Wild Salmon in a Warming World

Do we have the tools we need to manage our fisheries during rapid climate change?

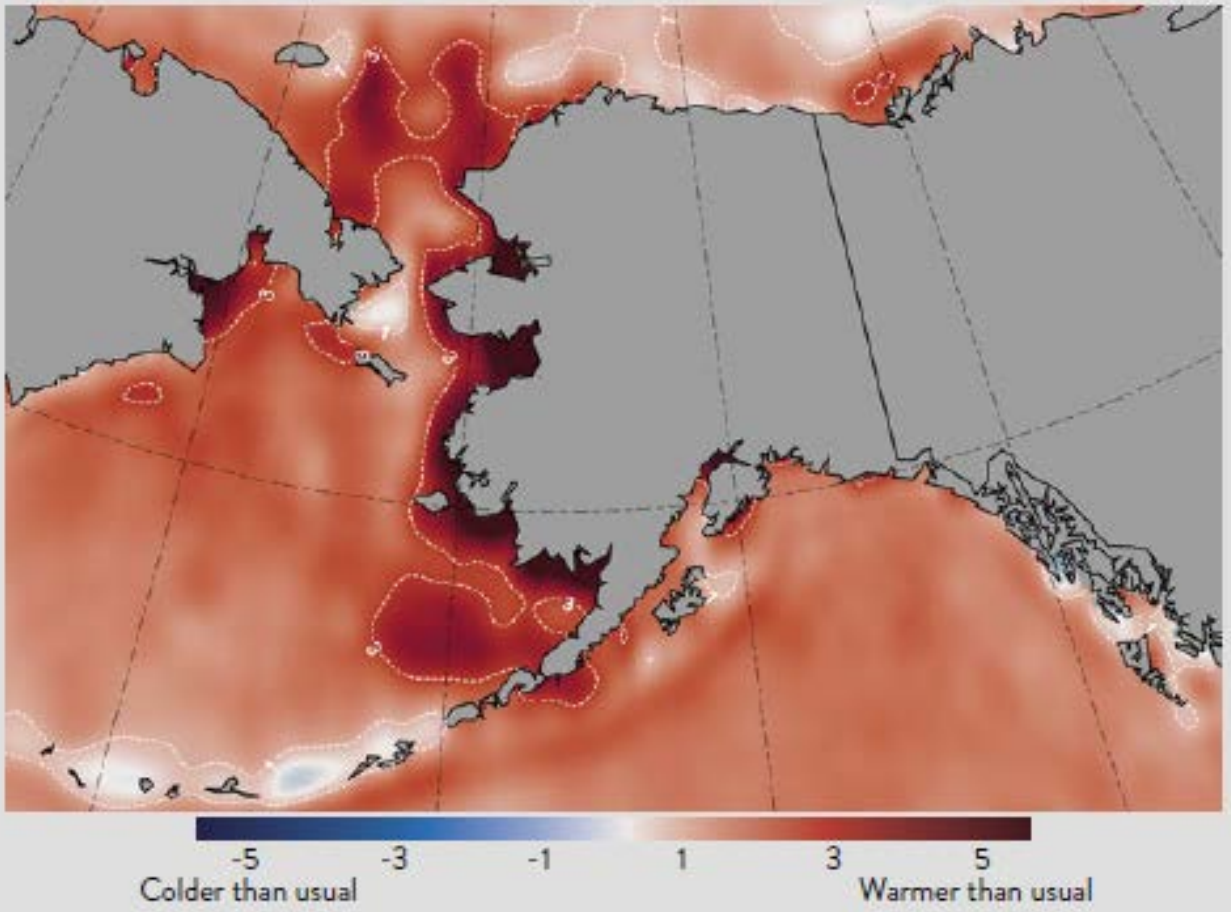
Sue Mauger
Science Director, Cook Inletkeeper
sue@inletkeeper.org

CLEAN WATER · HEALTHY SALMON
INLETKEEPER®

WARM SURFACE WATERS

Summer sea surface temperatures in Alaska waters have been much warmer (colored red below) than average (colored white) during 2014–2018, especially along the west coast, where the surface waters were 4–11°F warmer than average in the summer of 2019.

25



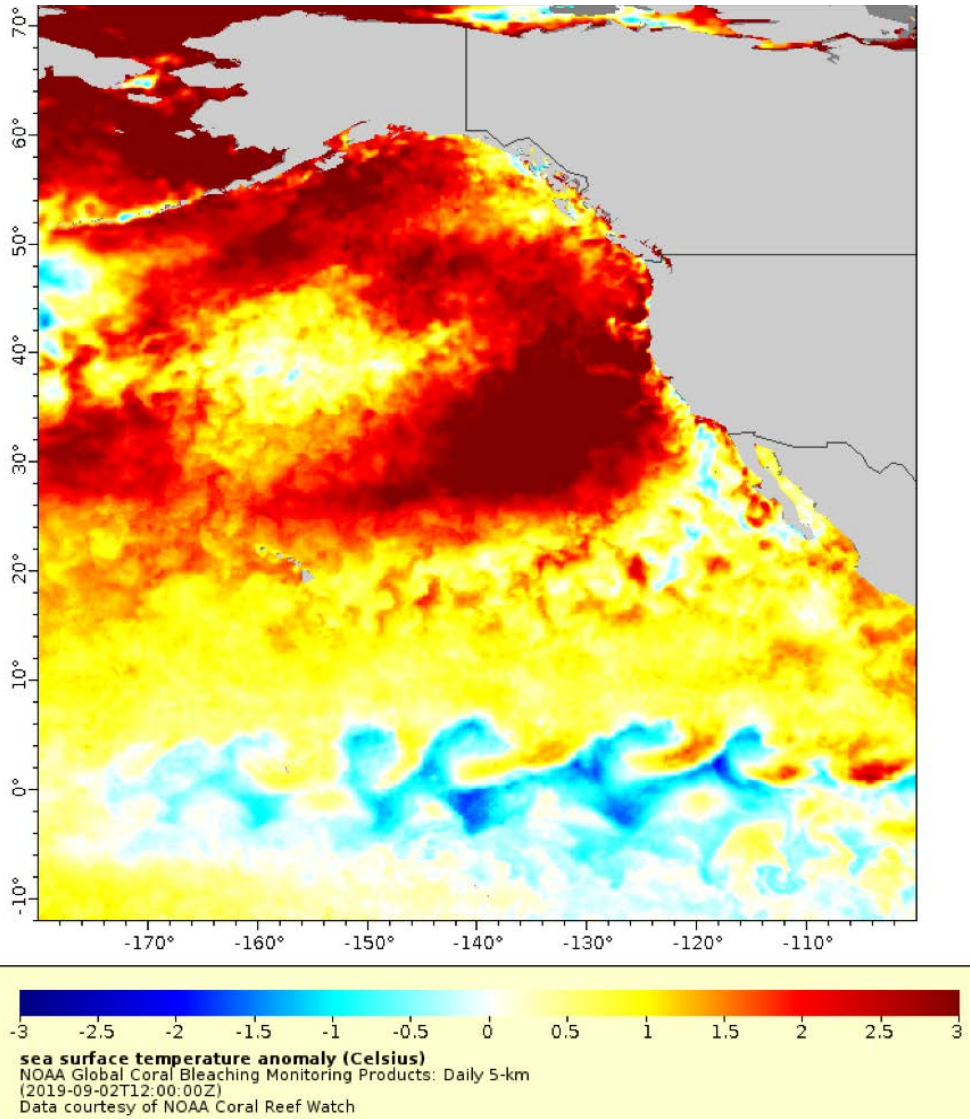
Data source: NOAA/NCEI

Thoman, R. & J. E. Walsh. (2019). Alaska's changing environment: documenting Alaska's physical and biological changes through observations. H. R. McFarland, Ed. International Arctic Research Center, University of Alaska Fairbanks.

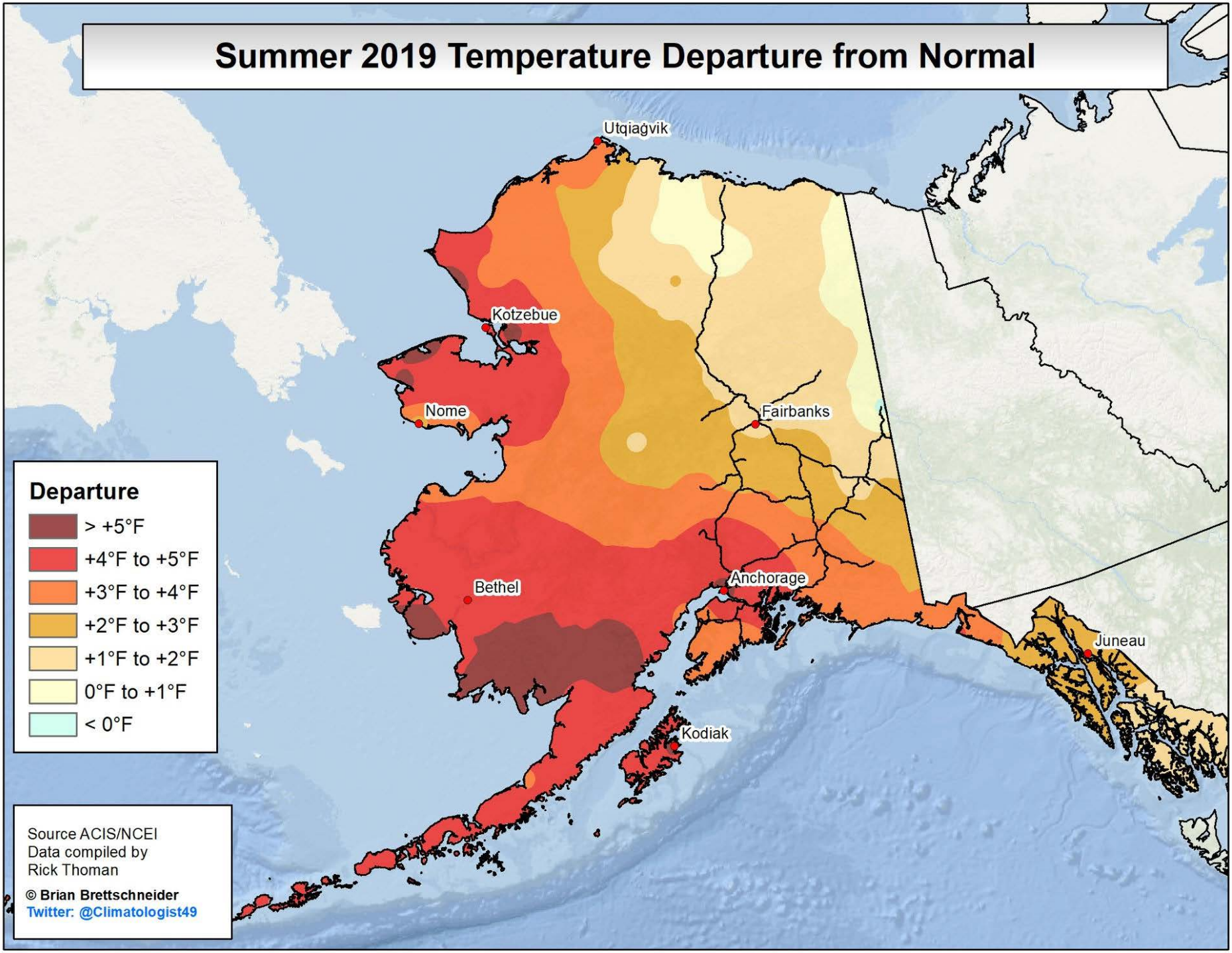
ENVIRONMENT

Is 'The Blob' Back? Latest Marine Heat Wave Could Pose New Risks To Sea Life

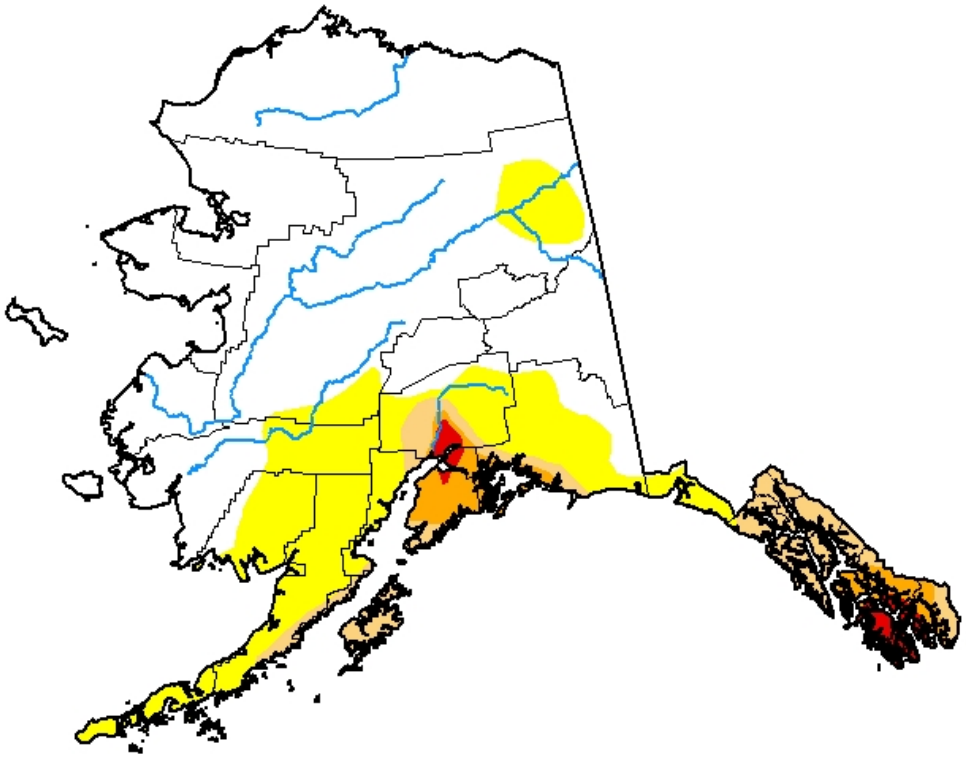
September 6, 2019 · 4:02 PM ET

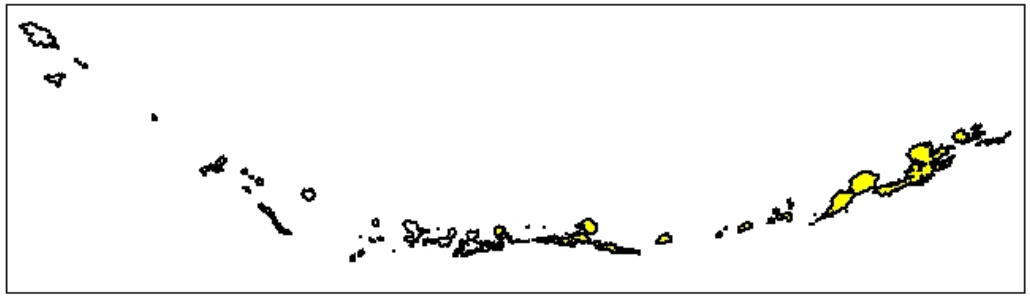


Summer 2019 Temperature Departure from Normal



U.S. Drought Monitor
Alaska





August 20, 2019
(Released Thursday, Aug. 22, 2019)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	66.67	33.33	11.19	4.58	1.32	.00
Last Week 08-13-2019	69.37	30.63	9.63	3.77	0.88	0.00
3 Months Ago 05-21-2019	94.17	5.83	2.78	1.65	0.88	0.00
Start of Calendar Year 01-01-2019	94.17	5.83	2.35	1.02	0.00	0.00
Start of Water Year 09-25-2018	95.65	4.35	2.34	2.06	0.00	0.00
One Year Ago 08-21-2018	95.65	4.35	2.34	0.00	0.00	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Jessica Blunden
NCEI/NOAA

droughtmonitor.unl.edu

https://www.drought.gov/drought/states/alaska

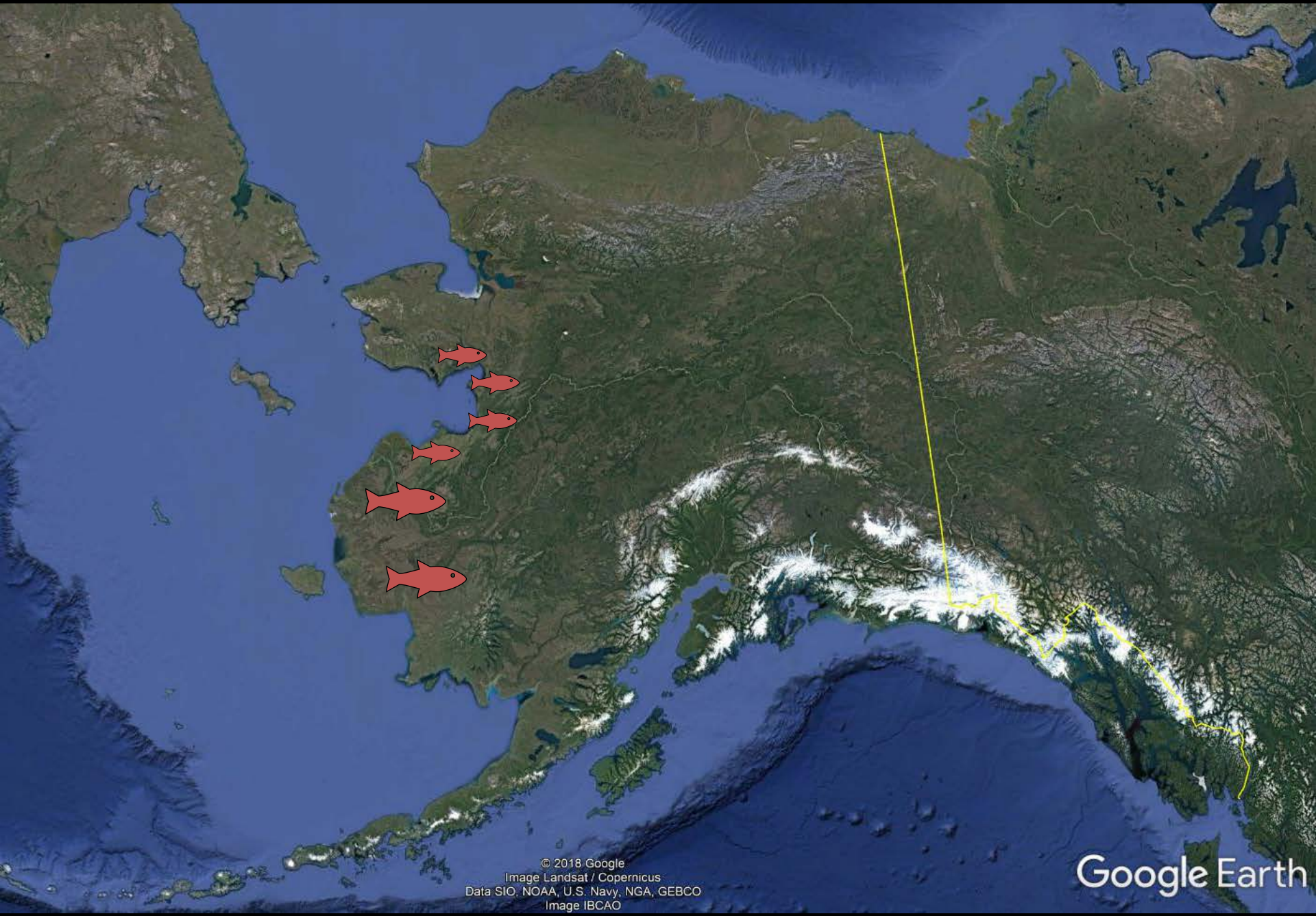

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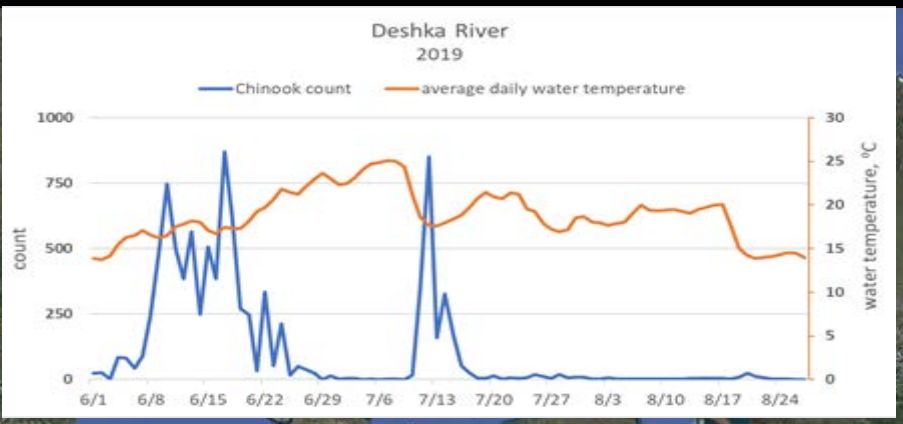
Image IBCAO
Google Earth


Photo credit: Stephanie Quinn-Davidson
DESHKA RIVER
CURRENT CONDITIONS:
07/08/2019
5:00 pm AK TIME
Water Temp = 27.1 °C (80.8 °F)
Air Temp = 31.0 °C (87.8 °F)
© 2018 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image IBCAO
Google Earth



DESHKA RIVER

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Photo credit: Stephanie Quinn-Davidson


Photo credit: LEO Network/Michael Opheim

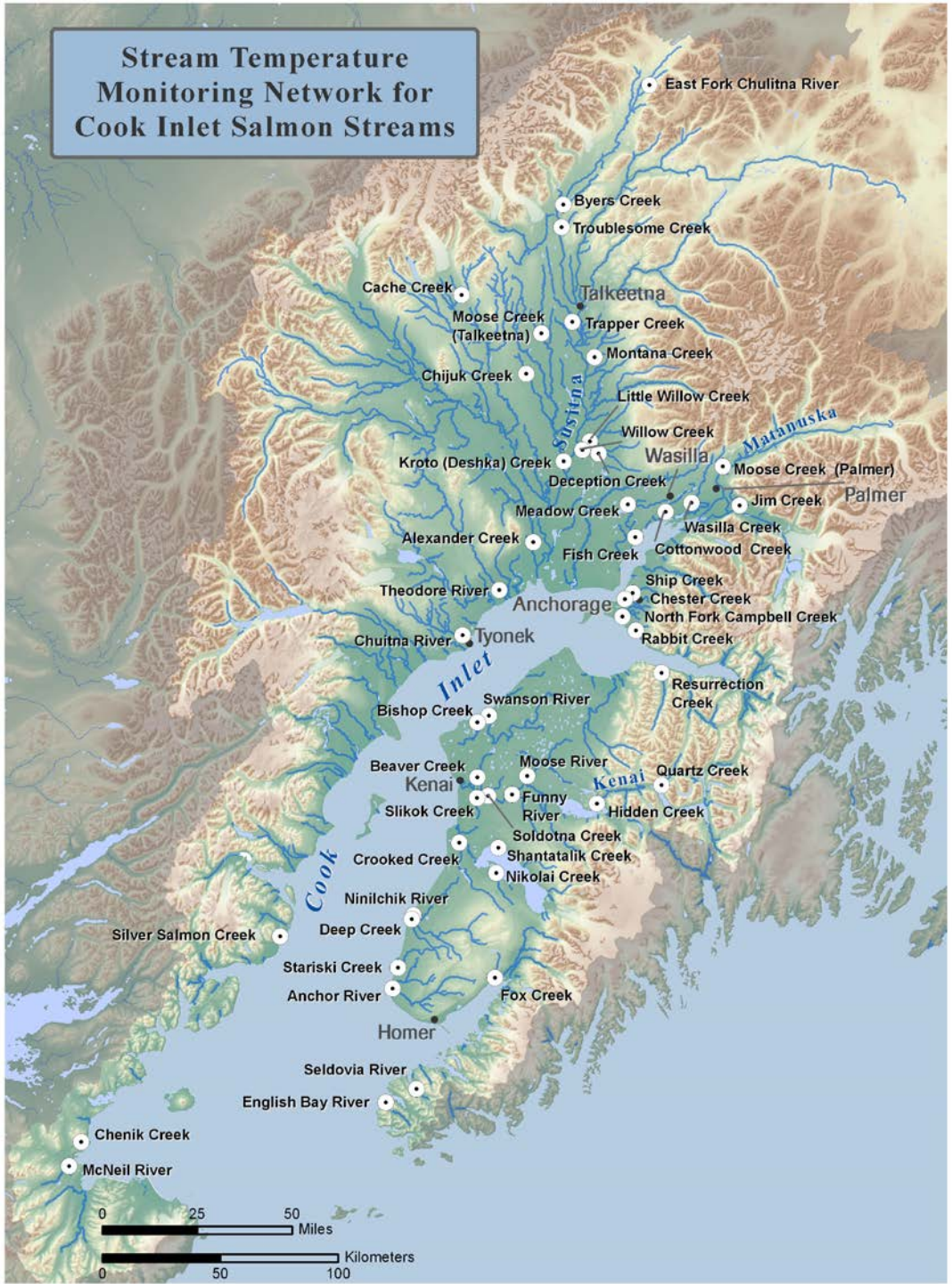
DESHKA RIVER

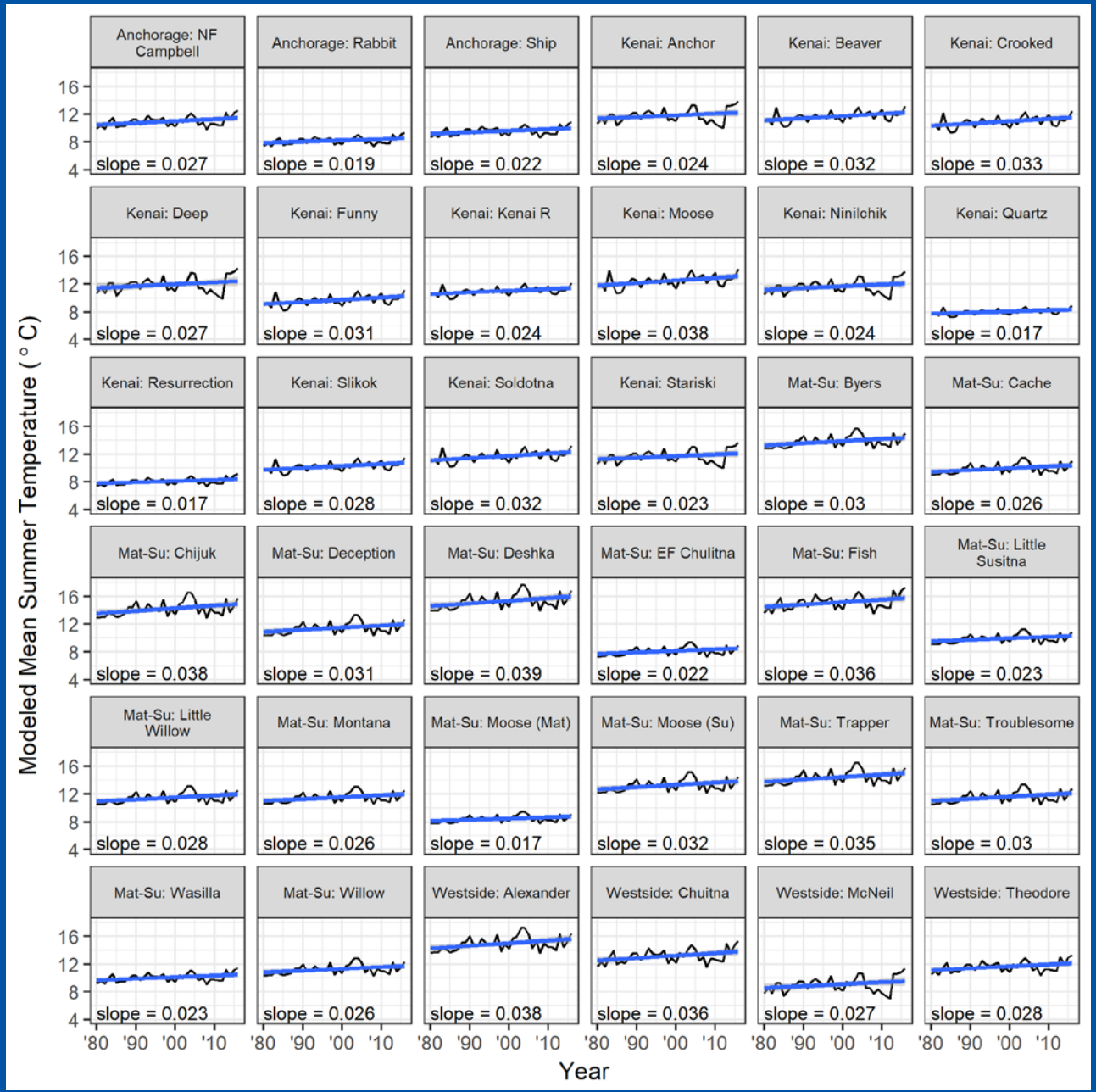
CURRENT CONDITIONS:

07/08/2019
5:00 pm AK TIME
Water Temp = 27.1 °C (80.8 °F)
Air Temp = 31.0 °C (87.8 °F)

Summer of 2019

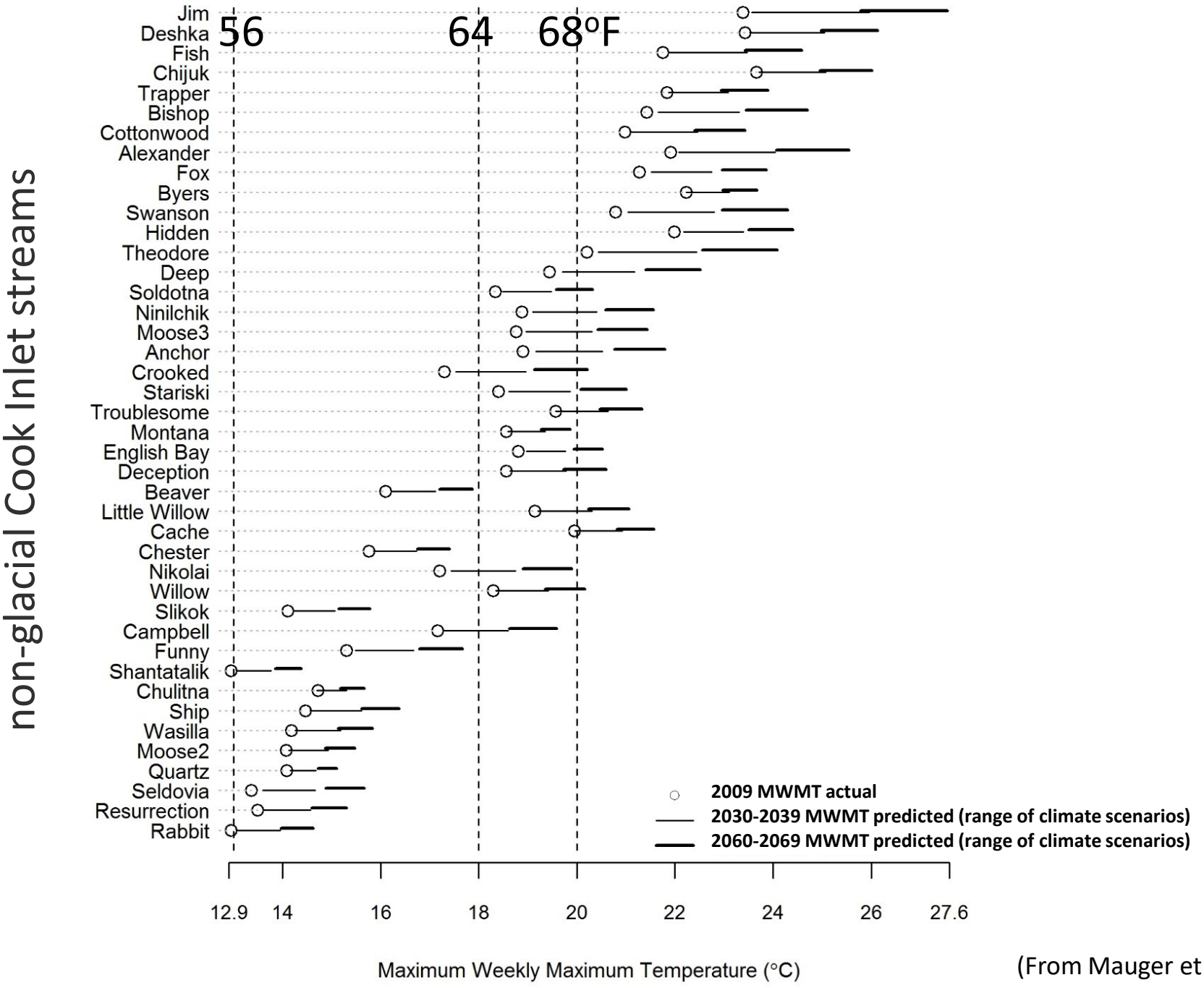
Warm and low freshwater conditions led to both physiological and behavioral responses by adults of all 5 species of wild Alaska salmon around the state and impacted commercial, sport and subsistence fishermen. Impacts to egg and juvenile life stages are unknown.


Stream Temperature Monitoring Network for Cook Inlet Salmon Streams
East Fork Chulitna River
Byers Creek
Troublesome Creek
Cache Creek
Talkeetna
Moose Creek (Talkeetna)
Trapper Creek
Montana Creek
Chijuk Creek
Little Willow Creek
Susitna
Willow Creek
Matanuska
Wasilla
Kroto (Deshka) Creek
Moose Creek (Palmer)
Deception Creek
Palmer
Jim Creek
Meadow Creek
Wasilla Creek
Alexander Creek
Cottonwood Creek
Fish Creek
Ship Creek
Theodore River
Chester Creek
Anchorage
North Fork Campbell Creek
Chuitna River
Tyonek
Rabbit Creek
Inlet
Resurrection Creek
Swanson River
Bishop Creek
Beaver Creek
Moose River
Quartz Creek
Kenai
Kenai
Funny River
Slikok Creek
Hidden Creek
Soldotna Creek
Cook
Crooked Creek
Shantatalik Creek
Nikolai Creek
Ninilchik River
Deep Creek
Silver Salmon Creek
Stariski Creek
Anchor River
Fox Creek
Homer
Seldovia River
English Bay River
Chenik Creek
McNeil River
0 25 50 Miles
0 50 100 Kilometers



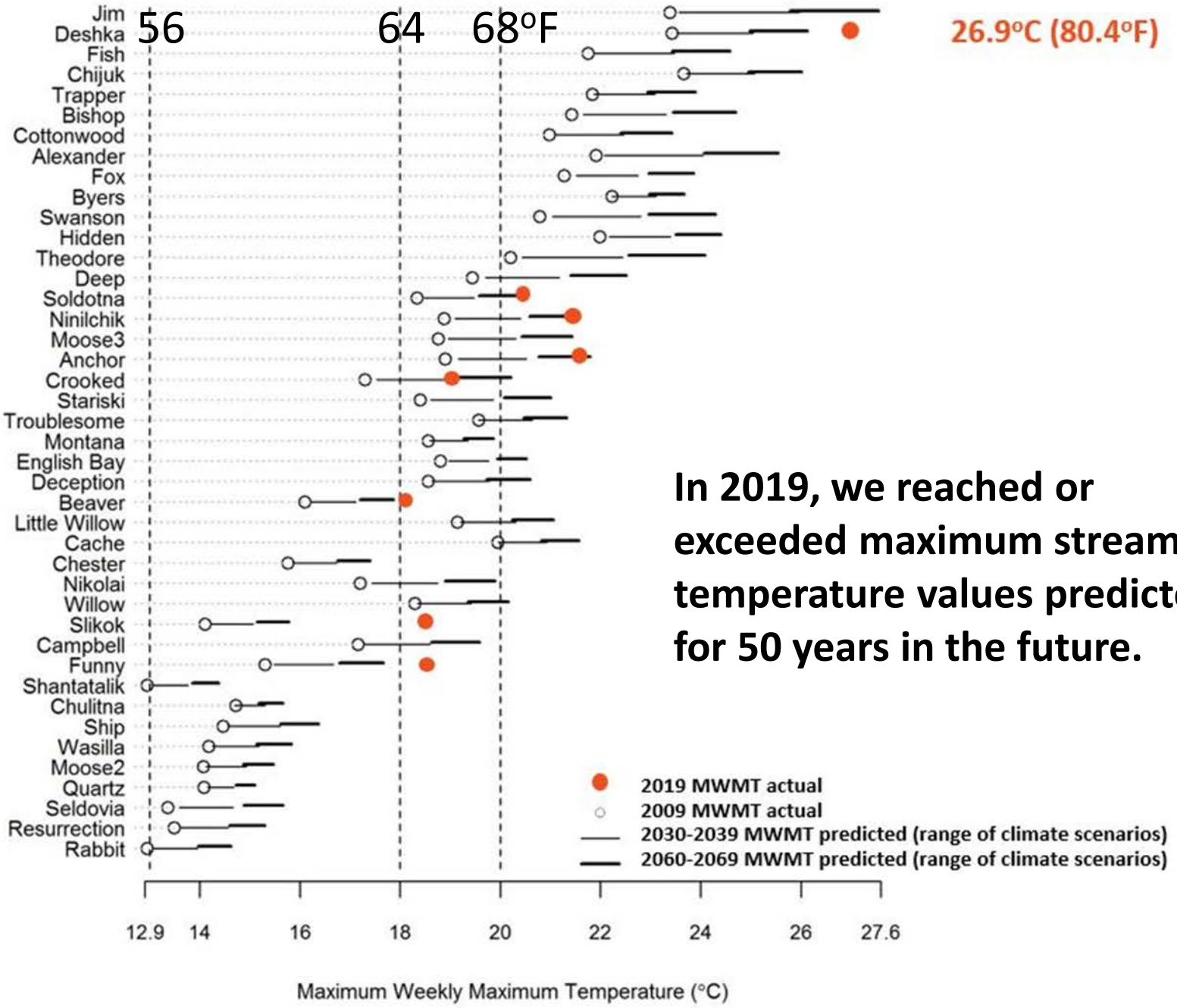
Average summer temperatures have increased by 0.5°F per decade since 1980 in non-glacial stream of Cook Inlet.

Schoen, E., R. Shaftel, C. Cunningham, L. Jones, S. Mauger, D. Rinella, and A. St. Saviour. 2018. Freshwater drivers of Chinook salmon in Cook Inlet, Alaska. Prepared for the Pacific Marine States Fisheries Commission. Alaska Center for Conservation Science, Anchorage, AK.



(From Mauger et al. 2017)

non-glacial Cook Inlet streams



In 2019, we reached or exceeded maximum stream temperature values predicted for 50 years in the future.

Regional and watershed-scale climate drivers influence Chinook salmon productivity in southcentral Alaska

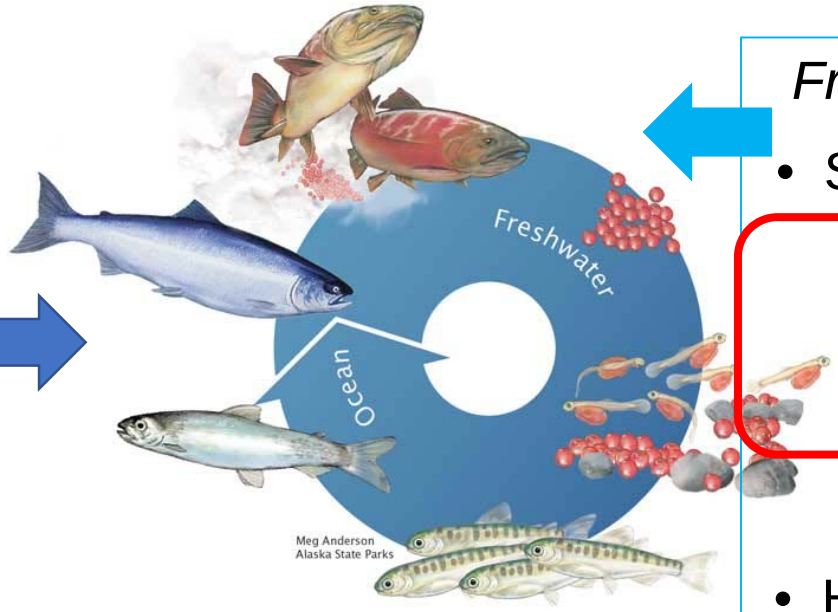
Leslie Jones, Erik Schoen, Rebecca Shaftel, Curry Cunningham, Sue Mauger, Daniel Rinella, and Adam St. Saviour

(*Global Climate Change*, in review)

Chinook salmon populations in Cook Inlet have declined during a period of rapid change

Ocean conditions

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



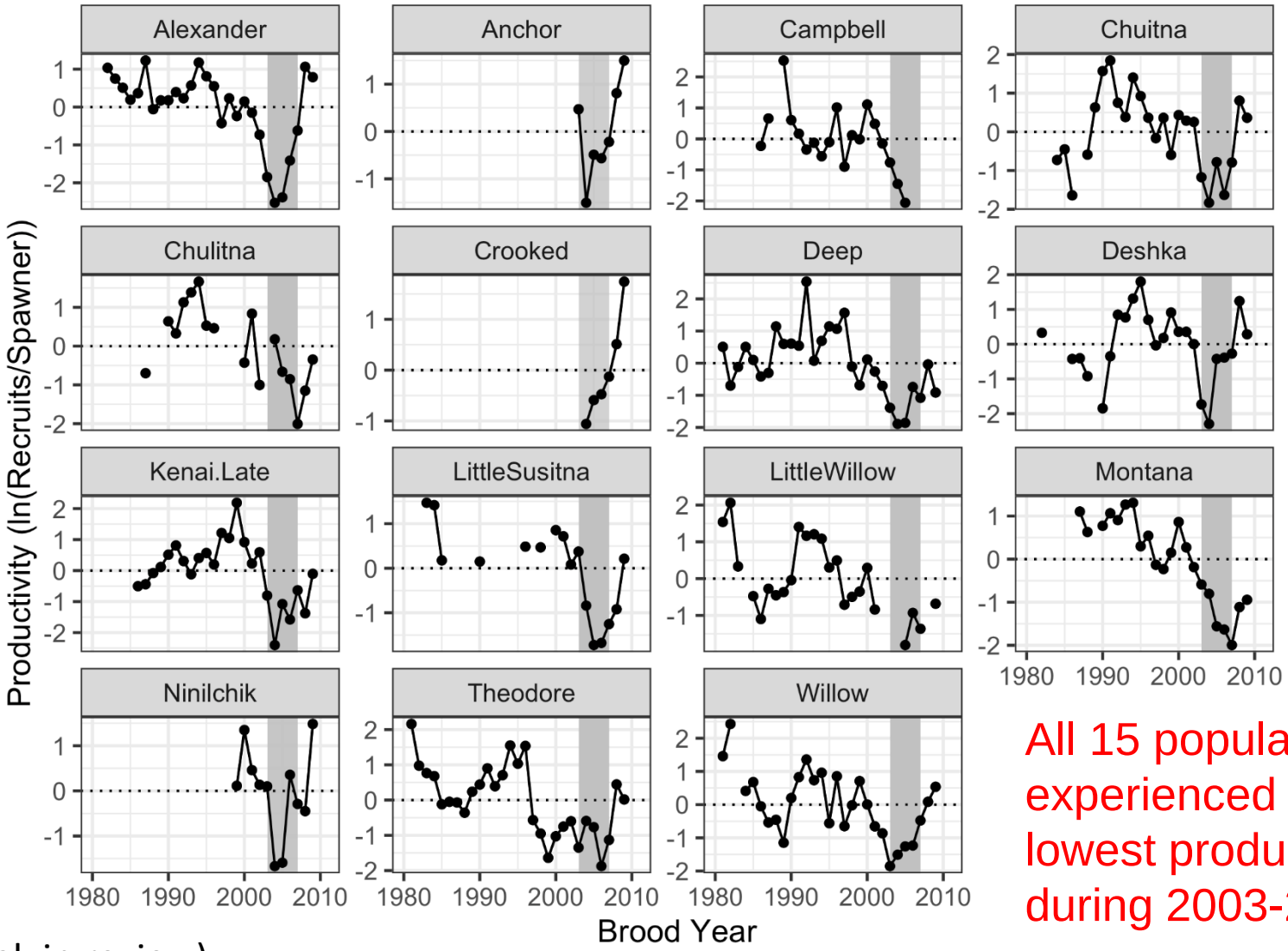
Freshwater conditions

- 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?

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



All 15 populations experienced their lowest productivity during 2003-2007

(Jones et al. in review)

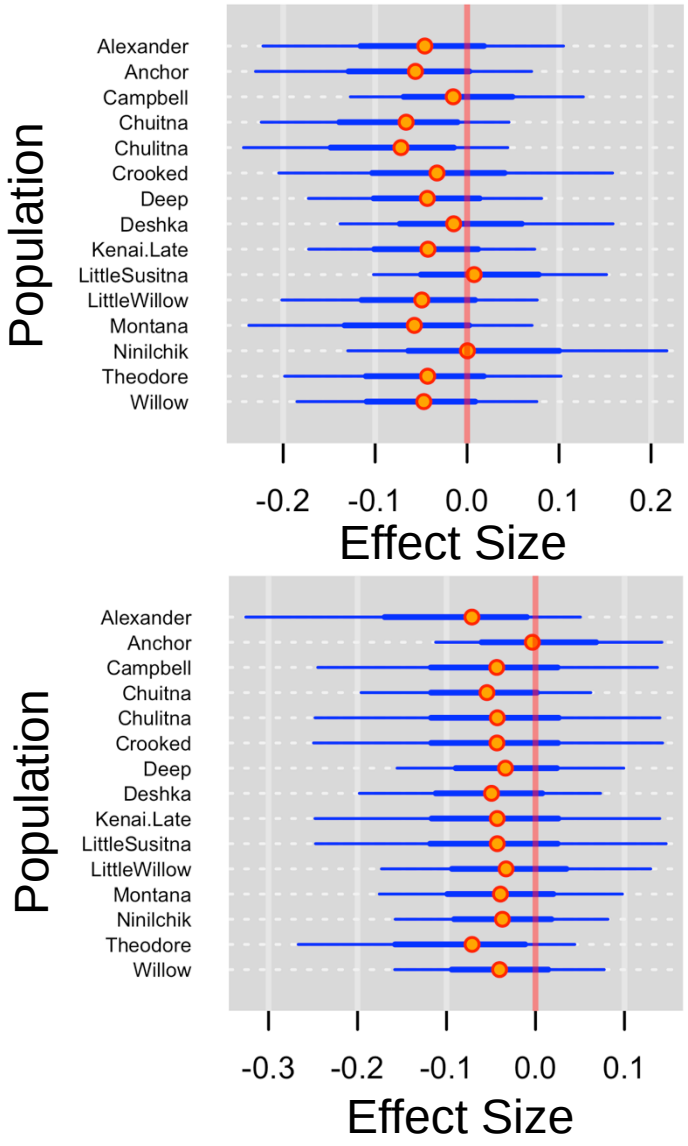
Results: Stream temperature

Maximum temperature during spawning had a **moderate negative effect**

- 4% reduction in productivity per 1-SD increase
- High temperatures → increased mortality of migrating adults or eggs

Number of weeks > 15˚C (59ºF) during juvenile rearing had a **moderate negative effect**

- 5% reduction in productivity per 1-SD increase
- High temperatures → reduced juvenile growth → poor survival

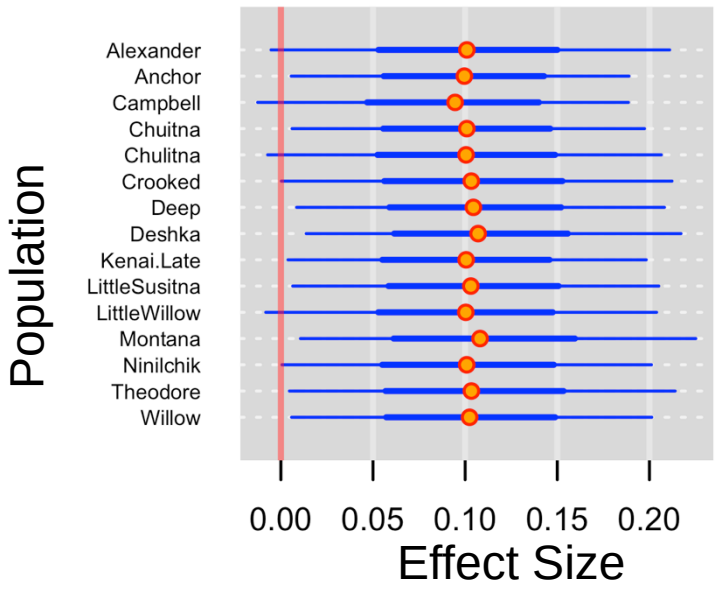


(Jones et al. in review)

Results: Precipitation

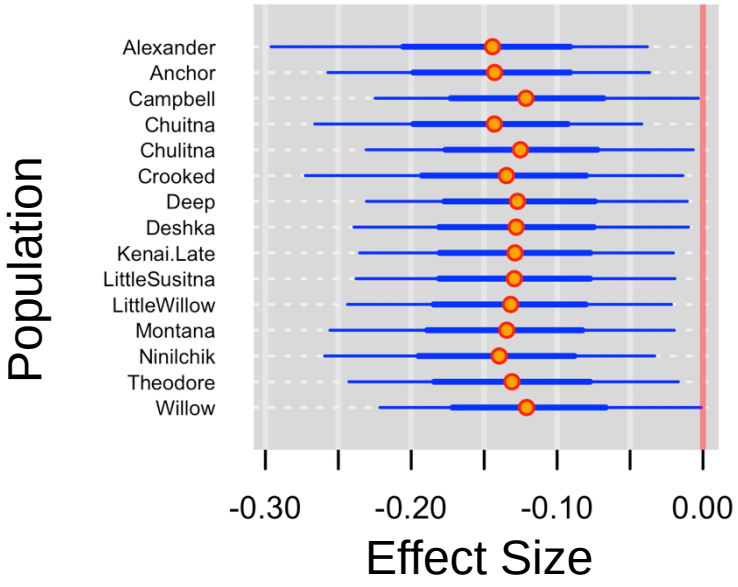
Greater average precipitation during juvenile rearing had a **strong positive effect**

- 10% increase in productivity per 1-SD increase (dome shaped)
- Moderate summer rains → increased habitat connectivity → beneficial for juvenile rearing
- Very high or low rain is harmful



Greater maximum precipitation during spawning / incubation had a **strong negative effect**

- 13% reduction in productivity per 1-SD increase
- Heavy rains → redd scour, siltation, or toxic urban runoff



(Jones et al. in review)

Mitigating adverse freshwater conditions through management and conservation

- Management tools

  real-time temperature stations to support in-season decision making

- Conservation tools

  To build resilience against high temperatures, maintain riparian vegetation for shade and protect cool-water habitats

  To build resilience again high/low flows, support strong wetland protections and riparian buffers and increase green stormwater infrastructure

ANCHORAGE DAILY NEWS

Business/Economy

Warmer waters threaten to make the commercial salmon fishery less predictable

Author: Laine Welch | Fish Factor Updated: September 17 Published September 17

Two Bristol Bay fishermen pull sockeye salmon from a net near Naknek in this undated file photo. (AP Photo/Al Grillo)

"Unpredictable" is the way salmon managers describe Alaska's 2019 salmon season, with "very, very interesting" as an aside.