DFO State of the Salmon Program

Environmental Conditions: Informing Salmon Returns in 2022

Bronwyn MacDonald, Niki Wilson & Sue Grant*
Contact: Sue.Grant@dfo-mpo.gc.ca

Salmon Outlook

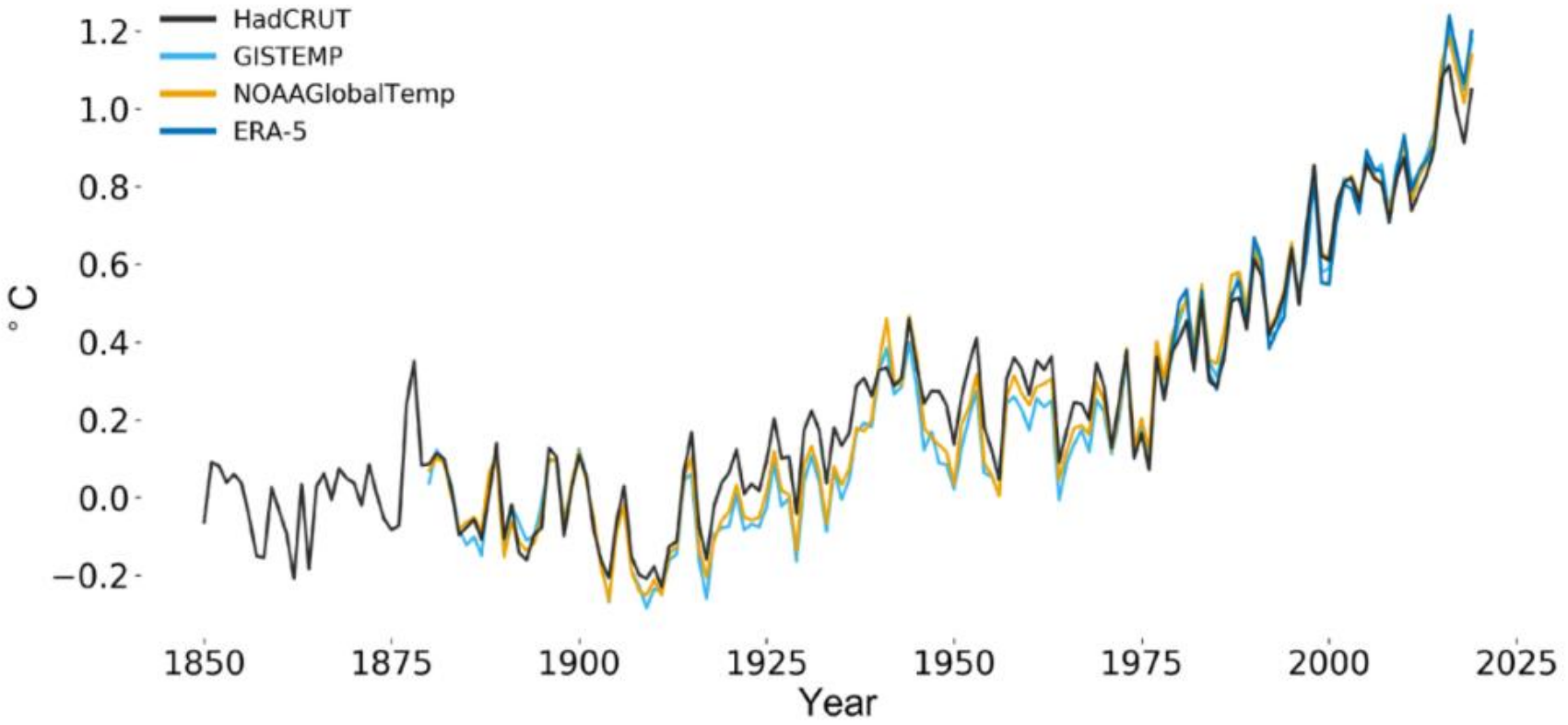
Photo: 4 Element Photos
S. Kalyn

Global Temperatures

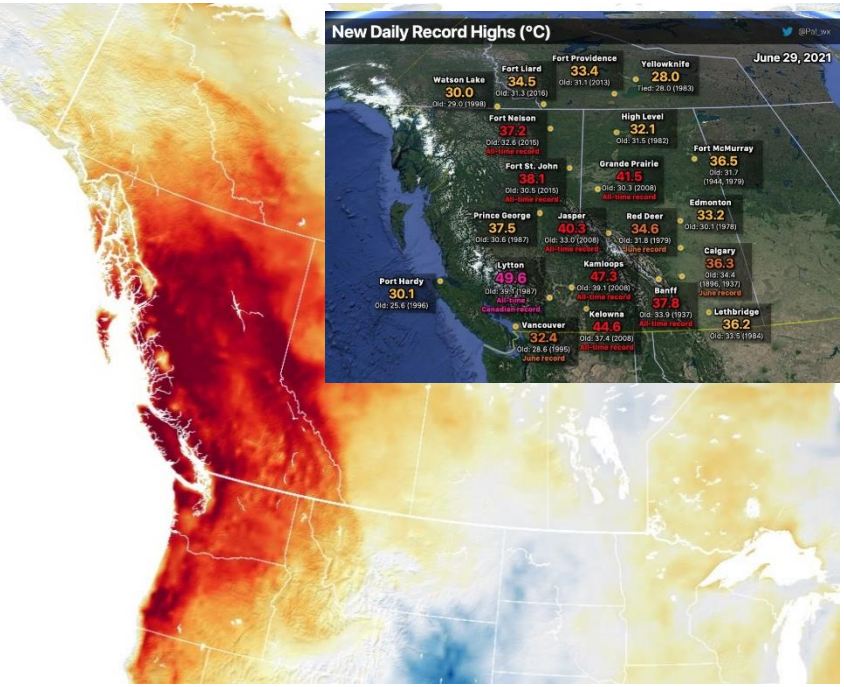
1880-2021*: Global Land & Ocean Temperature Anomalies

#1: 2016 (hottest year on record)

#2: 2020 #3: 2019 #4: 2015 #5: 2017

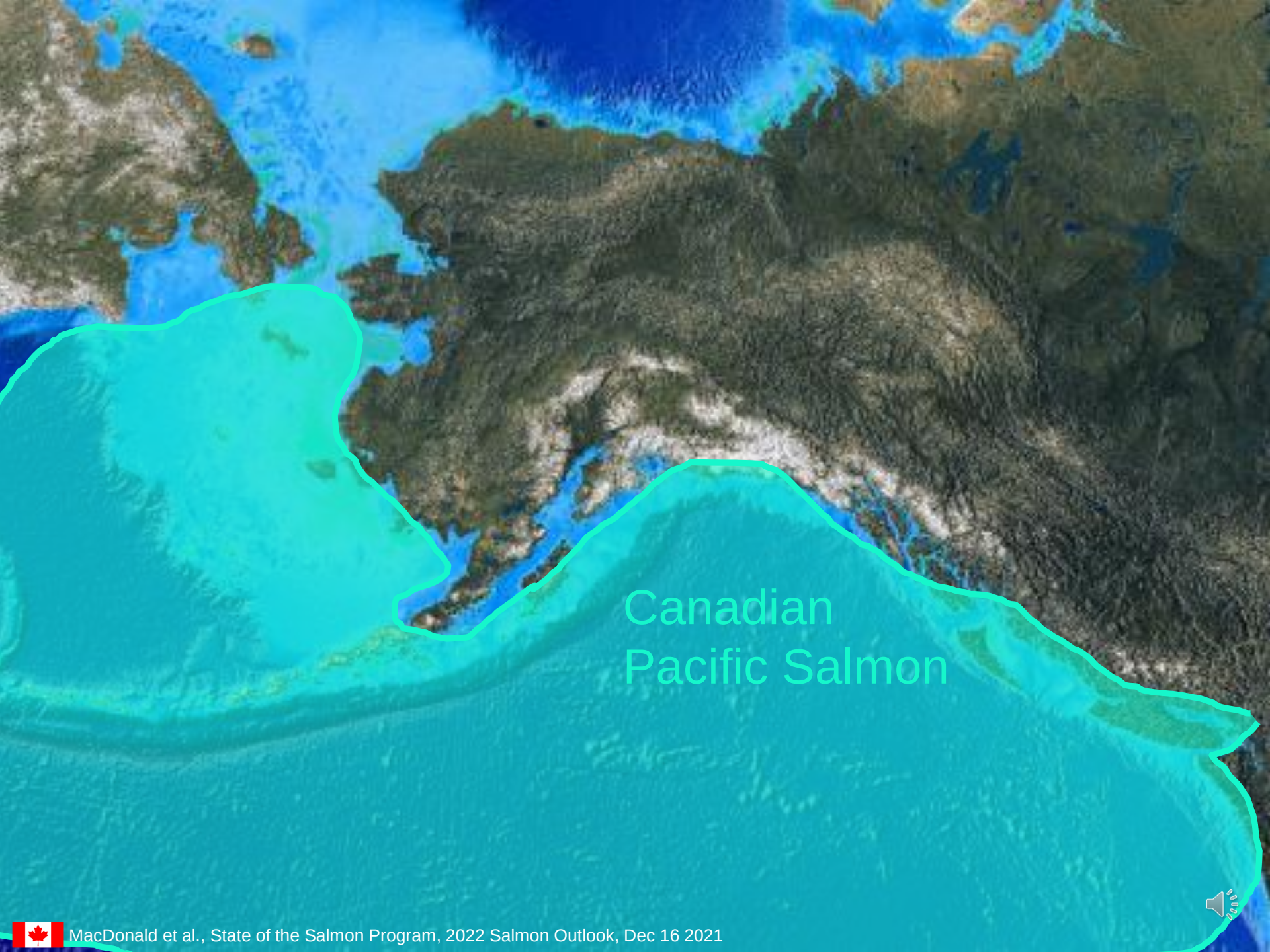


Source: Met Office Hadley Centre and the Climatic Research Unit at the University of East Anglia, UK (HadCRU) presented in World Meteorological Organization, 2020. WMO Statement on the State of Global Climate Change in 2019 (WMO-No. 1248), Figure 1, Page 6).



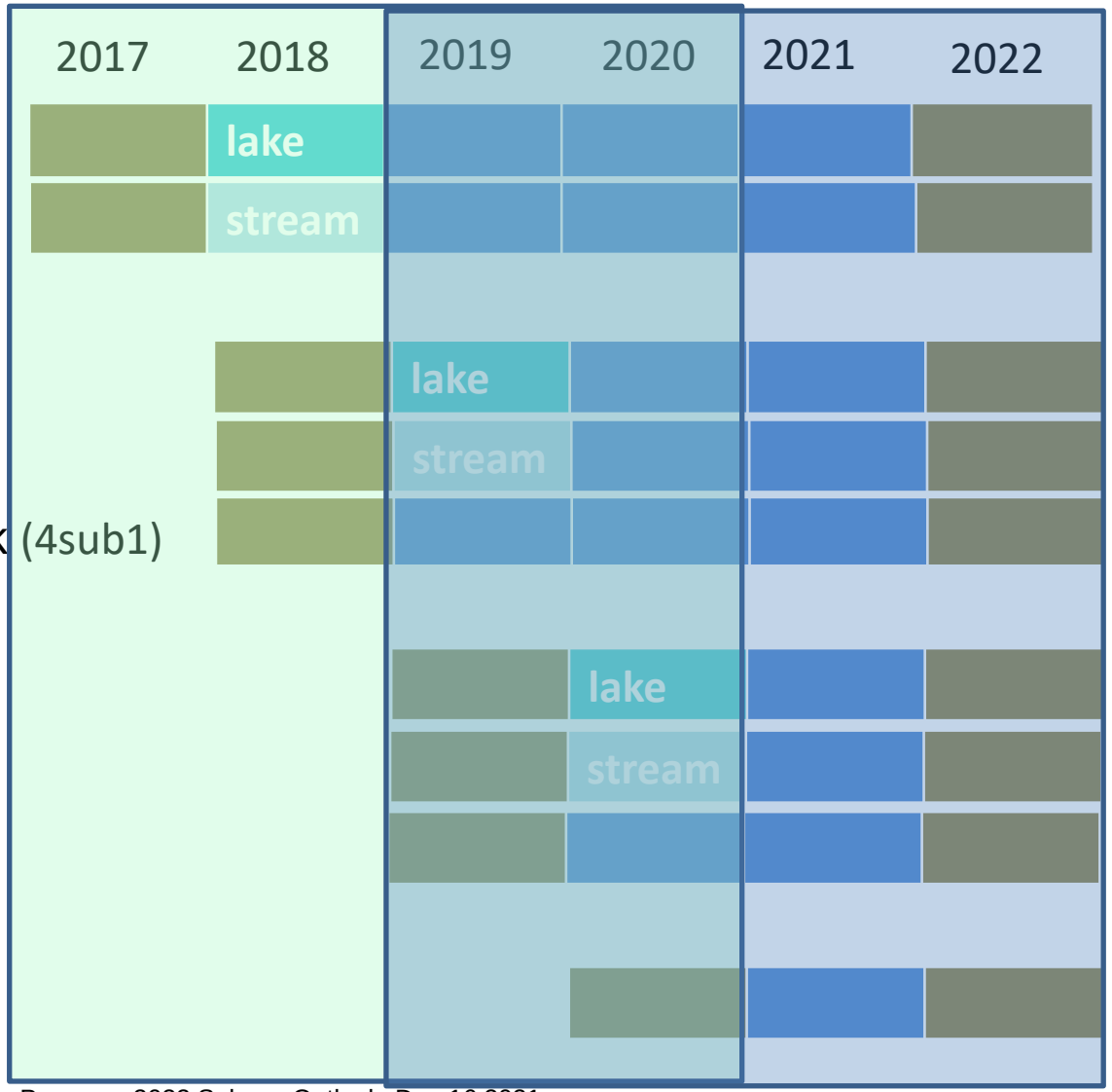
New Daily Record Highs (°C)
@Pol_wx
June 29, 2021
Watson Lake
30.0
Old: 29.0 (1998)
Fort Liard
34.5
Old: 31.3 (2016)
Fort Providence
33.4
Old: 31.1 (2013)
Yellowknife
28.0
Tied: 28.0 (1983)
Fort Nelson
37.2
Old: 32.6 (2015)
All-time record
High Level
32.1
Old: 31.5 (1982)
Fort McMurray
36.5
Old: 31.7 (1944, 1979)
Fort St. John
38.1
Old: 30.5 (2015)
All-time record
Grande Prairie
41.5
Old: 30.3 (2008)
All-time record
Edmonton
33.2
Old: 30.1 (1978)
Prince George
37.5
Old: 30.6 (1987)
Jasper
40.3
Old: 33.0 (2008)
All-time record
Red Deer
34.6
Old: 31.8 (1979)
June record
Calgary
36.3
Old: 34.4 (1896, 1937)
June record
Port Hardy
30.1
Old: 25.6 (1996)
Lytton
49.6
Old: 39.4 (1987)
All-time
Canadian record
Kamloops
47.3
Old: 39.1 (2008)
All-time record
Banff
37.8
Old: 33.9 (1937)
All-time record
Kelowna
44.6
Old: 37.4 (2008)
All-time record
Lethbridge
36.2
Old: 33.5 (1984)
Vancouver
32.4
Old: 28.6 (1995)
June record


Canadian
Pacific Salmon


Canadian
Pacific Salmon

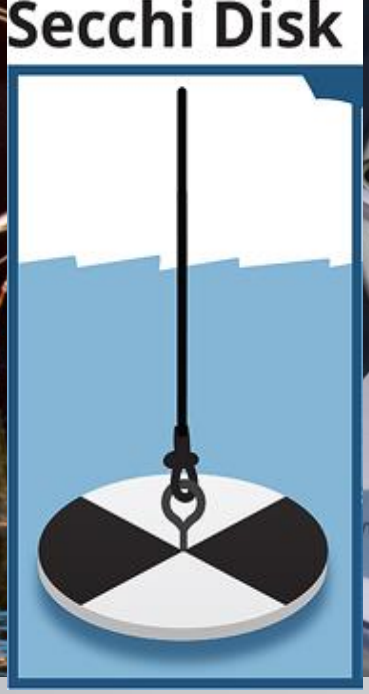
2022 Returns

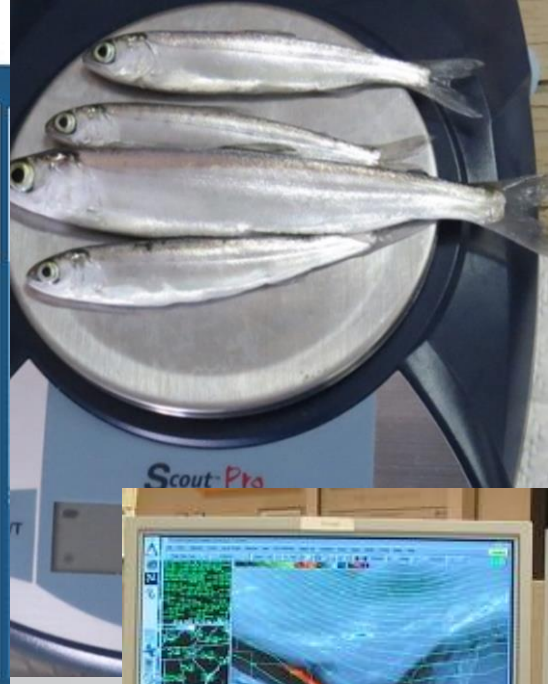
spawning & egg incubation	fry-stream	fry-lake	Juvenile-Ocean	spawning



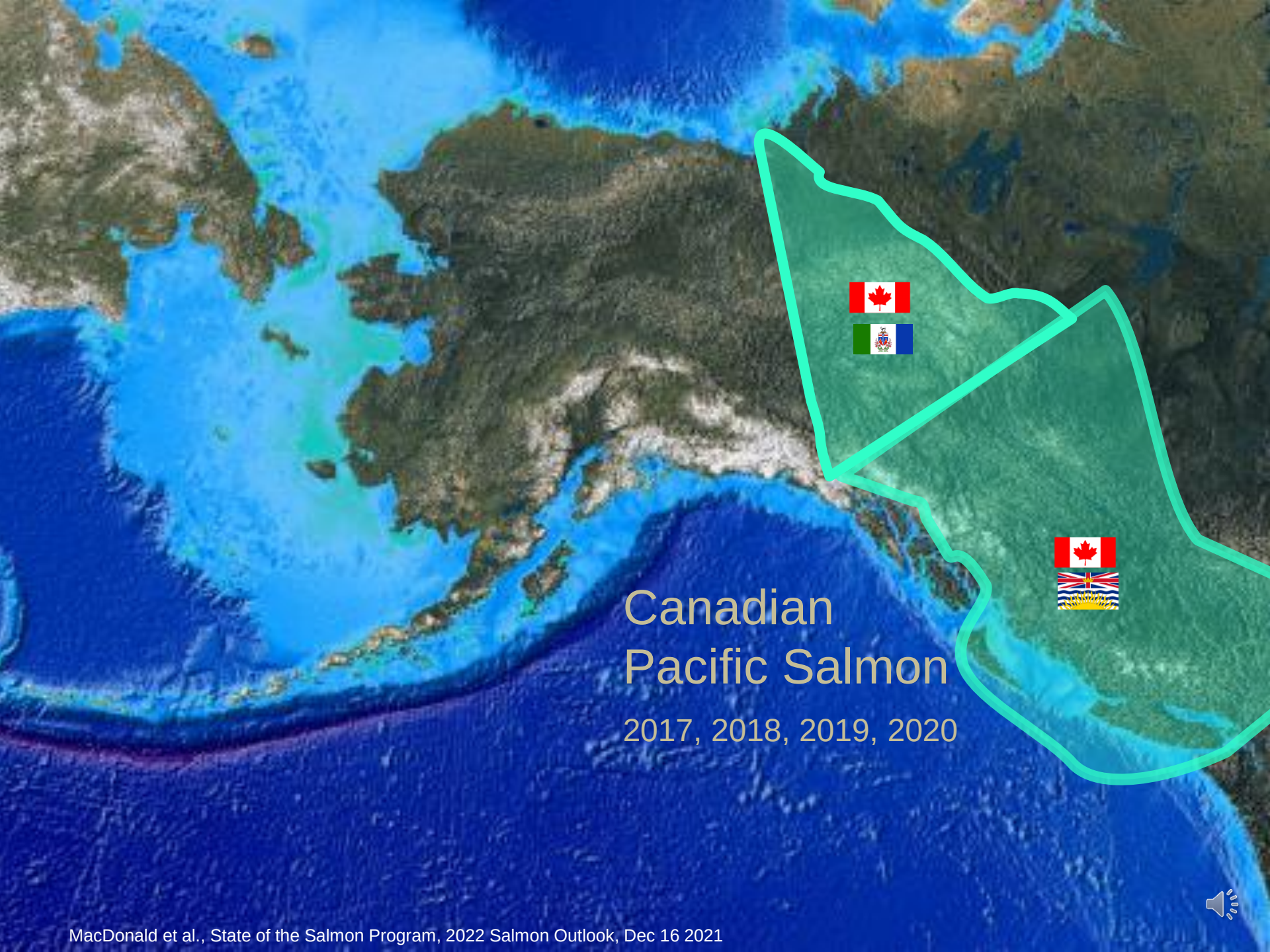
MacDonald et al., State of the Salmon Program, 2022 Salmon Outlook, Dec 16 2021


WALKER ROCK


Secchi Disk

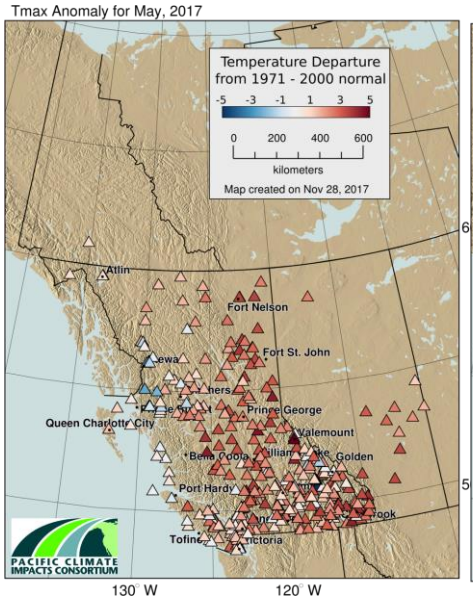



Canada
W. E. RICKER
Garde Coast
côtière Guard

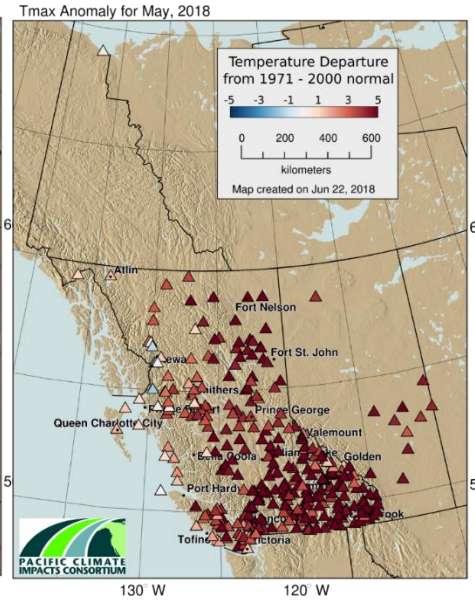


MacDonald et al., State of the Salmon Program, 2022 Salmon Outlook, Dec 16 2021

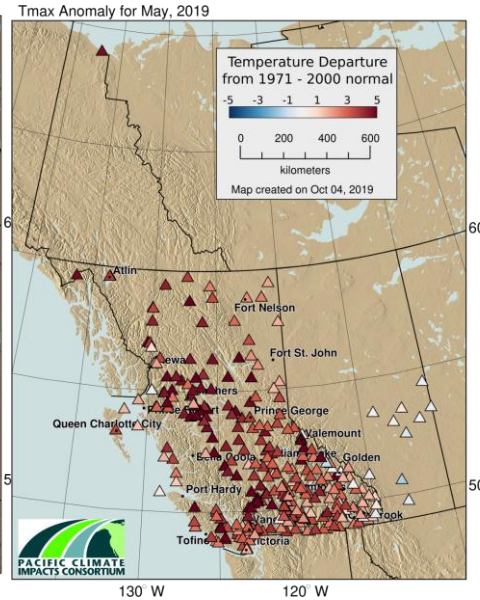
Spring Air Temperatures



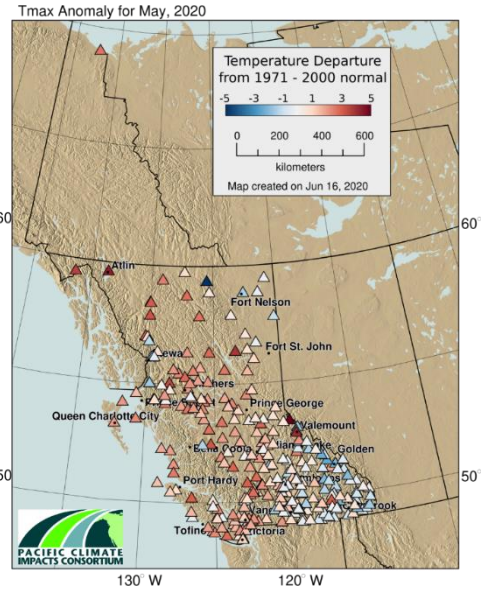
2017



2018



2019

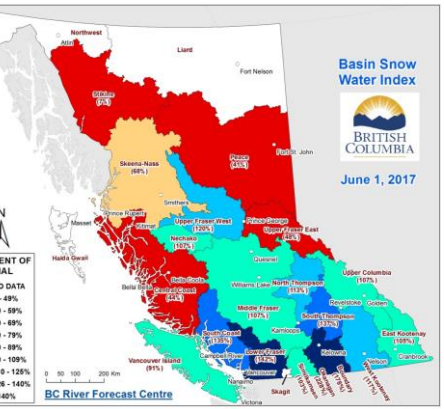


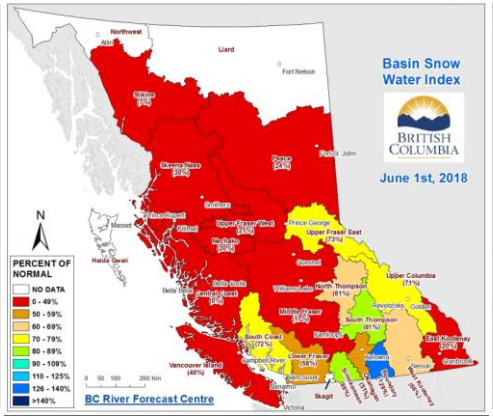
2020

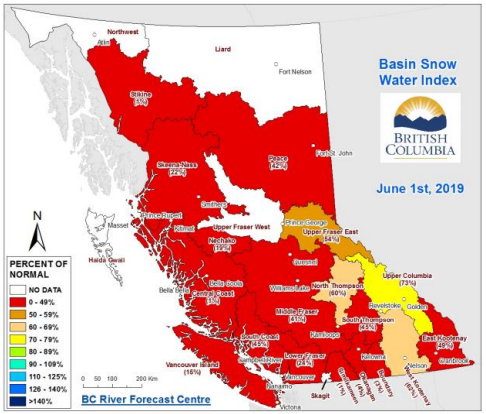
Cold -5 -3 -1 1 3 5 **Warm**

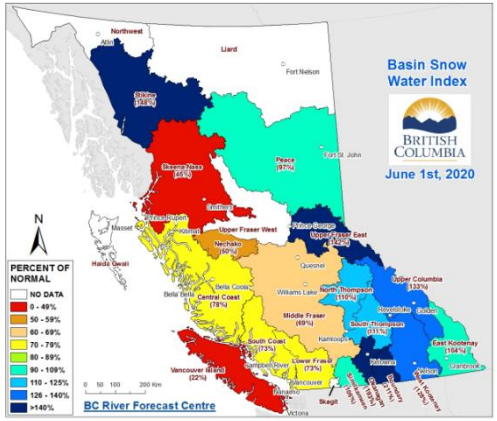
Reference period: 1971-2000

Contributes to summer water temperatures

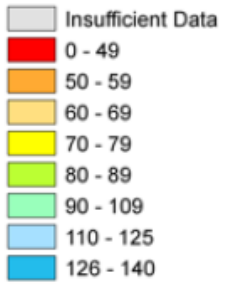




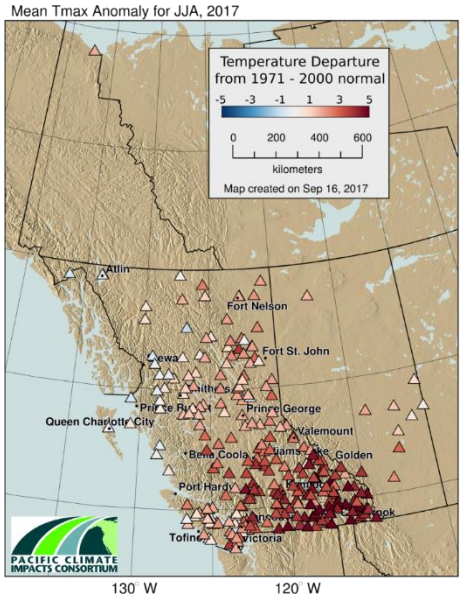




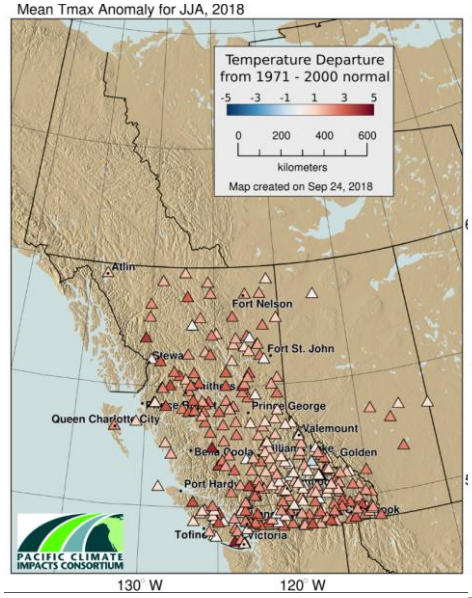
2017 2018 2019 2020



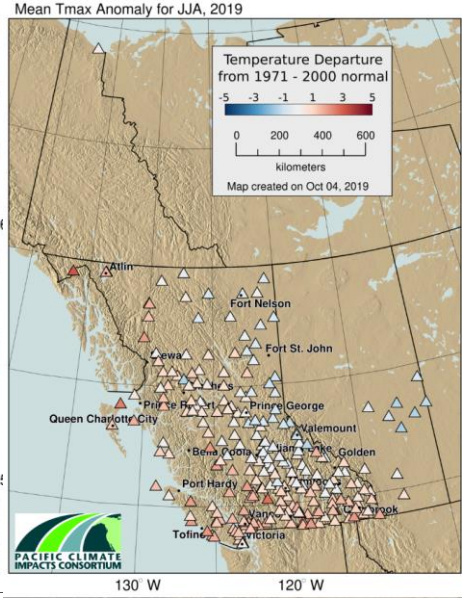
Summer Air Temperatures



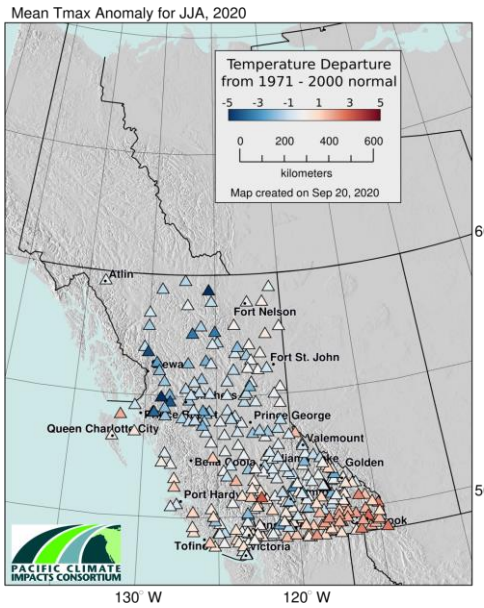
2017



2018



2019



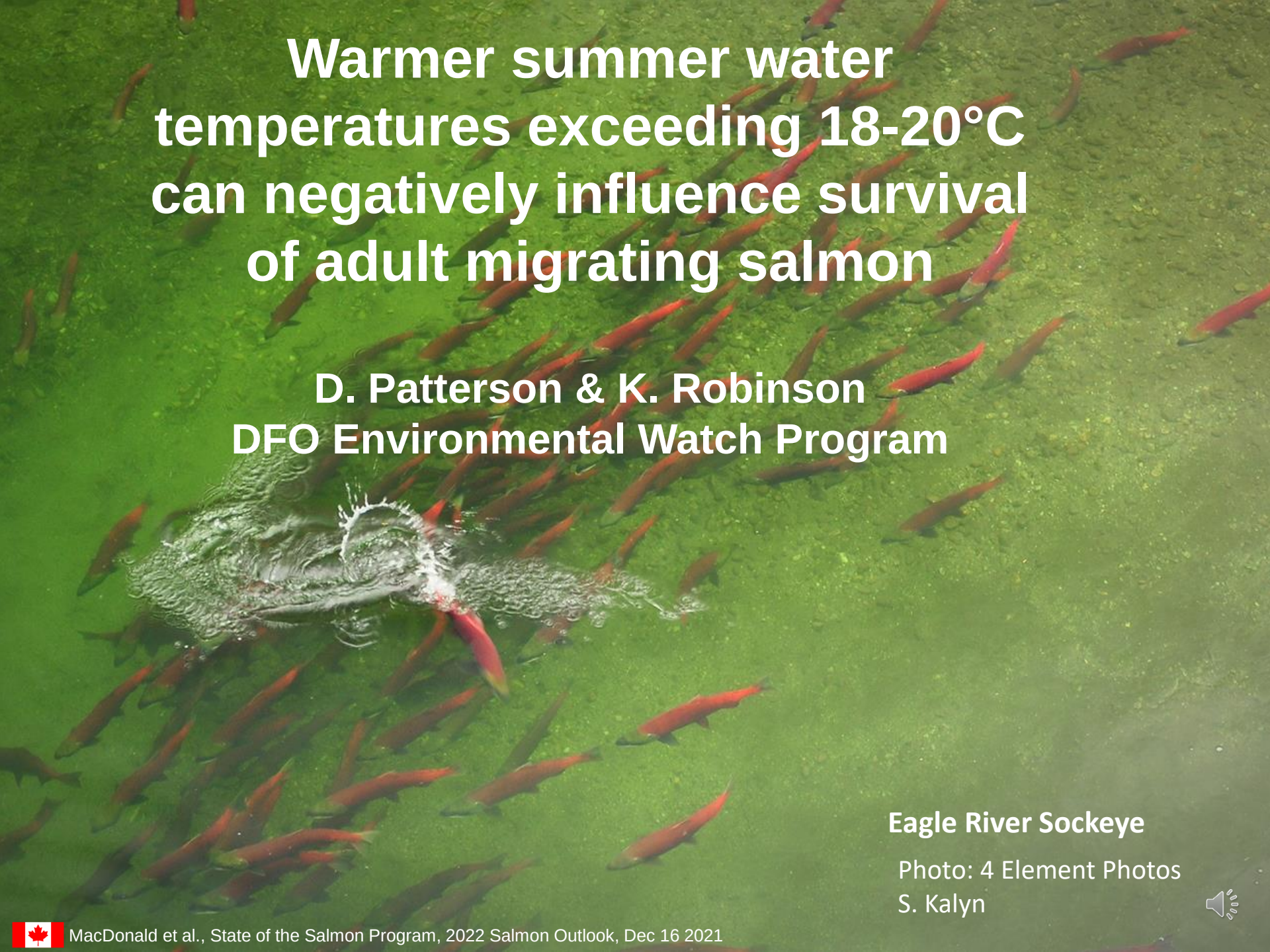
2020

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

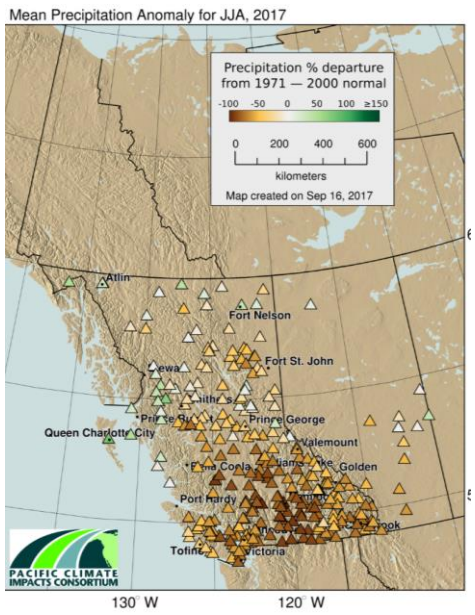
D. Patterson & K. Robinson
DFO Environmental Watch Program

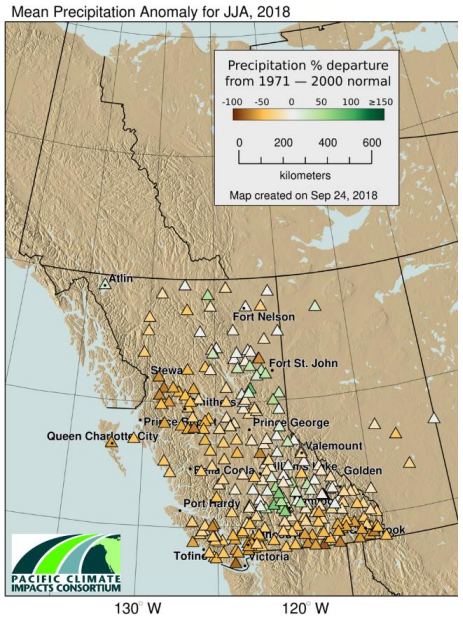


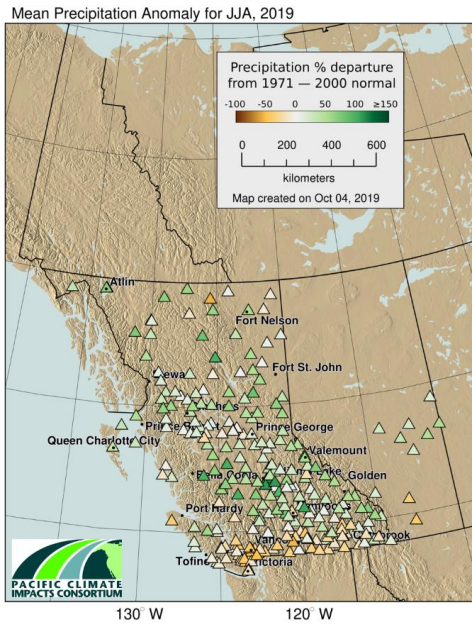
Eagle River Sockeye

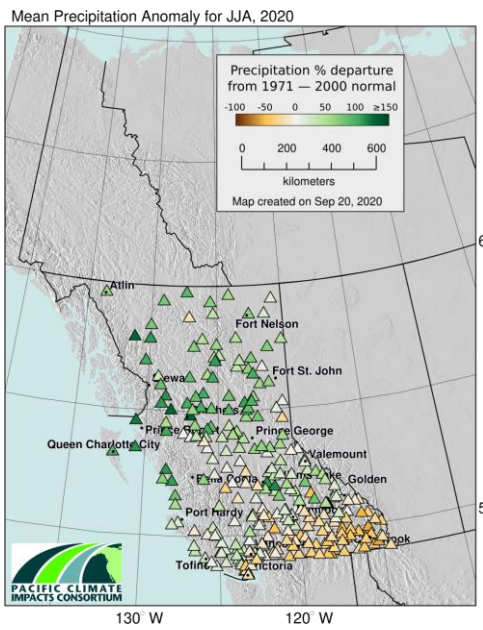
Photo: 4 Element Photos
S. Kalyn

Summer Precipitation



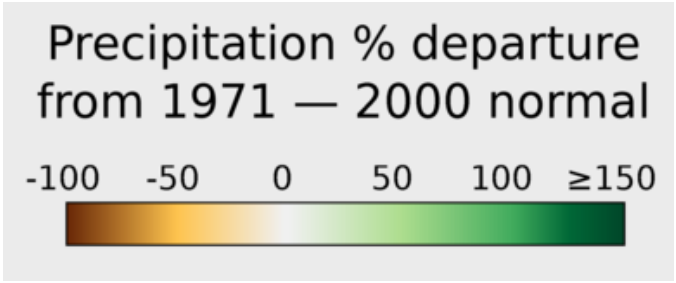






2017 2018 2019 2020

Dry



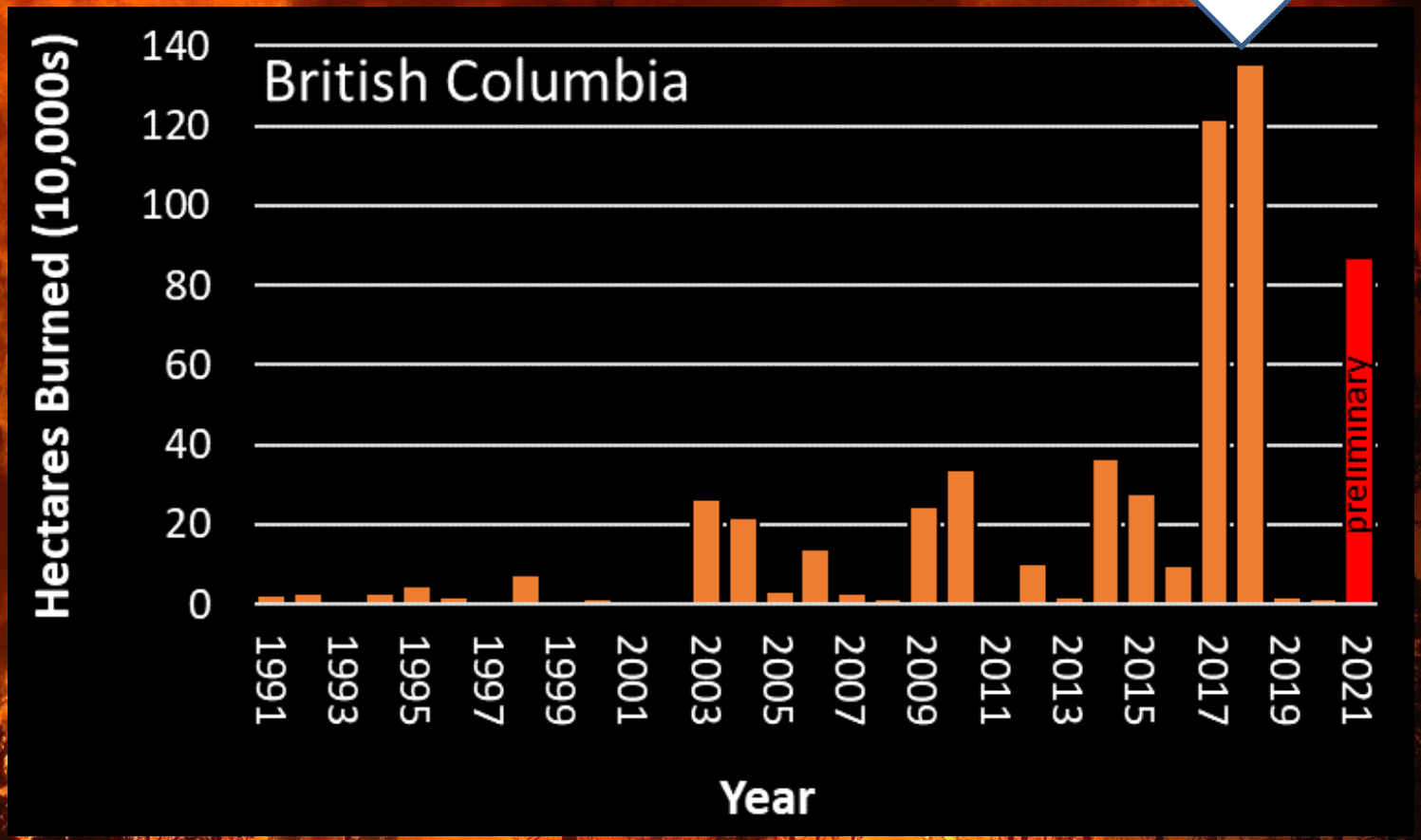
Wet

Reference period: 1971-2000

Drought conditions in Skeena/Nass in summer months

C. Carr-Harris, DFO

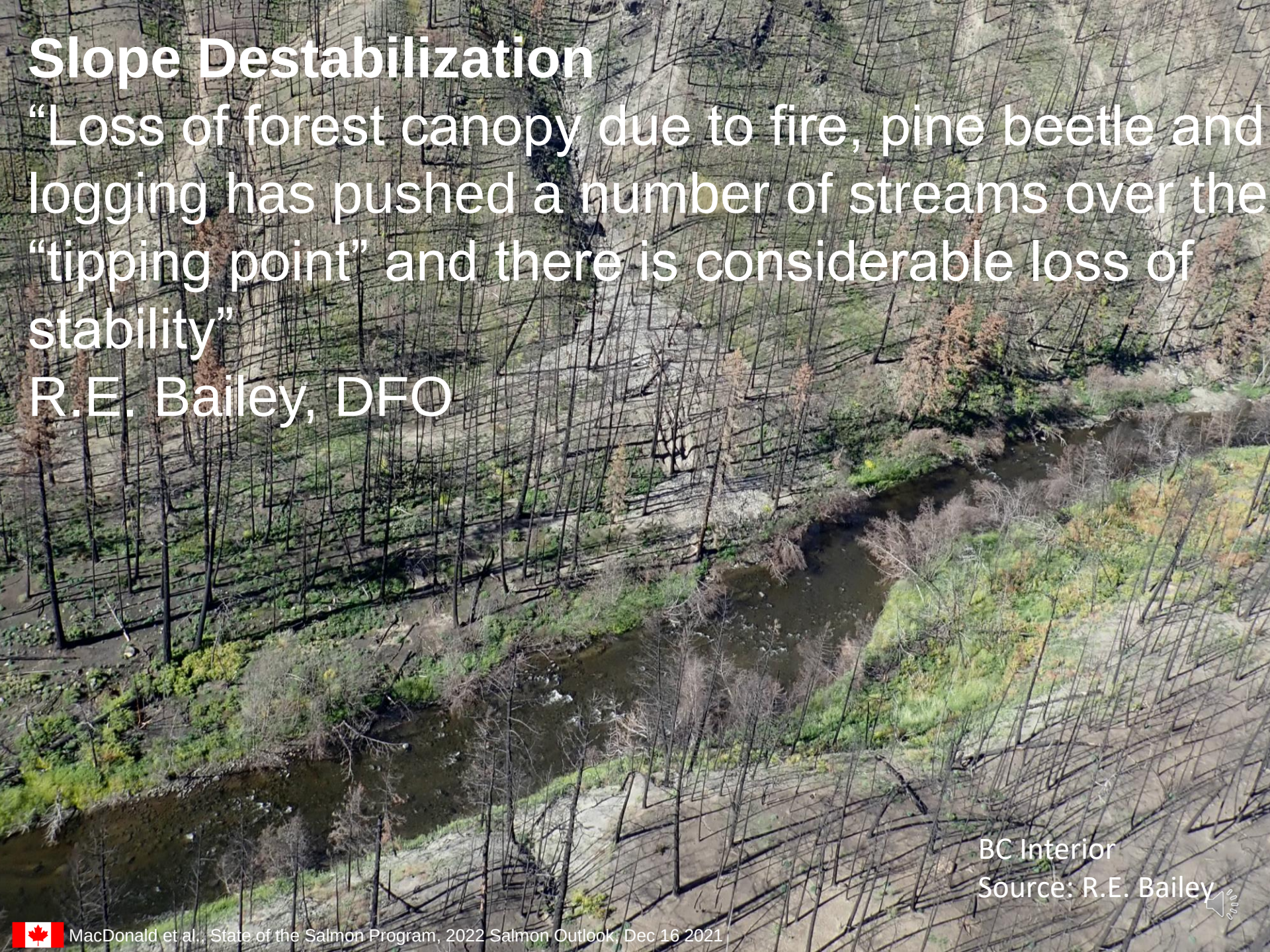
Bonaparte River from mid August 201
Source: C. Parken, DFO



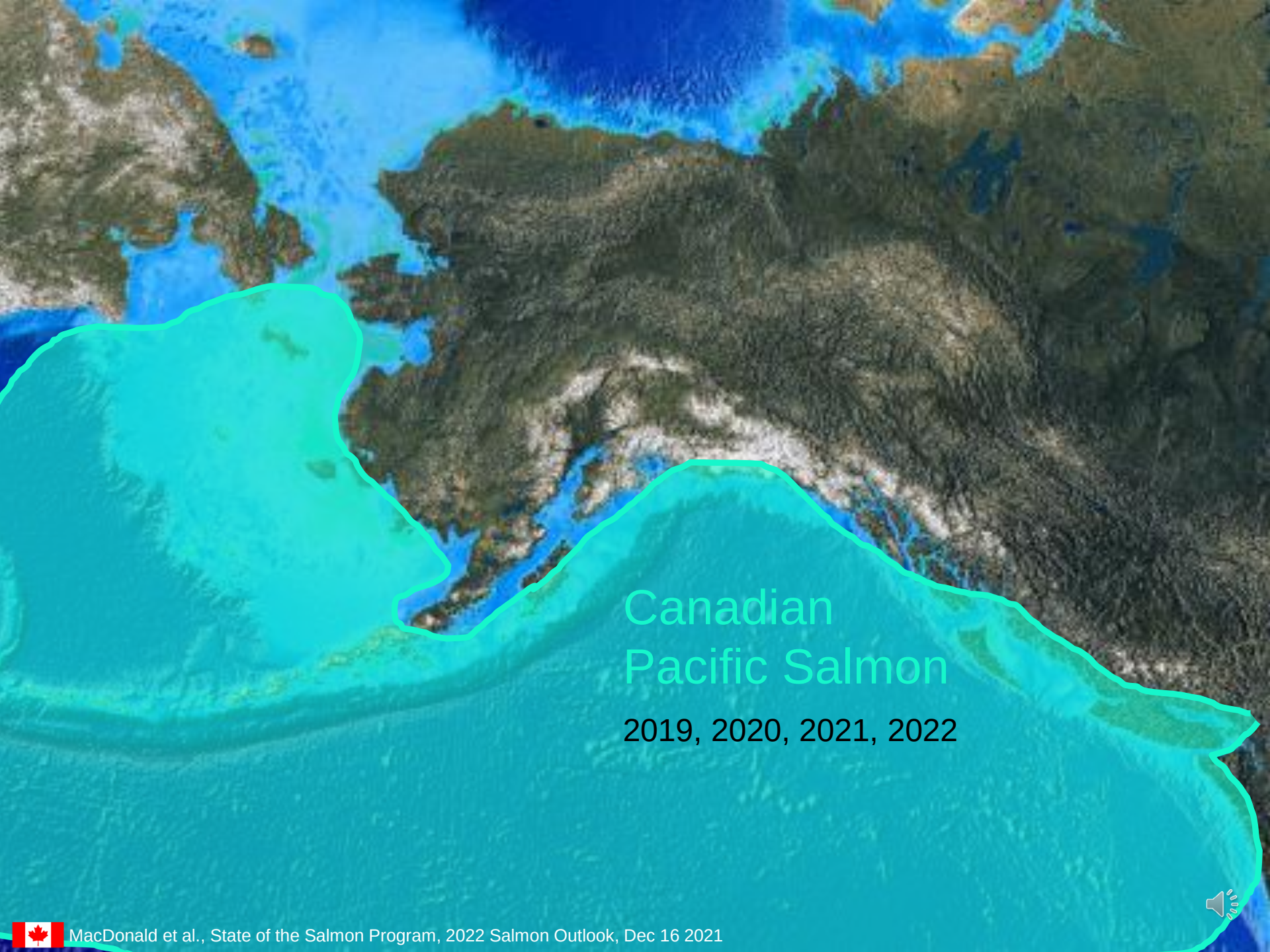
Implications for our salmon in freshwater are not entirely known

Slope Destabilization

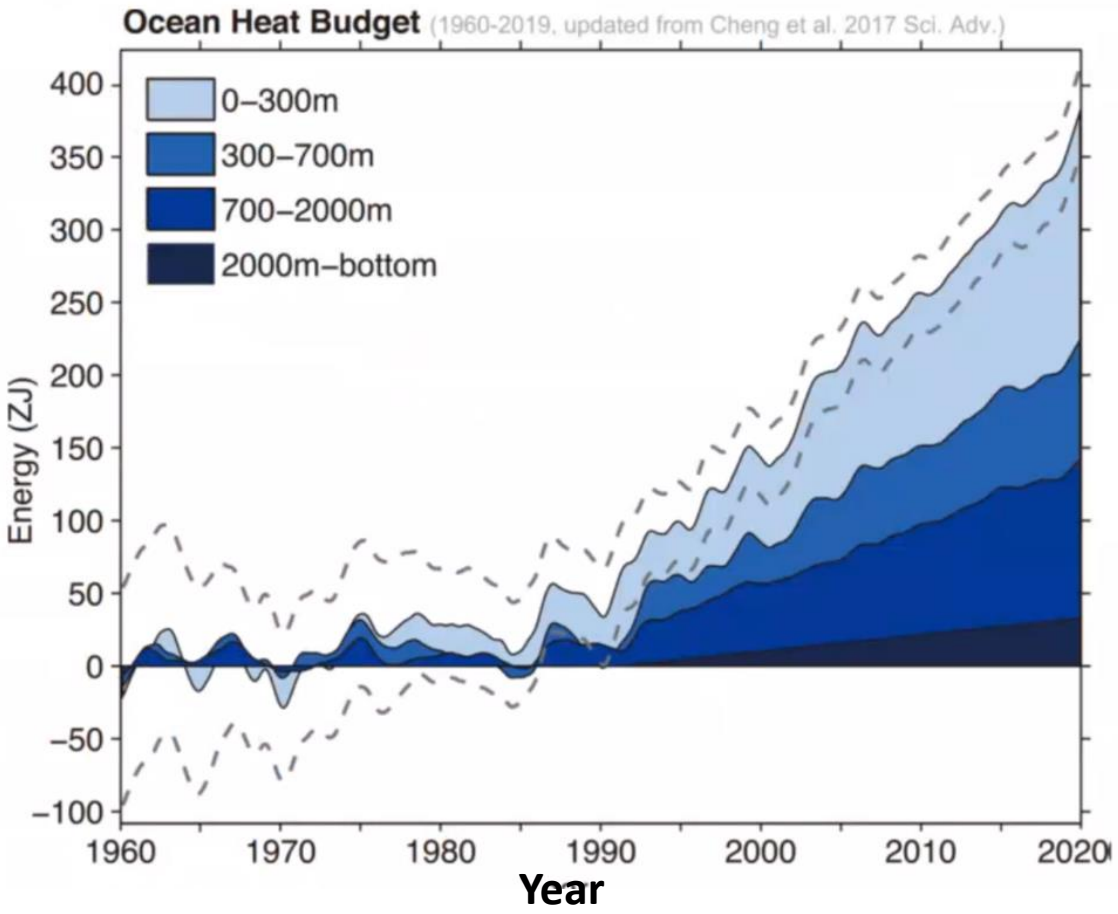
"Loss of forest canopy due to fire, pine beetle and logging has pushed a number of streams over the "tipping point" and there is considerable loss of stability"
R.E. Bailey, DFO



BC Interior
Source: R.E. Bailey


Canadian
Pacific Salmon
2019, 2020, 2021, 2022

The ocean has absorbed 90% of earth's excess heat



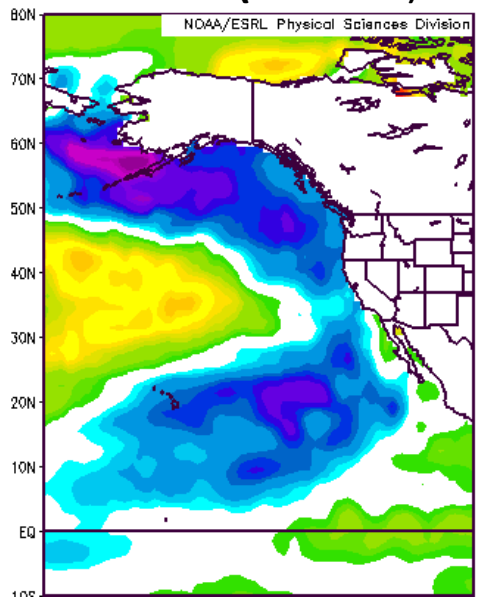
Year

Cheng et al. 2020. Adv. Atmos. Sci 37: 137-142

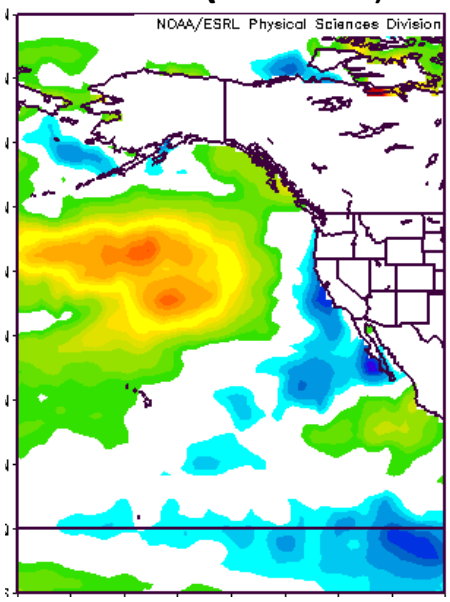
(1 ZJ = 10^{21} J)

Sea-Surface Temperature Anomalies

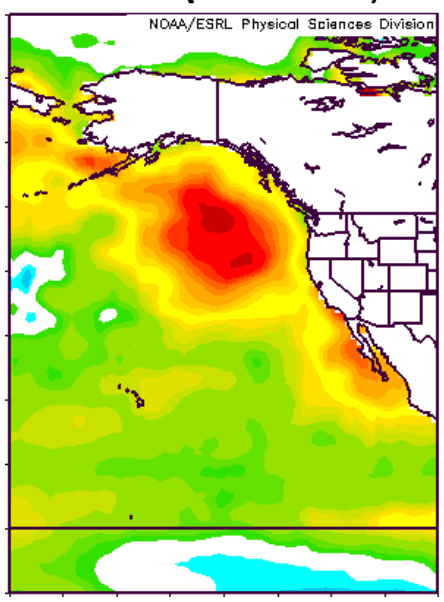
2012 (Jan-Dec)



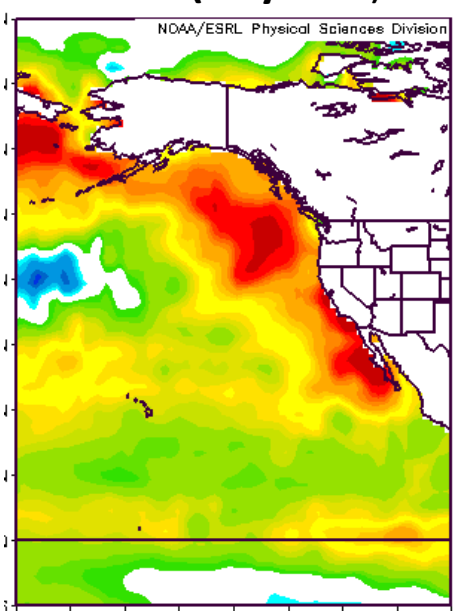
2013 (Jan-Dec)

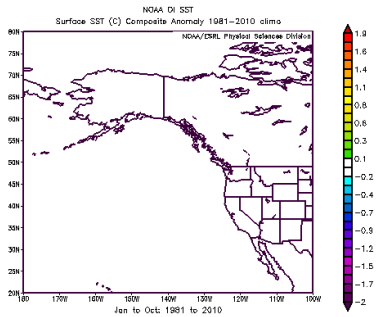


2014 (Jan-June)



2014 (July-Dec)





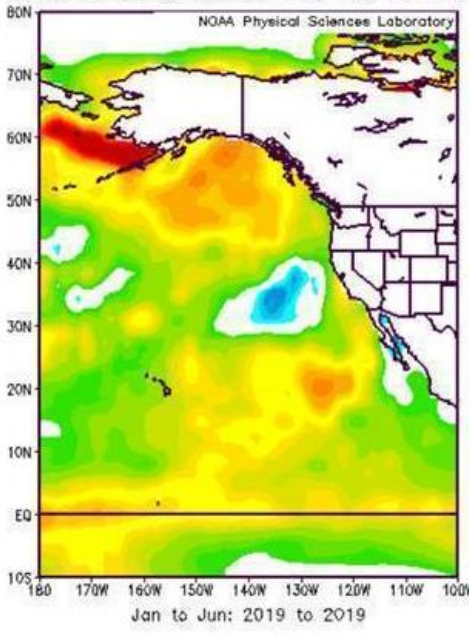
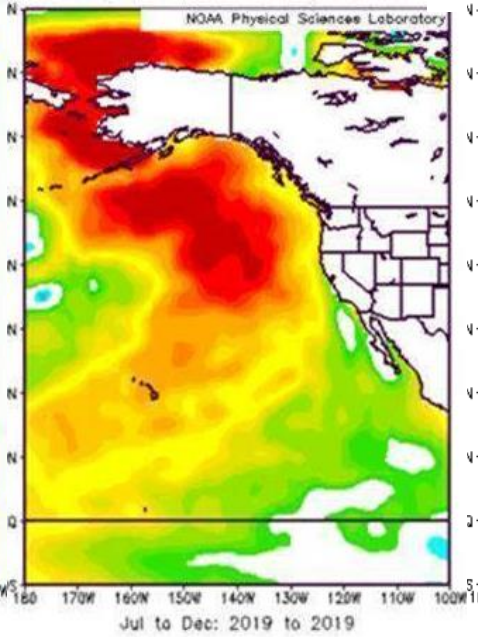
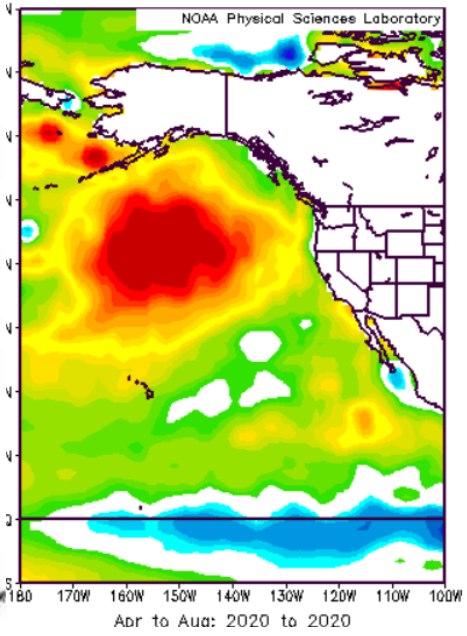
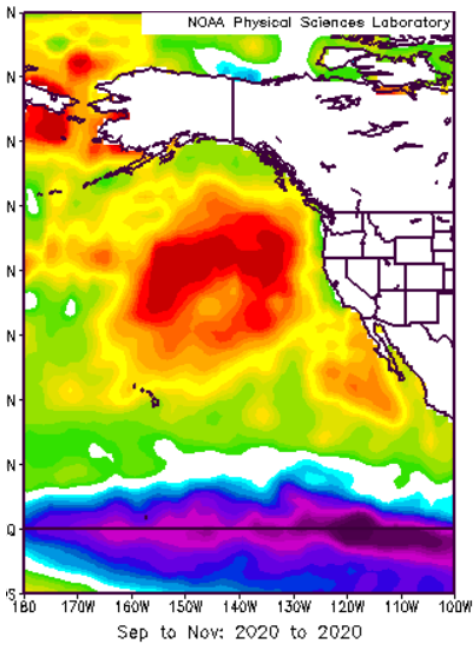
The 'Blob' 2nd half of 2013

The 'Blob'

The 'Blob' Coastal

Reference Period from 1981 to 2010

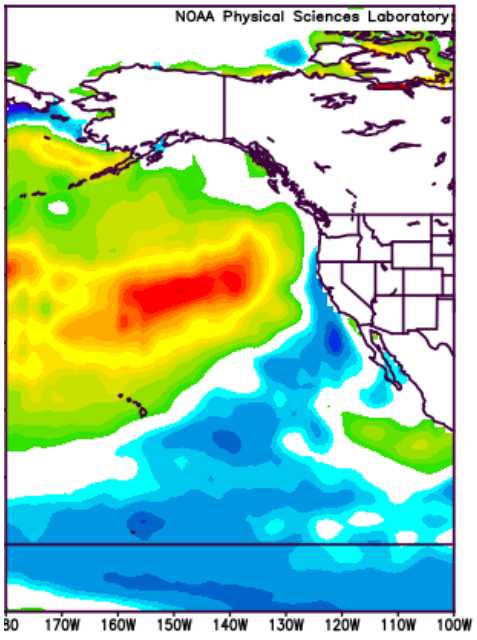
In consultation with J. Boldt, I. Perry, T. Ross, J. King & C. Neville

Jan - June 2019	July-Dec 2019	April-Aug 2020	Sept-Dec 2020
			
Similar to average	**2019 marine heatwave:** • Second largest observed in 40 years of data • Did not dissipate in 2019	**Heatwave returns in the spring & summer**	**Remains warm as La Niña develops**

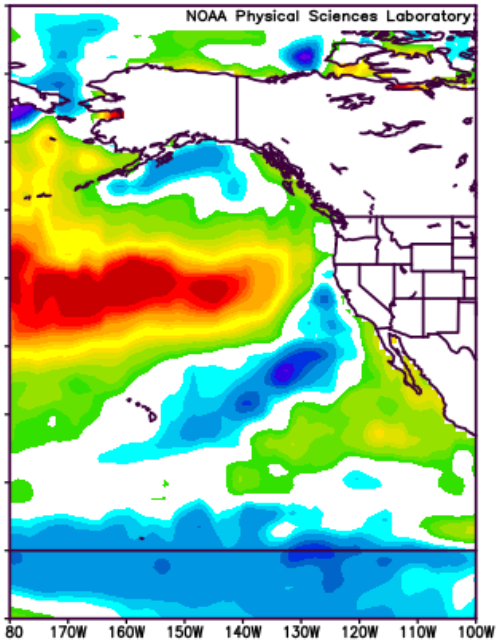
In consultation with J. Boldt, I. Perry, T. Ross, J. King & C. Neville

Sea-Surface Temperature Anomalies

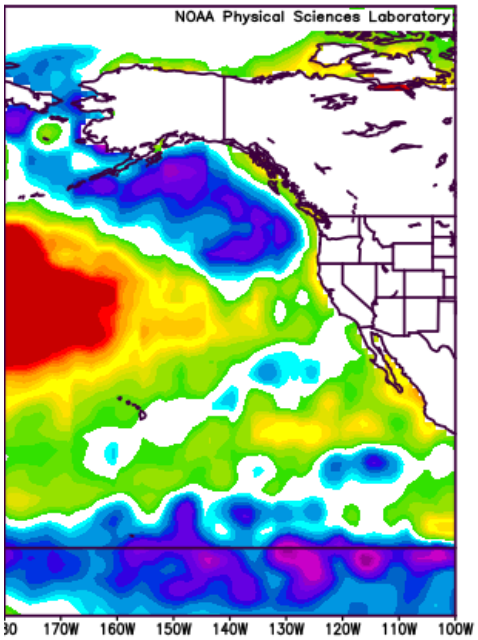
2021 (Jan-June)



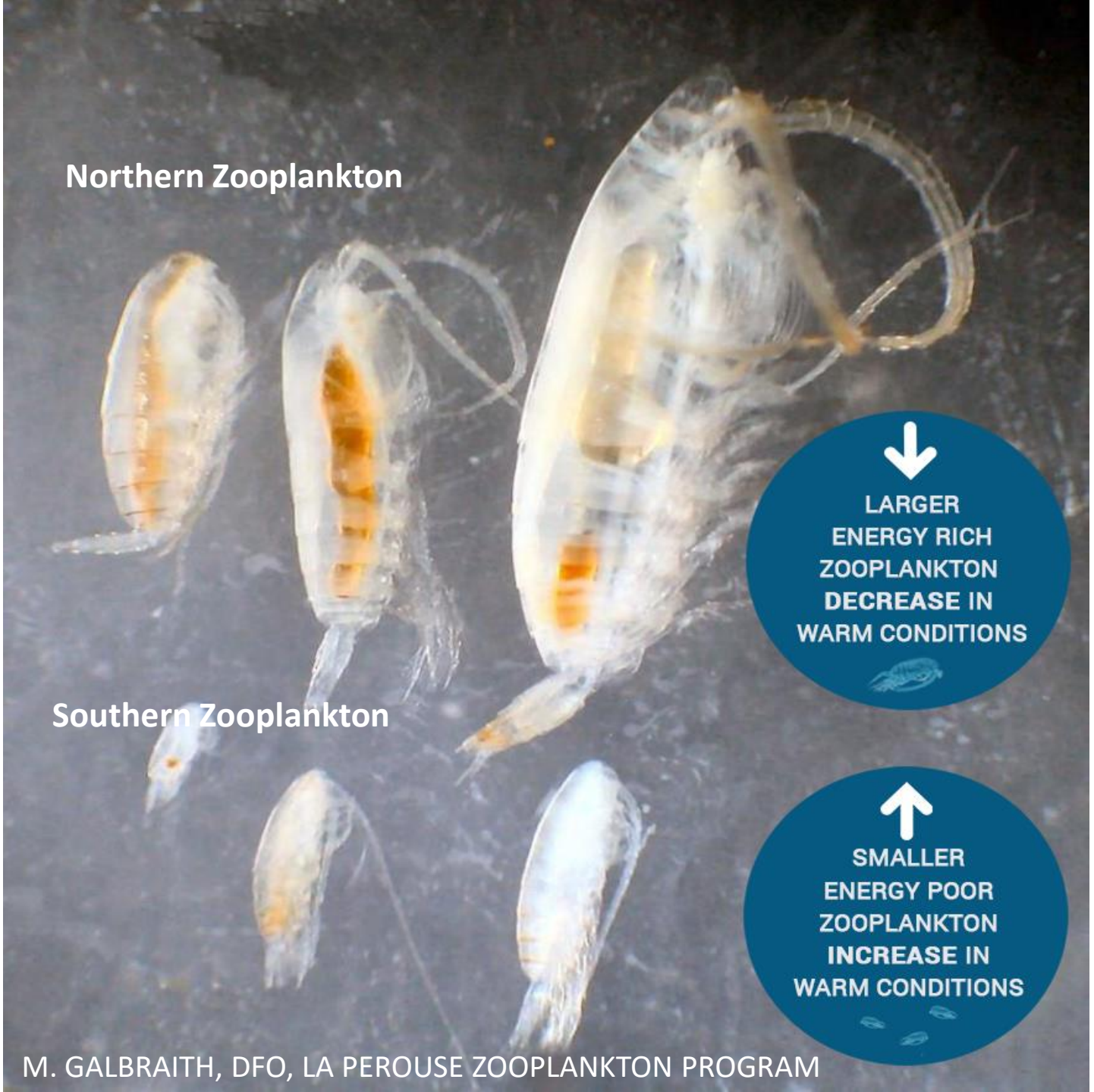
2021 (Jul-Nov)

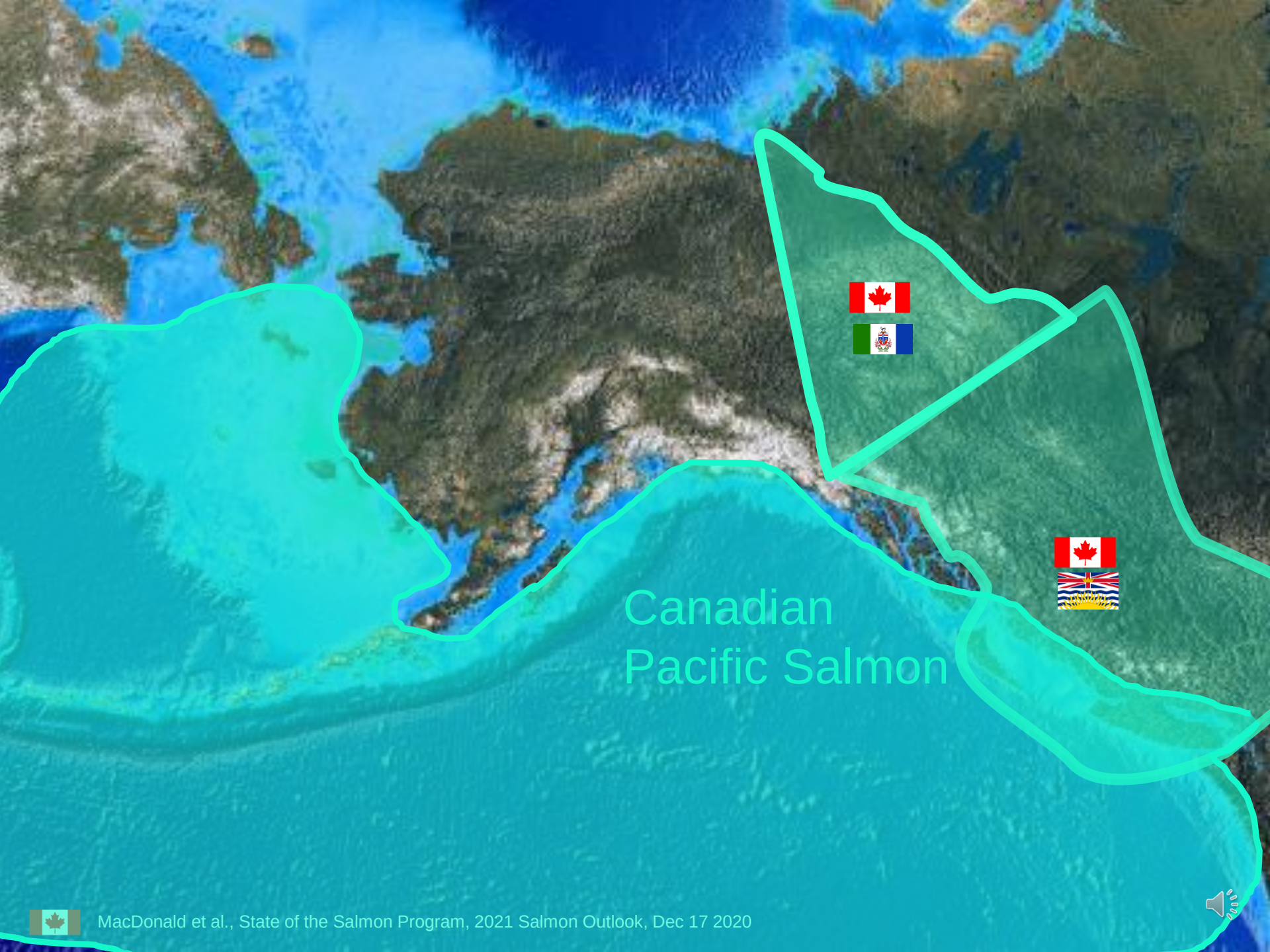


2021 (Nov)

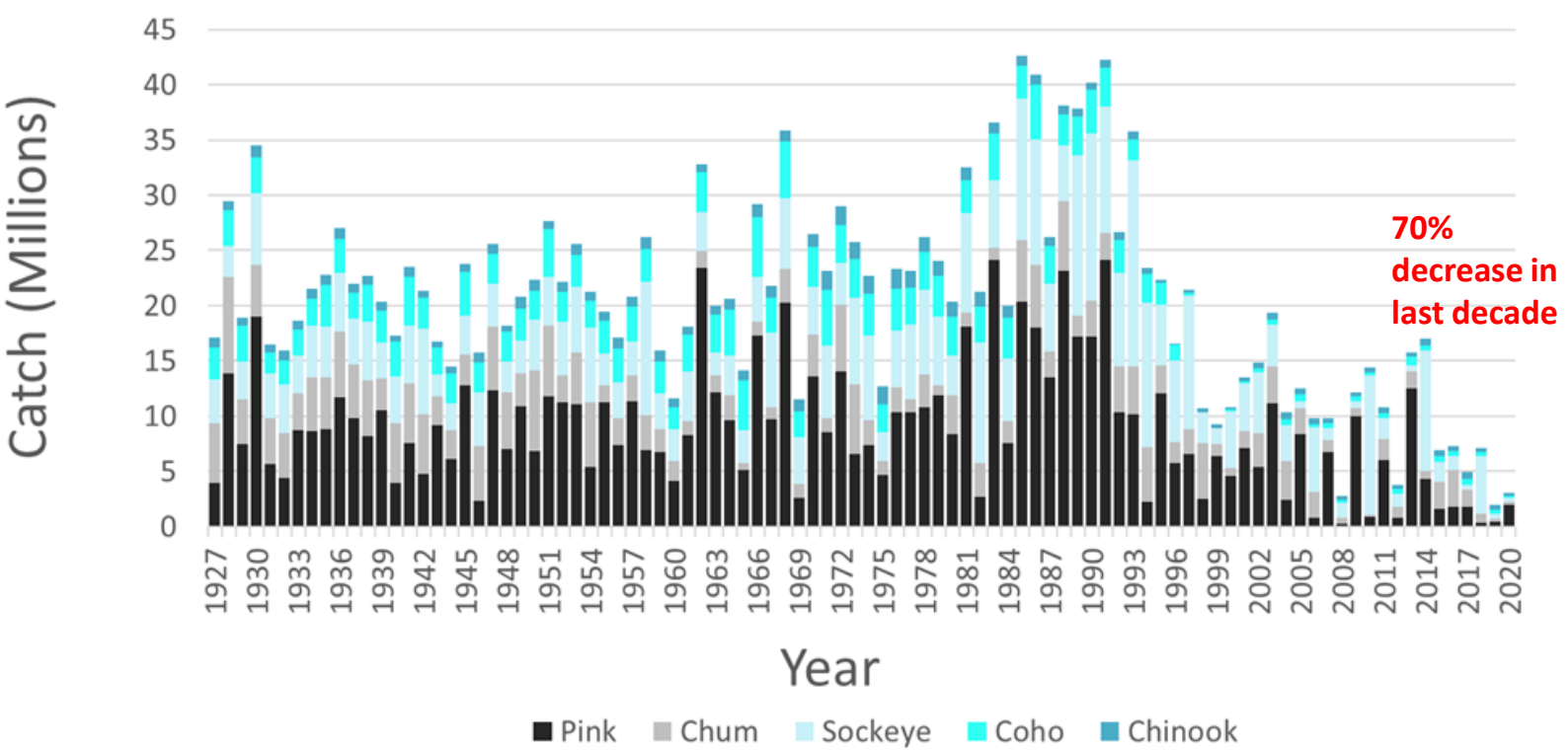


Remains warm as La Niña develops


Northern Zooplankton
LARGER ENERGY RICH ZOOPLANKTON DECREASE IN WARM CONDITIONS
Southern Zooplankton
SMALLER ENERGY POOR ZOOPLANKTON INCREASE IN WARM CONDITIONS
M. GALBRAITH, DFO, LA PEROUSE ZOOPLANKTON PROGRAM


Canadian
Pacific Salmon

Large Declines in Canadian Pacific Salmon Catch



MacDonald et al., State of the Salmon Program, 2022 Salmon Outlook, Dec 16 2021

Environmental Conditions: Informing Salmon Returns in 2022

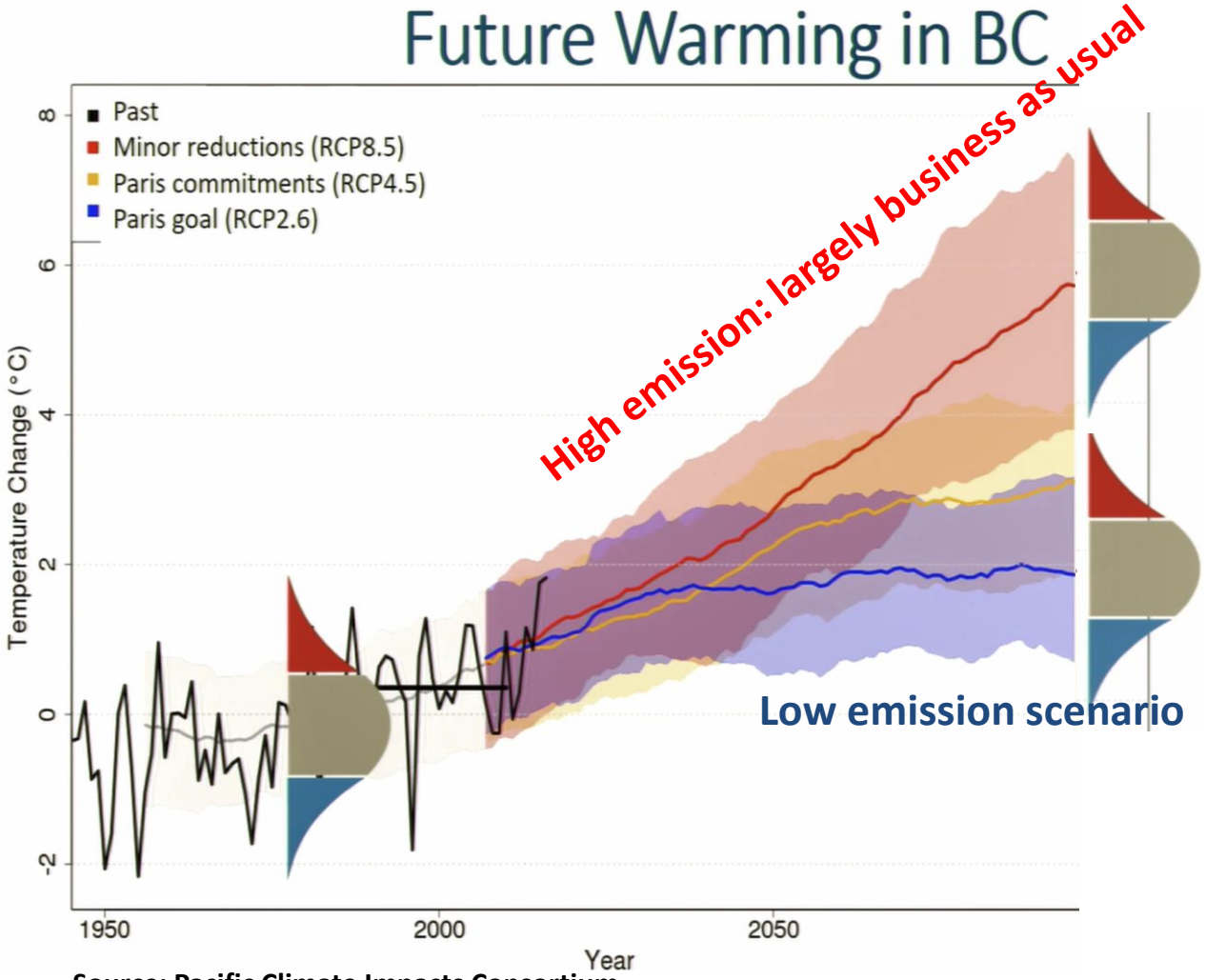
We predict that 2022 Canadian Pacific salmon productivity will generally be below historical averages

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

Photo: 4 Element Photos
S. Kalyn

MacDonald et al., State of the Salmon Program, 2022 Salmon Outlook, Dec 16 2021

The future of salmon species in the wild will depend on how successfully we curb greenhouse gas emissions.



Source: Pacific Climate Impacts Consortium

MacDonald et al., State of the Salmon Program, 2022 Salmon Outlook, Dec 16 2021

Contributors

DFO Marine:
J. King
C. Neville
I. Perry
J. Boldt
P. Chandler
T. Ross
A. Sastri
M. Galbraith
K. Young

DFO Freshwater:
D. Patterson
D. Selbie
L. Pon
K. Robinson

Photo: 4 Element Photos
S. Kalyn

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 2022 returning salmon will be published in Salmon Integrated Fisheries Management Plans (IFMP's)