Sockeye salmon & marine ecology

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North Pacific Marine Science Organization

PICES

Mandate

To promote and coordinate marine scientific research
To promote the collection and exchange of information and data related to marine scientific research

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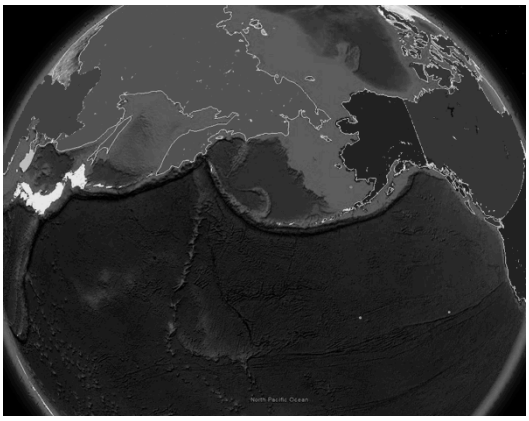
Established in 1992



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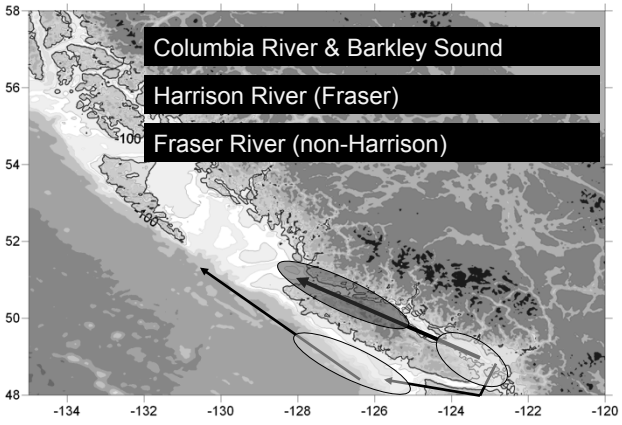
PICES Story

What happened to the 2009 return?
- DFO forecast was for lots!
- 77 million smolts from Chilko L.

Why so few for so long?
- Little or no fishing in 2007, 2008, 2009
- Low survival since early 1990s

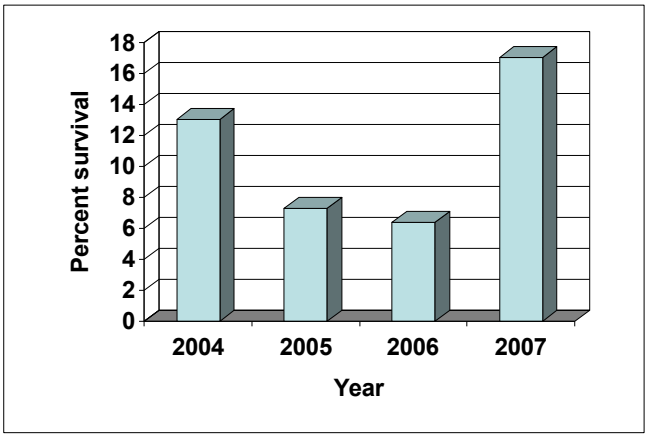
Follow-up questions
- Why were there so many fish in 2010?
- Do volcanos create salmon?

Run in 2009 went to sea in 2007



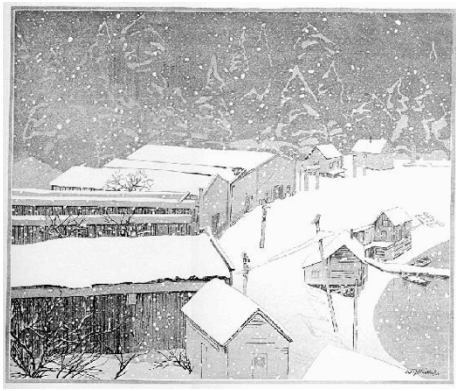
Focus on 2009 return

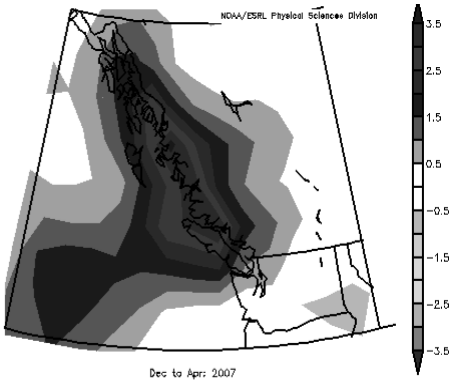
Survival in St. of Georgia



Welch et al. (2009) Acoustic tagging of Cultus L. sockeye smolts

Snow in 2007





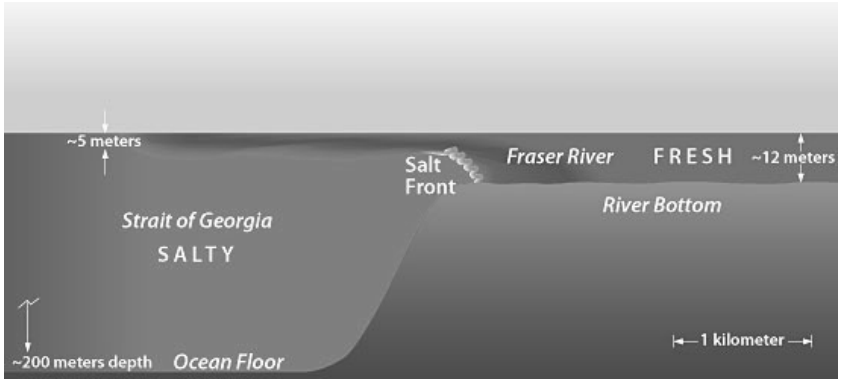
- 4.2 m (14 ft) more snow than an average year
- most accumulated on the Coast Mountain Range
- greatest amounts from Bute Inlet to Chatham Sound

Spring Flood

River	Rank of 2007 peak week
Cowichan	11
Fraser	17
Puntledge	51
Homathko	9
Klinaklini	2
Wannock	1
Bella Coola	2
Bulkley	1
Skeena	3
Stuart	7
Nass	1
Stikine	1

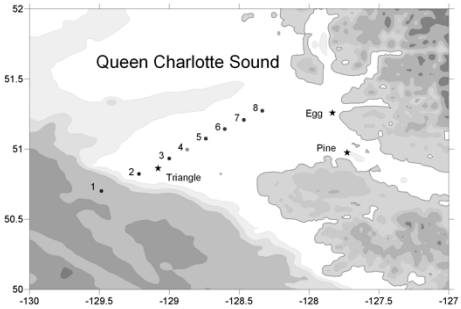
Mission City June 6, 1894 (Vancouver City Archives)

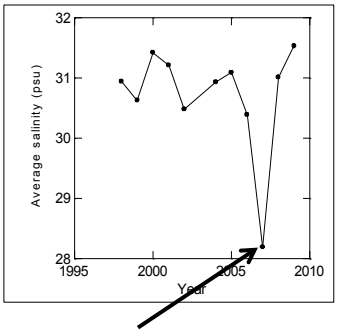
Fresh meets Salt



Two layers of water

Qu. Charlotte Sound Salinity

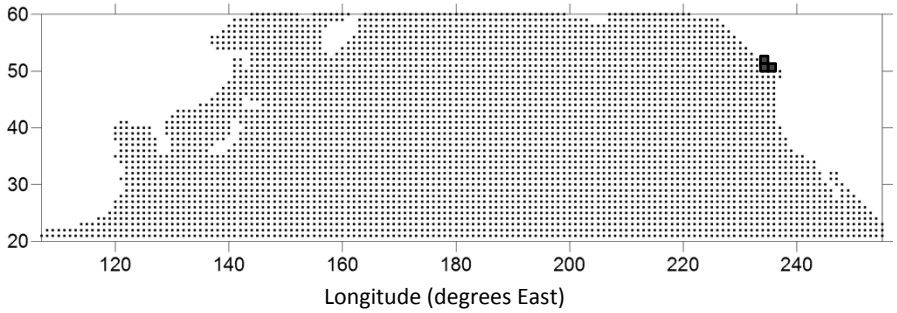




2007 is much fresher

Exposure to warm air in summer warms the upper layer

Temperature extremes in 2007

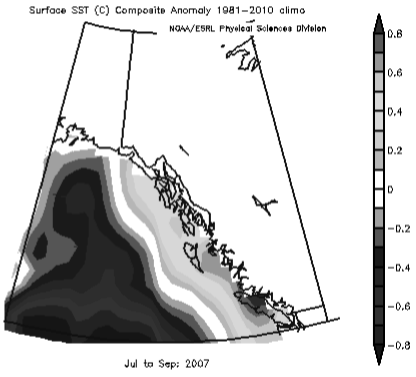


Sockeye salmon don't like warm water

Data: U.S. NOAA

Summer 2007

- Winter stayed through July in 2007
- Winter (SE) winds bring heat northward along the coast.
- Coastwide warming
- No effect on survival of West coast migrants
- Additional warmth from the fresh water layer in Q.C. Sound



Trophic Gauntlet Hypothesis

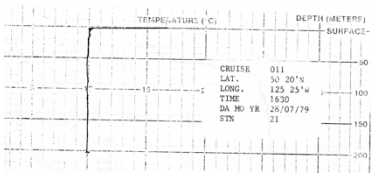
(Long migration, No food, you Die)

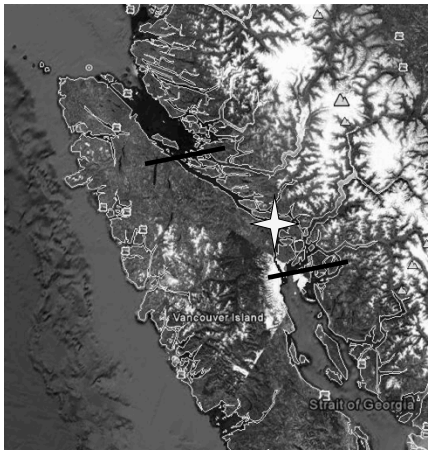
Hecate Strait 1986 and 1987

- "[juvenile salmon] *stomach contents and estimated daily rations were small enough to limit growth rates for all three species, especially sockeye salmon*." (Healy 1991)
- No salmon farms, before 1990s decline, sockeye salmon migrating through were in poor condition.
- Maybe this happens in most years!
- Why?

Trophic Gauntlet Hypothesis

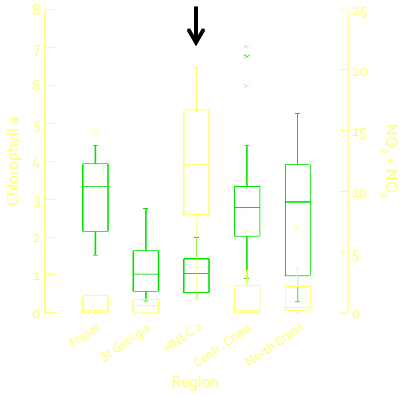
1. From Desolation Sound to Qu. Charlotte Strait, oceanography is like permanent winter.
2. Caused by tides and narrow channels
3. Little biological production (plankton)
4. Gauntlet for migrating sockeye to pass
5. Most survive because they can recover in QCS



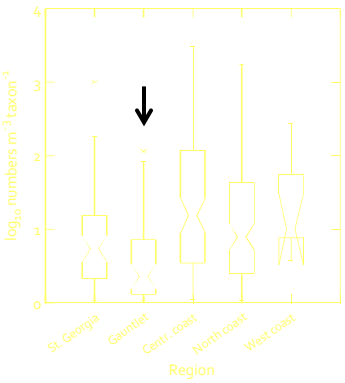


How does each region grow?

Phytoplankton (chlorophyll)
Plant nutrients (nitrogen, etc)



Zooplankton (salmon food)



Summary

- Acoustic tagging indicates average survival through the SoG in 2007
- Also seen in Harrison
- Climate extremes in the winter of 2007 created a sockeye-unfriendly environment in QCS
- Poor feeding after the Trophic Gauntlet
- Poor survival

Trophic Gauntlet Hypothesis is testable

- Monitor the condition of sockeye going into Desolation Sound and again when they come out at the other end in Q.C. St.

Decline - trend or shift?

Population	Shift	Trend	Which is better?	Trend gone?	Year of shift
Birkenhead				√	1991
Bowron				√	1994
Chilko				√	1992
Early Stuart				√	1989
Fennell				X	1980
Gates				X	1976
Harrison					
L. Shuswap				√	2003
Late Stuart				√	1992
Nadina				√	1999
Pitt				√	2002
Portage				√	1999
Quesnel				X	1995
Raft				√	2002
Scotch Ck.				√	1990
Seymour				√	1974
Stellako				√	2001
Weaver					1990