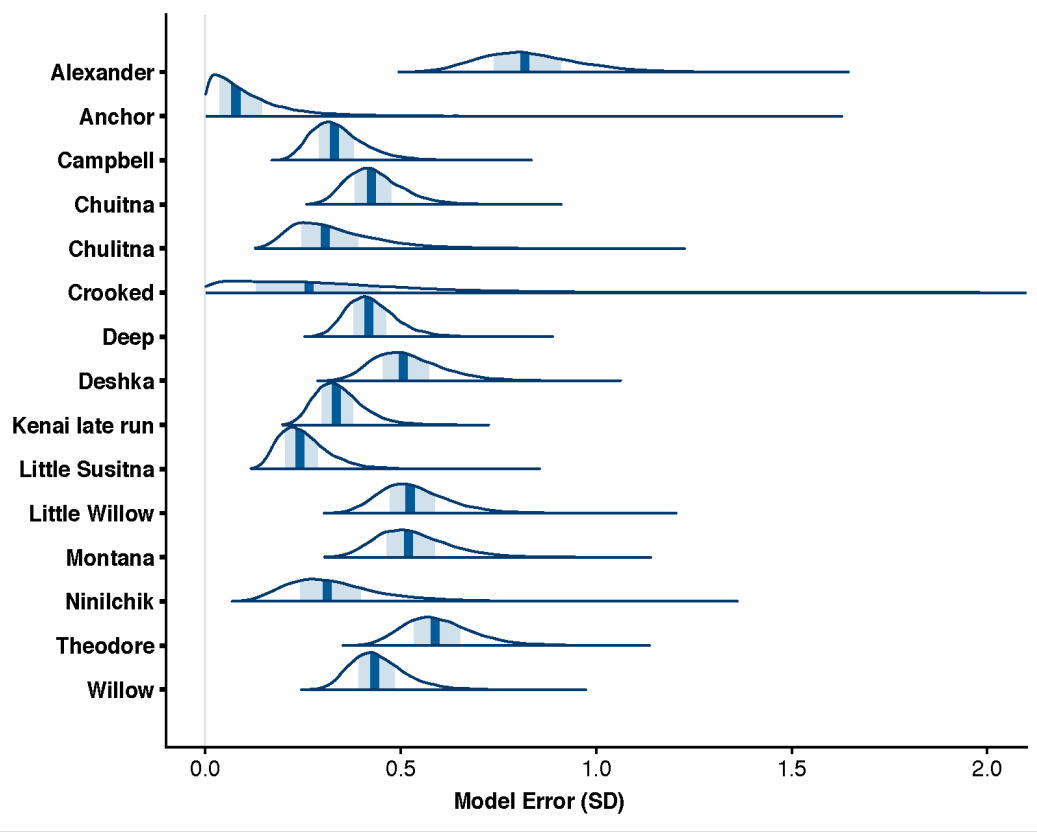



- Heavy fall rains strongly associated with reduced Chinook salmon productivity

- Cumulative effects: A perfect storm of heavy fall rains, high escapement, and high temperatures during 2003-2007 led to low returns during 2008-2012

# Caveats

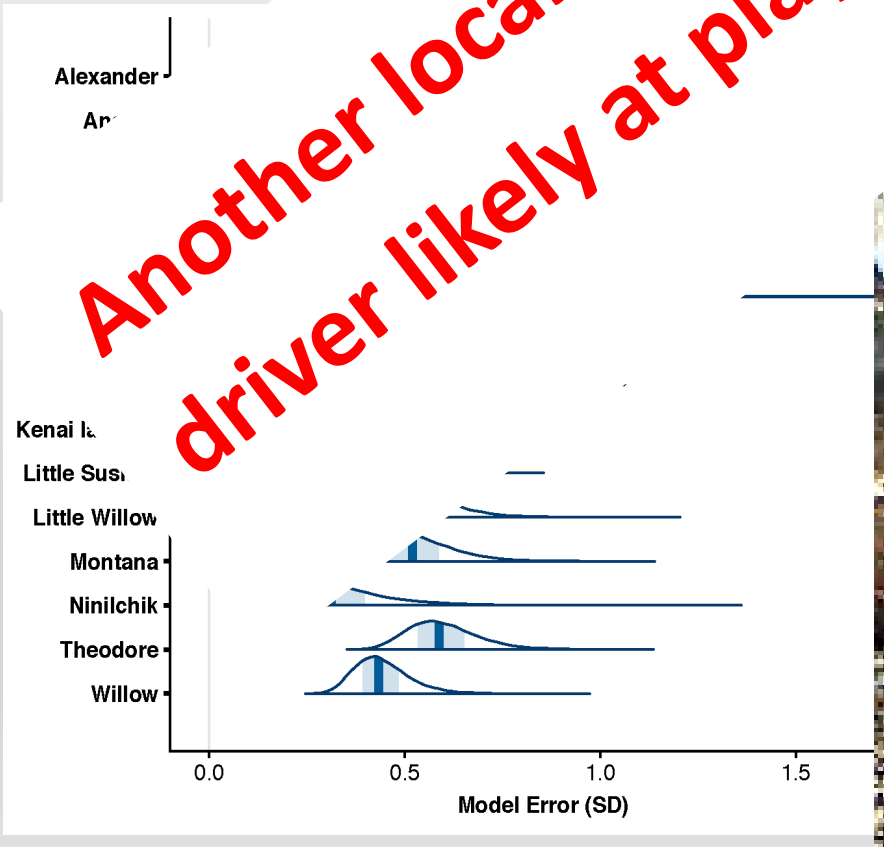
- Correlation ≠ Causation
- Anomalous results in Alexander Creek:



# Caveats

- Correlation ≠ Cau
- Anomalous re

**Another local-scale driver likely at play…**

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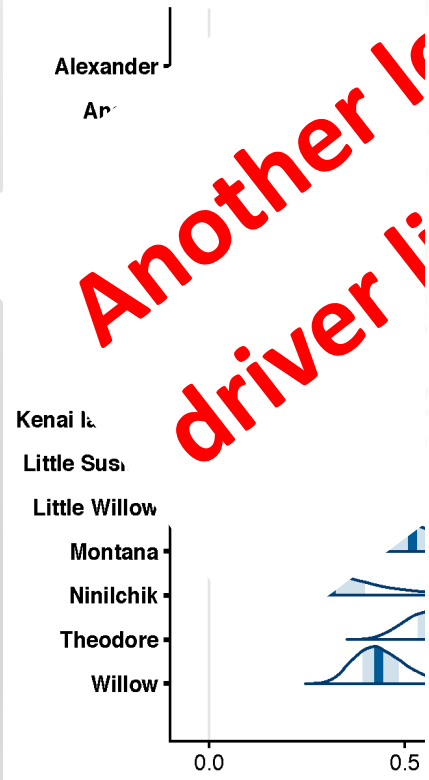
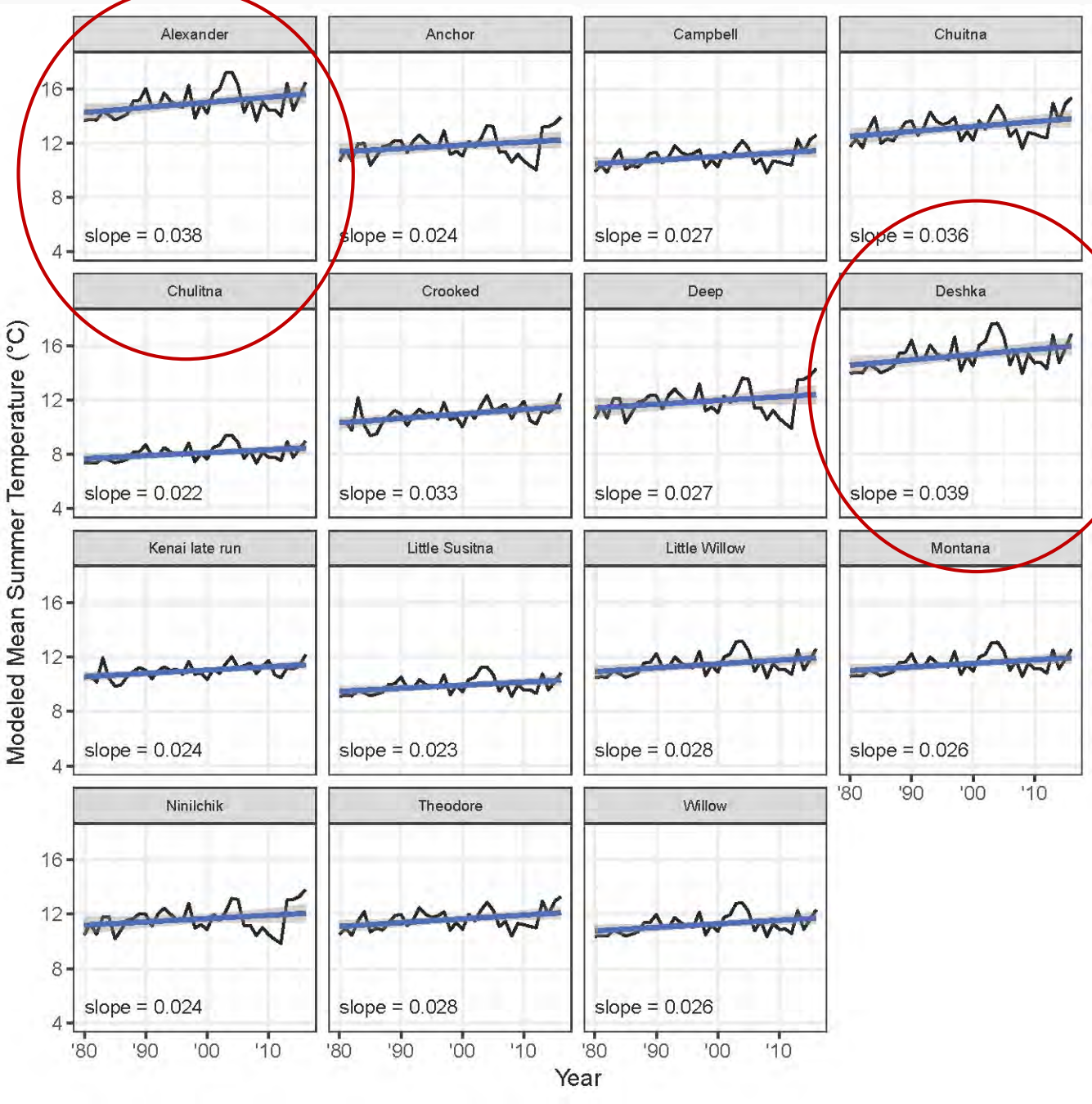
- Correlation ≠
- Anomalous re

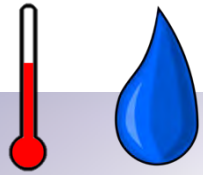
Another l
driver i



# *Climate is filtered by landscape*

Regional climate drivers



Regional-scale data not appropriate for population-specific questions

Importance of coordinating habitat and population monitoring

To detect freshwater effects on salmon productivity, we need watershed-specific physical habitat data

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# Acknowledgements

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