DFO State of the Salmon Program

Environmental Conditions: Informing Salmon Returns in 2023

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Salmon Outlook Jan 16 2023

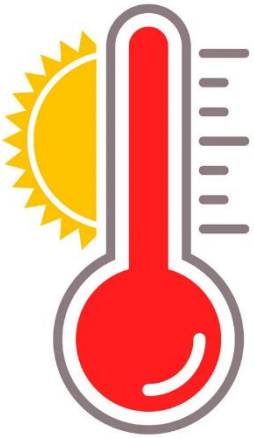
Photo: 4 Element Photos
S. Kalyn

Freshwater

Drought

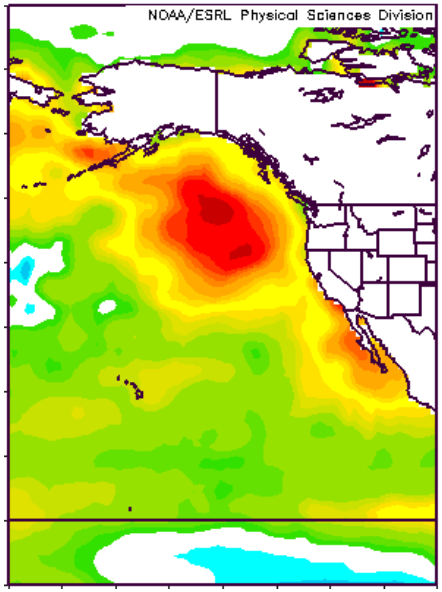
Flooding

Fires

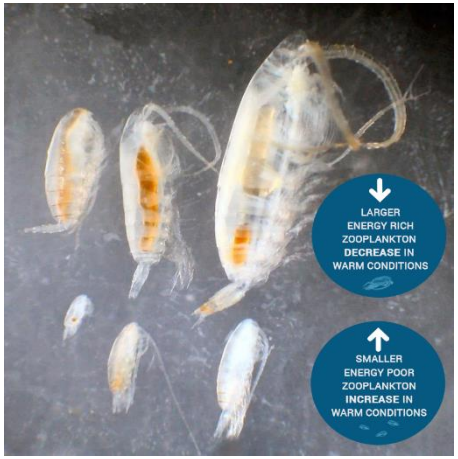


One decade since the Northeast Pacific Ocean Blob was first observed in 2013

Marine

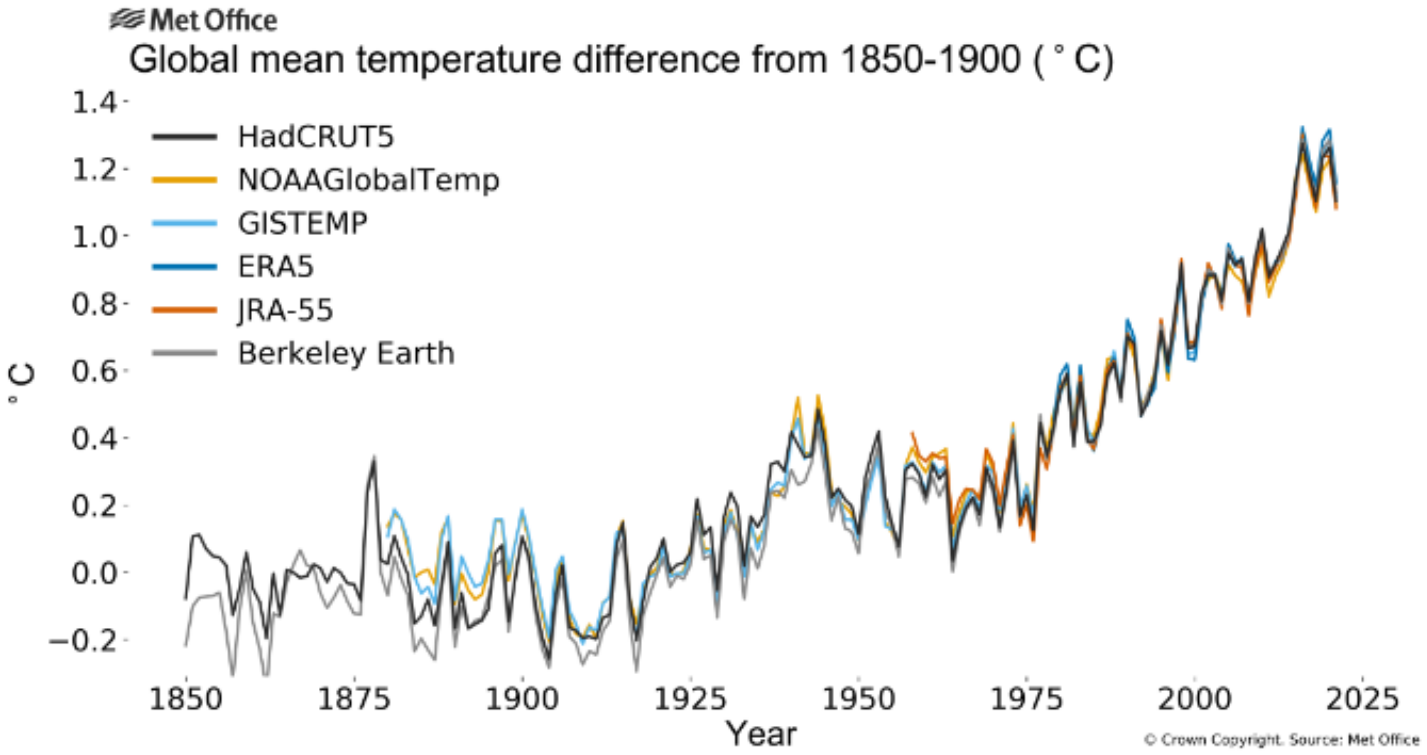


Marine heatwaves



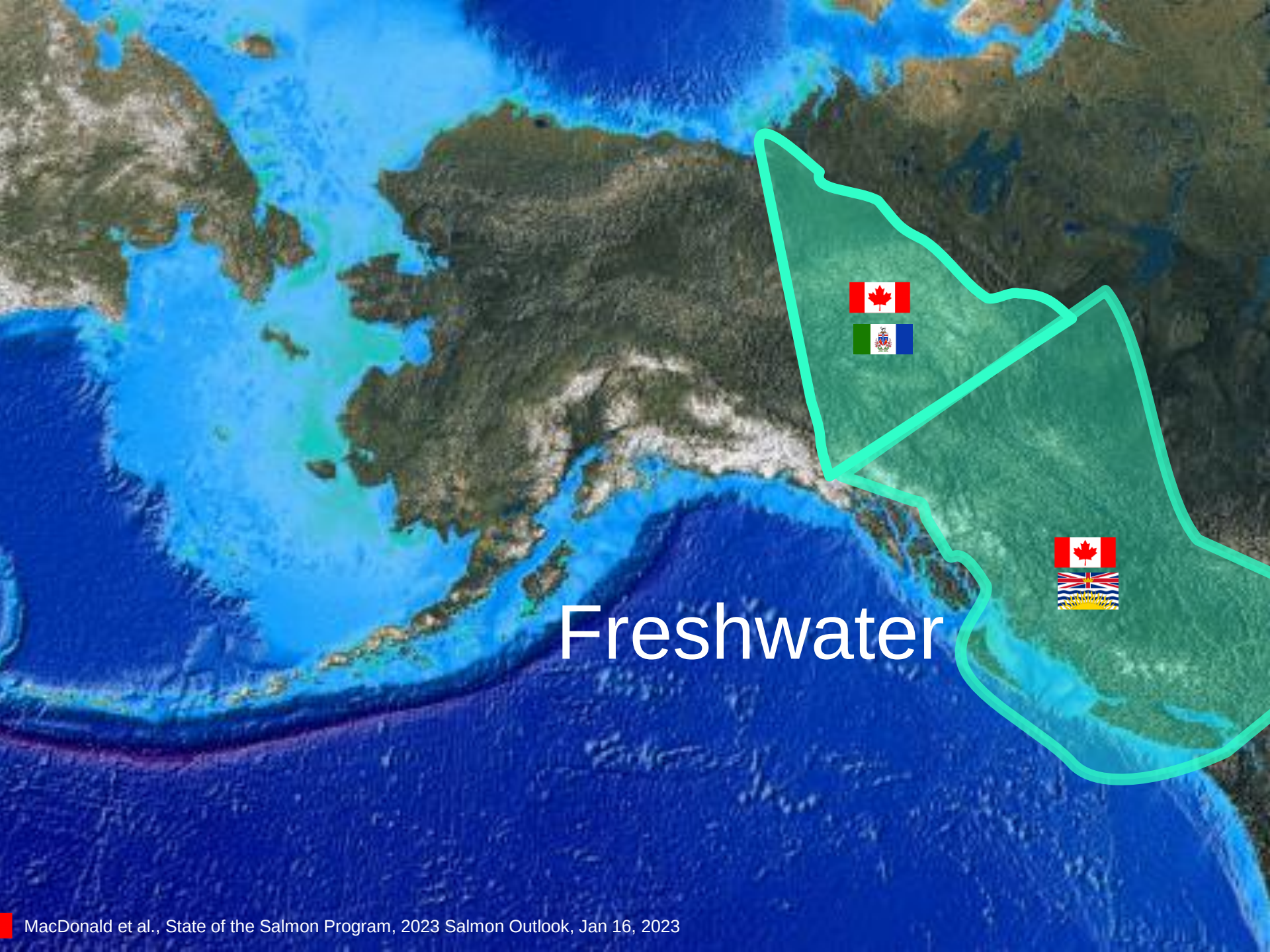
Shift towards less nutritious zooplankton species

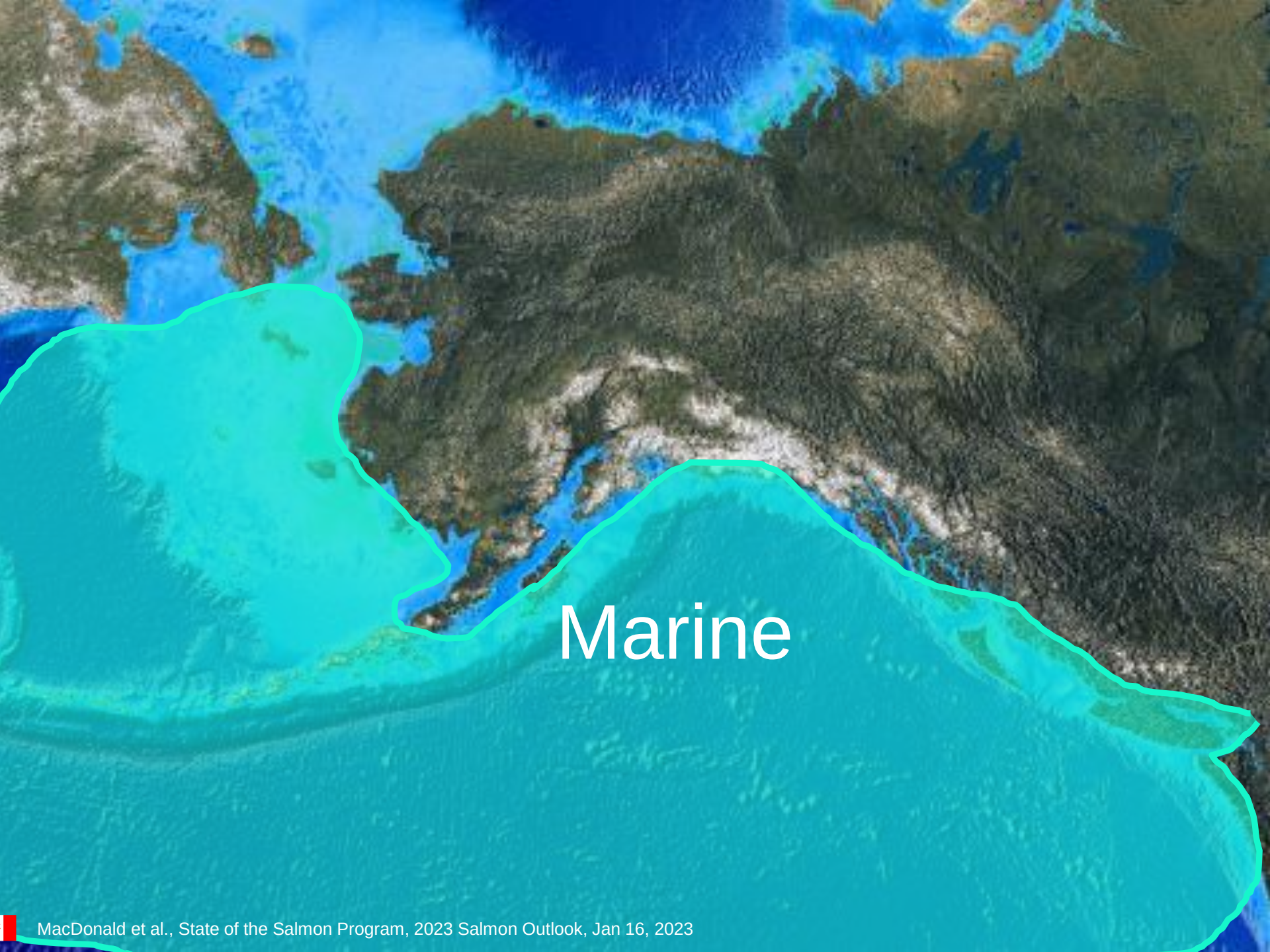
Human-caused greenhouse gas emissions are driving unprecedented warming on the planet



1850-2021: Global Land & Ocean Temperature Anomalies

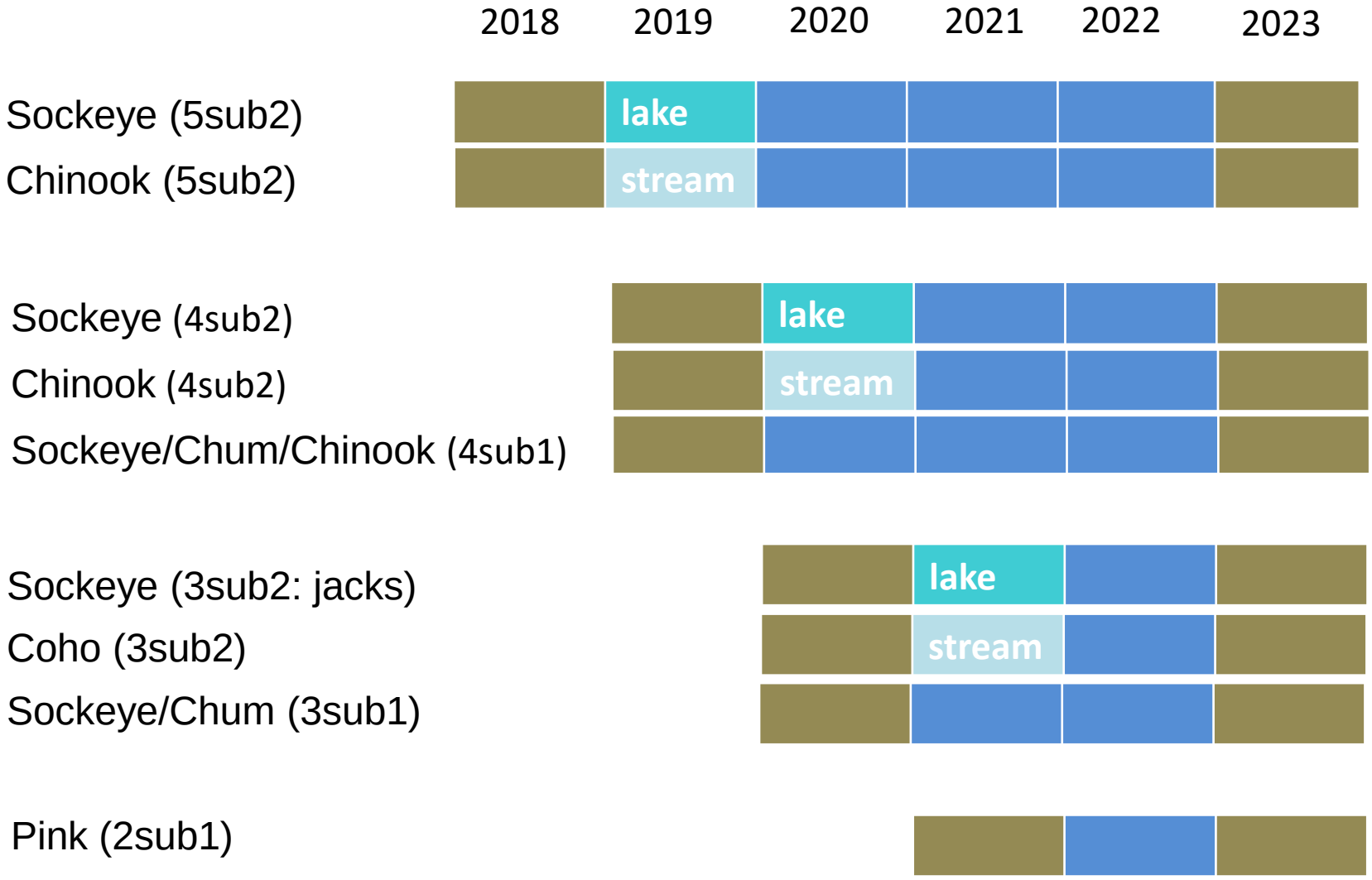
Source: Met Office Hadley Centre for Climate Science and Services, https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2022/2021-hadcrut5-wmo-temperature-statement


Freshwater


Marine

2023 Returns

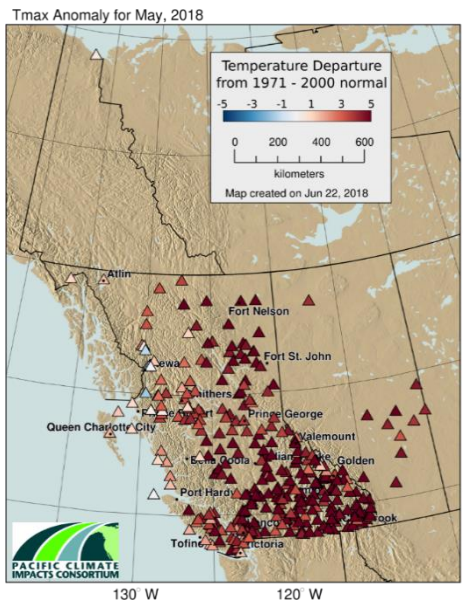
spawning & egg incubation	fry-stream	fry-lake	Juvenile-Ocean	spawning

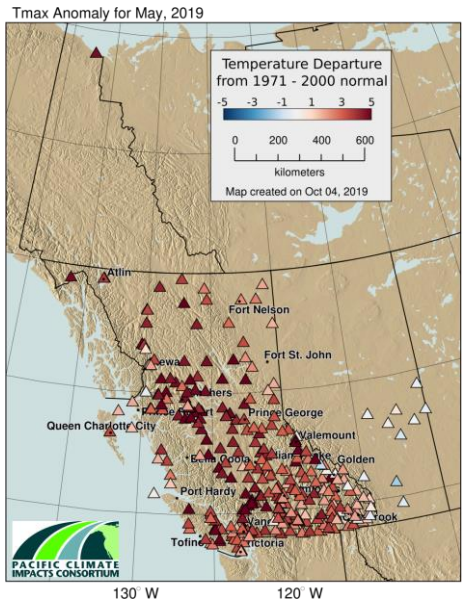


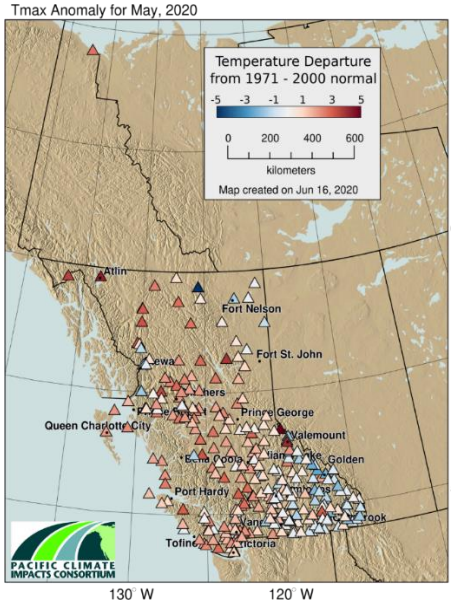
MacDonald et al., State of the Salmon Program, 2023 Salmon Outlook, Jan 16, 2023

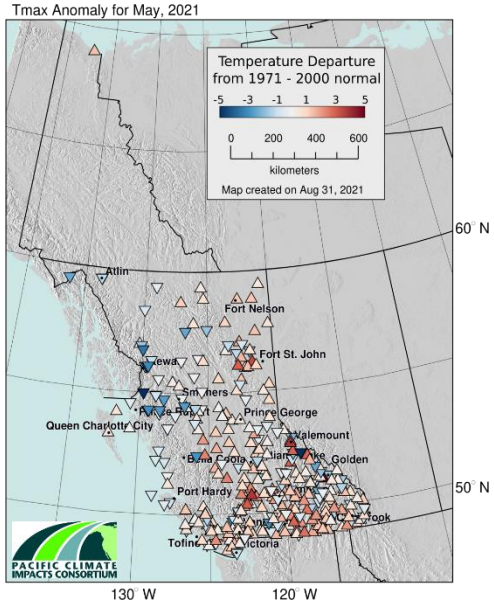
MacDonald et al., State of the Salmon Program, 2023 Salmon Outlook, Jan 16, 2023

Spring Air Temperatures









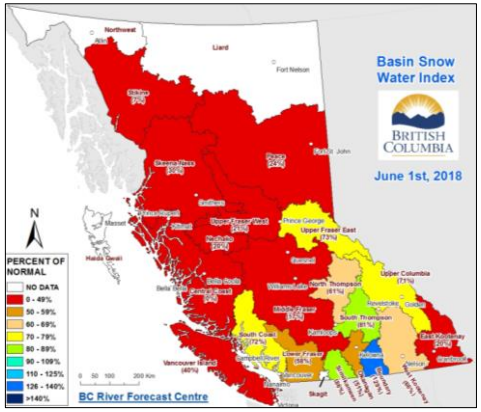
2018 2019 2020 **2021**

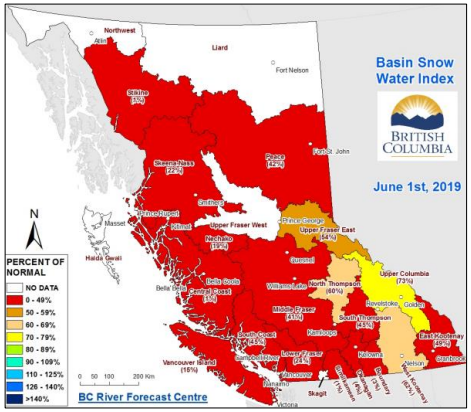
*heat dome year

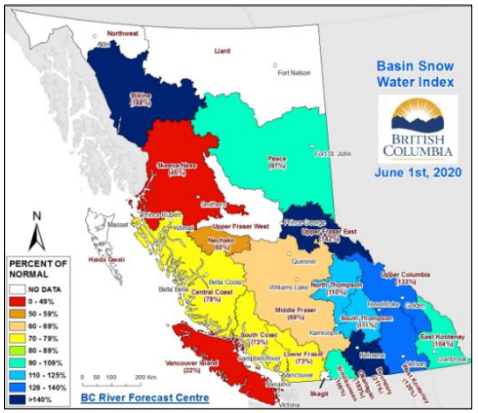
Cold -5 -3 -1 1 3 5 **Warm**

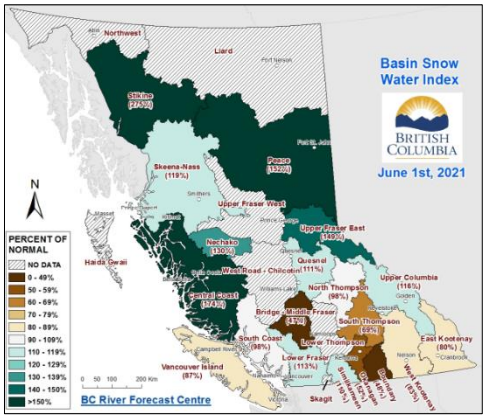
Reference period: 1971-2000

Contributes to summer water temperatures



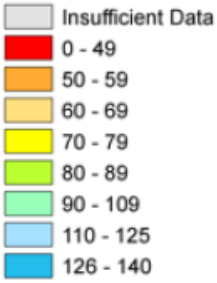


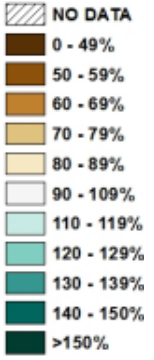




2018 2019 2020 2021

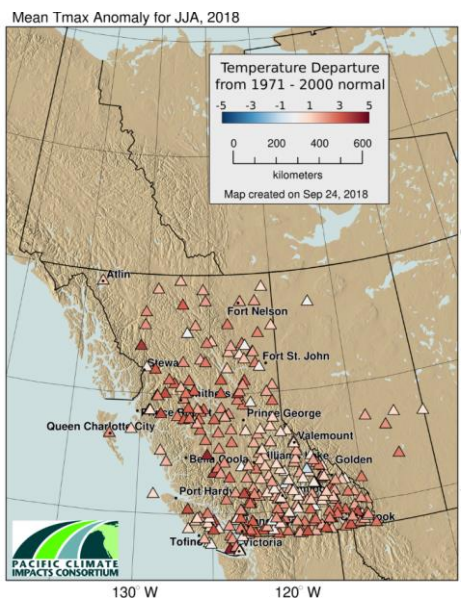
*heat dome year

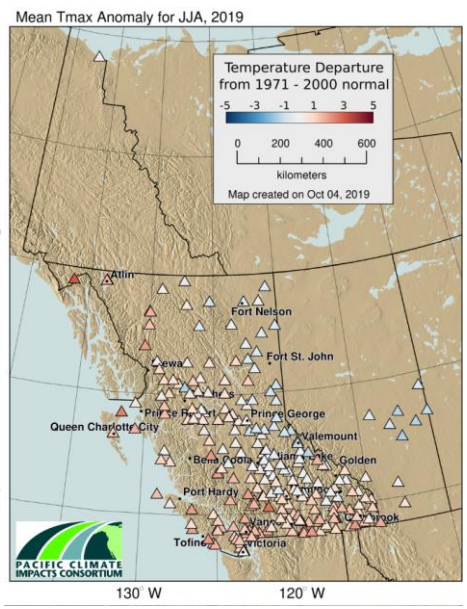


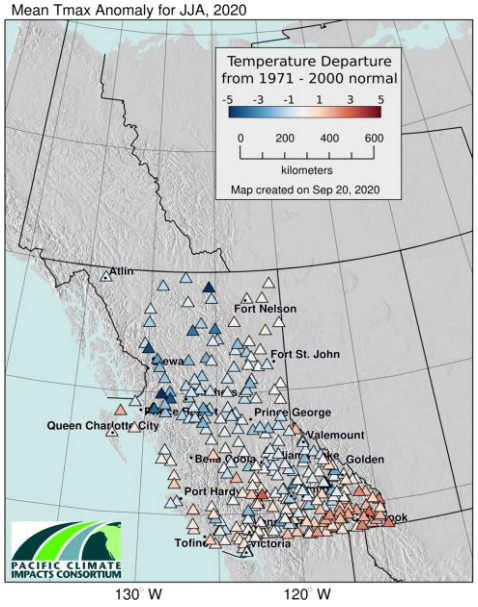


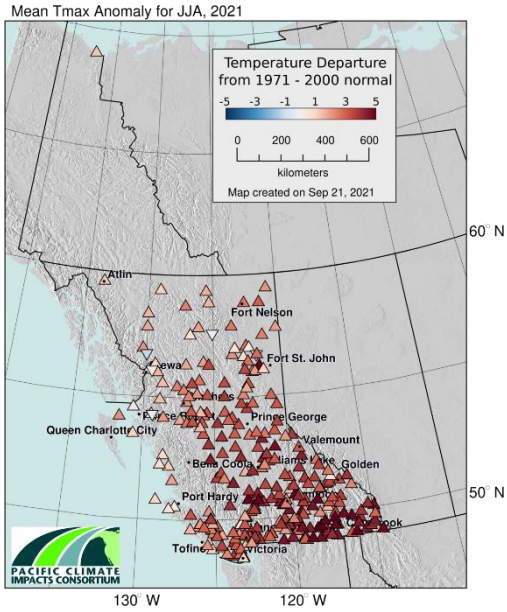
MacDonald et al., State of the Salmon Program, 2023 Salmon Outlook, Jan 16, 2023

Summer Air Temperatures









2018 2019 2020 2021

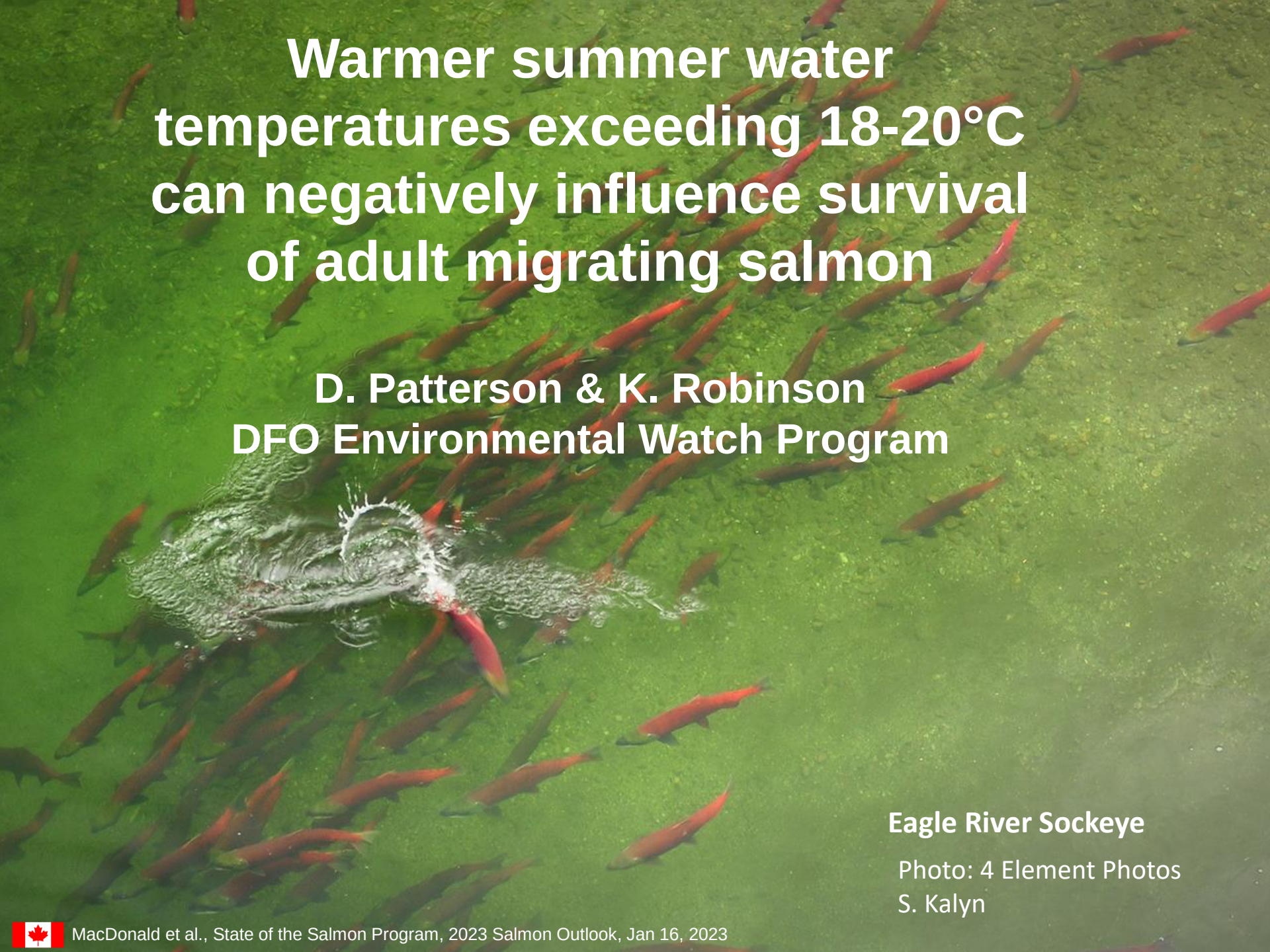
*heat dome year

Cold -5 -3 -1 1 3 5 **Warm**

Reference period: 1971-2000

Warmer summer water temperatures exceeding 18-20°C can negatively influence survival of adult migrating salmon

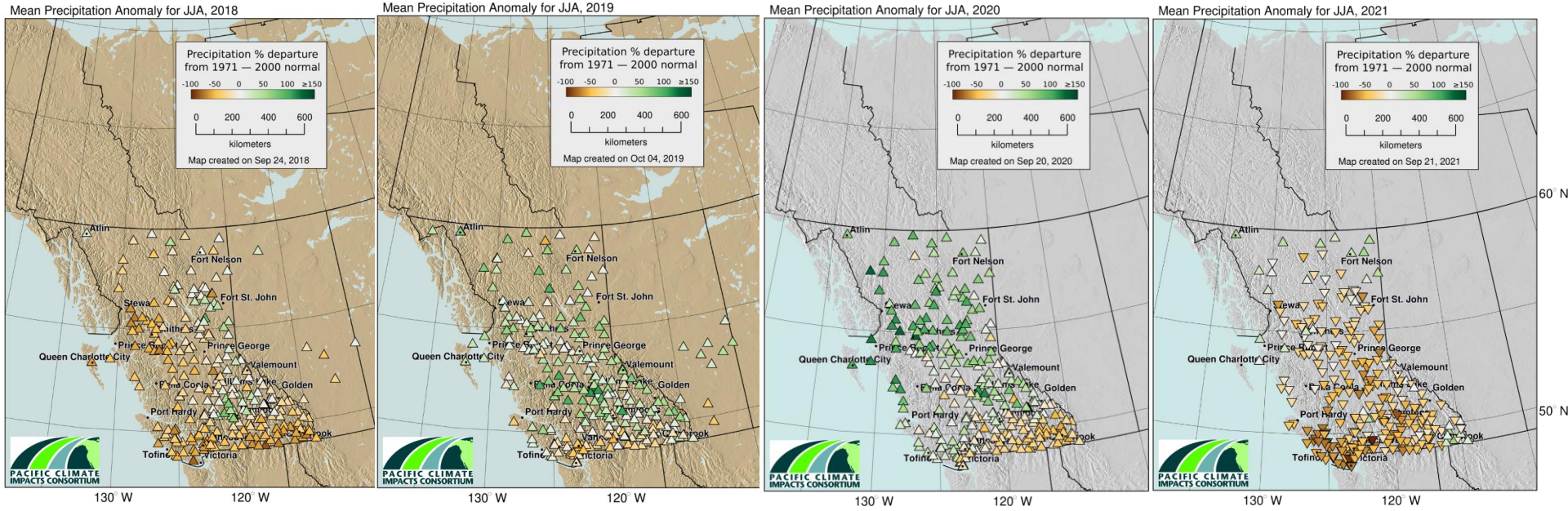
D. Patterson & K. Robinson
DFO Environmental Watch Program



Eagle River Sockeye

Photo: 4 Element Photos
S. Kalyn

Summer Precipitation



2018 2019 2020 **2021**

*heat dome year

Dry

Precipitation % departure from 1971 — 2000 normal

-100 -50 0 50 100 ≥150

Wet

Reference period: 1971-2000

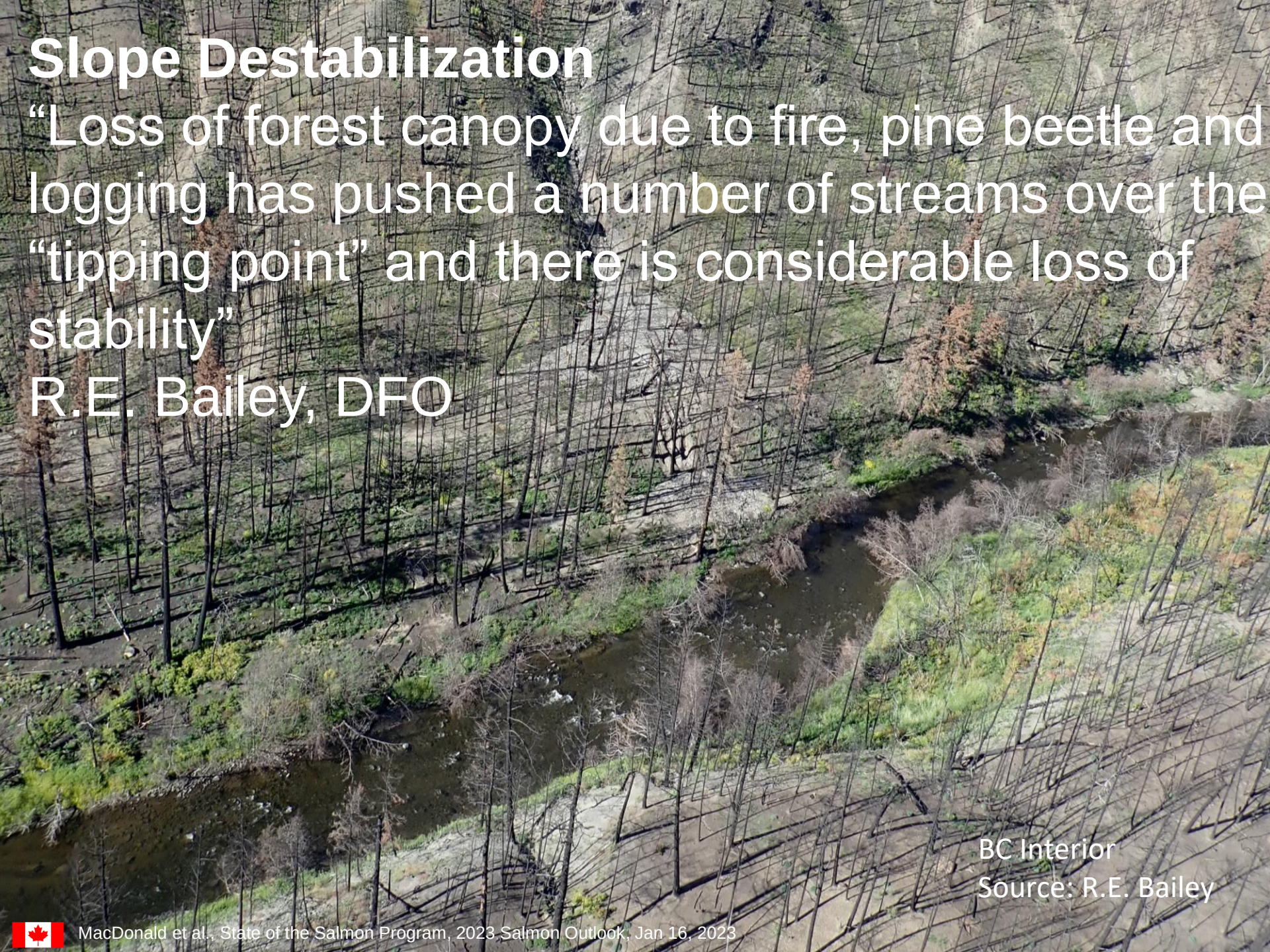
MacDonald et al., State of the Salmon Program, 2023 Salmon Outlook, Jan 16, 2023

Drought conditions

Implications for our salmon in freshwater are not entirely known

Slope Destabilization

"Loss of forest canopy due to fire, pine beetle and logging has pushed a number of streams over the "tipping point" and there is considerable loss of stability"
R.E. Bailey, DFO



BC Interior
Source: R.E. Bailey

Photo credit: CBC News: Historic flooding in southern B.C., by the numbers
November 17, 2021

Fall 2021

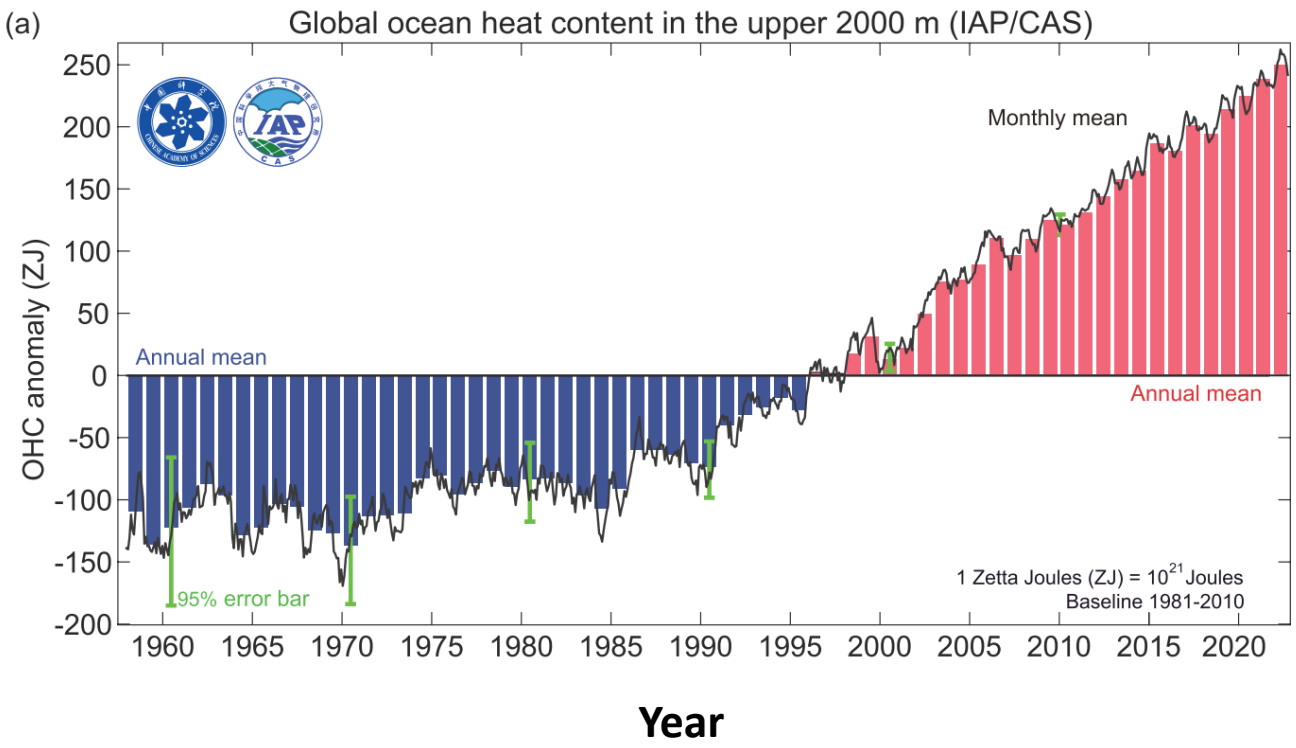
"Salmon are really good at finding places that won't scour and so they sort of evolved for flooding, but not this level of flooding," Jonathan Moore said. "It depends a ton on the watershed and the watershed characteristics.“ The main concern, he said, is whether newly spawned eggs could have been washed away — also known as scouring.

Source: https://www.cbc.ca/news/canada/british-columbia/bc-salmon-floods-1.6256629


2020, 2021, 2022, 2023

The planet is warming driven by human-caused greenhouse gas emissions

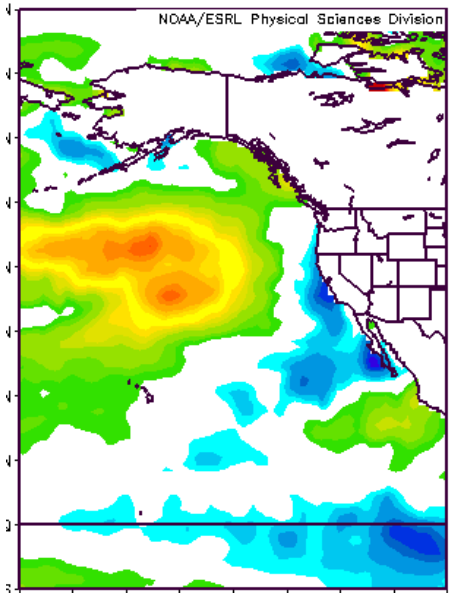
90% of this excess heat is absorbed by the ocean



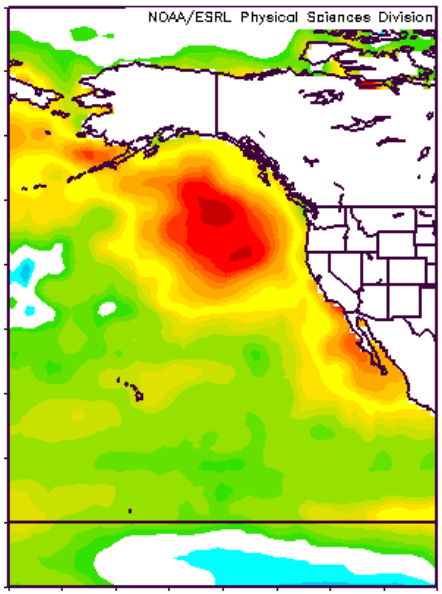
Cheng et al. (2023): https://doi.org/10.1007/s00376-023-2385-2

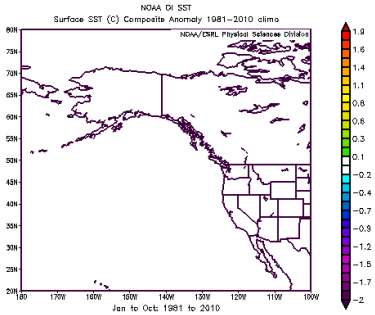
Sea-Surface Temperature Anomalies

2013 (Jan-Dec)



2014 (Jan-June)





Reference Period
from 1981 to 2010

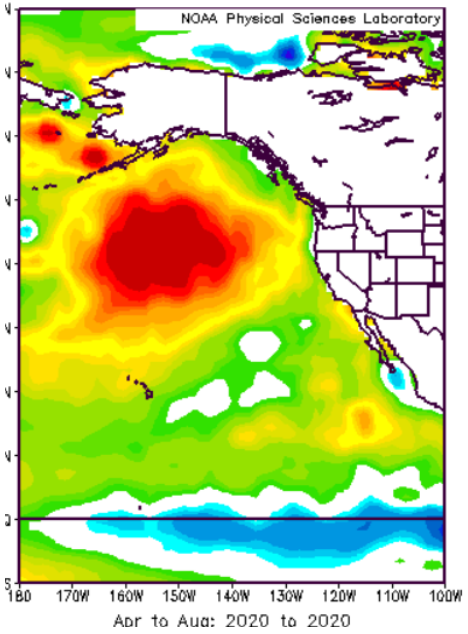
The ‘Blob’
2nd half of 2013

Coined by, Bond et al. (2015). Geophysical Research Letters, 42, 3414–3420. https://doi.org/10.1002/2015GL063306

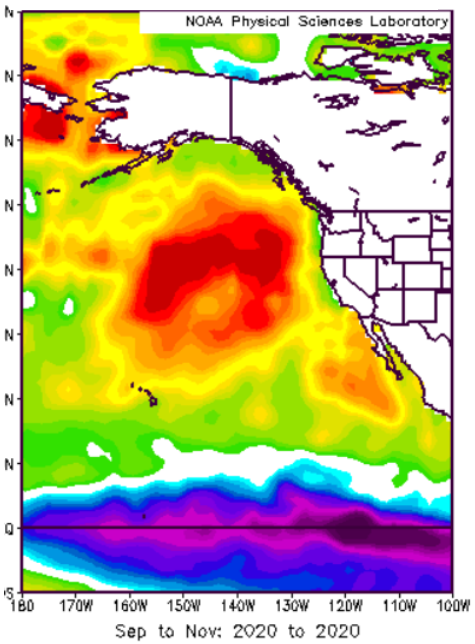
The ‘Blob’

In consultation with J. Boldt, I. Perry, T. Ross, J. King & C. Neville

April-Aug 2020



Sept-Dec 2020



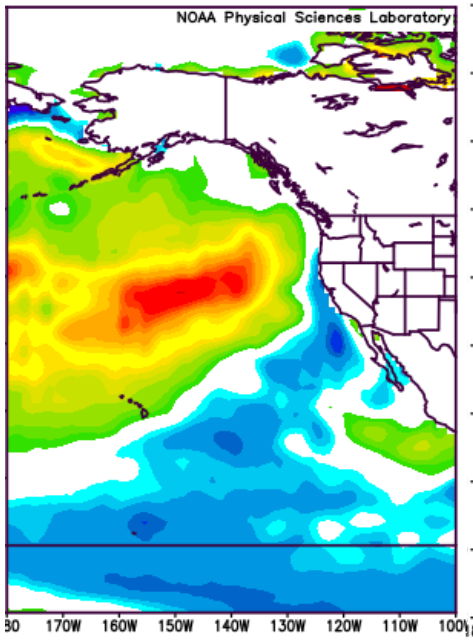
Heatwave returns in the spring & summer

Third largest

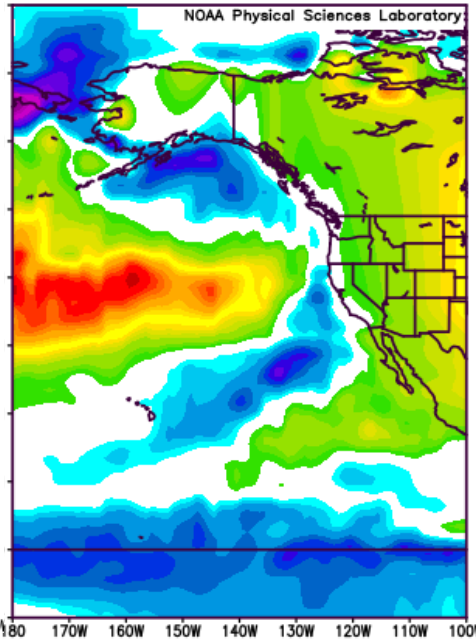
Remains warm as La Niña develops

Sea-Surface Temperature Anomalies

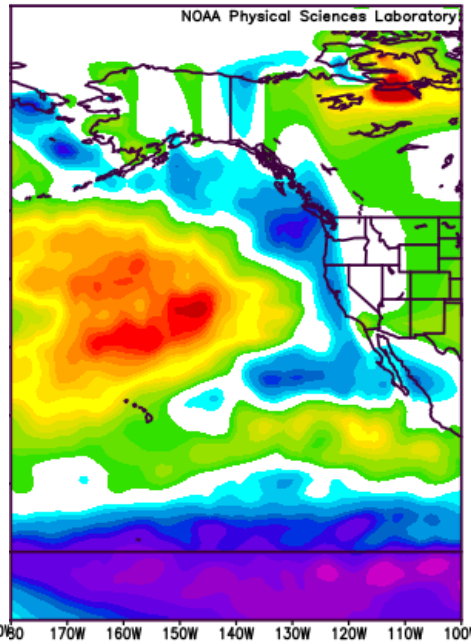
2021 (Jan-June)



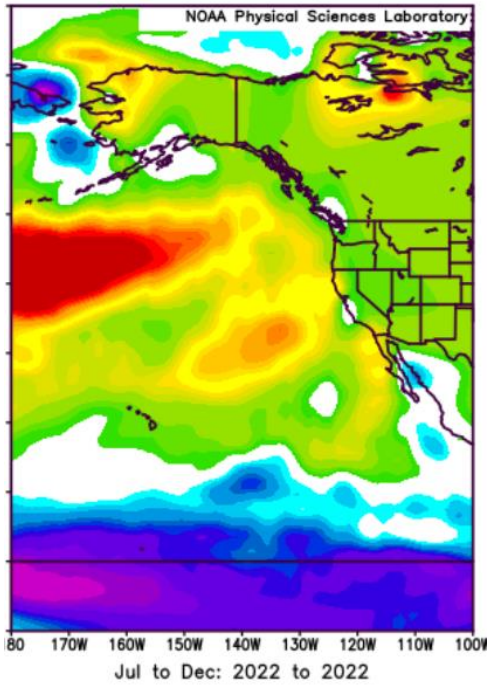
2021 (Jul-Dec)



2022 (Jan-June)



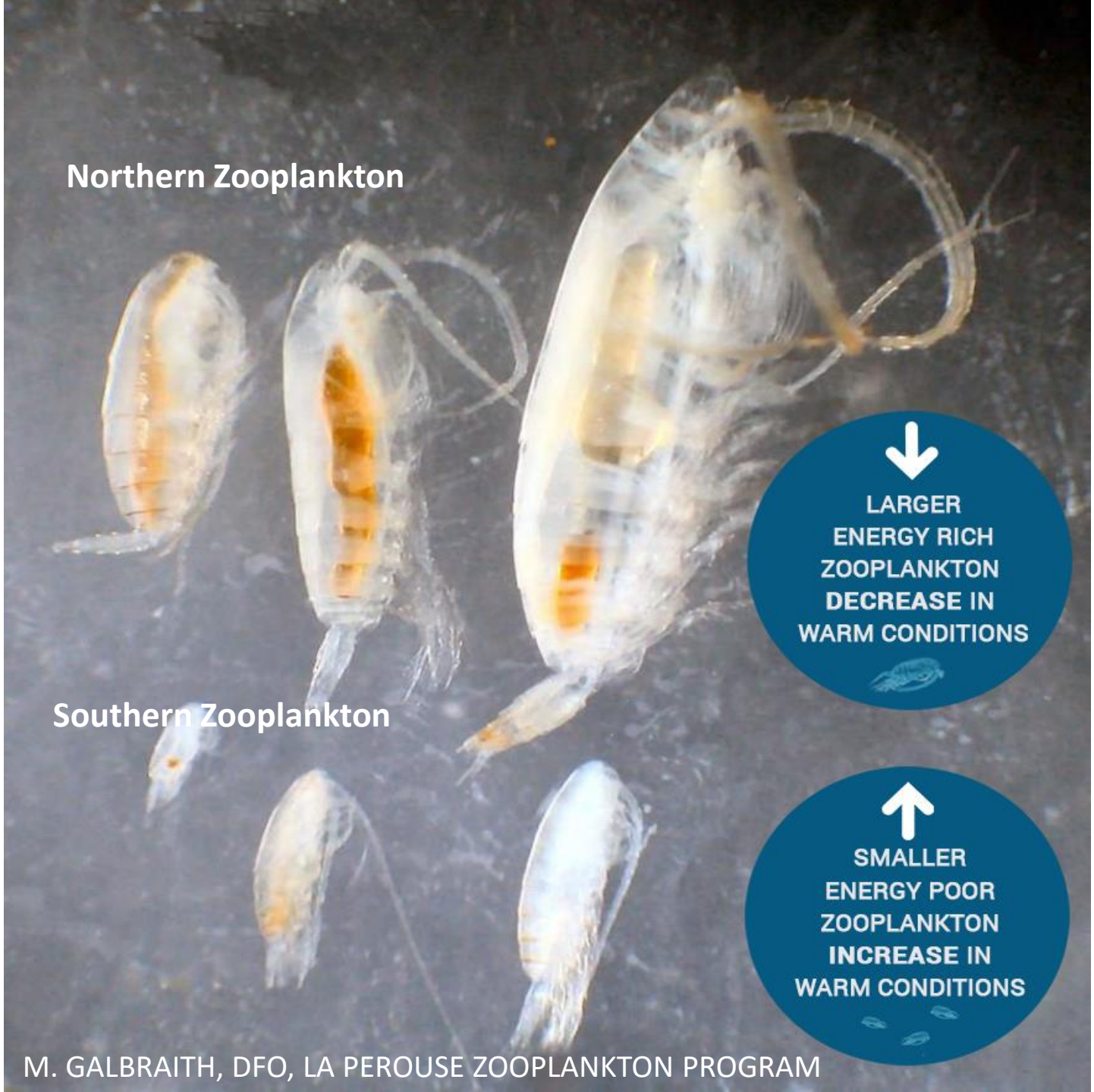
2022 (July-Dec)



Cooler than 2020
Marine Heatwaves
La Niña conditions

4th largest marine heatwave

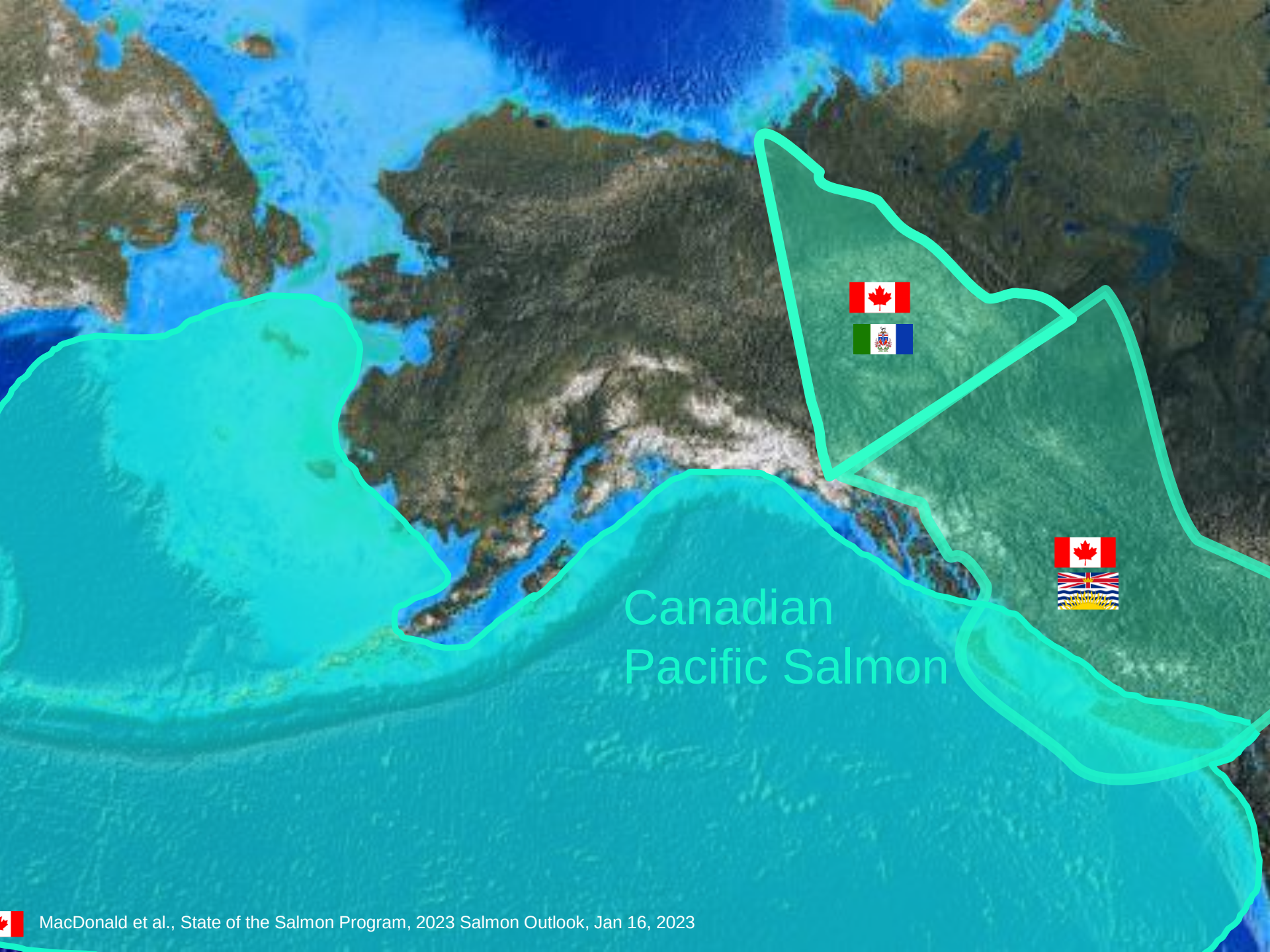
MacDonald et al., State of the Salmon Program, 2023 Salmon Outlook, Jan 16, 2023



Southern zooplankton (less nutritious) dominated starting in late-2013

Recent 2021, shift back to northern zooplankton dominated (typical of composition prior to warm blob).

2022: don't have info yet



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Environmental Conditions: Informing Salmon Returns in 2023

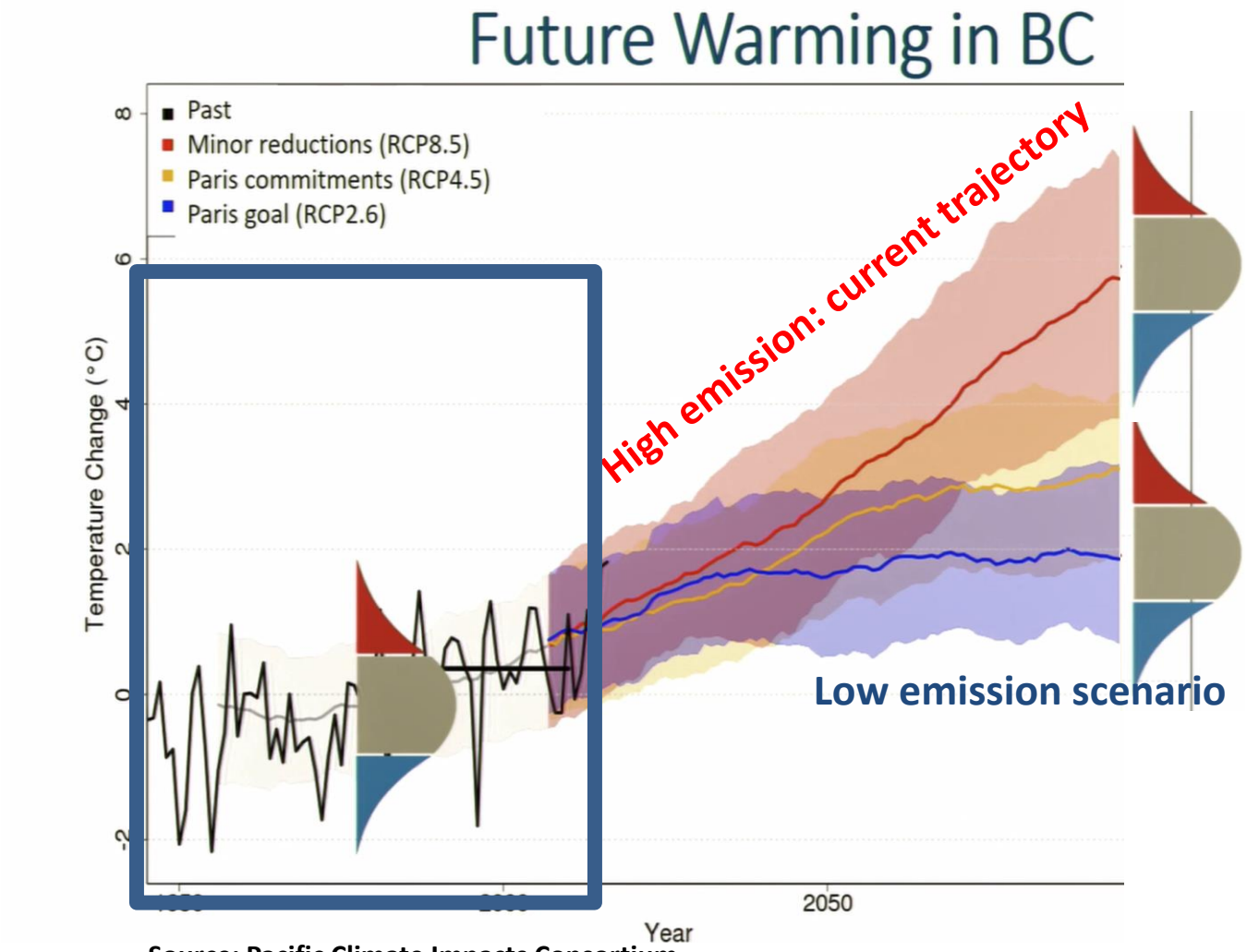
Mixed negative & average survival signals for 2023 returns

***Exceptions & conditions will vary by population**

Photo: 4 Element Photos
S. Kalyn

MacDonald et al., State of the Salmon Program, 2023 Salmon Outlook, Jan 16, 2023

Pacific salmon numbers and distributions will continue to change as the planet warms further



Source: Pacific Climate Impacts Consortium

Contributors

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D. Patterson
D. Selbie
L. Pon
K. Robinson

State of Pacific Ocean reports:
https://www.dfo-mpo.gc.ca/oceans/publications/index-eng.html#soto-pac-tech

University of Victoria Pacific Climate Impacts Consortium anomaly maps
https://www.pacificclimate.org/analysis-tools/seasonal-anomaly-maps

DFO's State of Salmon report
https://www.dfo-mpo.gc.ca/species-especes/publications/salmon-saumon/state-etat-2019/abstract-resume/index-eng.html

Environmental conditions for 2023 returning salmon will be published in Salmon Integrated Fisheries Management Plans (IFMP's)

Photo: 4 Element Photos
S. Kalyn