

Climate variation and natural selection in salmon: Simon and Garfunkel were right

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Global warming!

Climate change

Climate variation

Pacific
Decadal
Oscillation
(PDO)

El Nino

Many scientists have focused on the predicted *warming trend*, and on the *ecological processes*.

What about *other effects* of climate?

What about *evolutionary processes*?



Wood River system

- ~1,000,000 sockeye spawn per year
- Drains 300,000 ha
- > 50 spawning populations

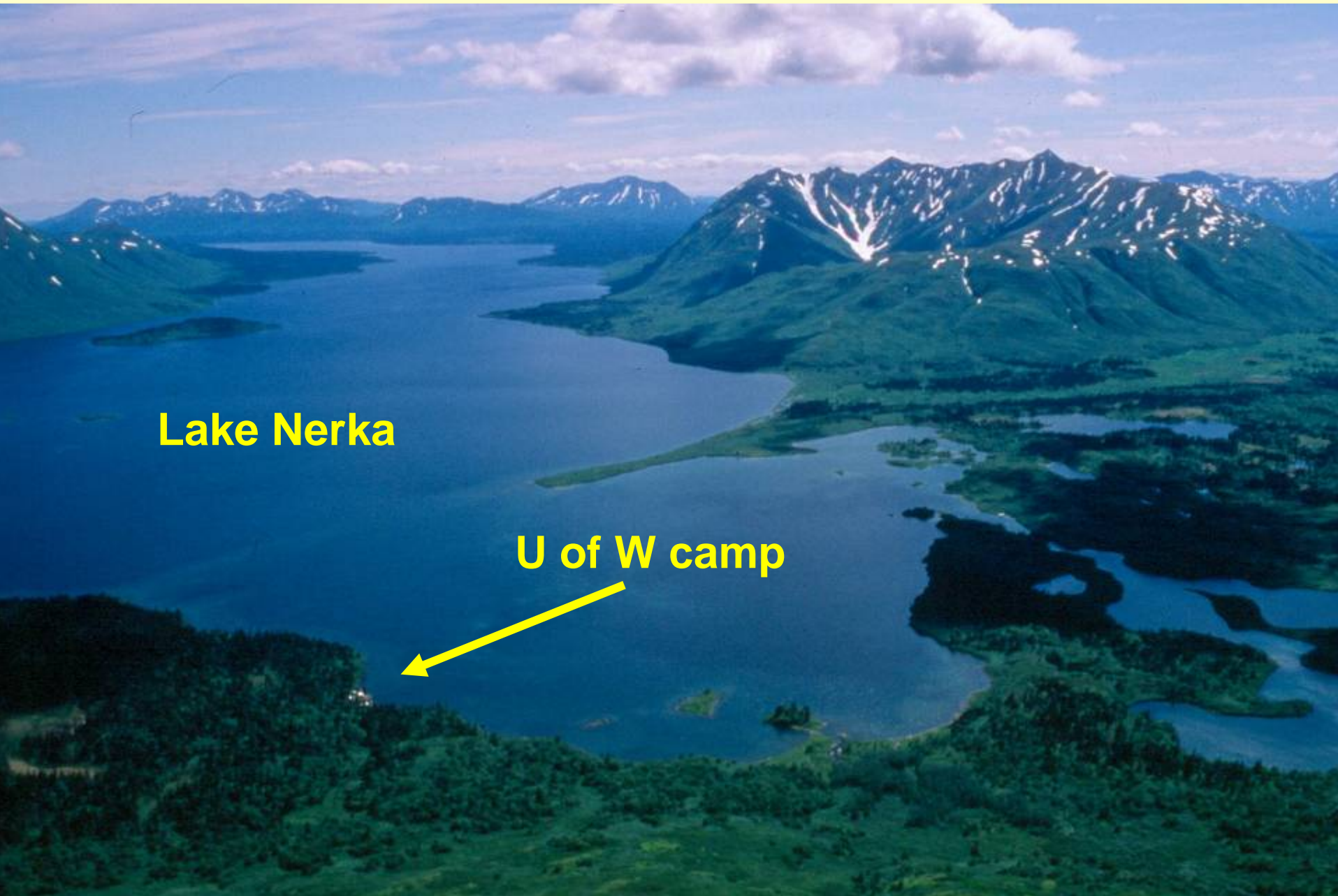
Bristol Bay,
Alaska

Sockeye salmon (*Oncorhynchus nerka*)



H. Rich

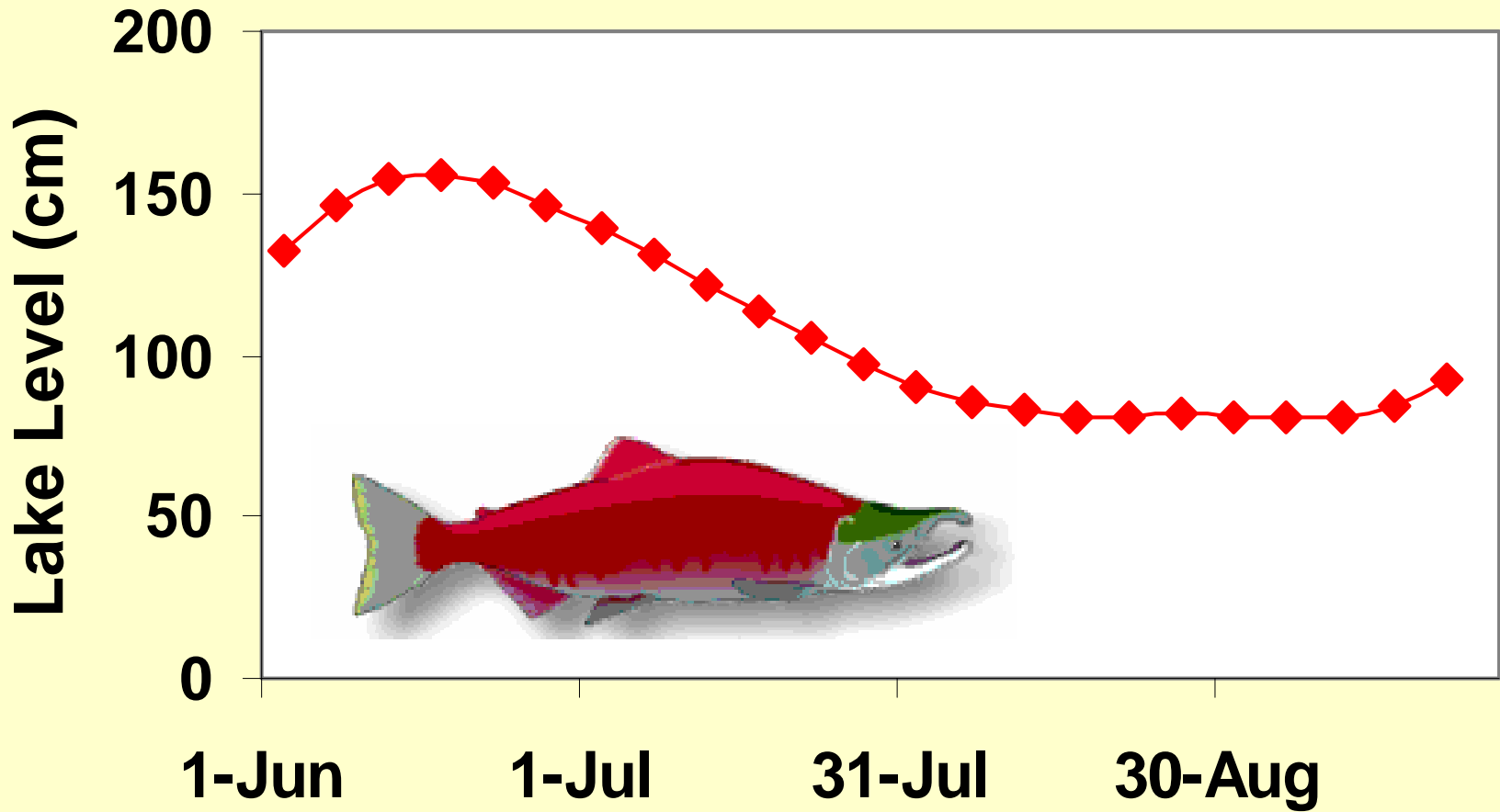
Lake level: not as boring as you might think...



Lake Nerka

U of W camp

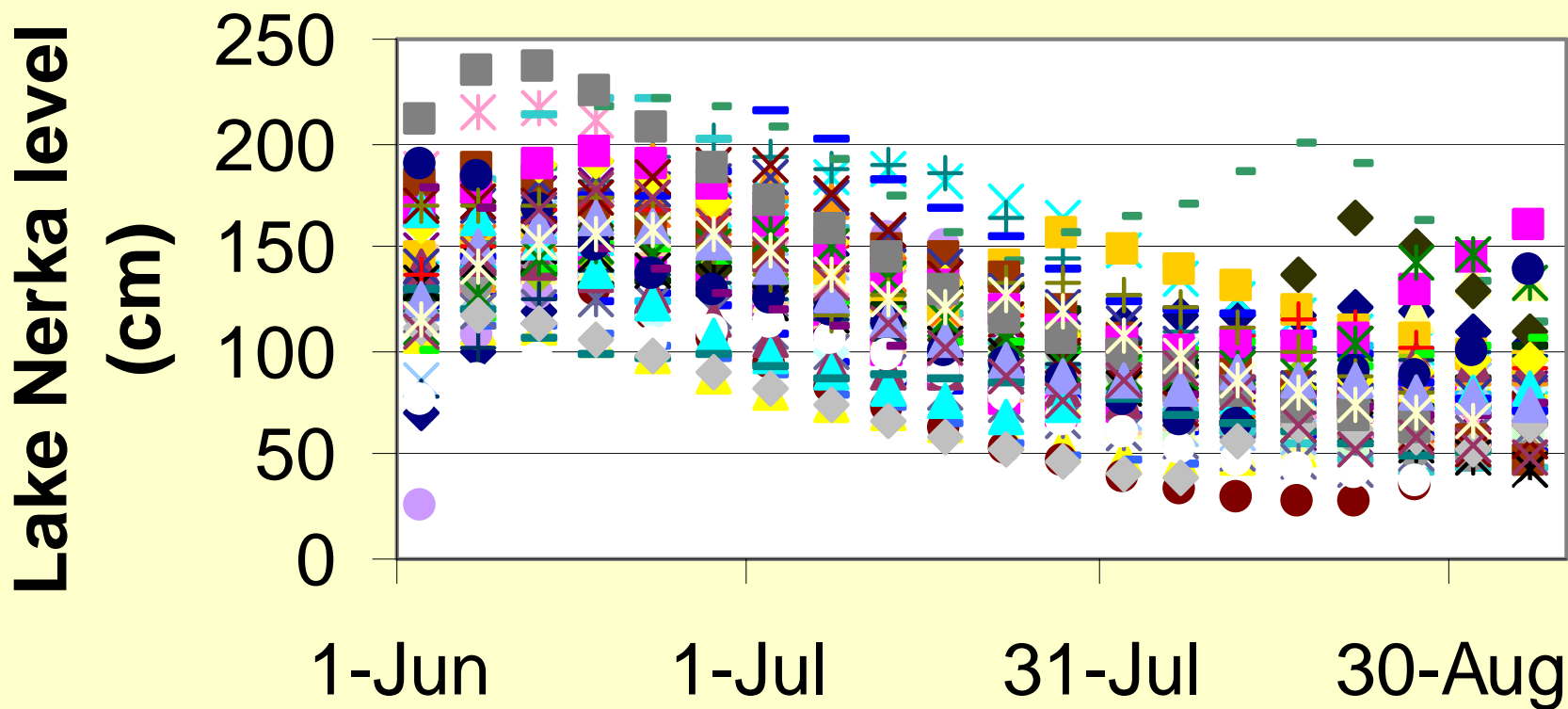
Average level of Lake Nerka (> 50 yrs)



Lake levels rise in spring as snow melts, then fall during summer except after heavy rains

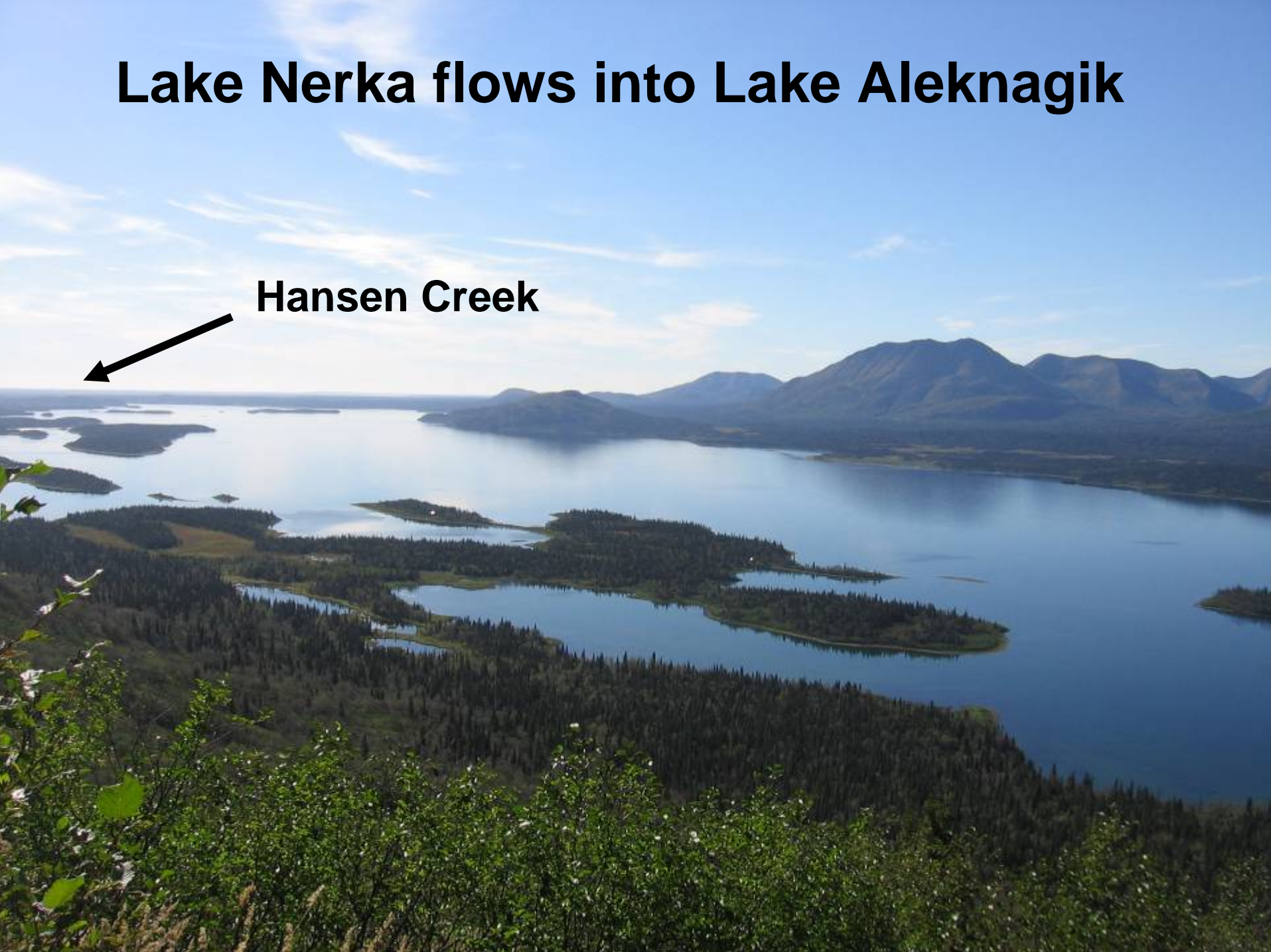


There is great variation in lake level
(5 day averages, each color is a different year)



Lake Nerka flows into Lake Aleknagik

Hansen Creek



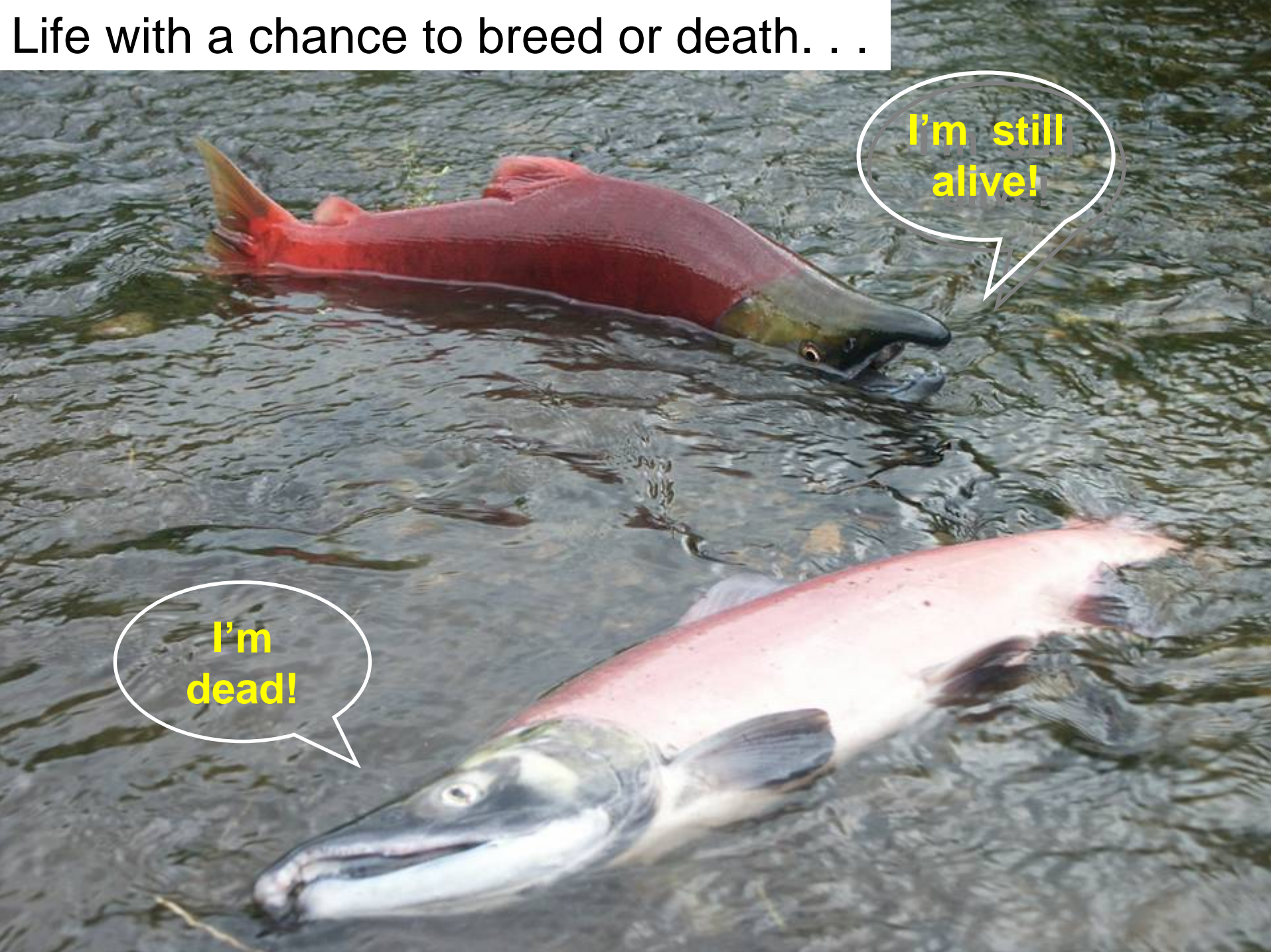








Life with a chance to breed or death. . .



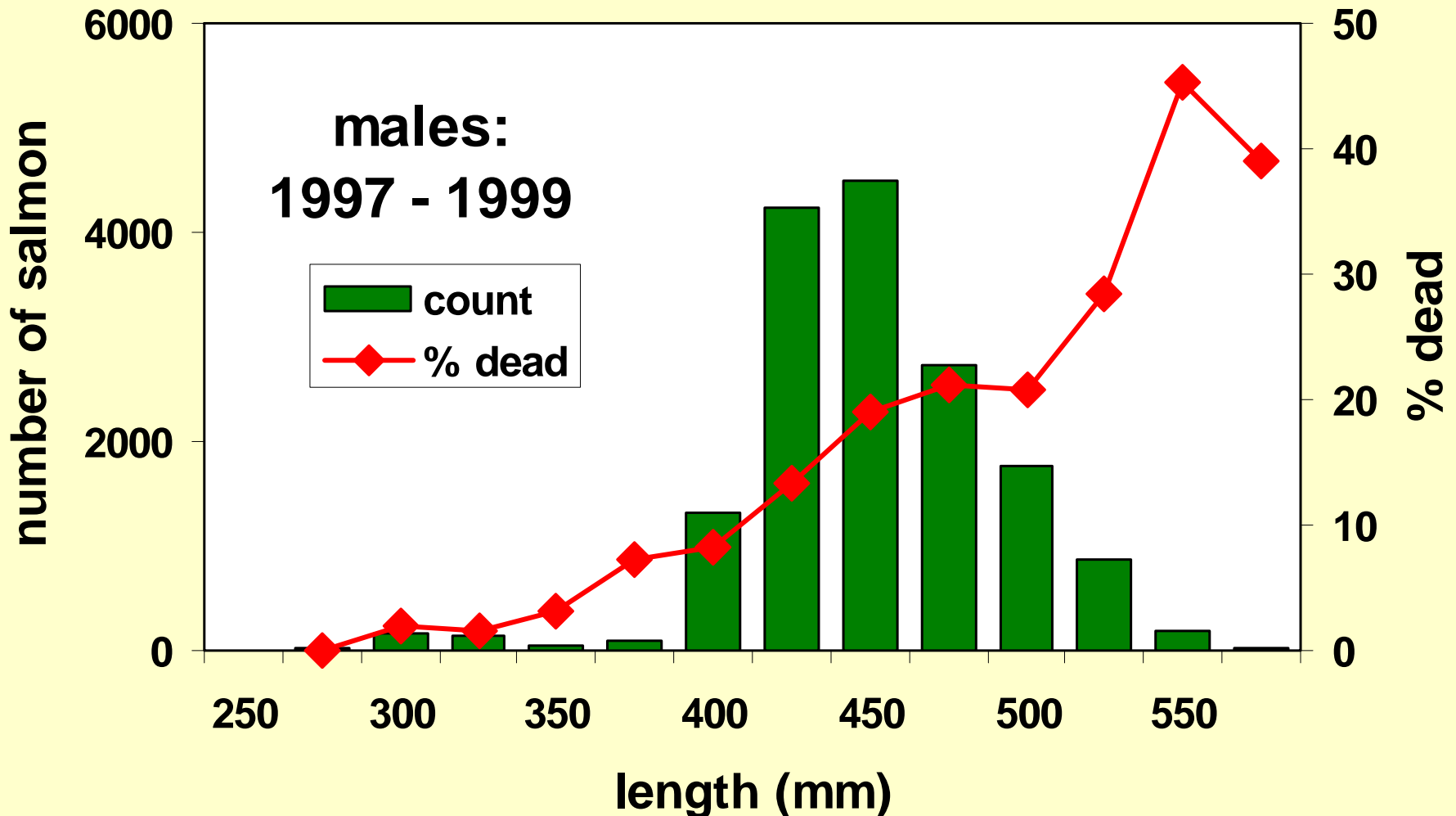
I'm still alive!

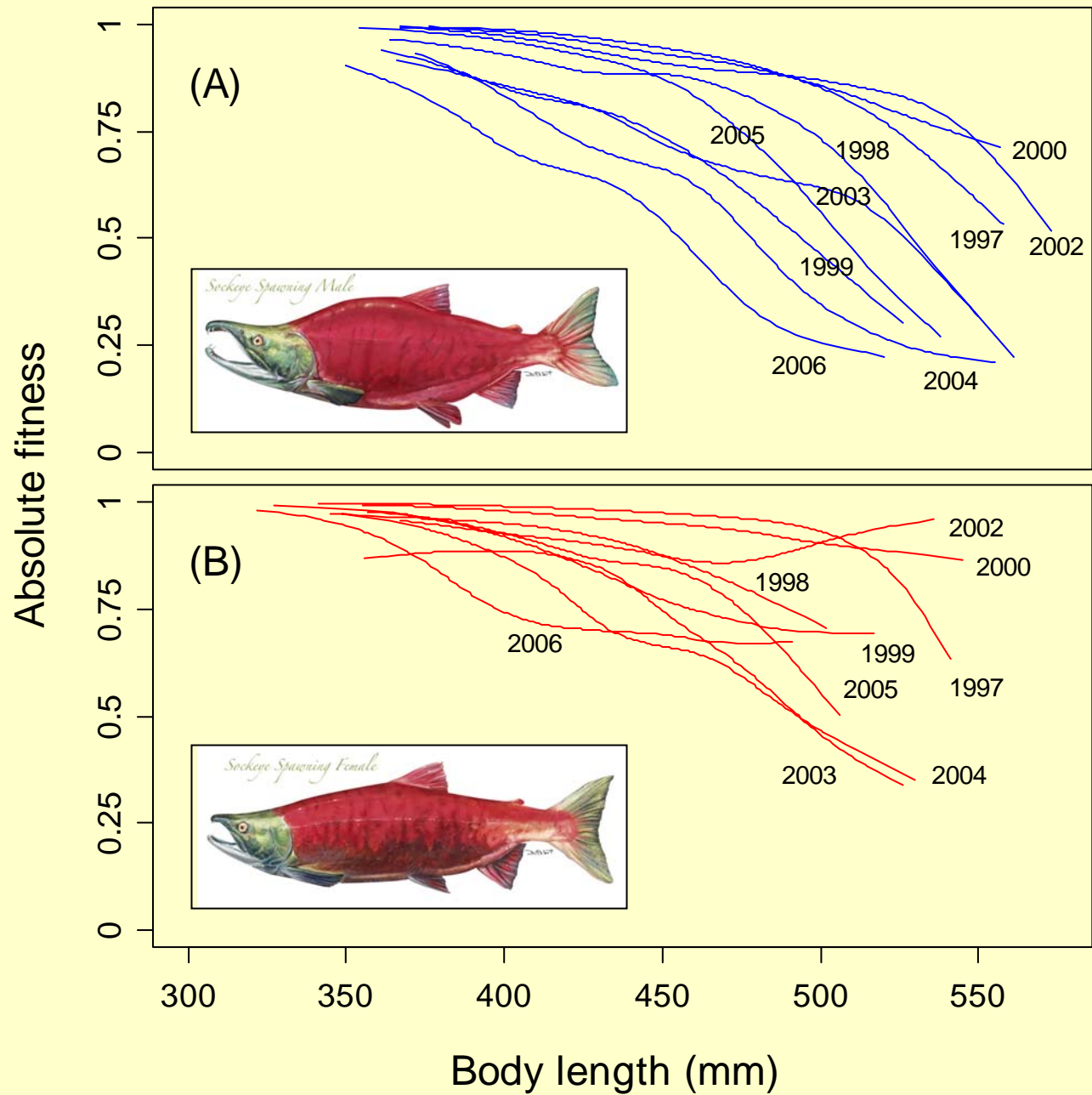
I'm dead!

Research Questions:

- 1) Is stranding mortality size-selective?
- 2) Does mortality rate vary with lake level?
- 3) Does selection intensity vary with lake level?
- 4) What climate factors affect lake level?

Mortality at the mouth of Hansen Creek is size-selective and can be severe





Do changes in lake level affect the magnitude and selectivity of the mortality?

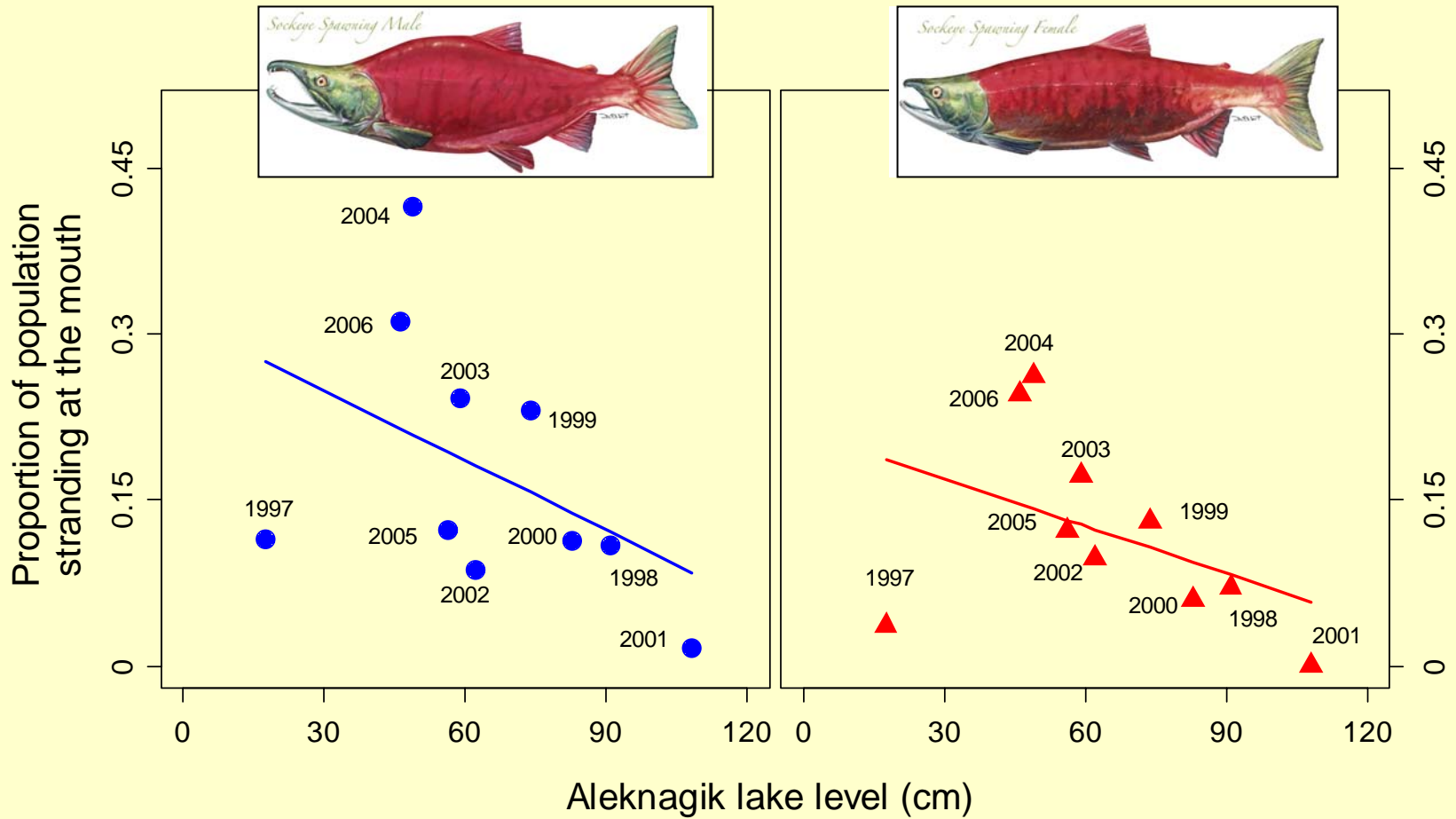


1999

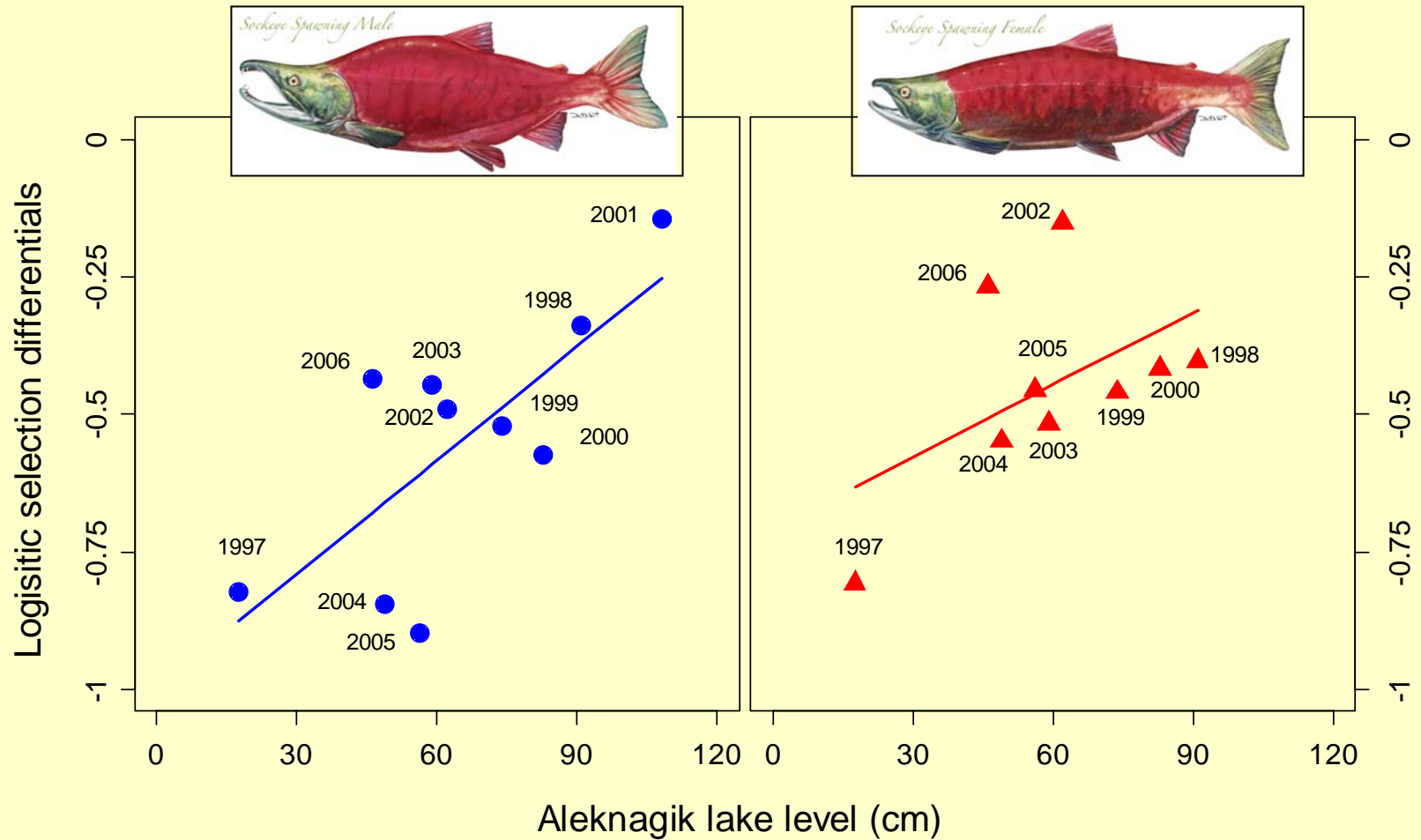


2001

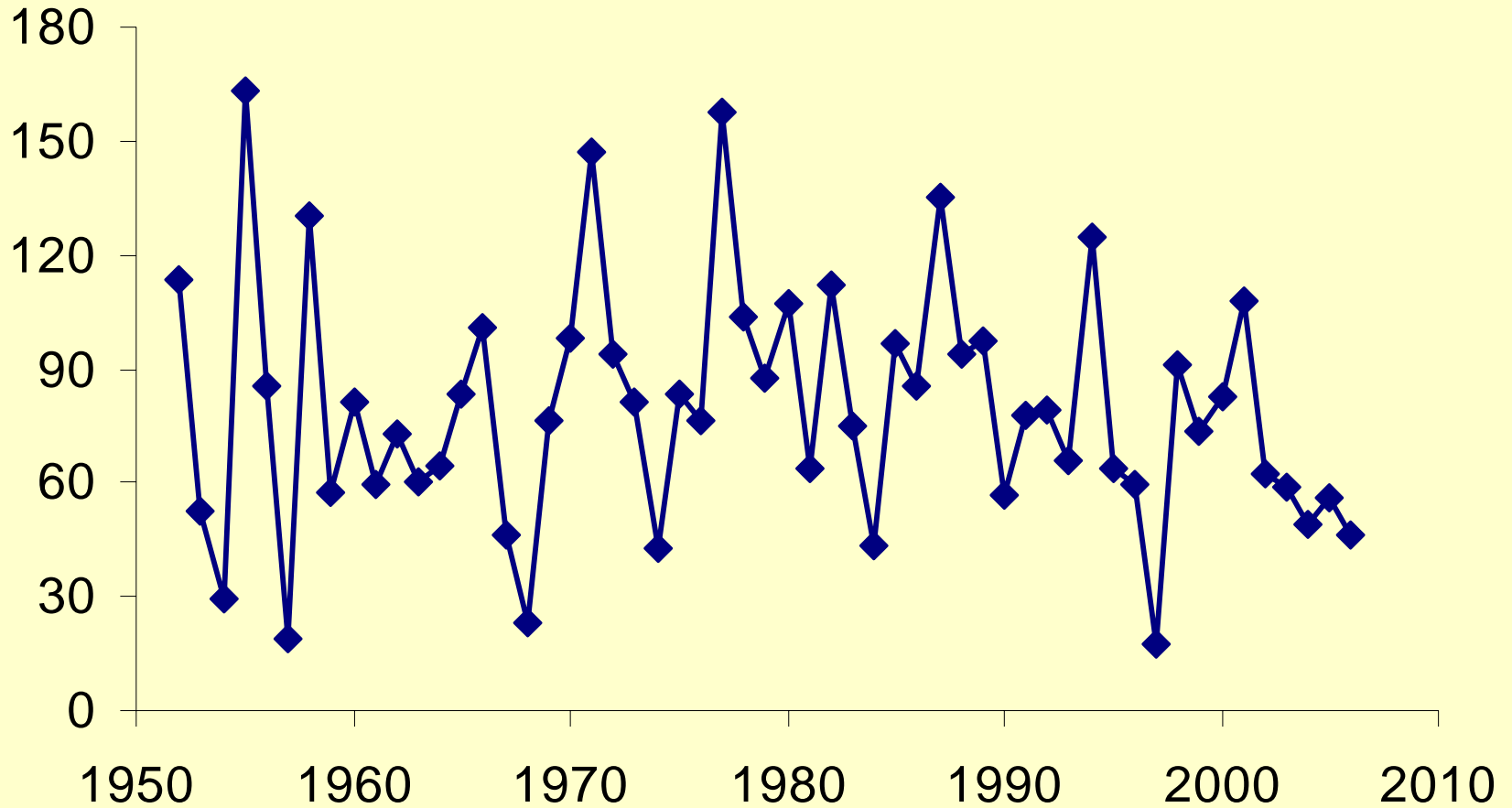
A higher proportion of the fish strand when the lake is low

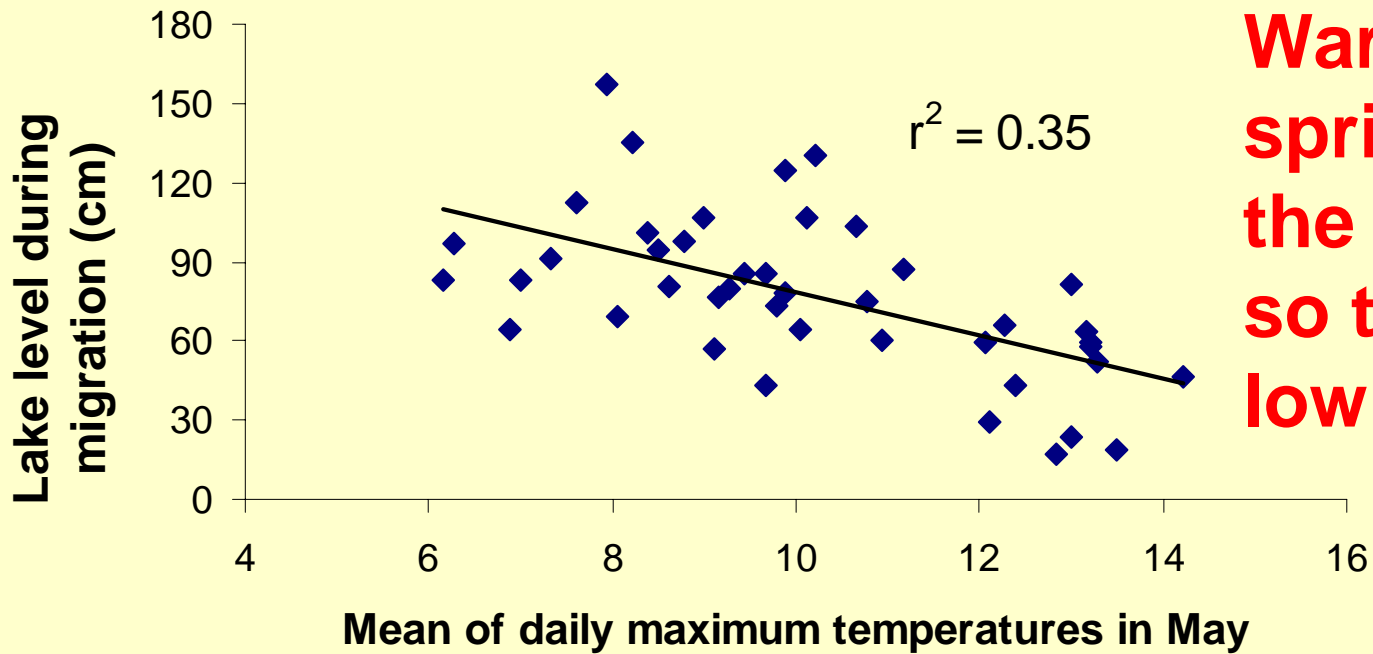


Stranding mortality is more size-selective when the lake level is low

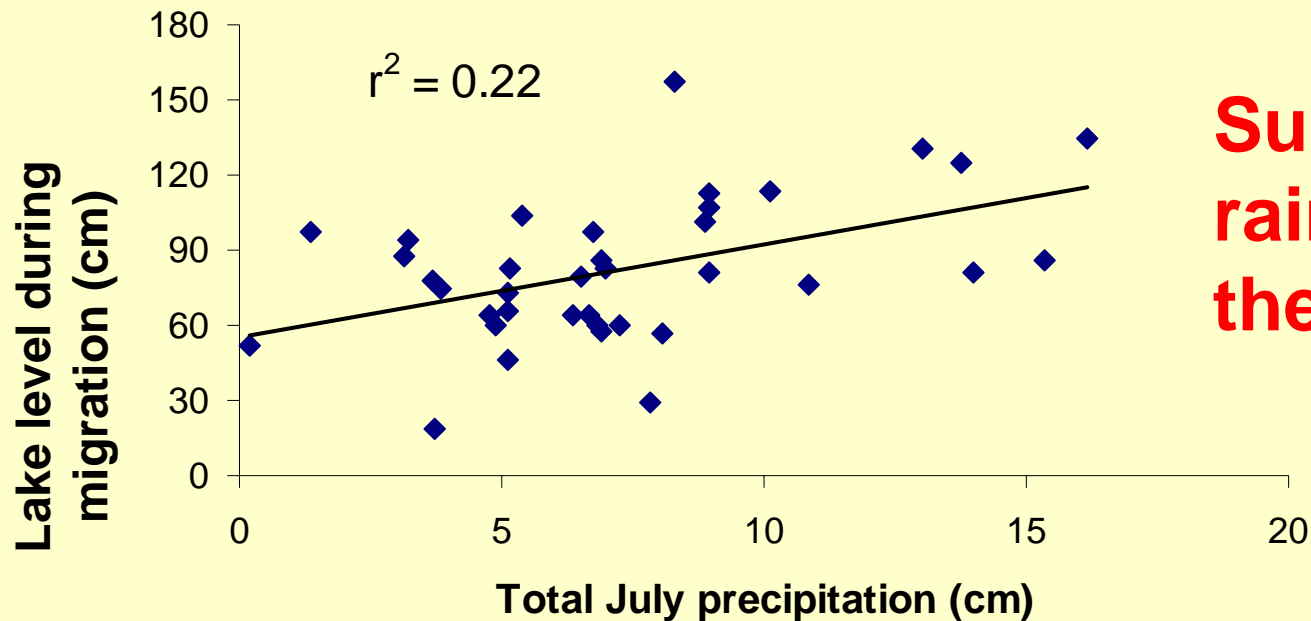


Lake level during the migration period has varied greatly among years with no clear trend. What factors control it?





Warm air in spring melts the snow early so the lake is low in July



Summer rains re-fill the lakes

Conclusions

- 1. Access by sockeye salmon to Hansen Creek is affected by lake level.**
- 2. Stranding mortality is size-selective, and precludes any chance of reproduction.**
- 3. When the lake is low, both the rate and the selectivity of stranding mortality increase.**
- 4. Lake level is affected by May air temperature (melting the snow) and July rainfall.**
- 5. Lake level reinforces size-selective bear predation in the evolution of small size and early age at maturity of these salmon.**

So, Simon and Garfunkel were right!

“I get the news I need on the weather report”



From: The Only Living Boy in New York