What makes Alaska's salmon rivers resilient?

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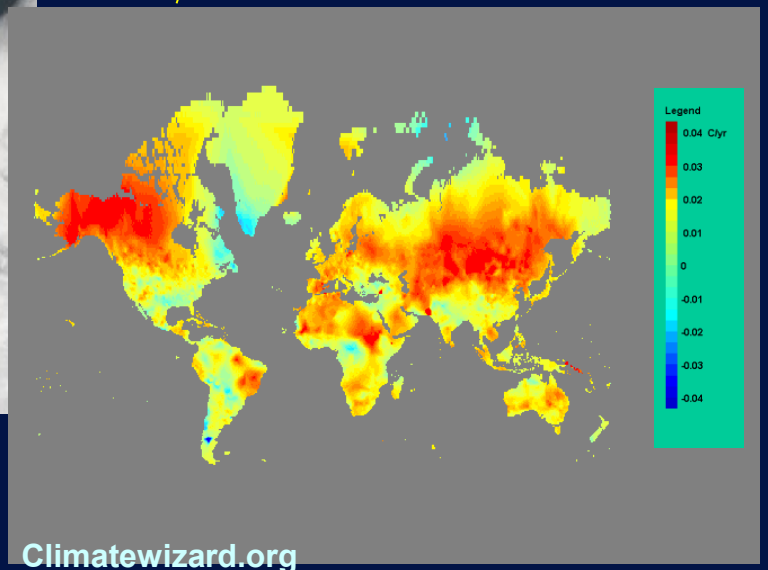
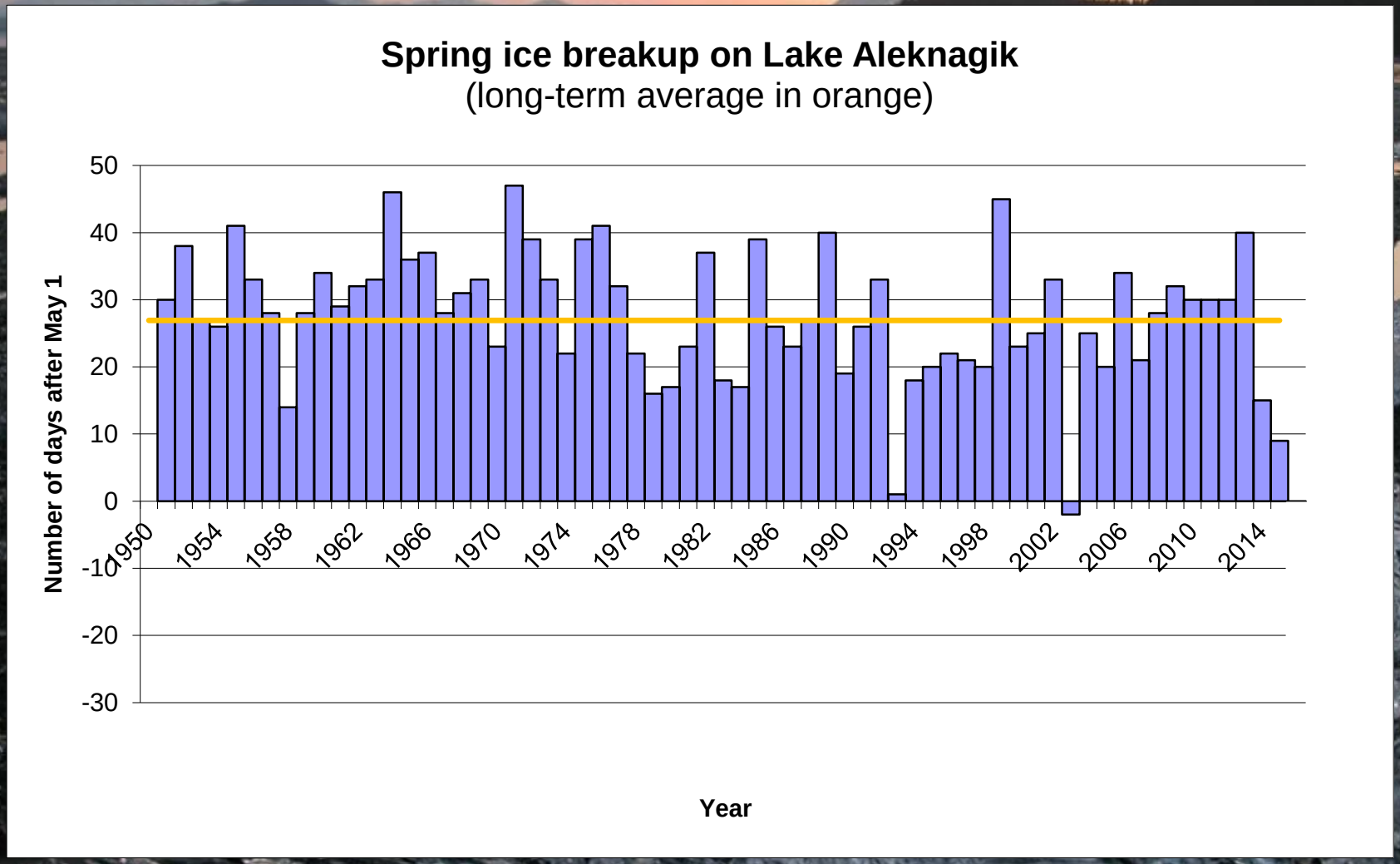
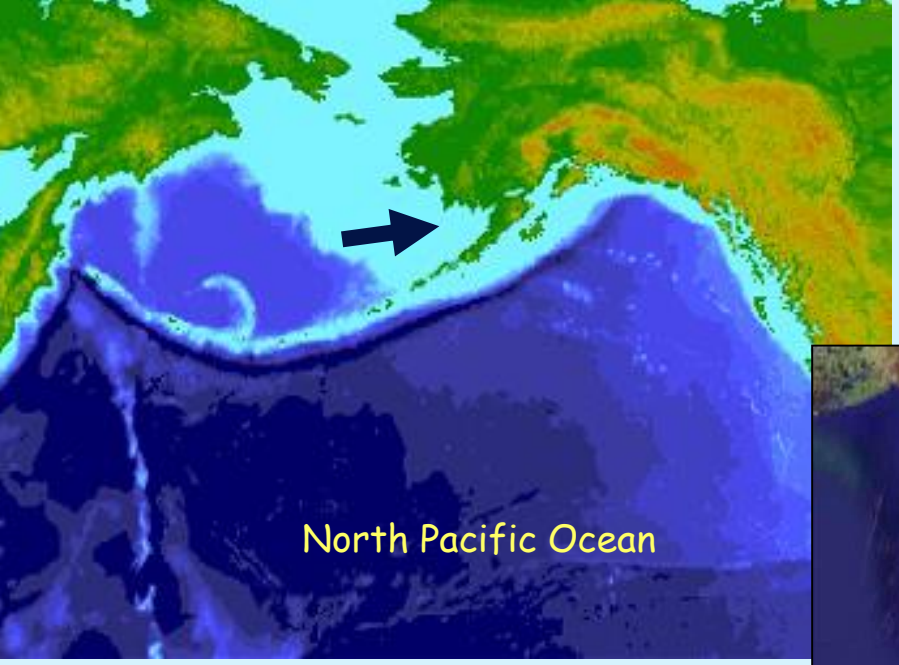
Bristol Bay, Alaska



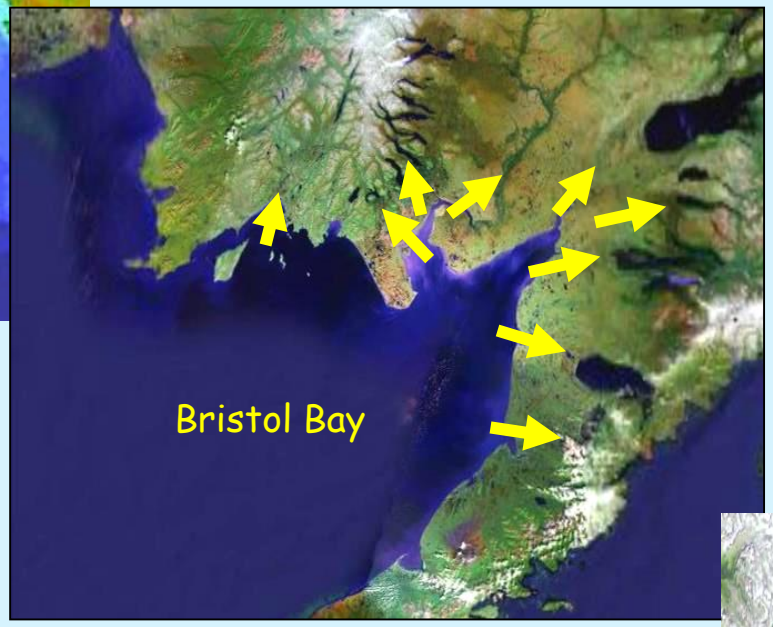
Changing climate in Western Alaska



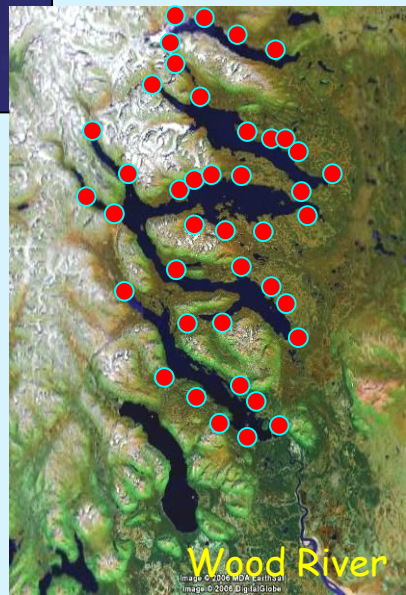
Salmon habitat in Bristol Bay



9 major rivers

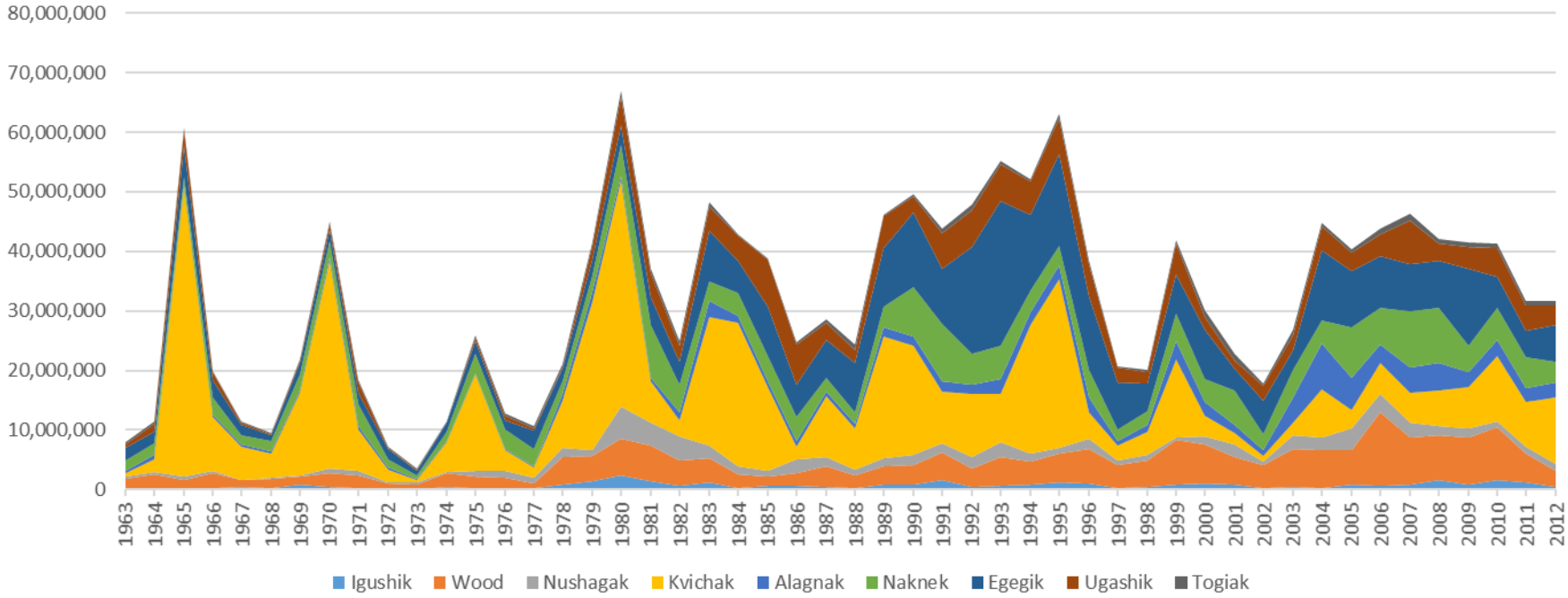


each with many populations



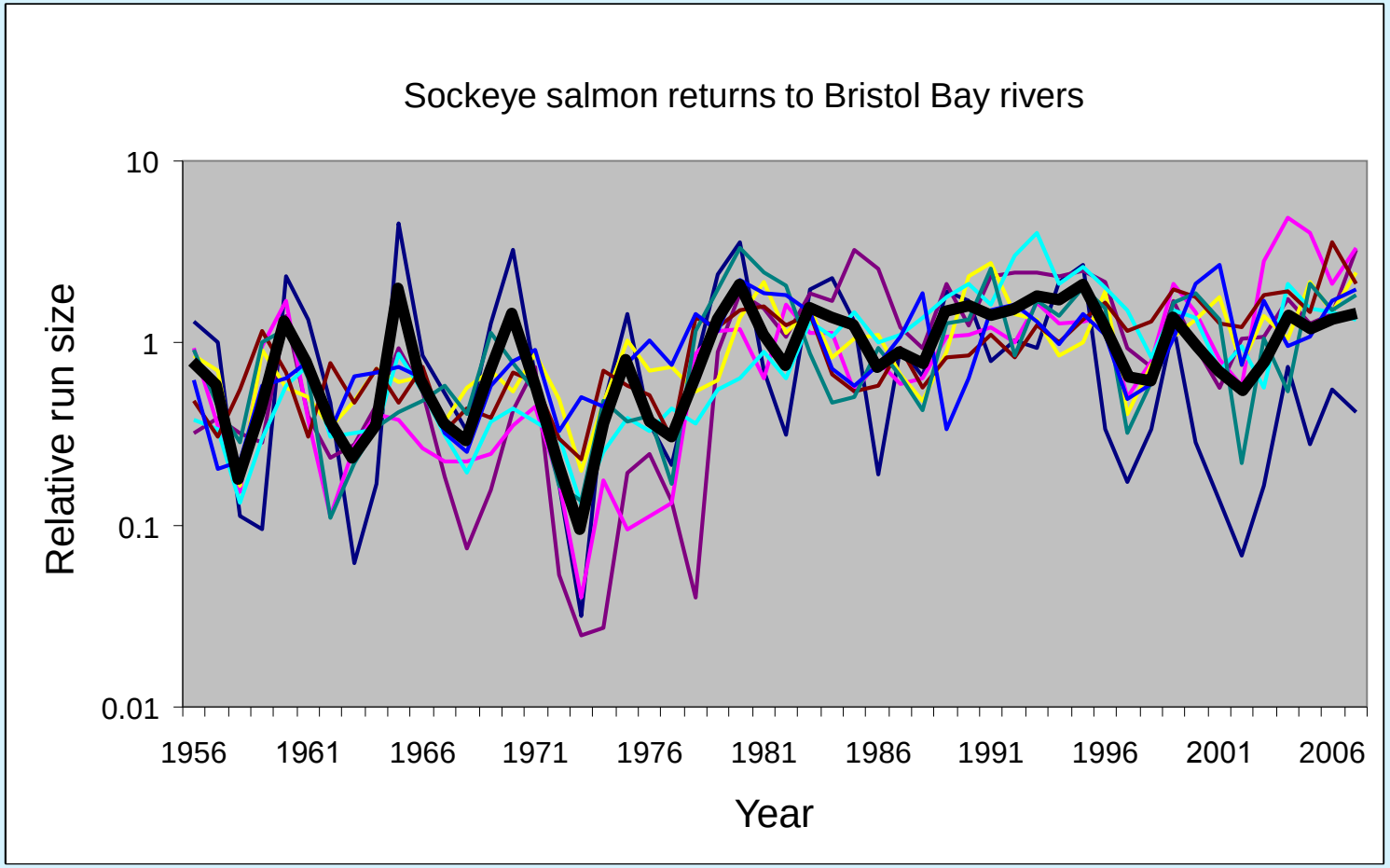
Sockeye salmon returns to Bristol Bay

Data from ADFG



http://www.absc.usgs.gov/research/Fisheries/Lake_Clark/subsistence.htm

Complementary dynamics in stocks of Bristol Bay sockeye produce portfolio effects in fisheries



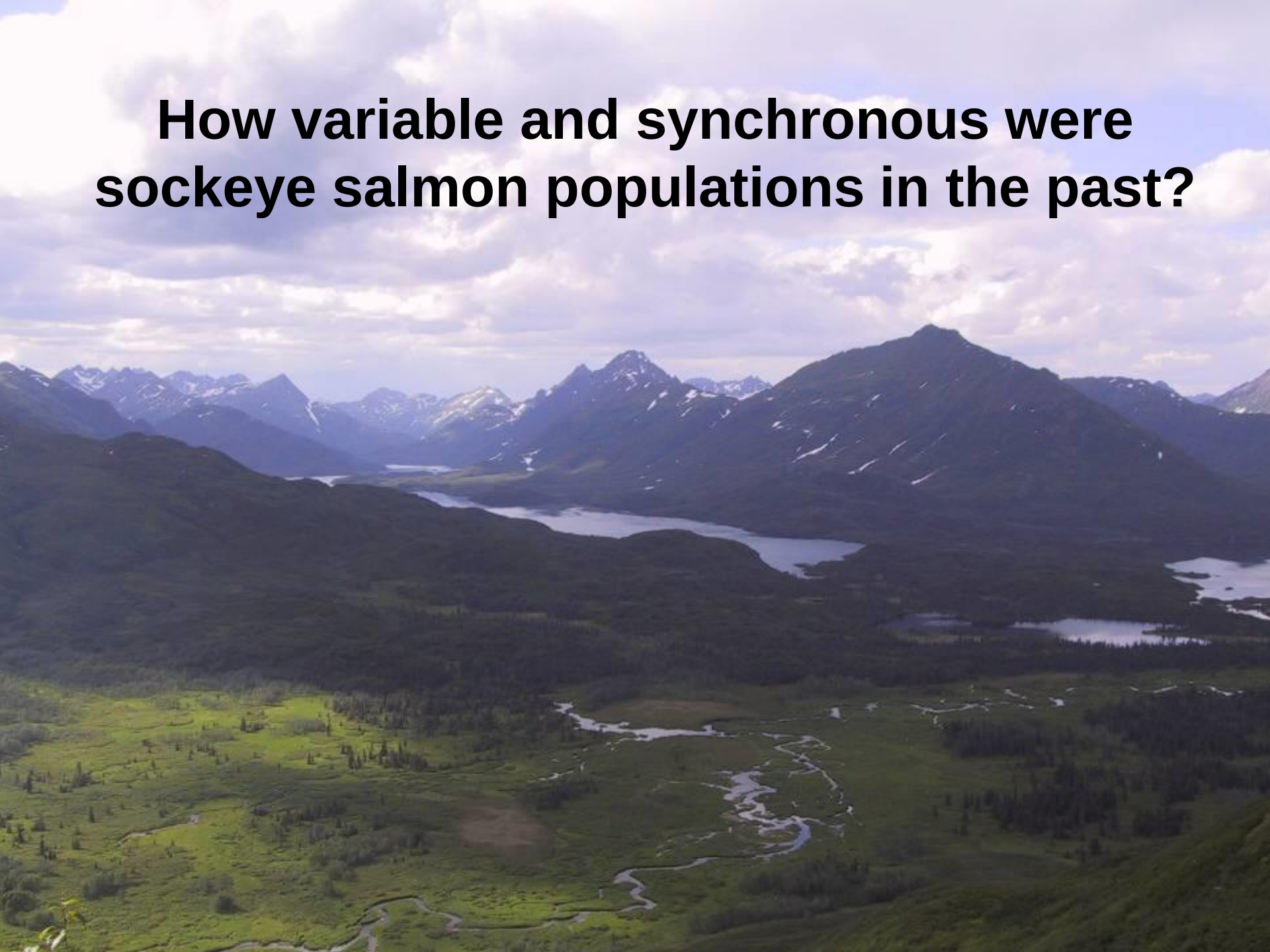
Sockeye salmon fisheries in Bristol Bay, Alaska

Does reliability affect people dependent on fisheries?

http://www.absc.usgs.gov/research/Fisheries/Lake_Clark/subsistence.htm

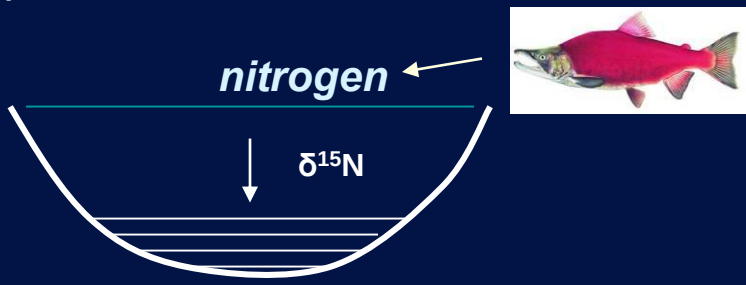
The front line at Egegik

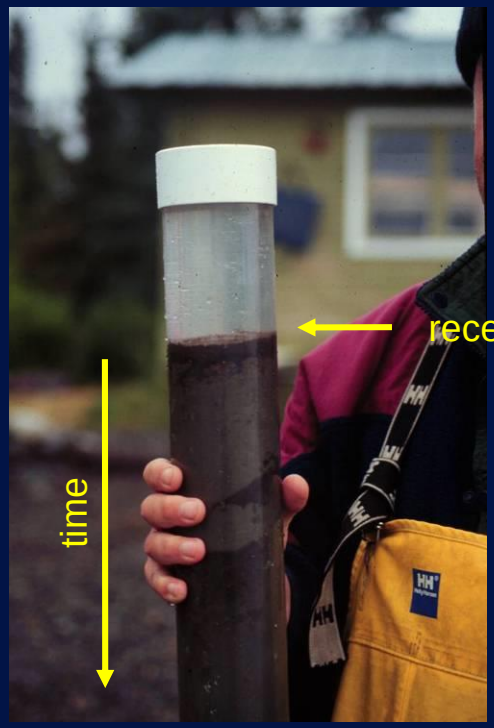
How variable and synchronous were sockeye salmon populations in the past?



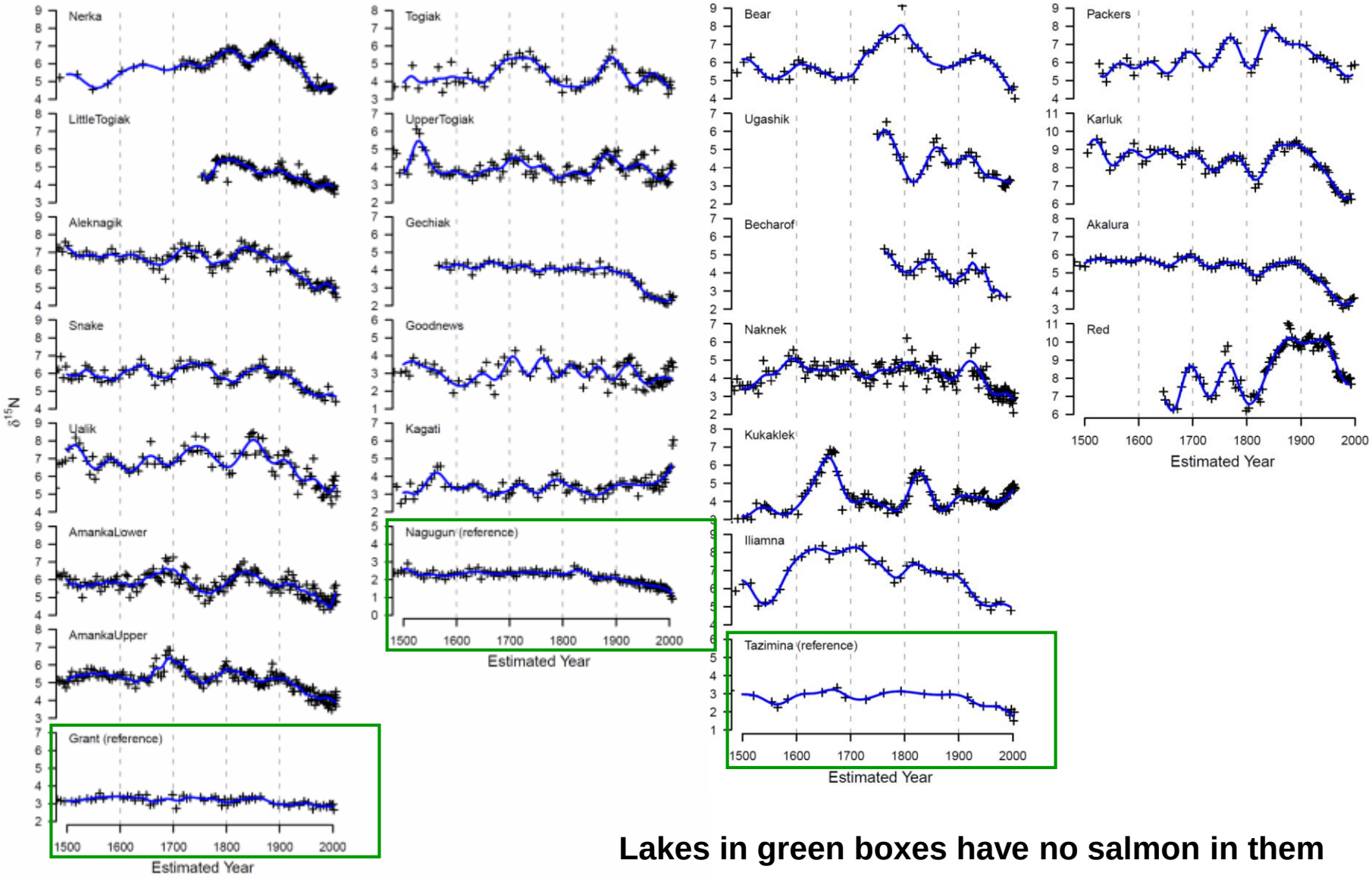
Paleolimnology

Lake sediments contain a biogeochemical archive that reflects salmon abundance (centuries to millenia)





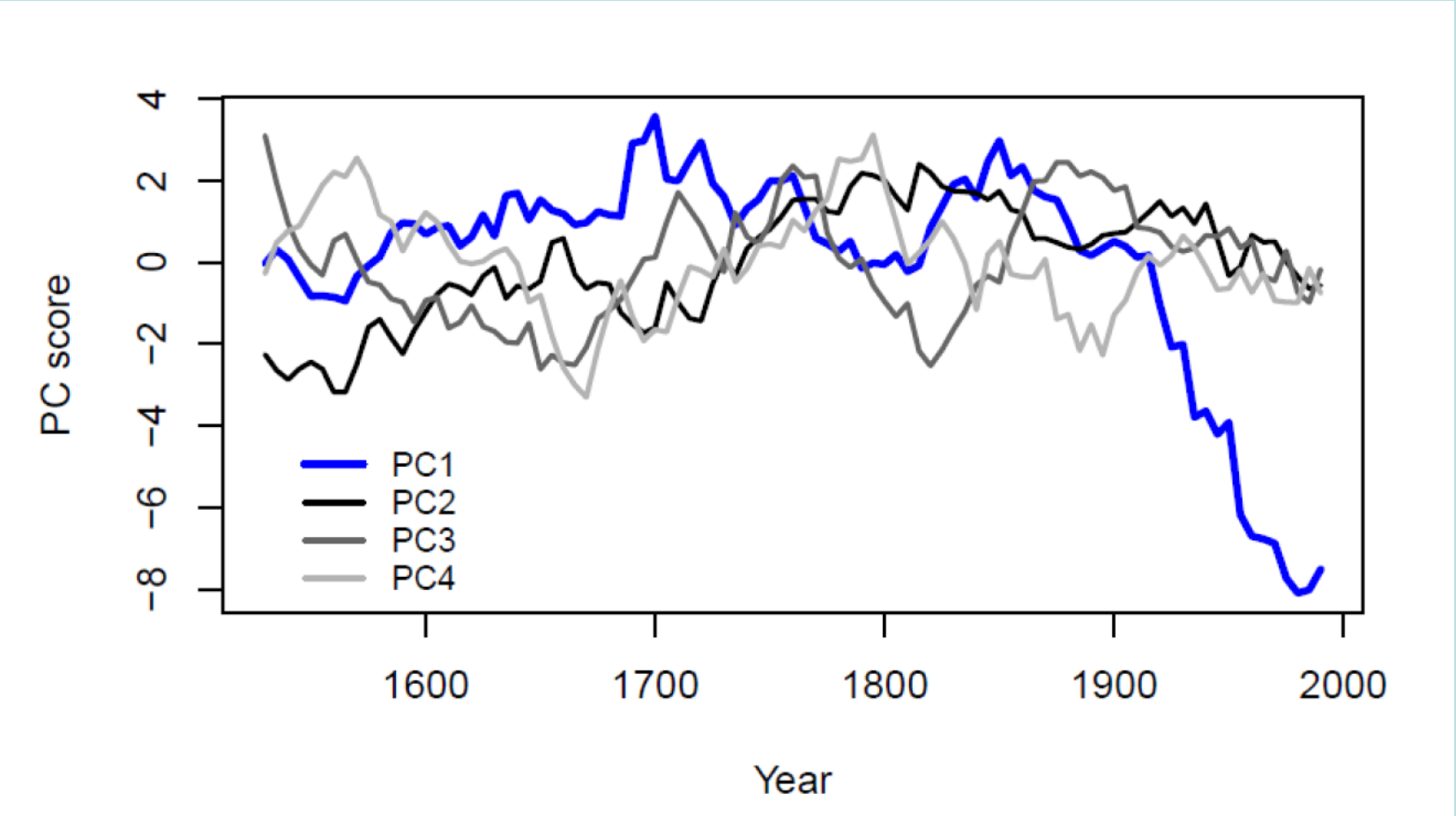
Variation in salmon returns to Alaskan lakes 1500-2000



Lakes in green boxes have no salmon in them

Rogers et al., PNAS 2003

Weak coherence in salmon population dynamics among stocks in western Alaska (1500-present)

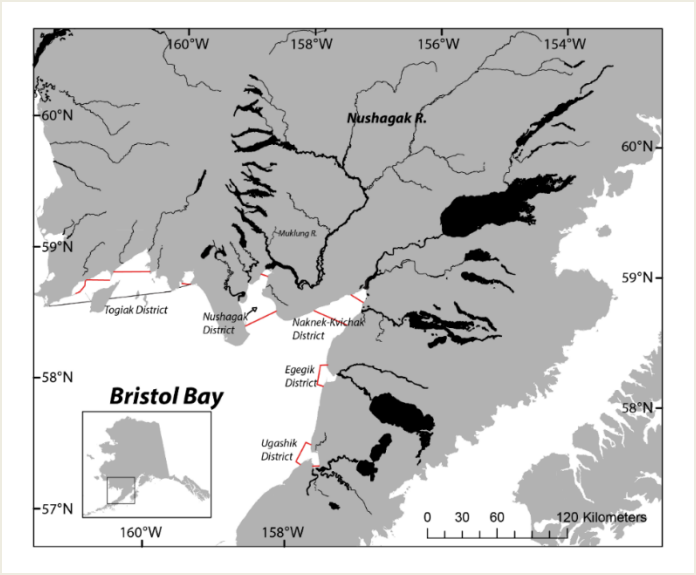


Rogers et al. PNAS 2013

Salmon landscapes are shifting mosaics of suitable habitat

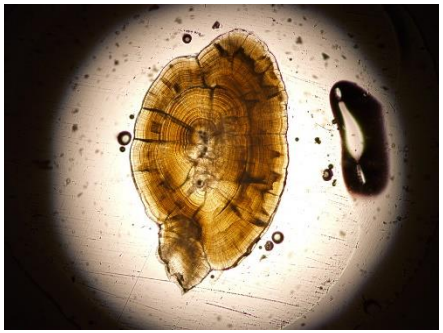
(*sensu* Stanford et al. 2005)

Chinook salmon – habitat use within watersheds (how consistent is production within individual tributaries?)

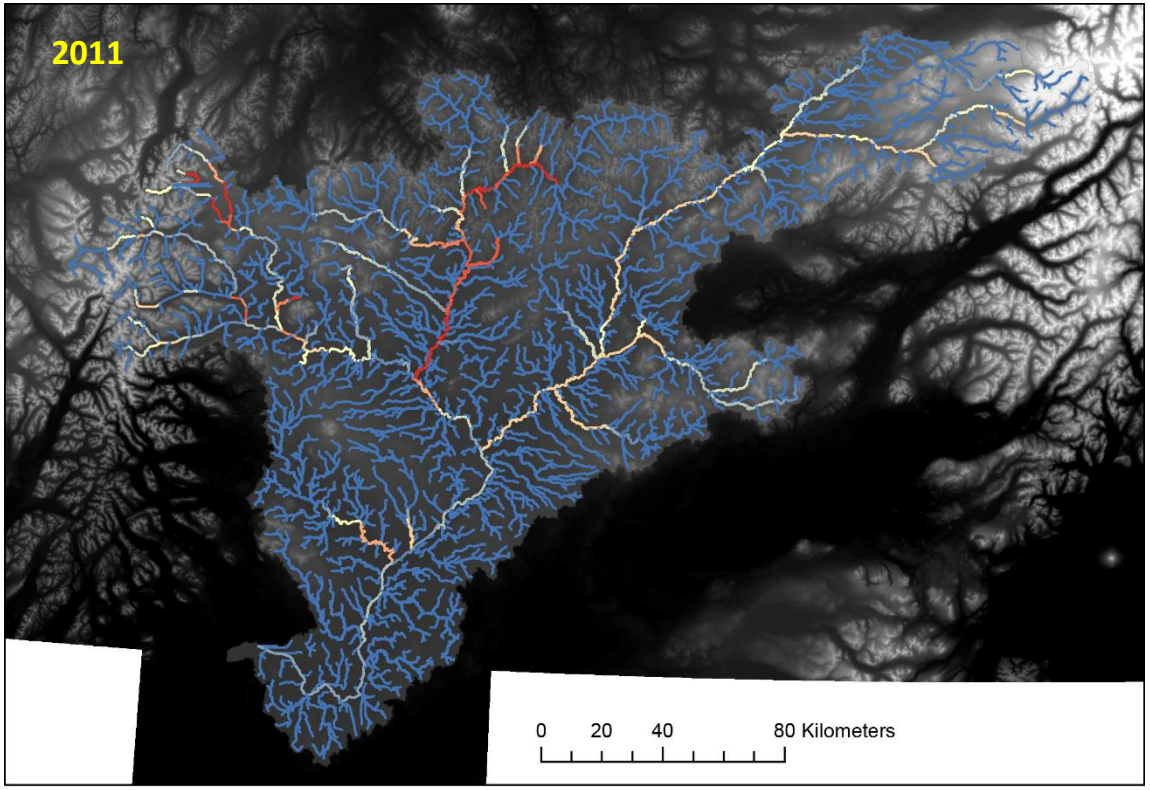


Chinook salmon production in the Nushagak River

Nushagak R.
2011 (n=255)

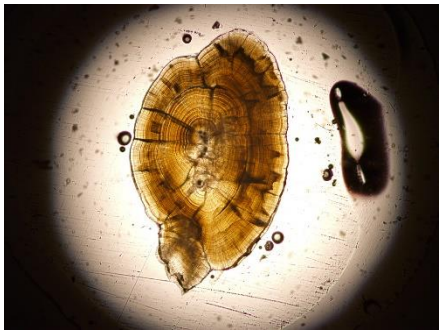


Brennan and Schindler, in press



Chinook salmon production in the Nushagak River

Nushagak R.
2014 (n=279)



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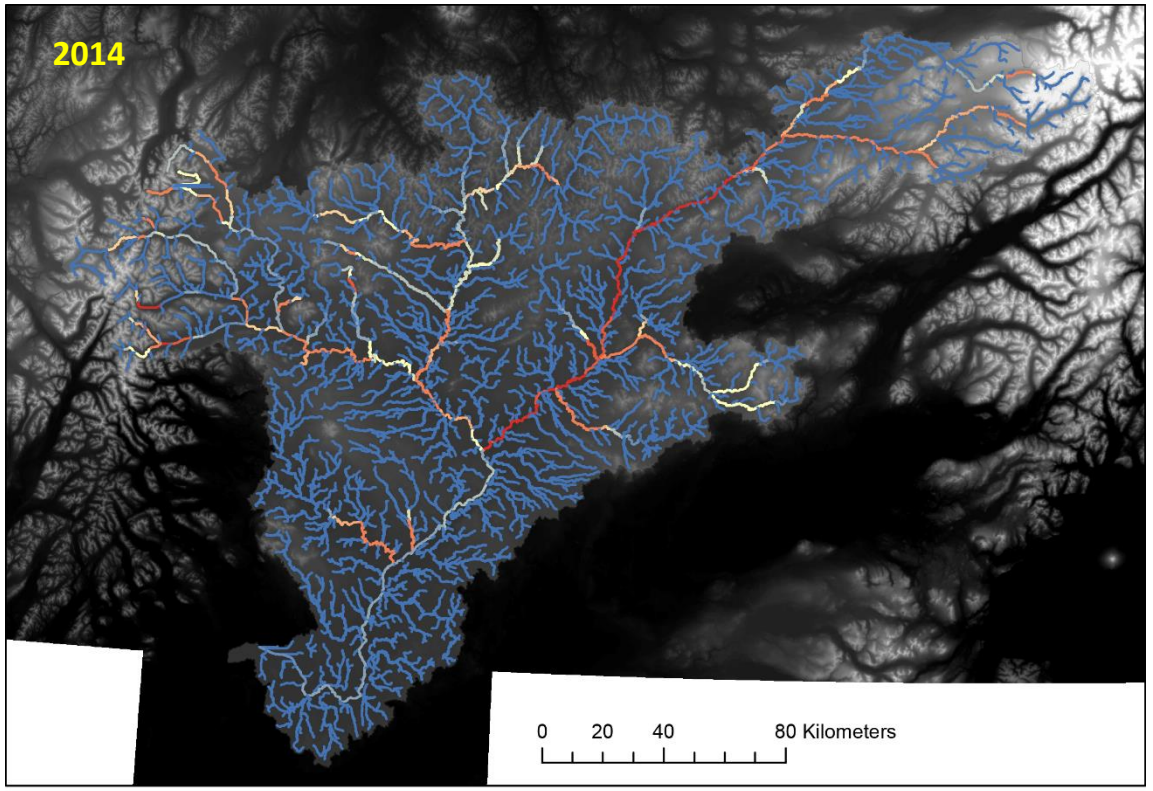



Habitat variation is also important at very small scales

Jonny Armstrong

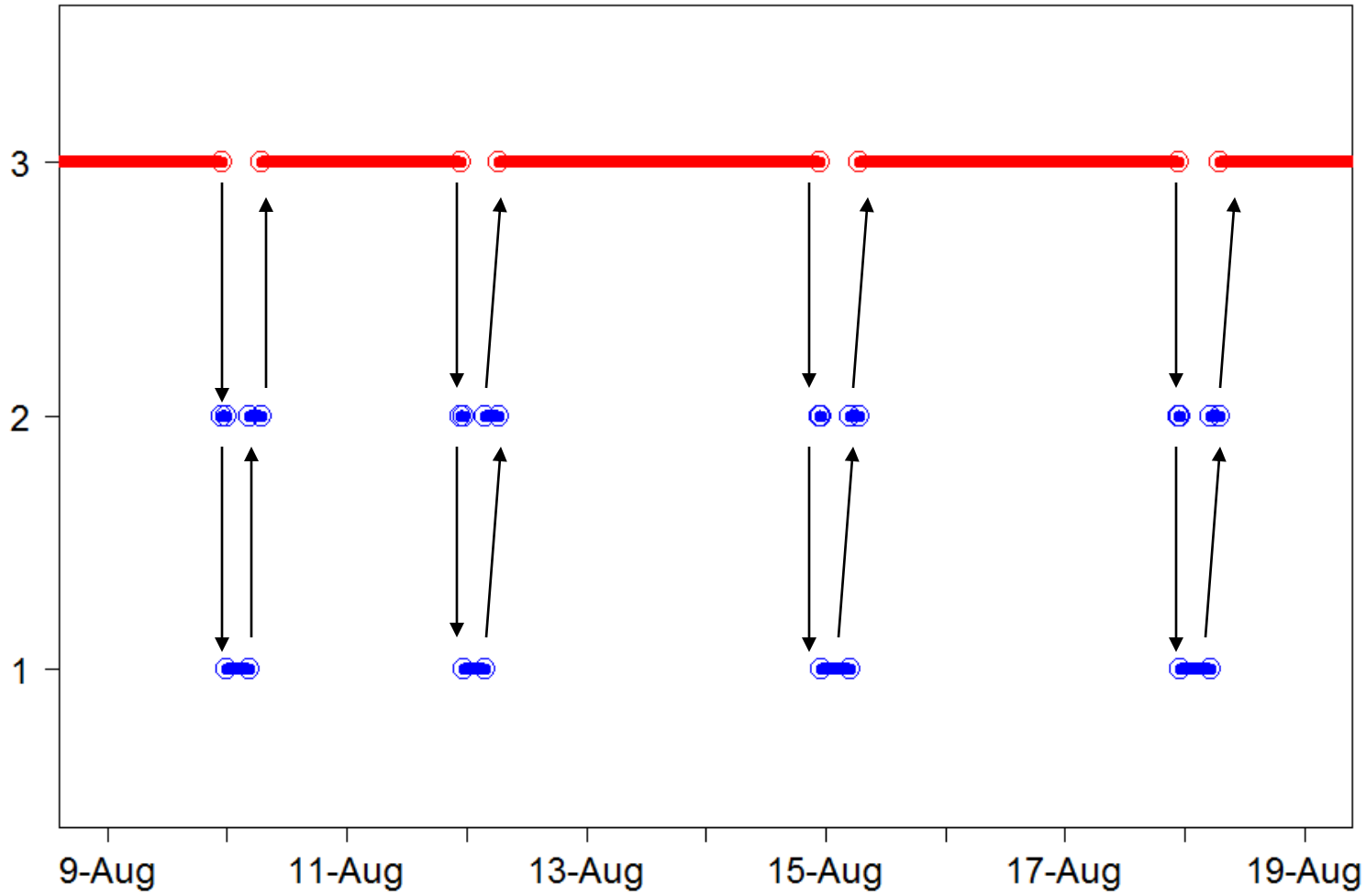
2008:
PIT tag
antenna arrays

1. 0-850m: cold w/ sockeye

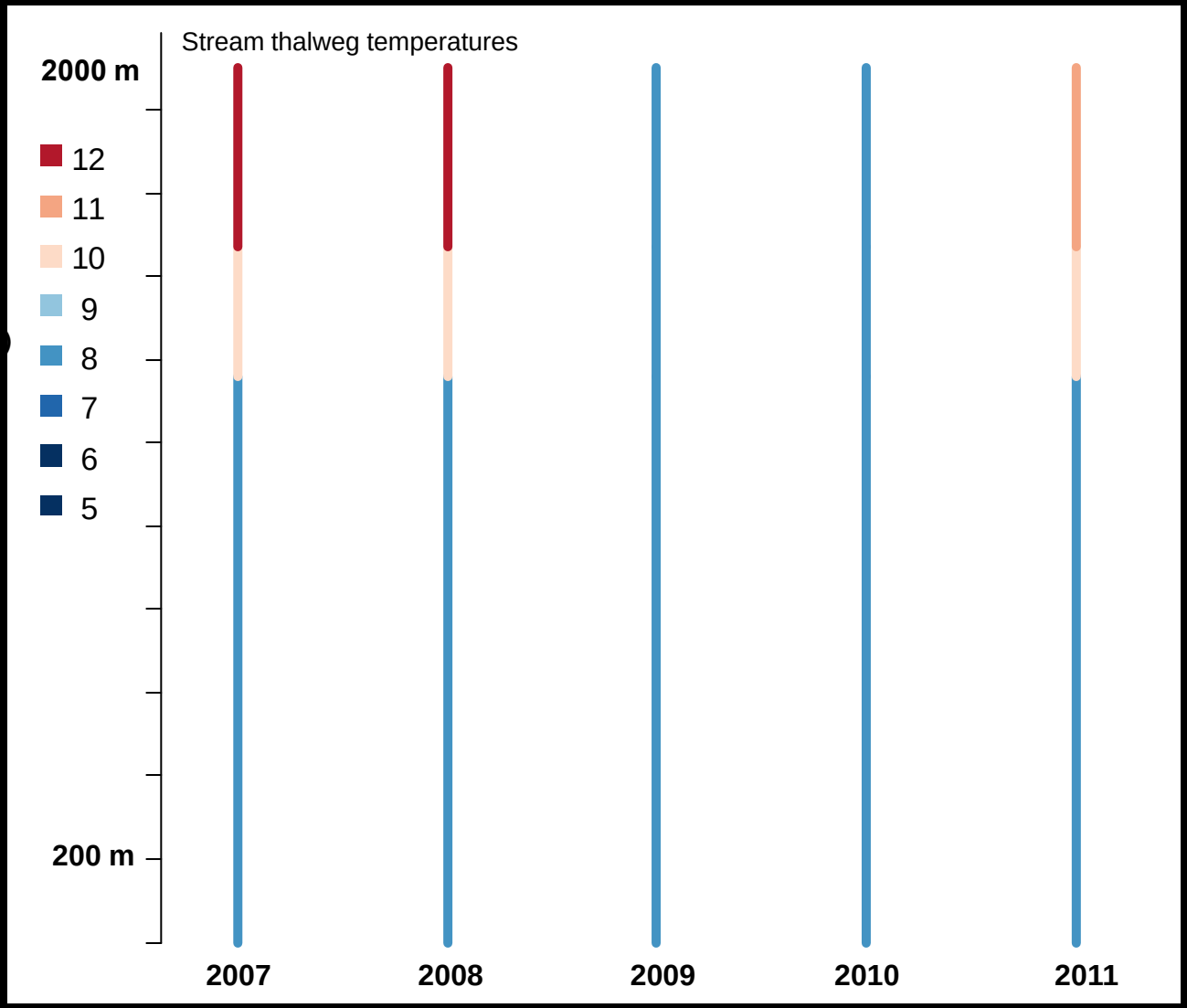
3. 1300m and up: warm w/o sockeye

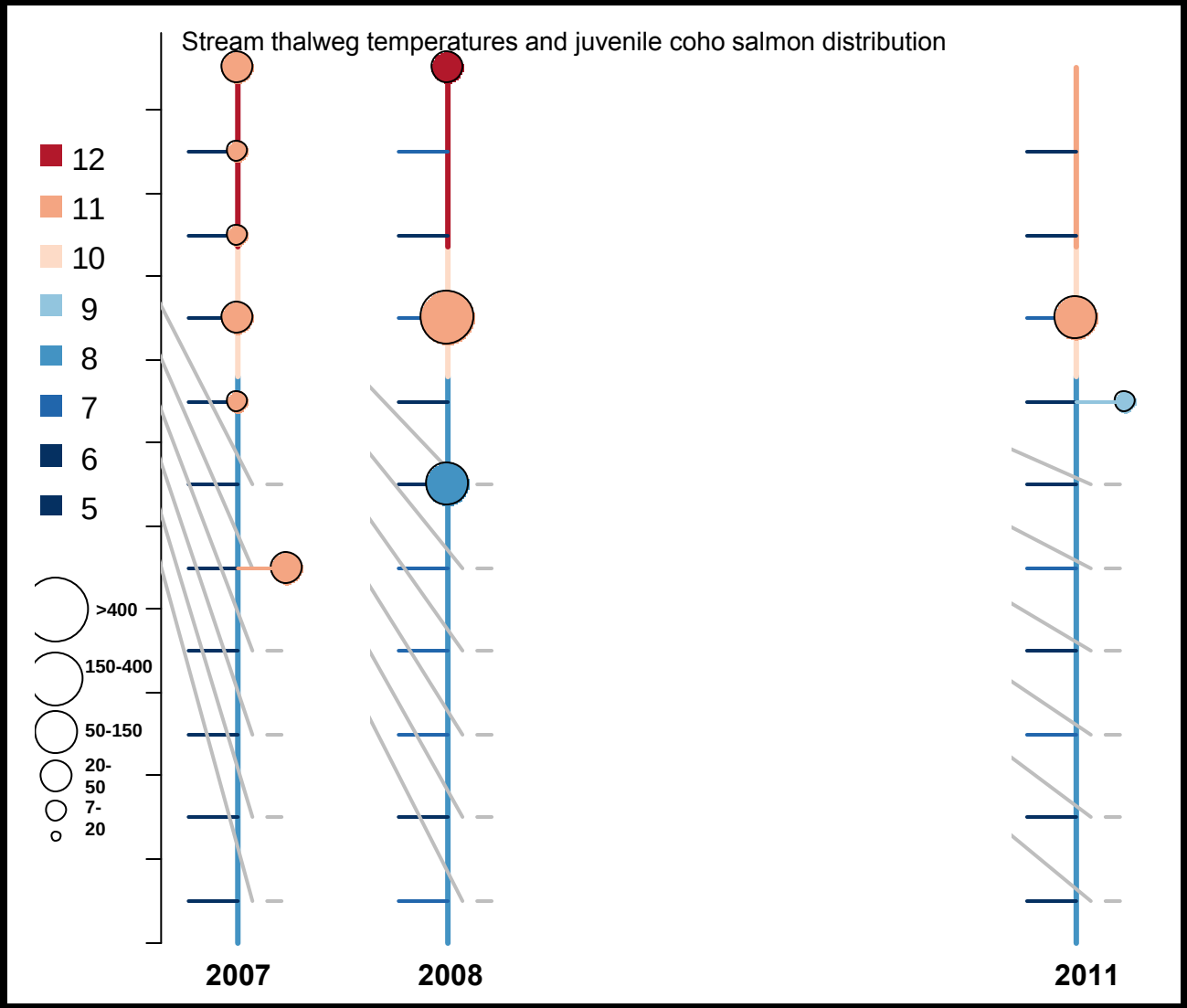
2. 850-1300m: cold w/o sockeye

Little coho salmon move between warm and cold sections of stream



Age-1 coho salmon-- 24-July: 85 mm 7.1 g
21-Aug: 108 mm 17.6 g


Stream thalweg temperatures
2000 m
12
11
10
9
8
7
6
5
200 m
2007
2008
2009
2010
2011


Stream thalweg temperatures and juvenile coho salmon distribution
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50-150
20-50
7-20
2007
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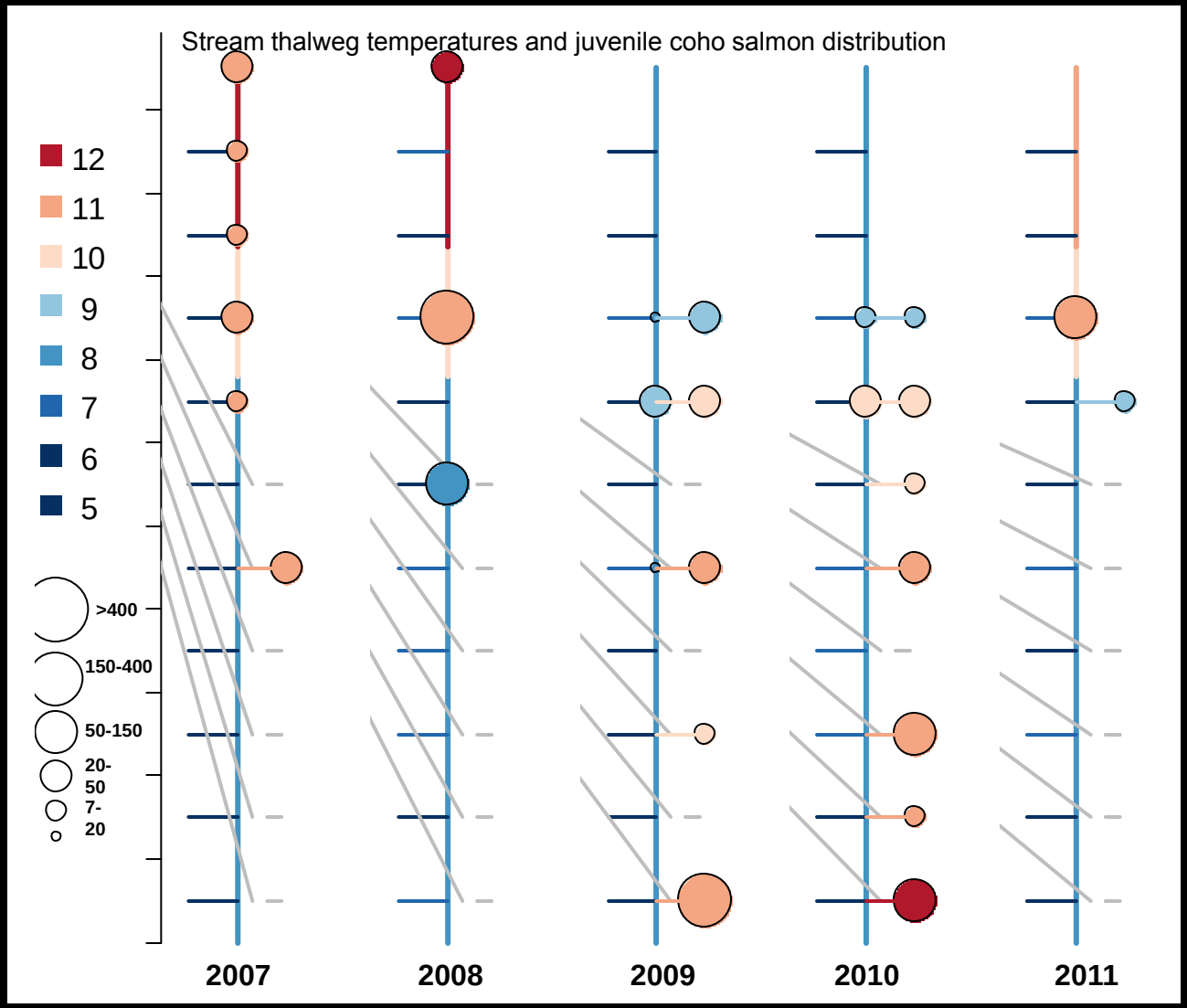
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20-50
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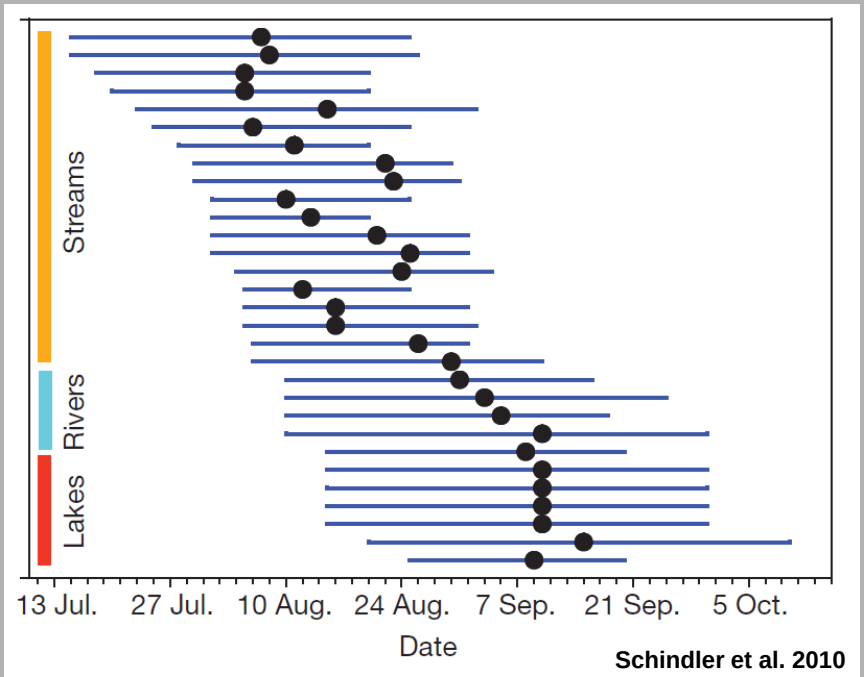
2008
2009
2010
2011


Sue Johnson


Jonny Armstrong

Jul-28

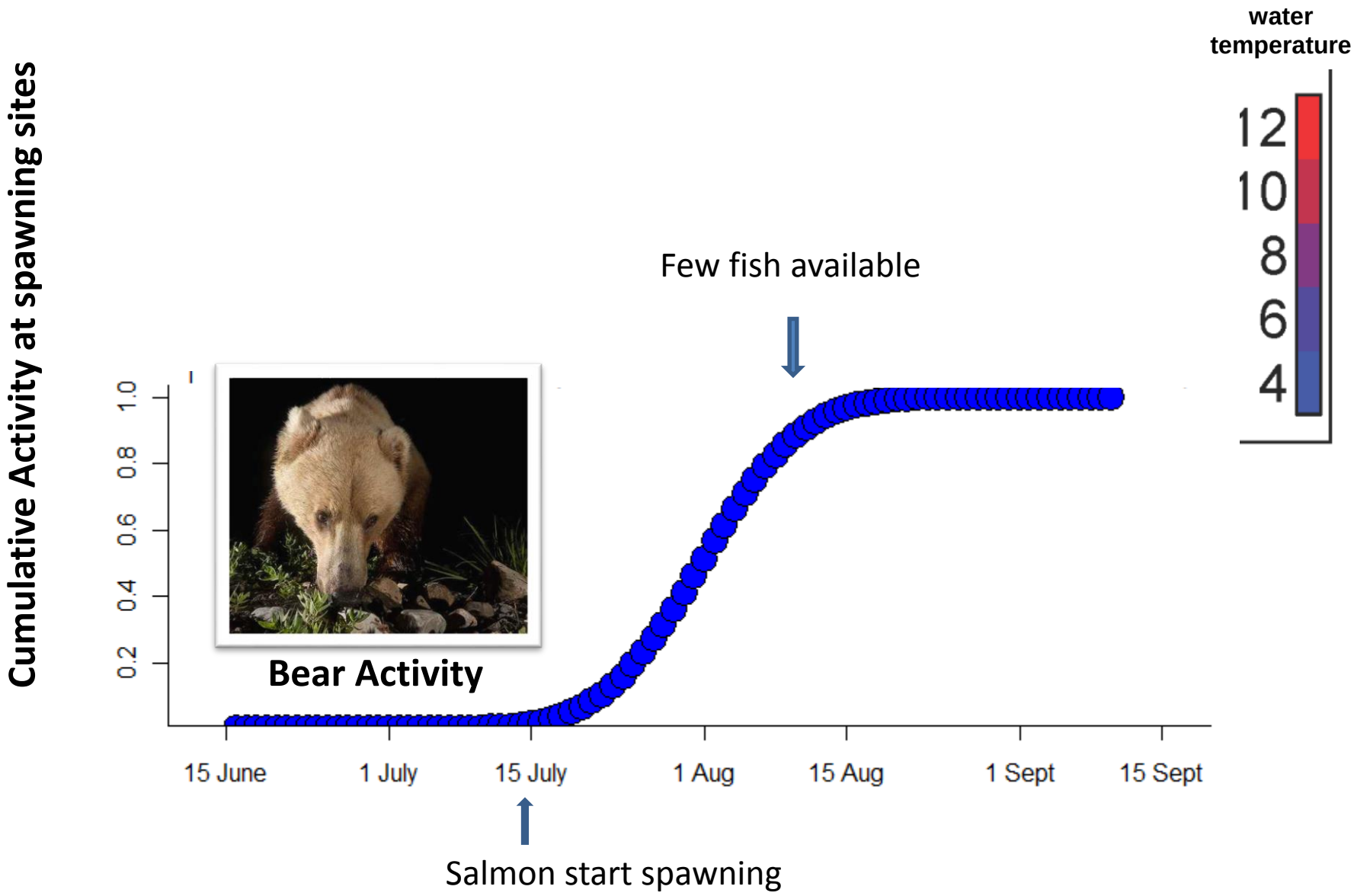
Sept 8

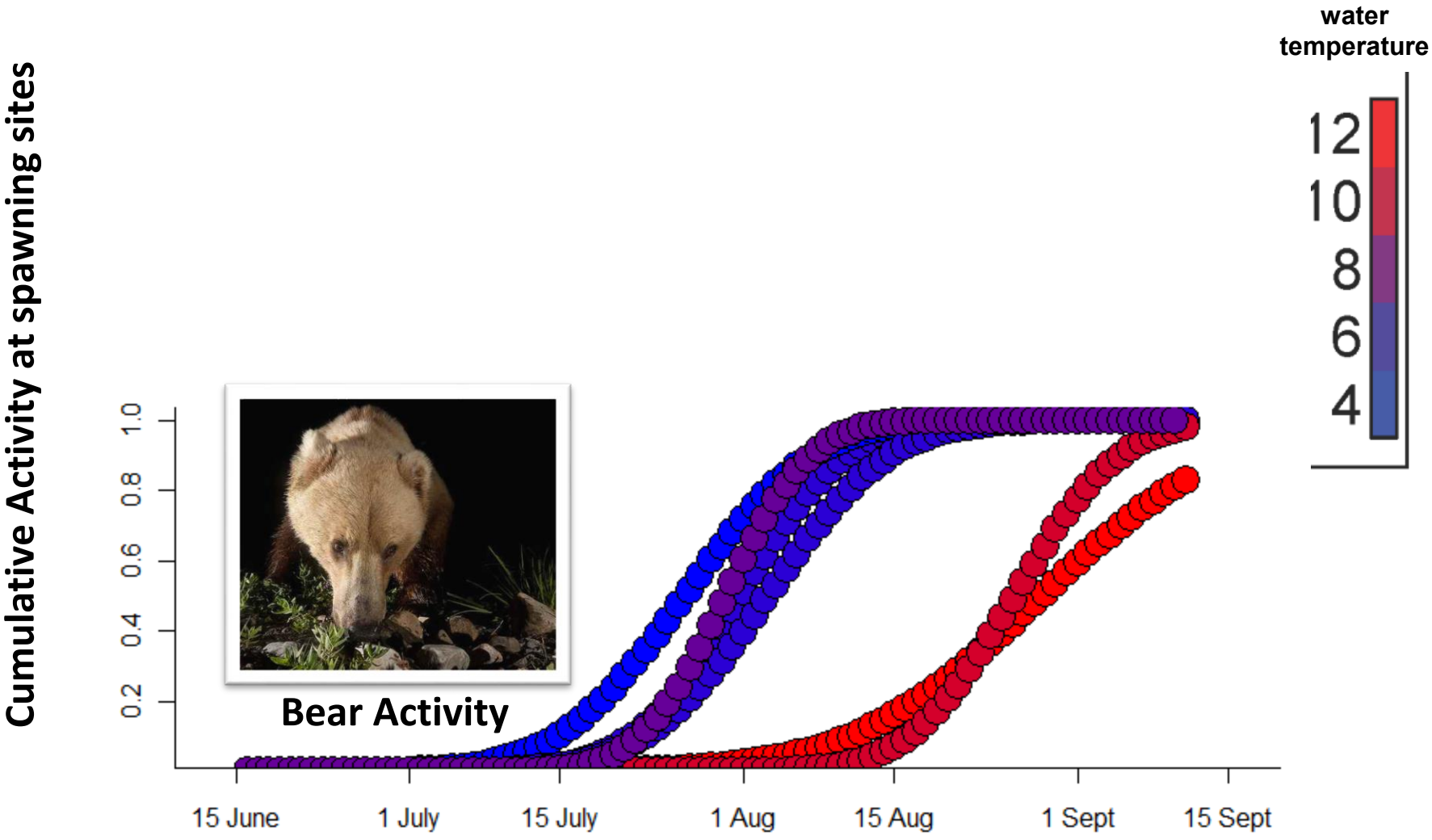


Schindler et al. 2010


Photos by J. Armstrong

Video from Jason Ching


water temperature
12
10
8
6
4
Few fish available
Cumulative Activity at spawning sites
0.2
0.4
0.6
0.8
1.0
Bear Activity
15 June
1 July
15 July
1 Aug
15 Aug
1 Sept
15 Sept
Salmon start spawning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12
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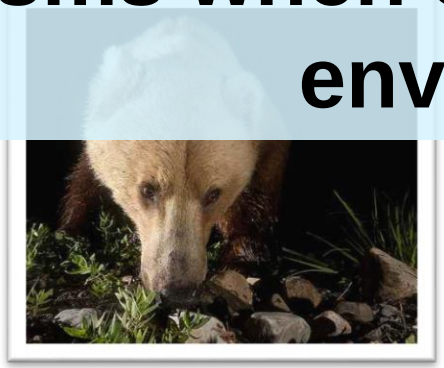
8
6
4



Complexity provides options for organisms when coping with a changing environment

Cumulative Activity at spawning sites

0.2 0.4 0.6 0.8 1.0

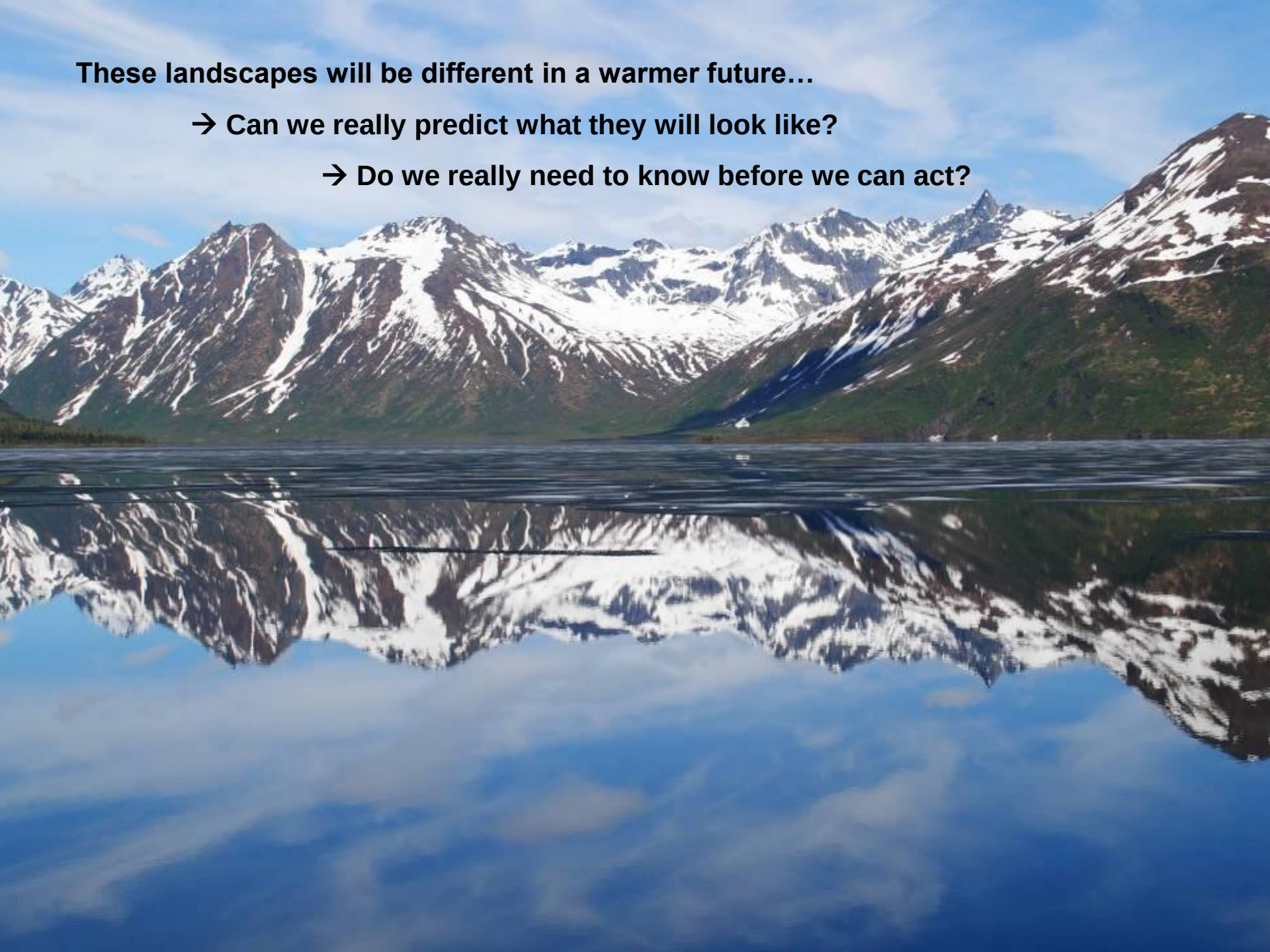
Gull Activity

Bear Activity

water temperature

12 10 8 6 4

15 June 1 July 15 July 1 Aug 15 Aug 1 Sept 15 Sept

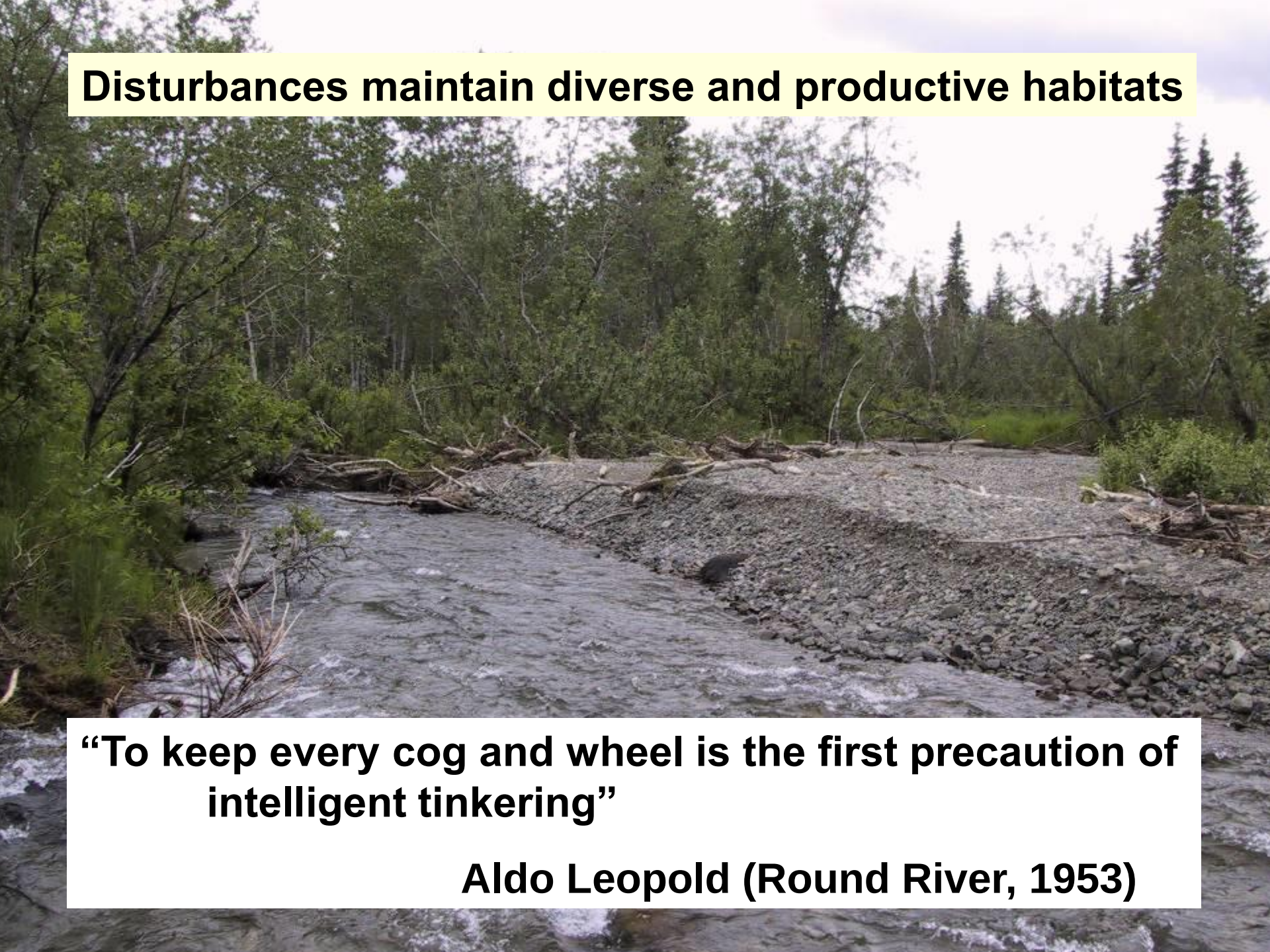


These landscapes will be different in a warmer future…

→ Can we really predict what they will look like?

→ Do we really need to know before we can act?

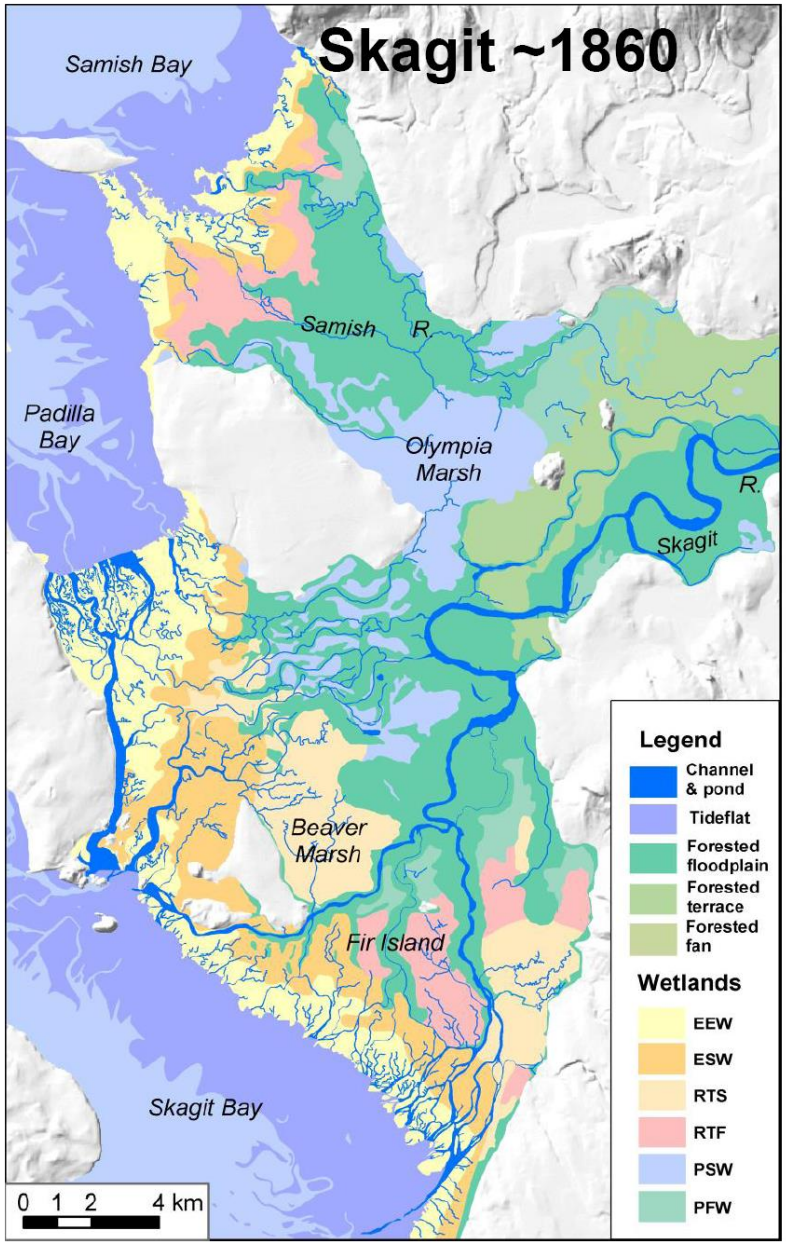

Maintaining diversity in landscapes is a tangible way to manage the risks of ongoing climate warming

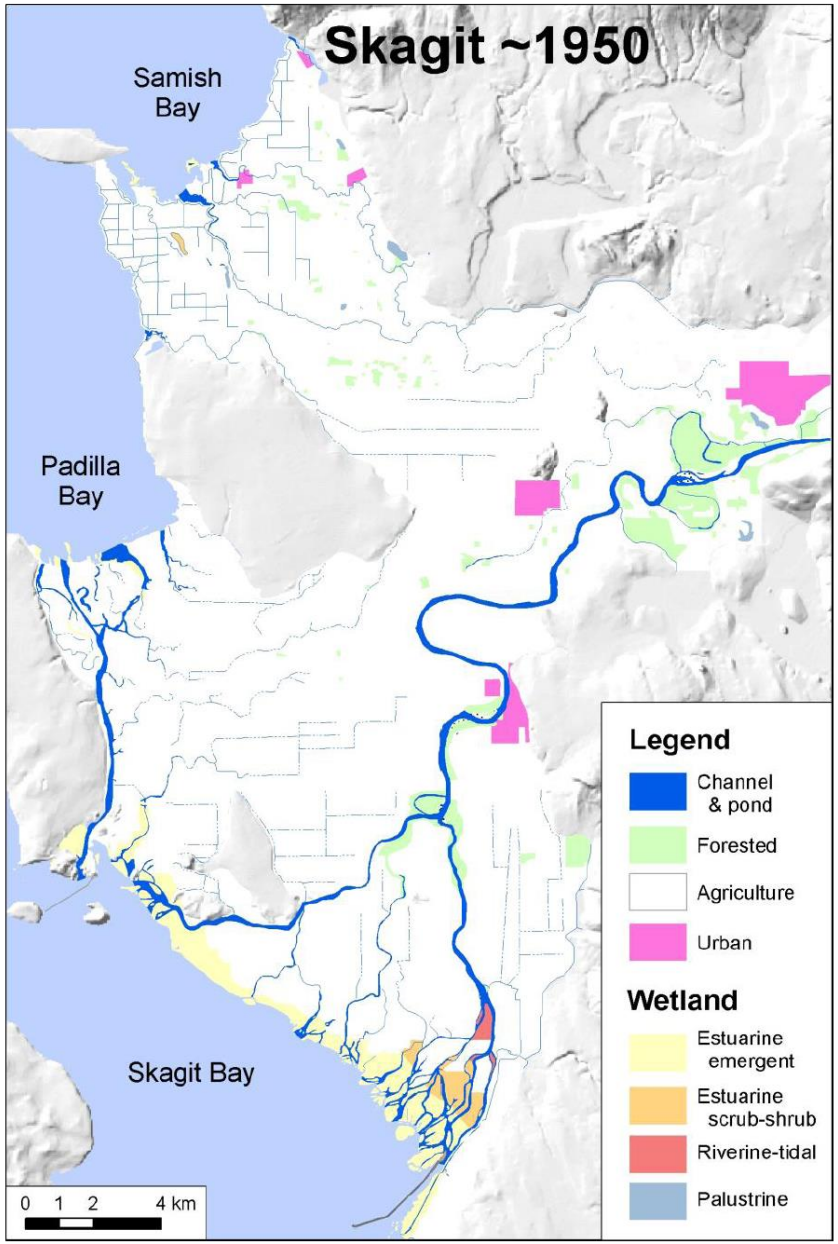


Disturbances maintain diverse and productive habitats

"To keep every cog and wheel is the first precaution of intelligent tinkering"

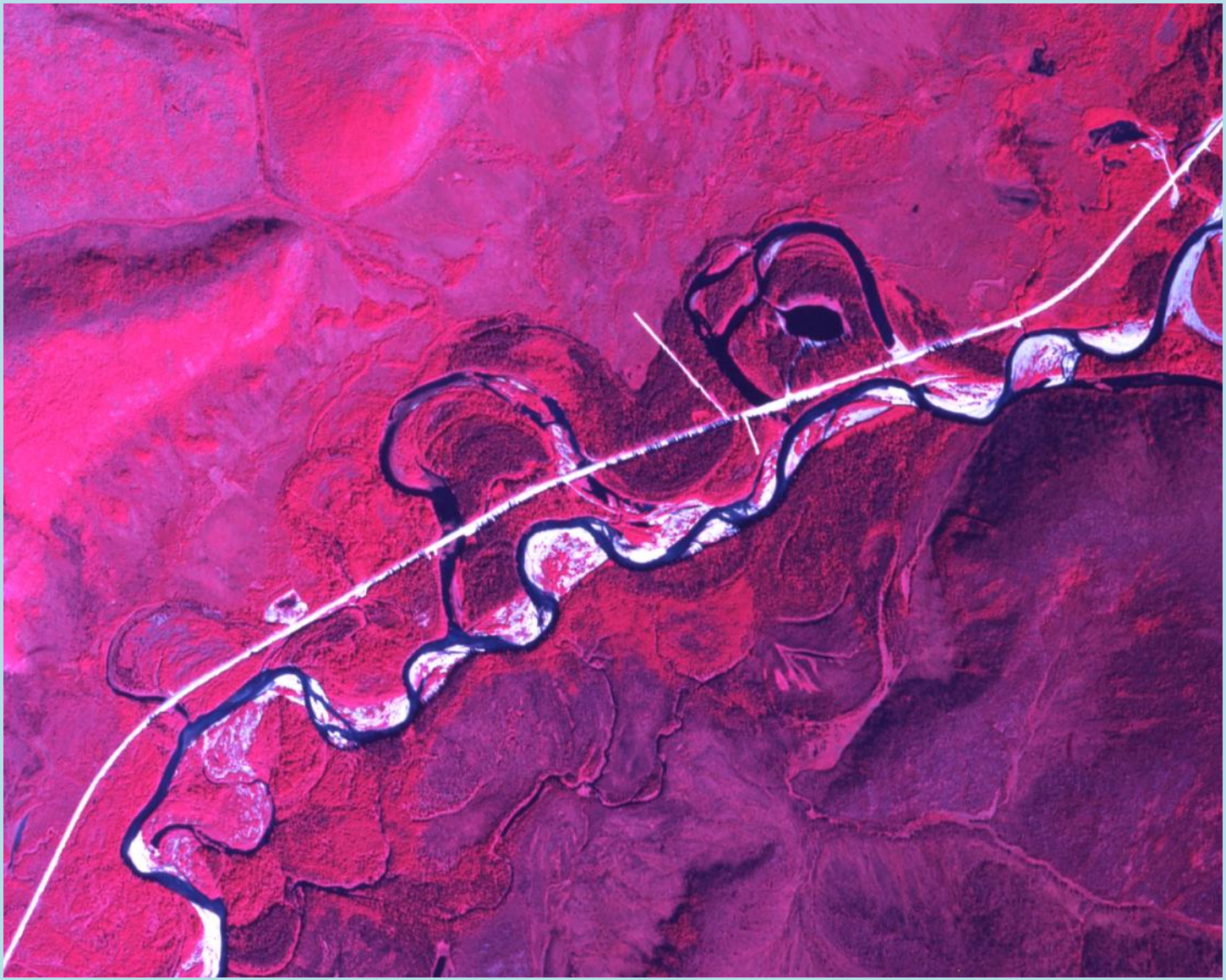
Aldo Leopold (Round River, 1953)





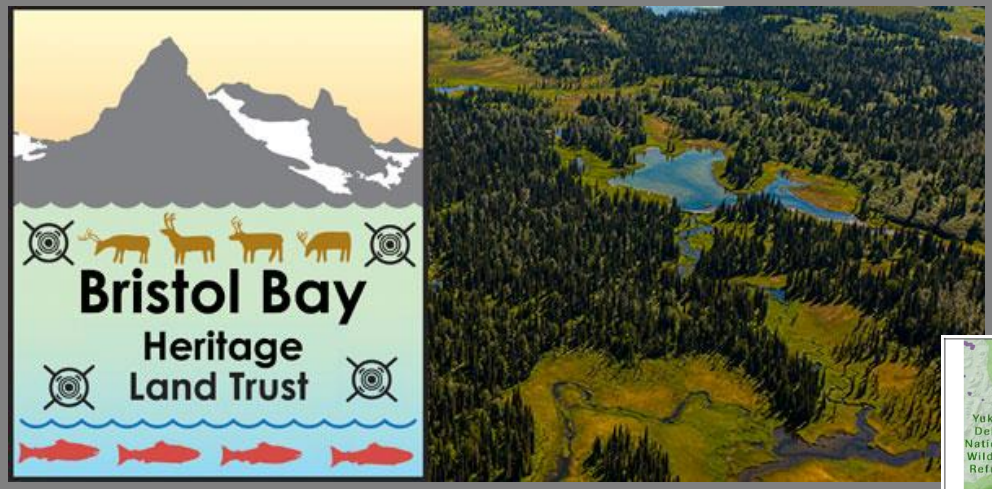
Collins, 2002

Chena River, Alaska



Courtesy of Chris Stark, UAF

Protecting habitat networks is a way to build climate resilience



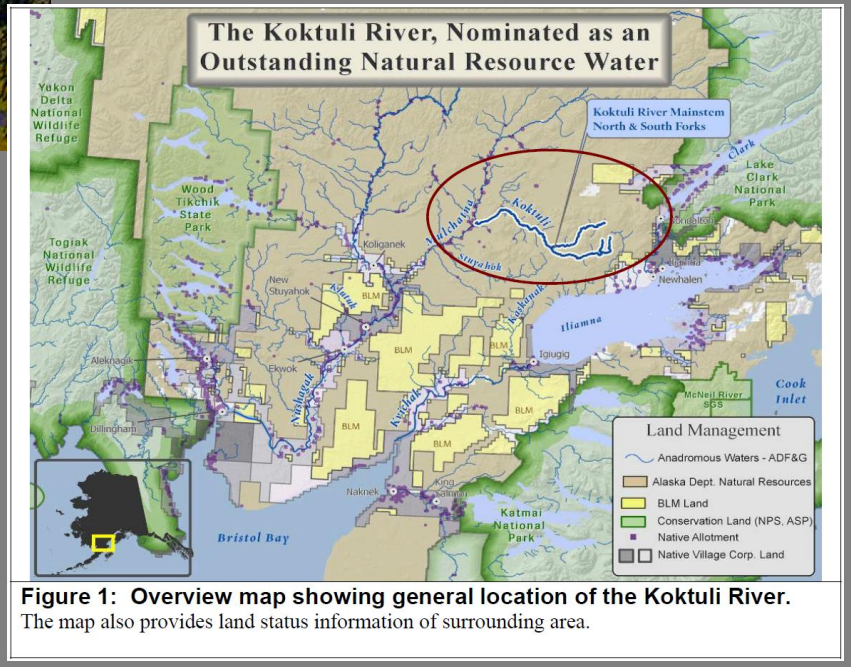
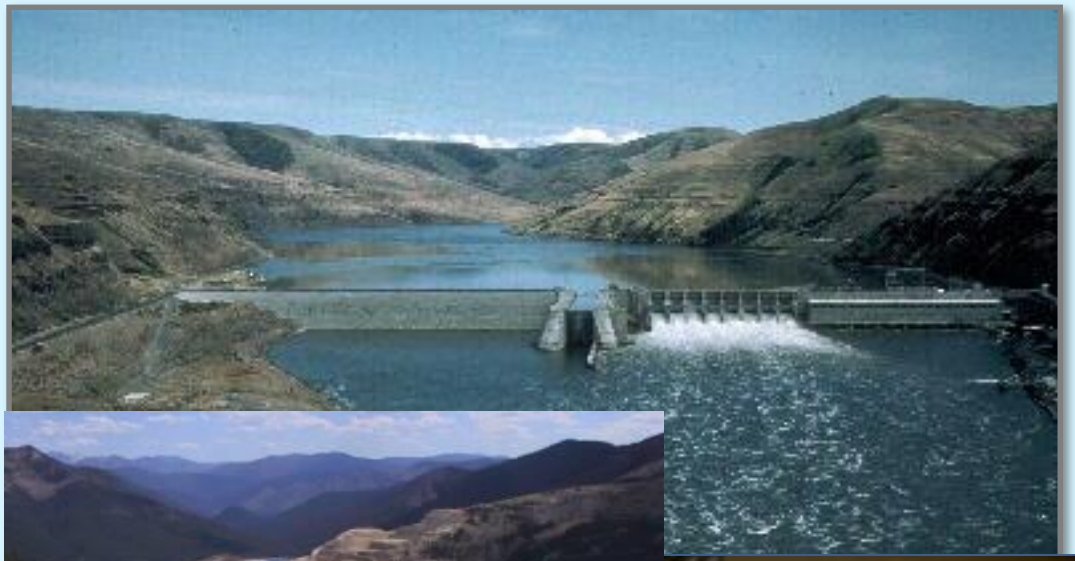


Figure 1: Overview map showing general location of the Koktuli River.
The map also provides land status information of surrounding area.

Stability and productivity derive from diverse and changing habitat

Bristol Bay, Alaska

Pacific Northwest



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University of Washington

NOAA