

# A survey of the coast-wide collapse in NE Pacific Chinook and Steelhead survival: Looming problems for set piece solutions

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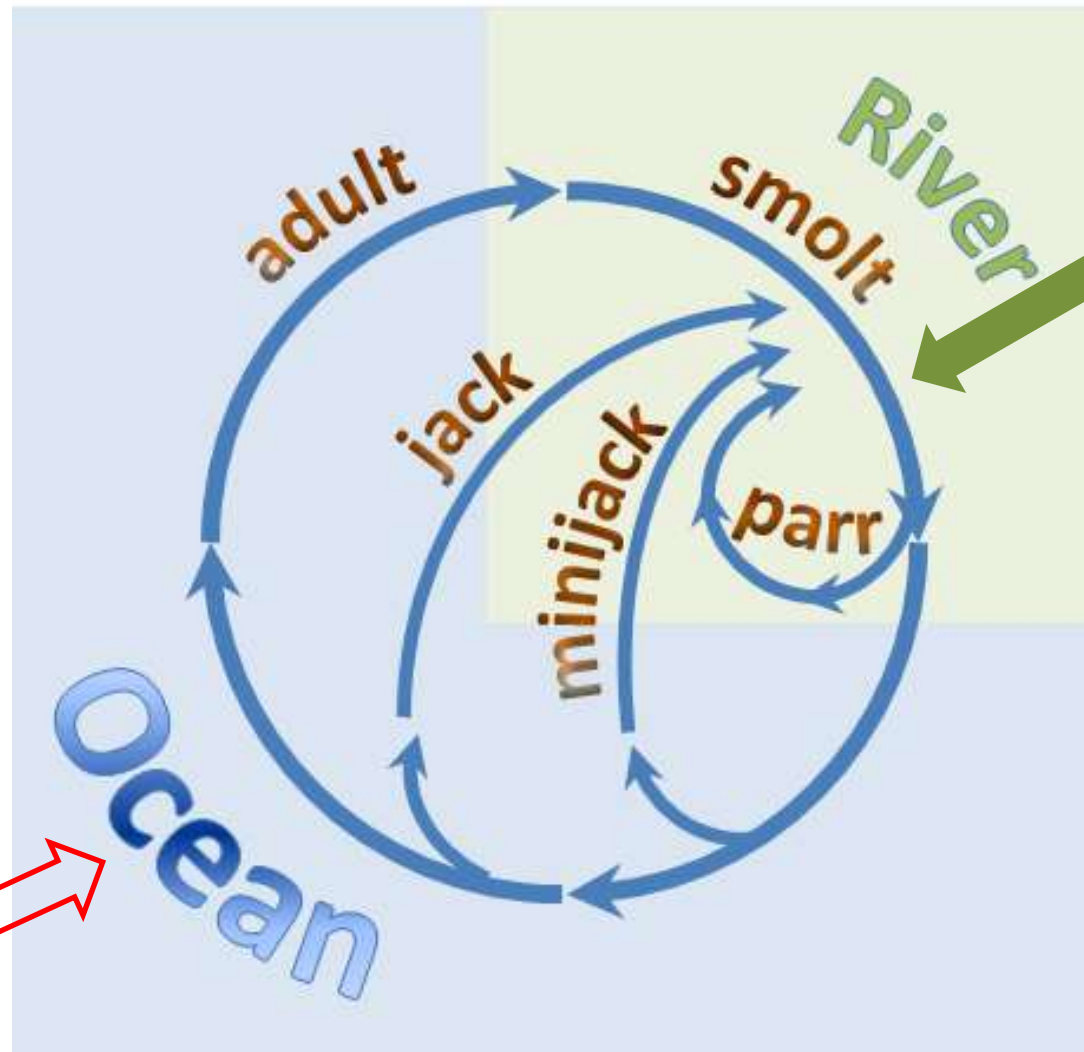
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Aswea Porter, M.Sc.



# The Real Salmon Habitat Problem: There are Many Habitats!!

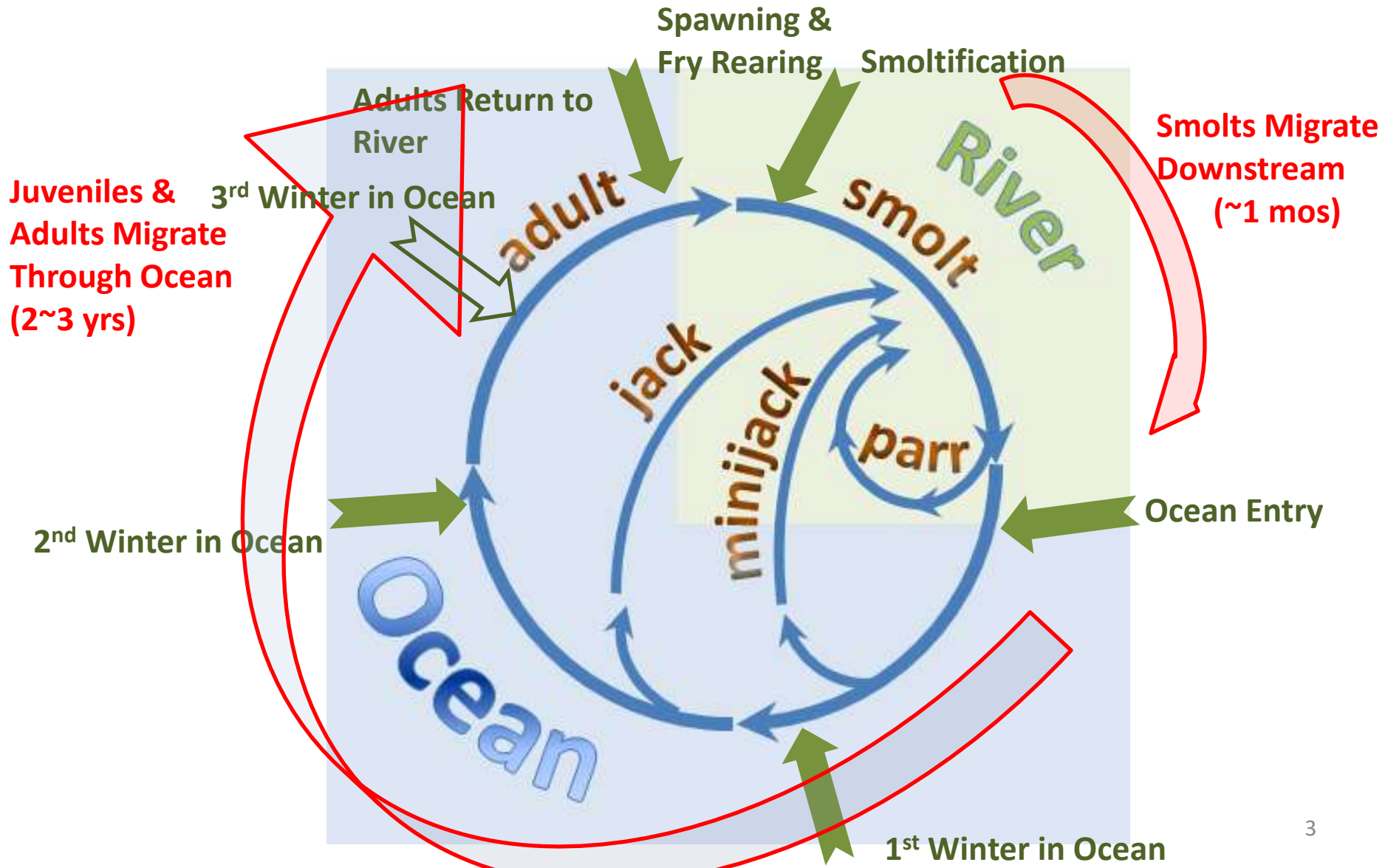


If the Ocean is the problem...

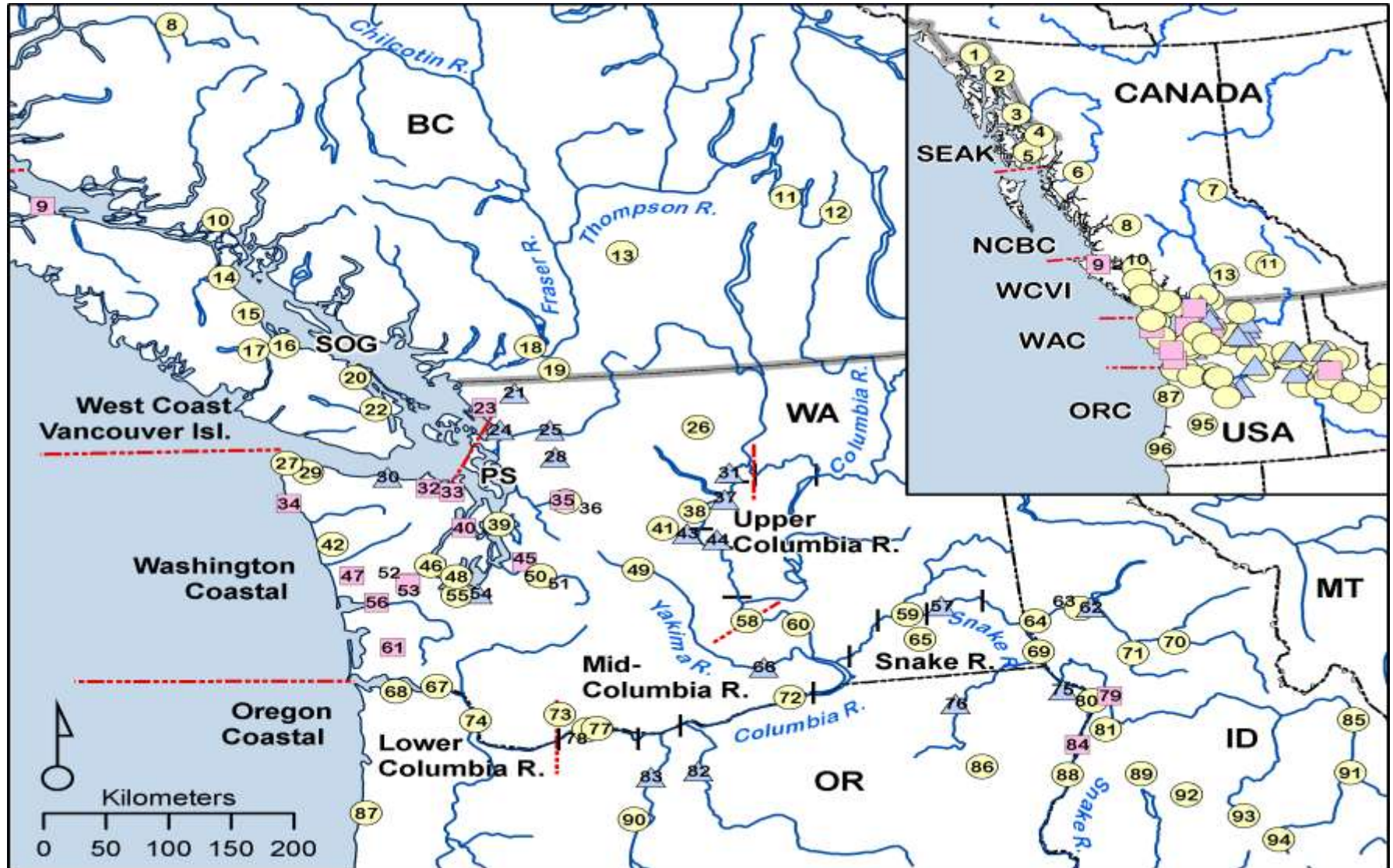
...can we make enough modification to freshwater to compensate?  
... And how do we do so??

*And are we even approaching the problem in the right way?*

# Measuring Smolt-to-Adult Survival (SARs)



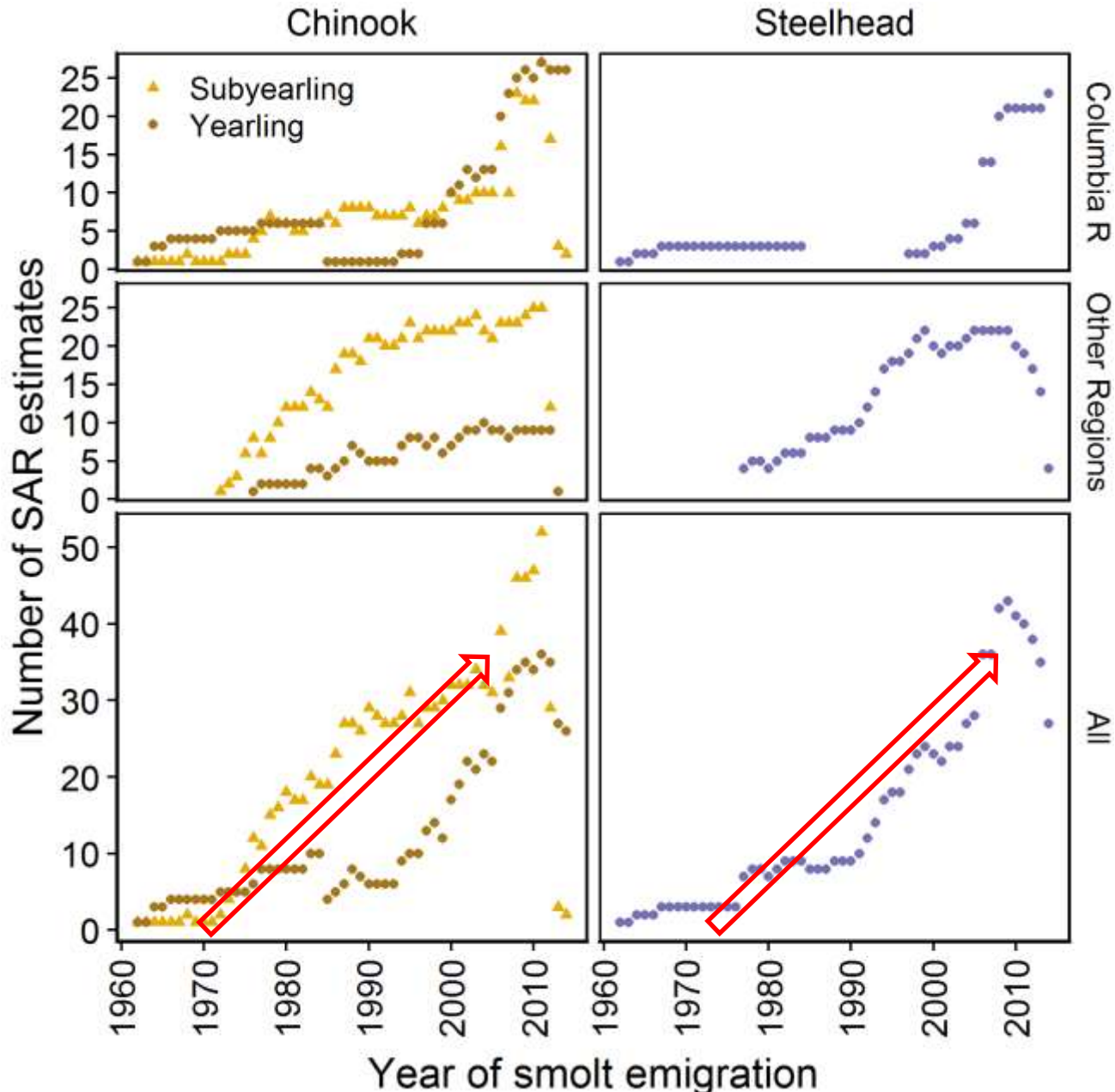
# The Current Study: Coast-wide Salmon Survival for Chinook & Steelhead



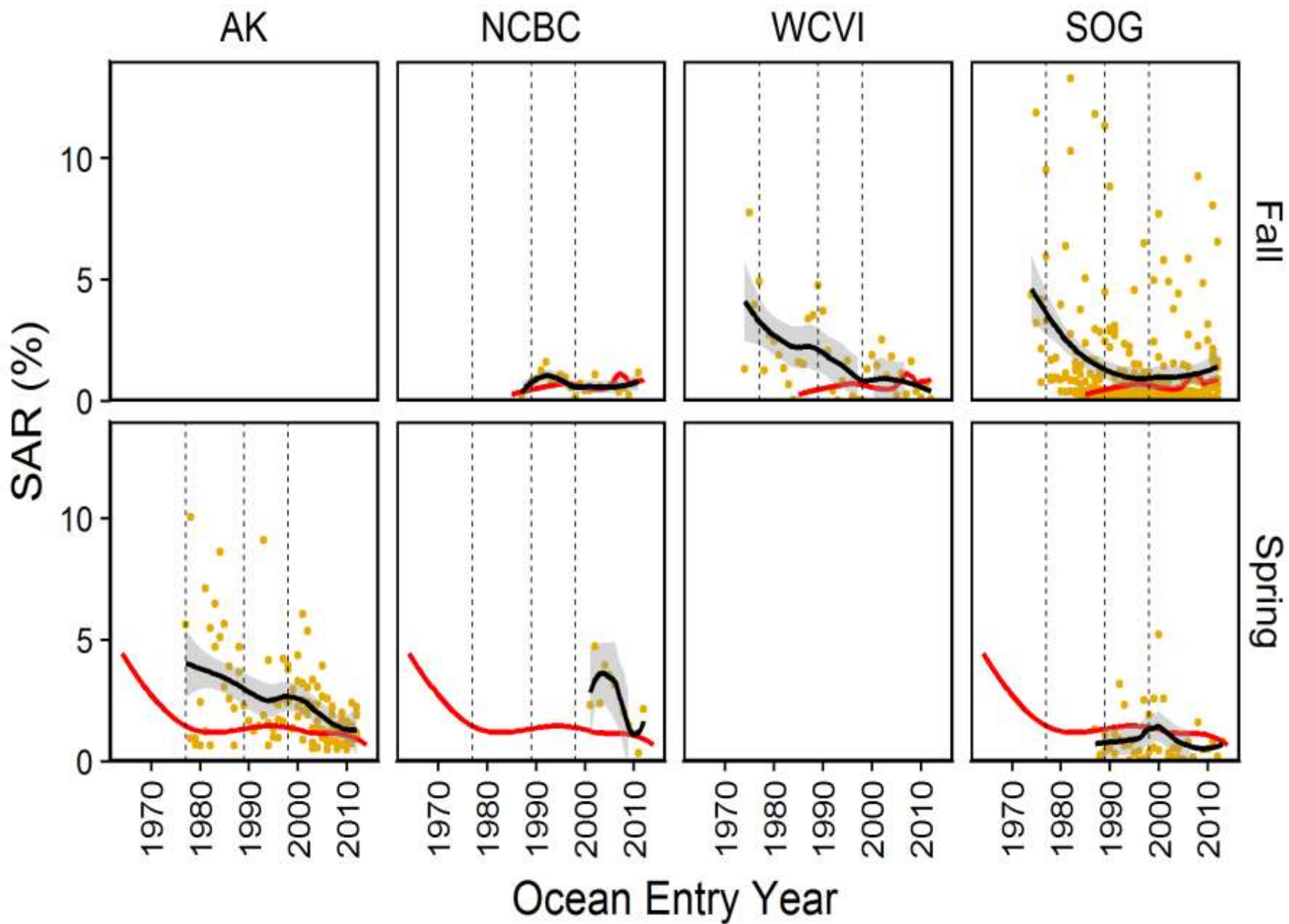
# Chinook & Steelhead SAR Data

- Chinook survival data from Pacific Salmon Commission
  - 1) Smolt-to-adult survival data submitted by State & Federal agencies for the west coast of North America (*CWT-based*)
  - 2) Columbia River data from Fish Passage Center (*PIT*)
- Steelhead survival data not available for Province of BC hatcheries, but available for Washington State (courtesy Dr Nealla Kendall; *CWT-based*).
- B.C. contributed the long-running Keogh River wild steelhead survival dataset (*Mark-recapture*)
- In total, 3,055 years of annual survival available estimates for analysis (a few datasets characterized as “*experimental*” excluded)

# As SARs Drop, Monitoring Increases



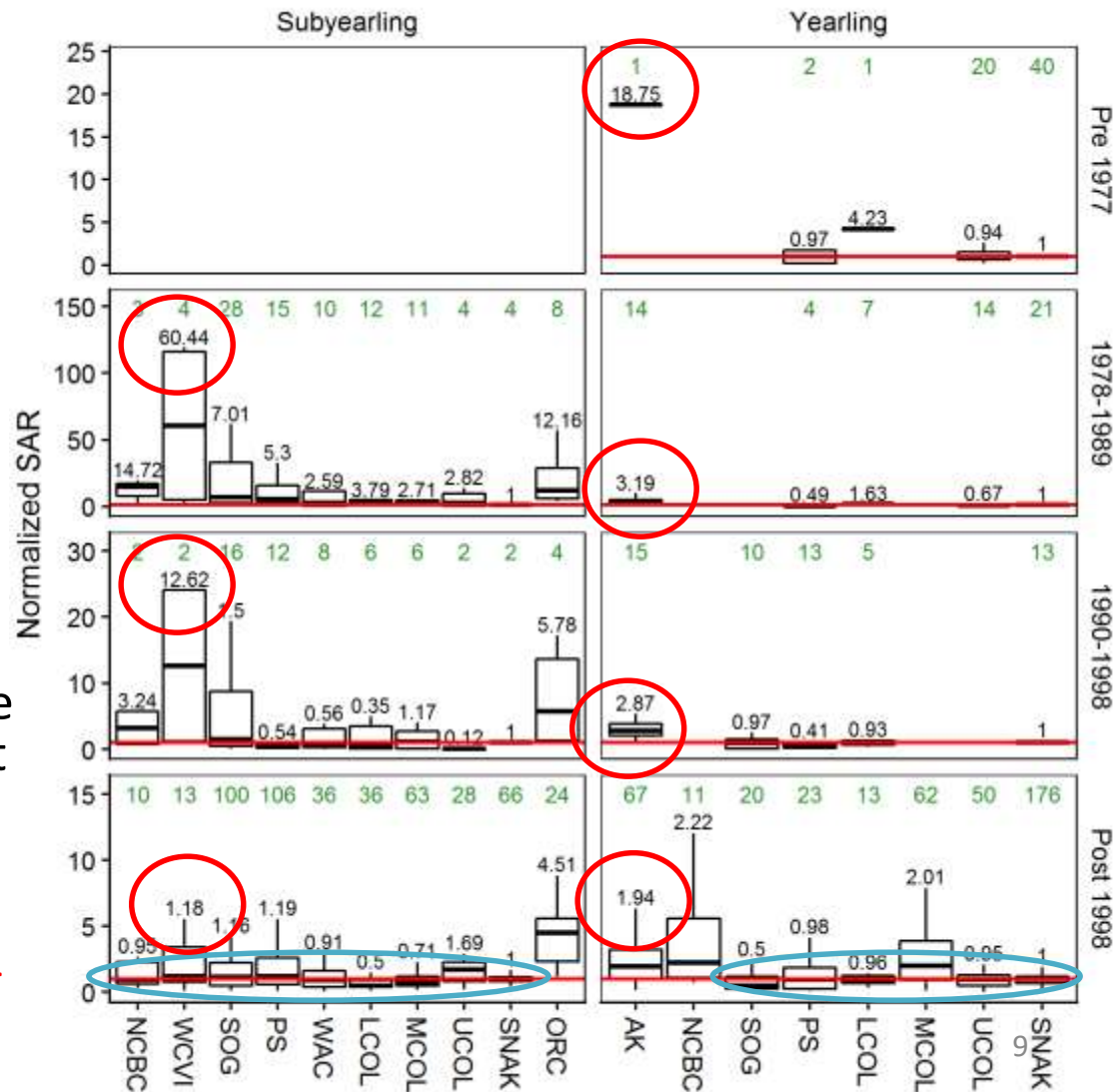






# Chinook SARs Normalized by Snake River Median SARs (i.e., Relative Survival)

- Compared SARs for the west coast of North America (excl. California)
- SARs are scaled by dividing by annual Snake River values
- So  $SAR_{SnakeRiver} = 1$
- The major regional difference in SARs seen in earlier time periods no longer exists
- Almost all regions now have SARs equivalent to the Snake River
- Even AK & NCBC SAR difference now ***much*** smaller...and almost the same in the most recent years
- How can we recover salmon if Alaska & N. BC can't with near-pristine freshwater habitat??



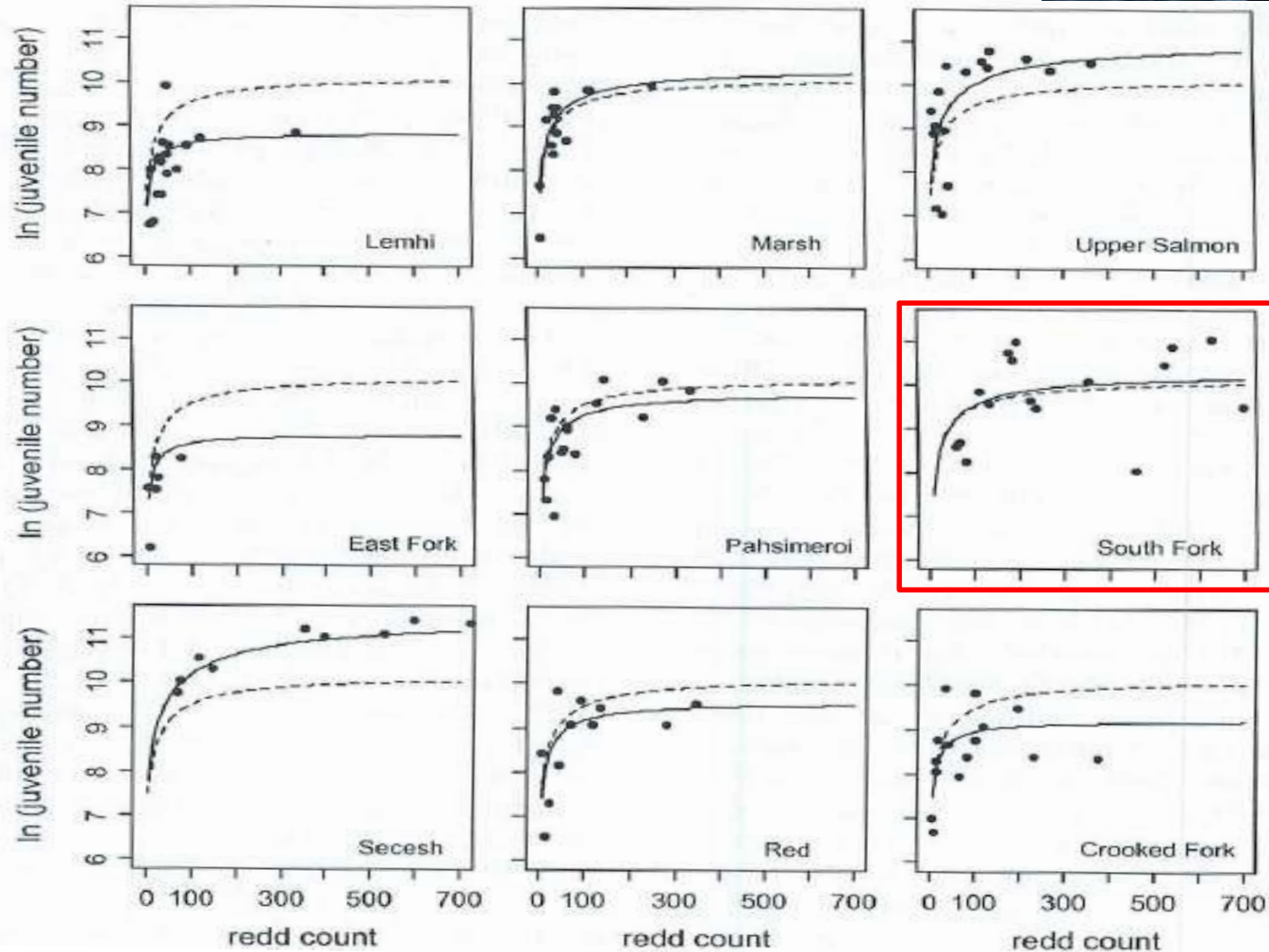
# Conclusions

- 1) Almost all regions of the west coast show large drops in salmon SARs over time
  - A. This includes regions with essentially pristine freshwater habitats (→ SE Alaska, N. BC)
  - B. We don't know where in the life cycle survival is dropping but it is likely marine
  - C. Geographically widespread declines in SARs raise important questions about how effective point-source recovery actions can be

# DENSITY-DEPENDENCE IS UBIQUITOUS

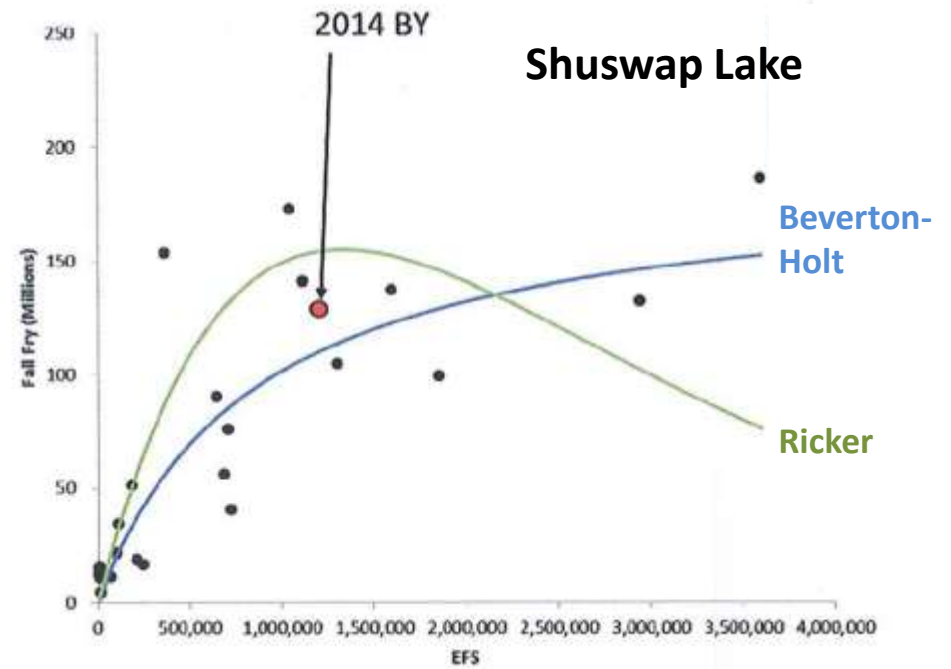
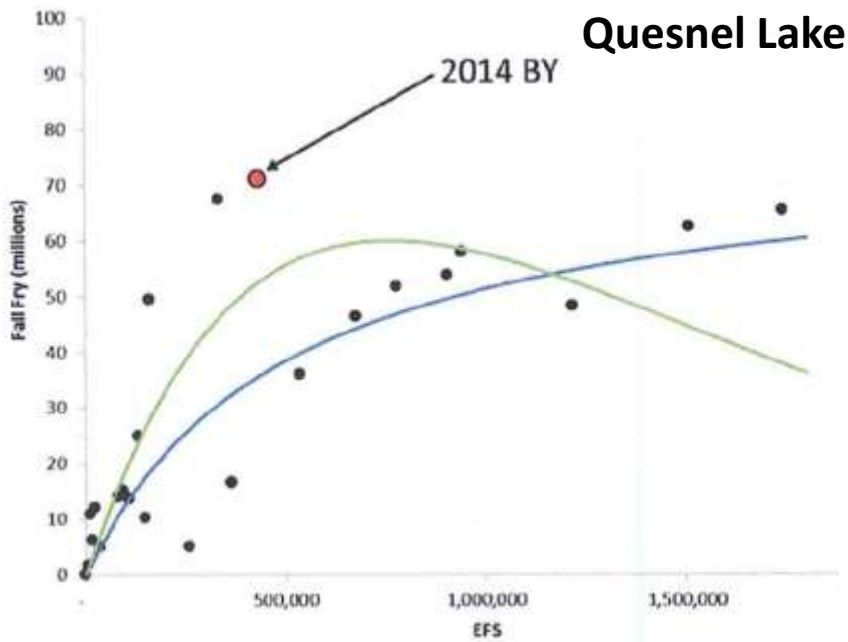
- **Columbia River basin:** *“Strong density-dependence is now evident in at least 25 of 27 Spring/Summer Chinook populations, the Snake River Fall Chinook ESU, and all 20 steelhead populations examined upstream of Bonneville Dam”* **Independent Scientific Advisory Board (2015)**

# Snake River Chinook



Reference: Walters, A. W., T. Copeland and D. A. Venditti (2013). "The density dilemma: limitations on juvenile production in threatened salmon populations." *Ecology of Freshwater Fish* 22(4): 508-519. (Fig. 2)

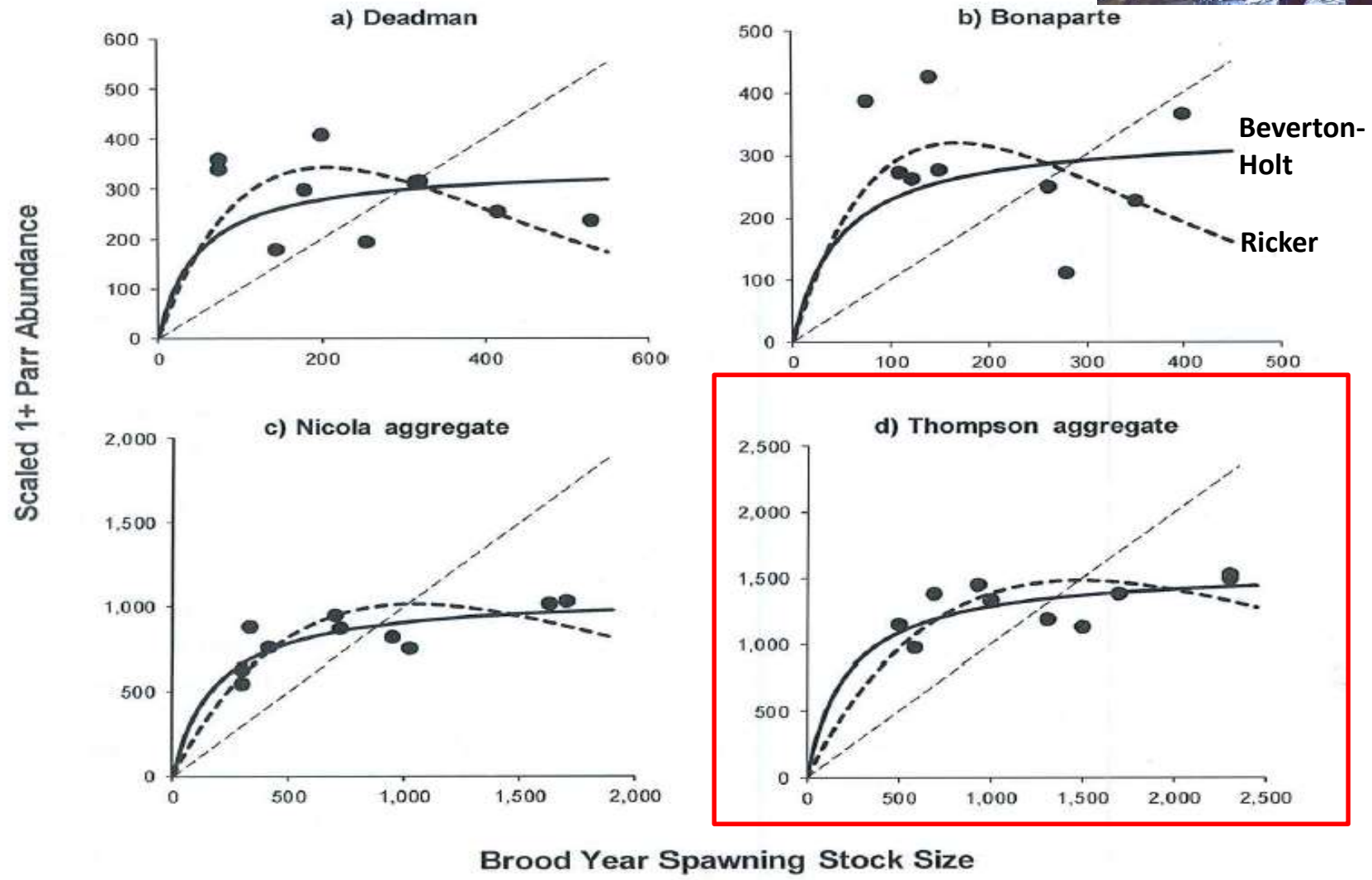
# Fraser Sockeye



Reference: MacDonald et al (2018). State of the Salmon: Informing the survival of Fraser Sockeye returning in 2018 through life cycle observations. DFO. Can. Tech. Rep. Fish. Aquat. Sci. 3271: 53 + v pp.

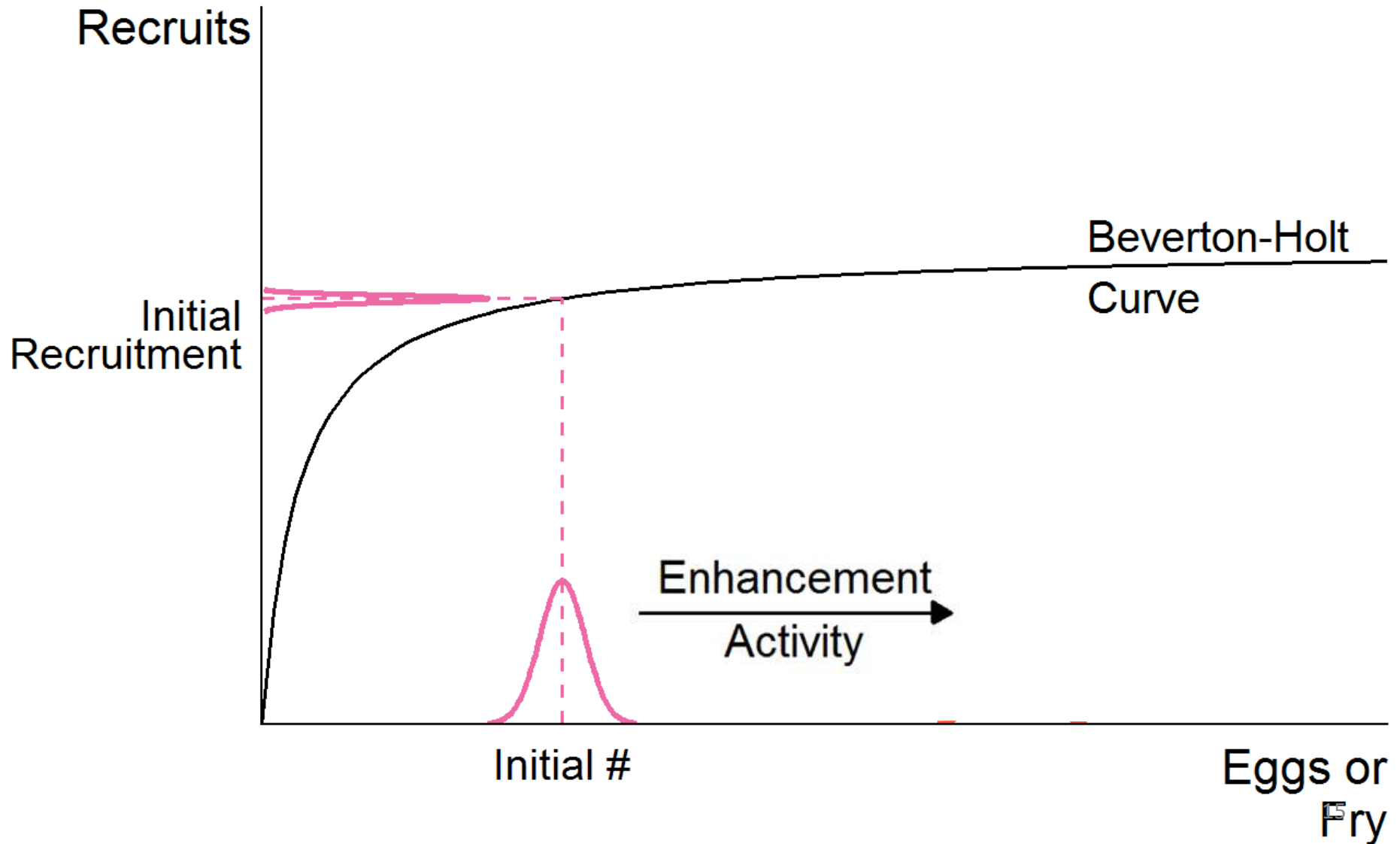


# Interior Fraser Steelhead

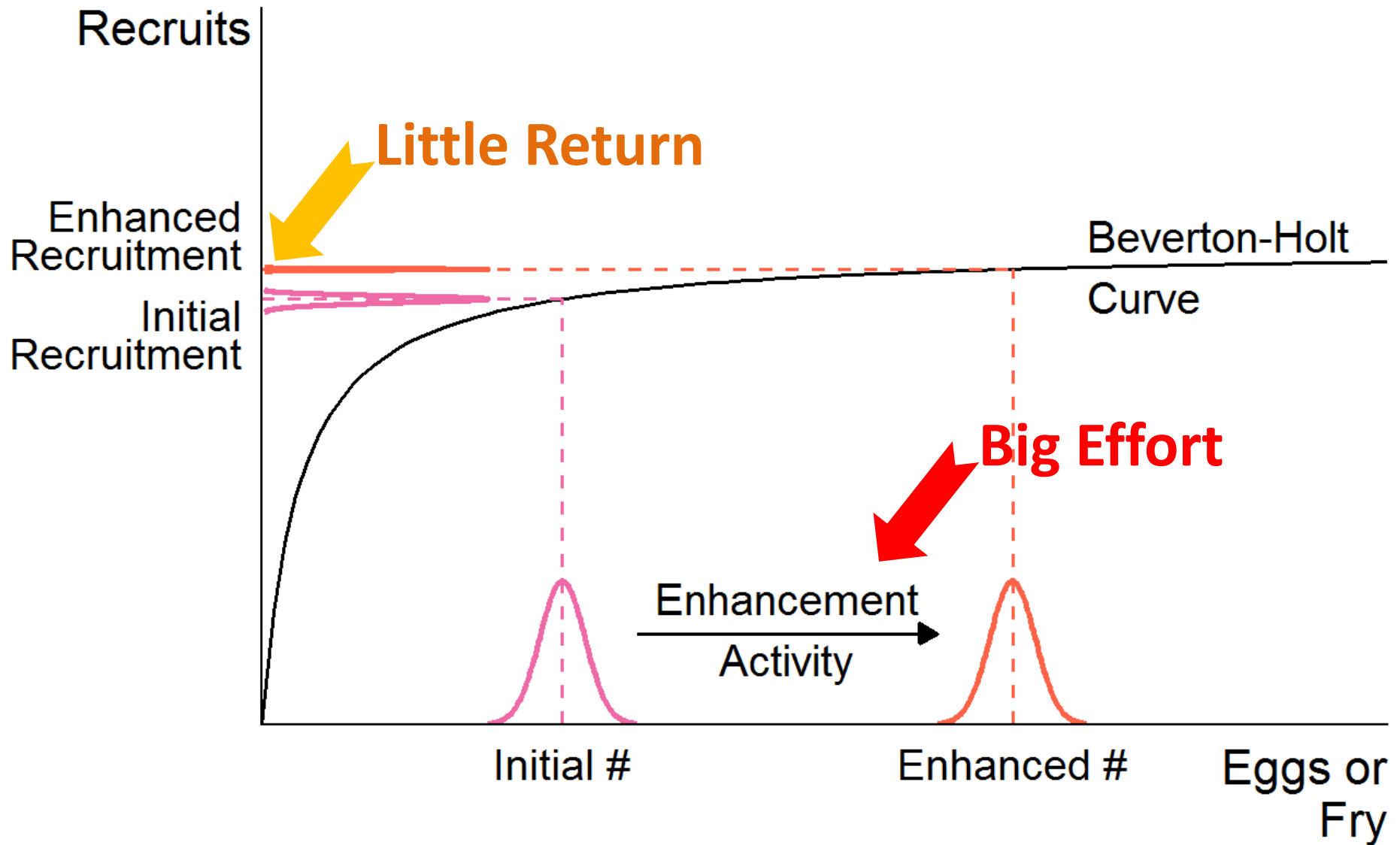


Reference: Decker, A. S., J. Hagen and R. G. Bison (2015). Stock-recruitment relationships for steelhead populations can be used to define biological reference points that signal the need for management changes. Province of British Columbia: Report ID 54914. (Fig. 7)

# Stock-Recruitment & Salmon Recovery



# Stock-Recruitment & Salmon Recovery





# Conclusions

- 1) *Almost all regions of the west coast show large drops in salmon SARs over time*
  - A. *This includes regions with essentially pristine freshwater habitats (→SE Alaska, N. BC)*
  - B. *We don't know where in the life cycle survival is dropping (i.e., "proof"), but it is likely marine*
- 2) **DENSITY-DEPENDENCE is critical and its effects are often overlooked (certainly occurs in FW)**
  - A. It provides regulation and stabilization, (partially) compensating for poor SARs 😊
  - B. It will severely reduce the effectiveness of even well-intentioned habitat interventions occurring **prior** to its expression 😞
  - C. **Where (When) density-dependence is expressed is critical to successful salmon recovery efforts.**

# Summary

- 1) The drop in survival to essentially the same level in SE Alaska & North-Central BC means that FW habitat degradation is not **the** major problem
- 2) The biggest survival problem is thus in the marine phase of the life history
- 3) My current view is that it must be determined by an interaction between where salmon migrate to and ocean conditions that cause the equally poor SARs
- 4) I confess to not be able to satisfactorily explain the coastwide pattern... why survival of northern populations **is at the same level** as southern populations eludes me.

**THANK YOU**

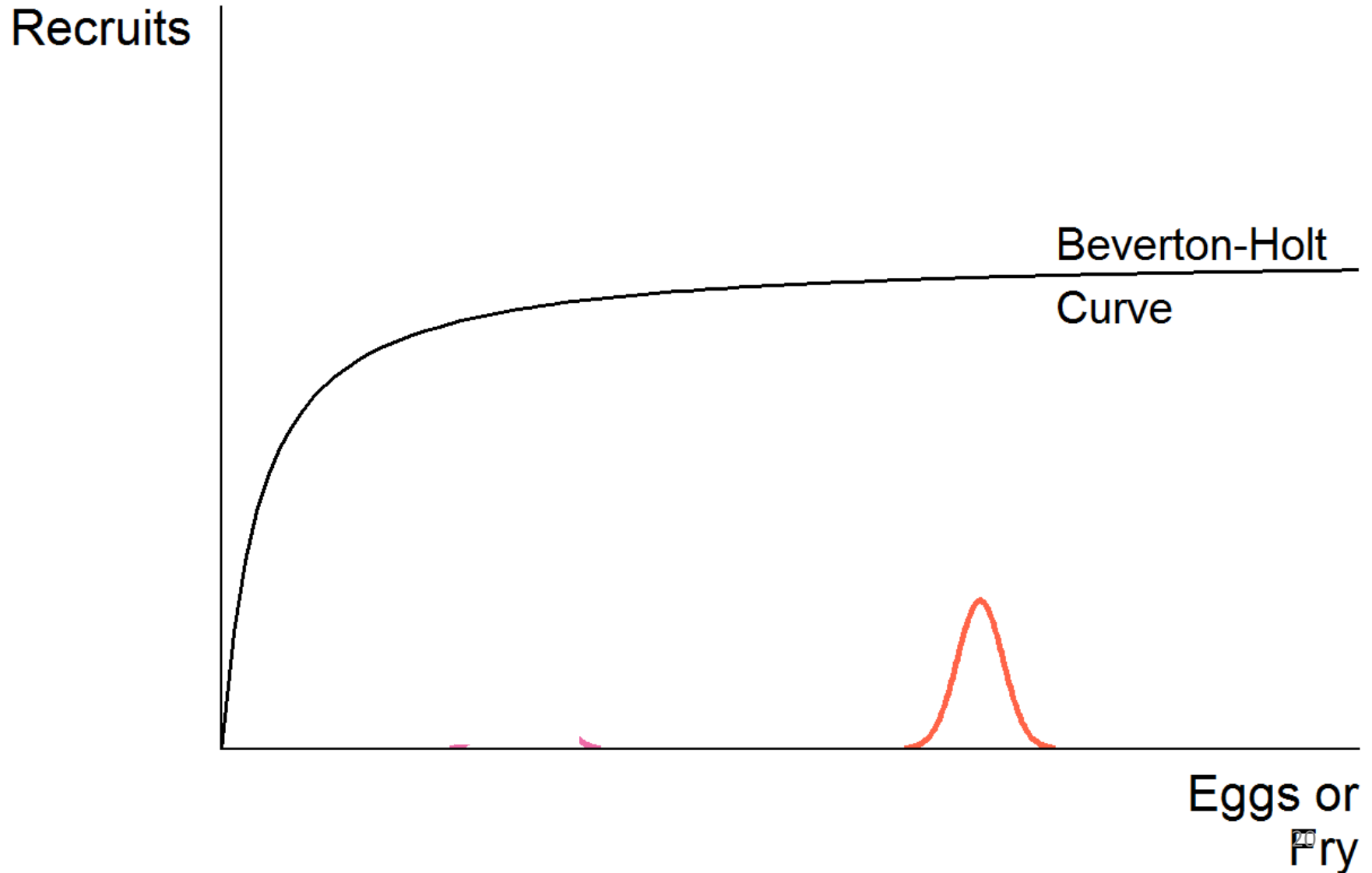


Erin Rechisky

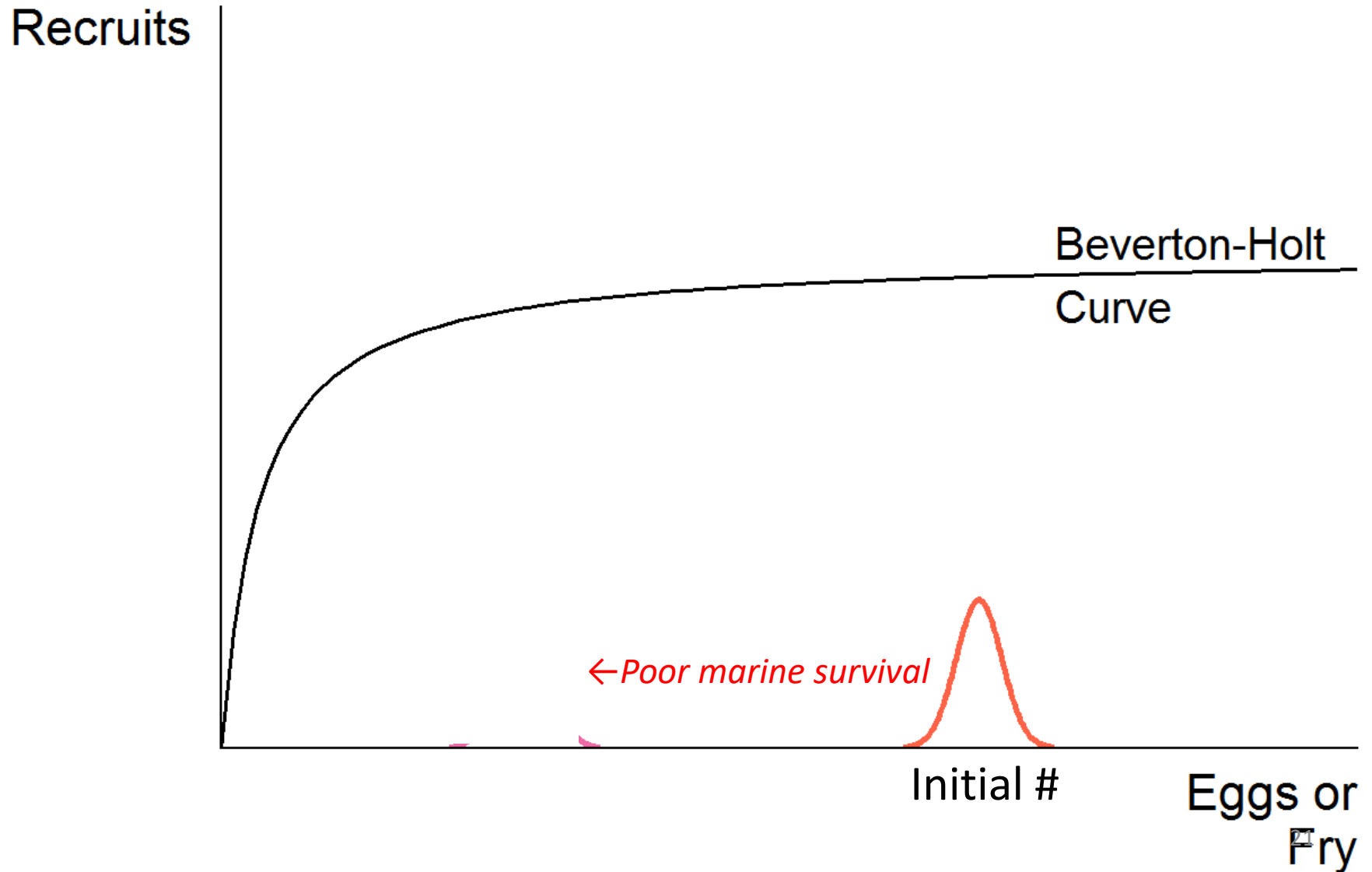


Aswea Porter

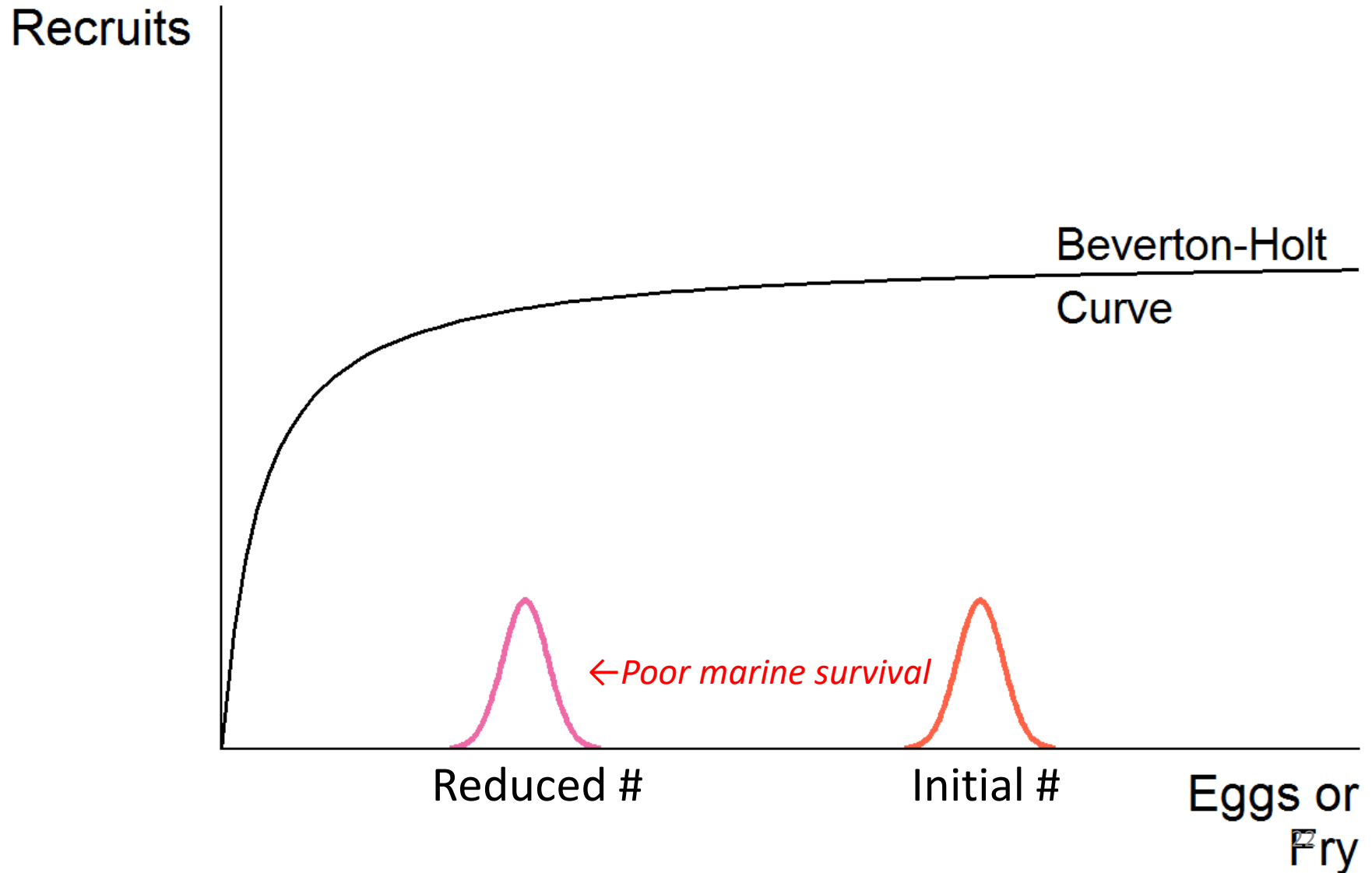
# Stock-Recruitment & Salmon Recovery



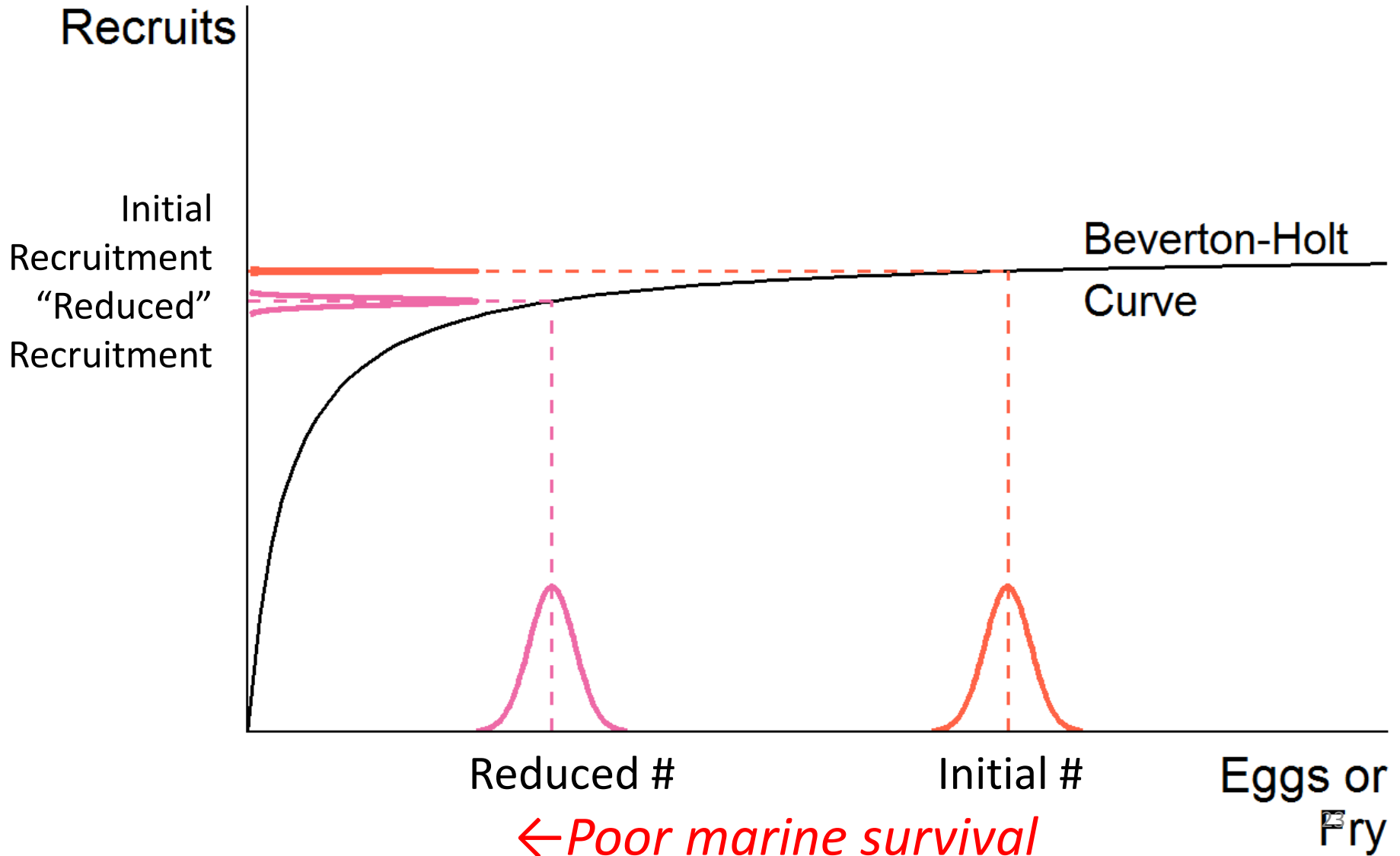
# Stock-Recruitment & Salmon Recovery



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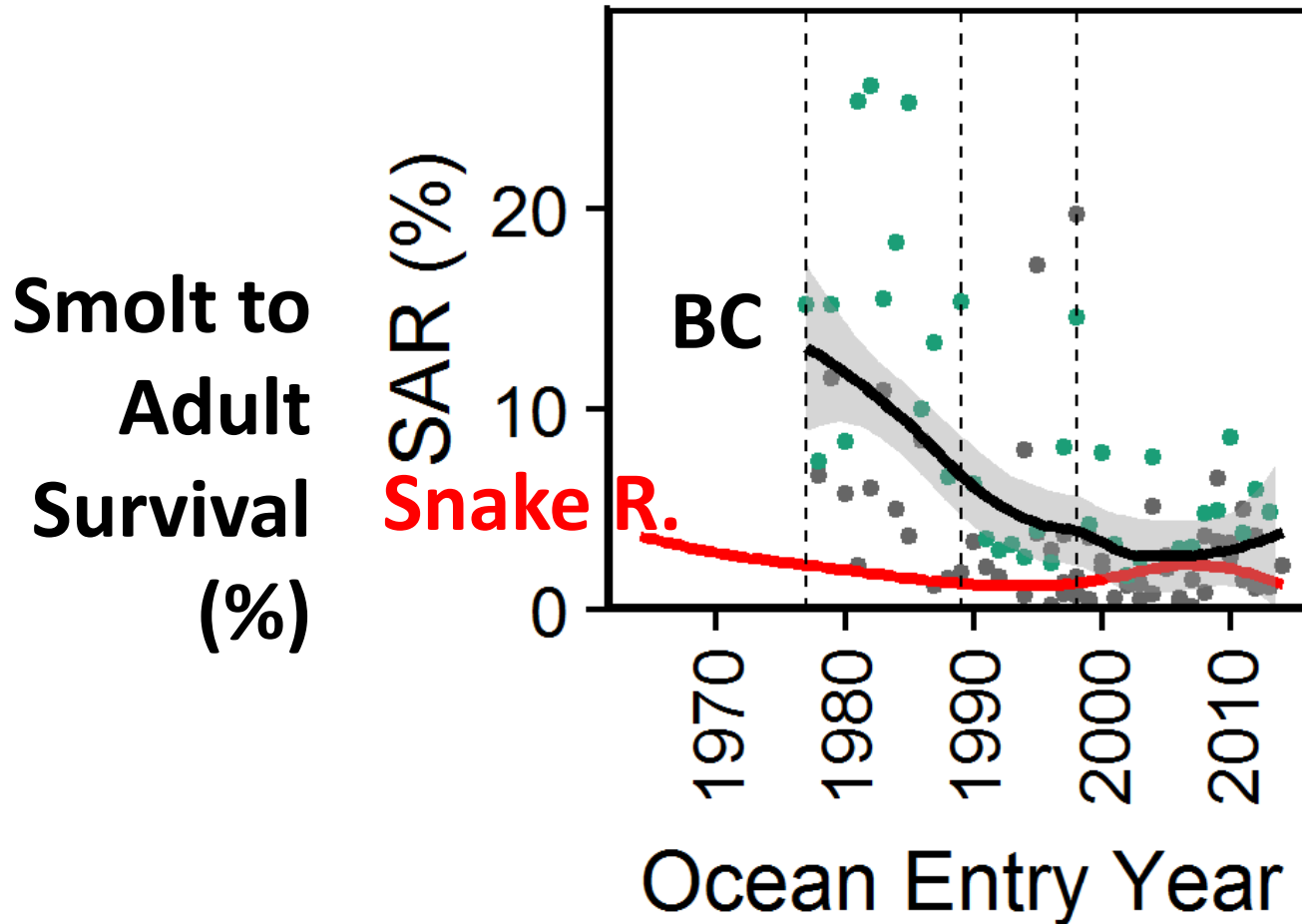


# Stock-Recruitment & Salmon Recovery



# BC Chinook Survival Trends

SOG



← *Survival collapse is to nearly the same level as the Snake River (8 dams!), but is of more recent timing*