



# **Sustaining Marine Science**

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Pacific Biological Station  
Nanaimo, BC CANADA**

# International Projects - solving the odd and even year pink salmon puzzle



**North Pacific Marine Science Organization**

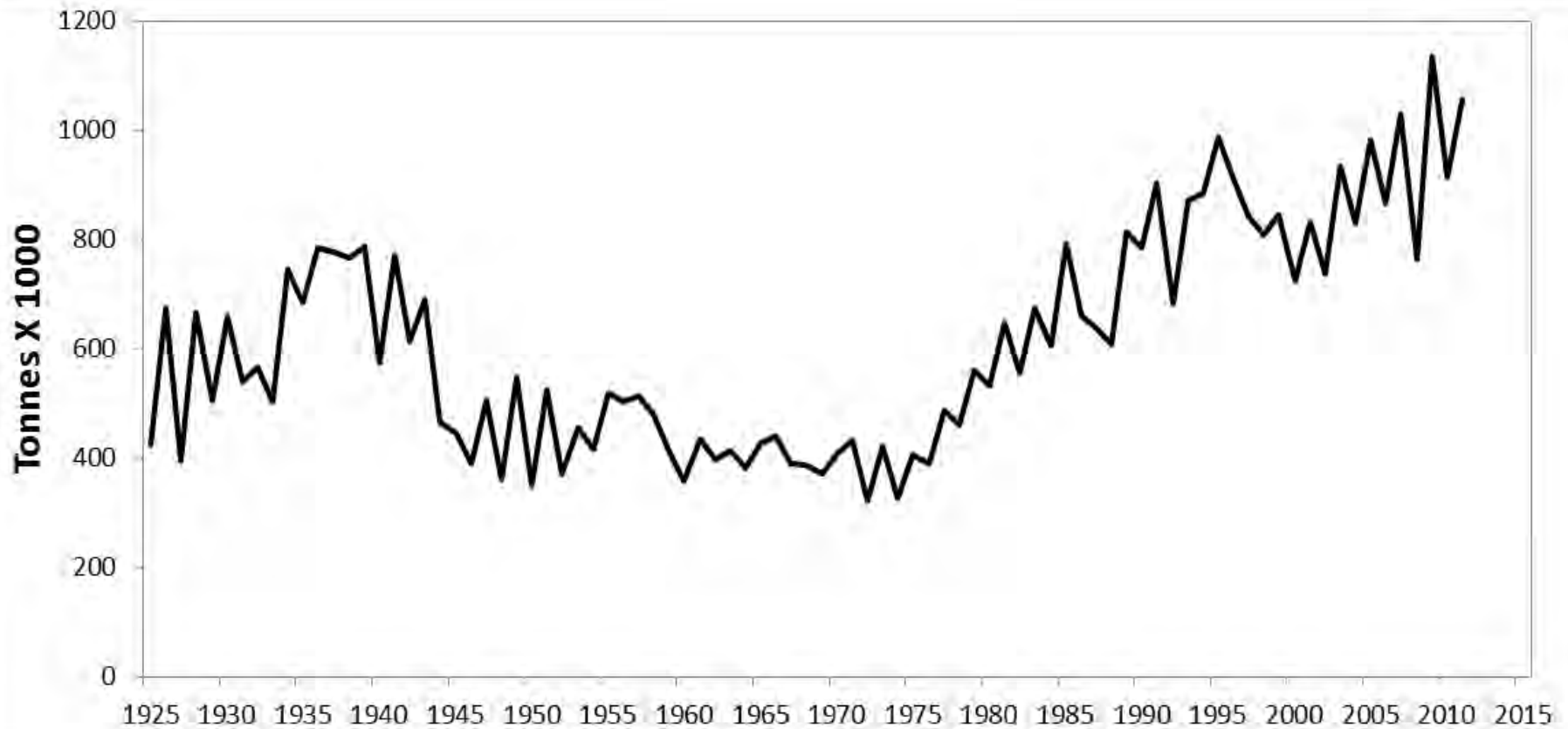




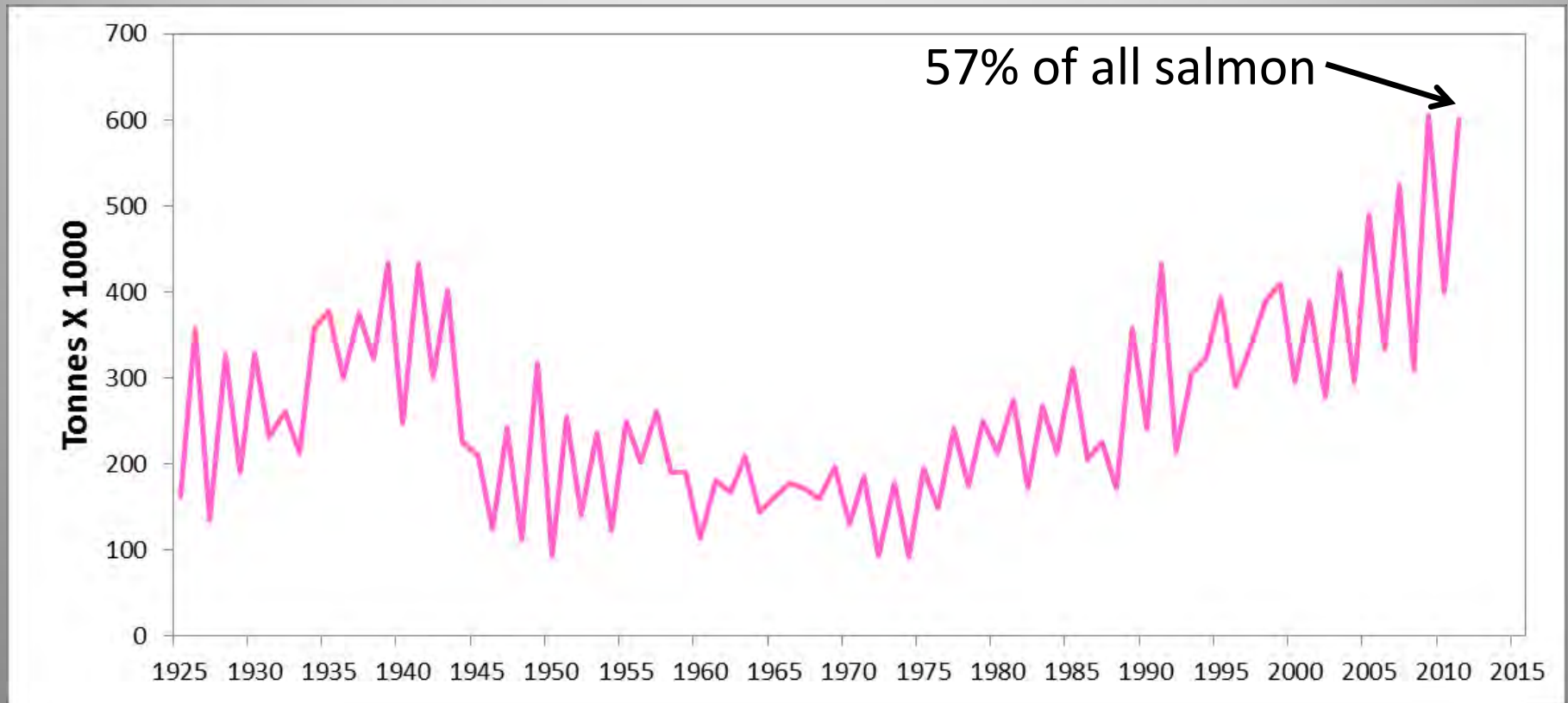
- **Future abundances of odd and even-year pink salmon is an important economic issue that is related to fishing, hatchery construction, ecosystem interactions and public confidence in marine science.**

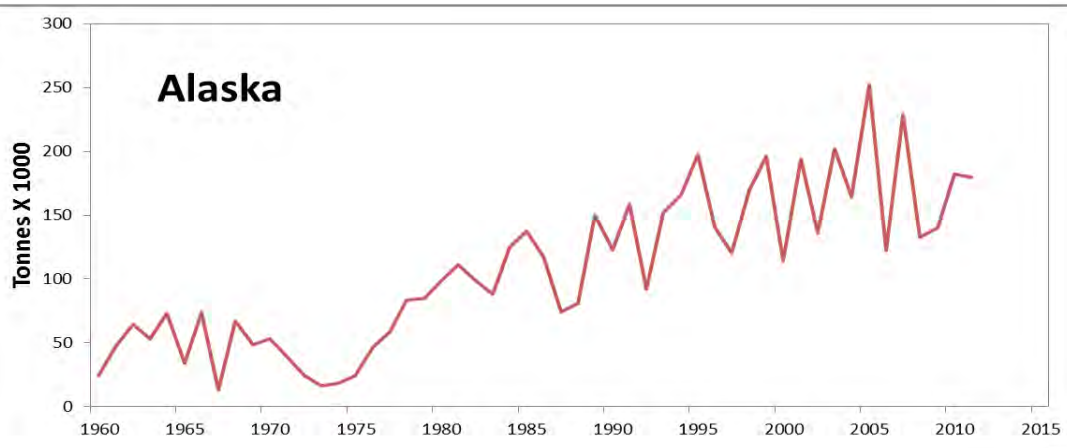
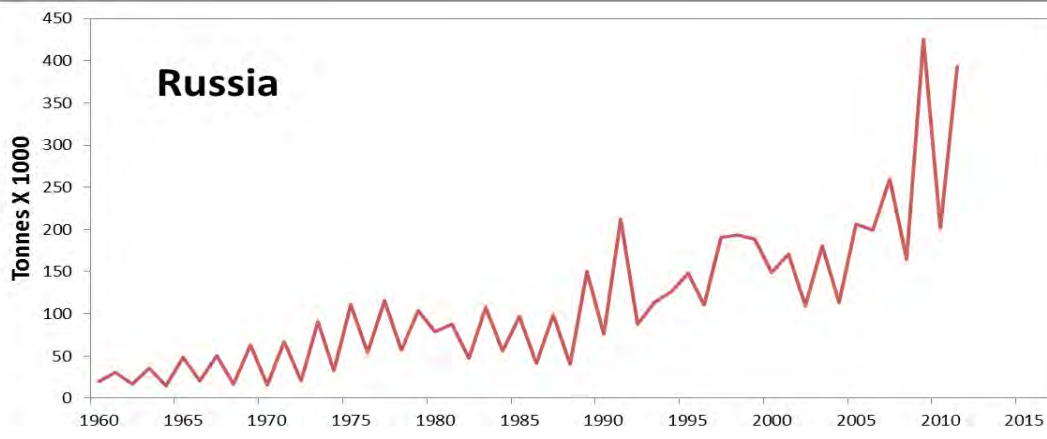


# Total catch of Pacific salmon by all countries, 1925-2011

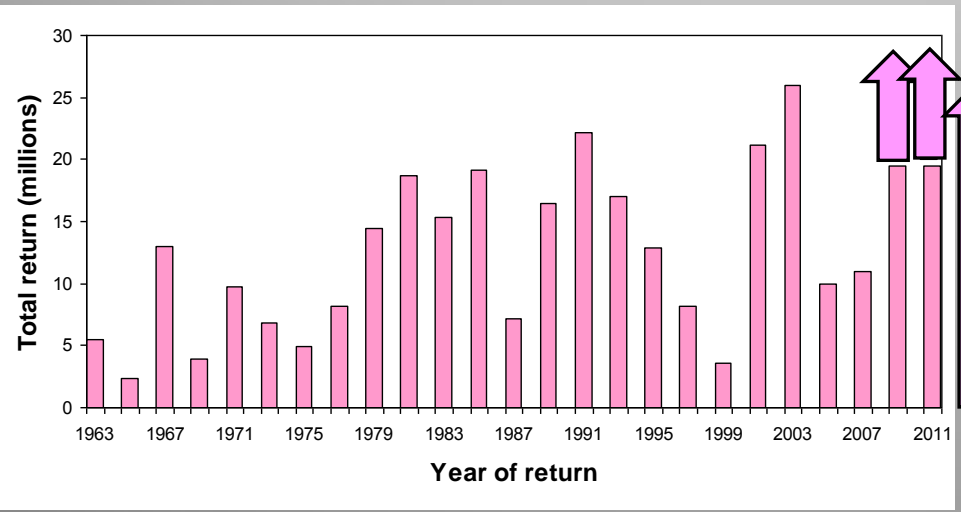


# The total catch of pink salmon by all countries is increasing





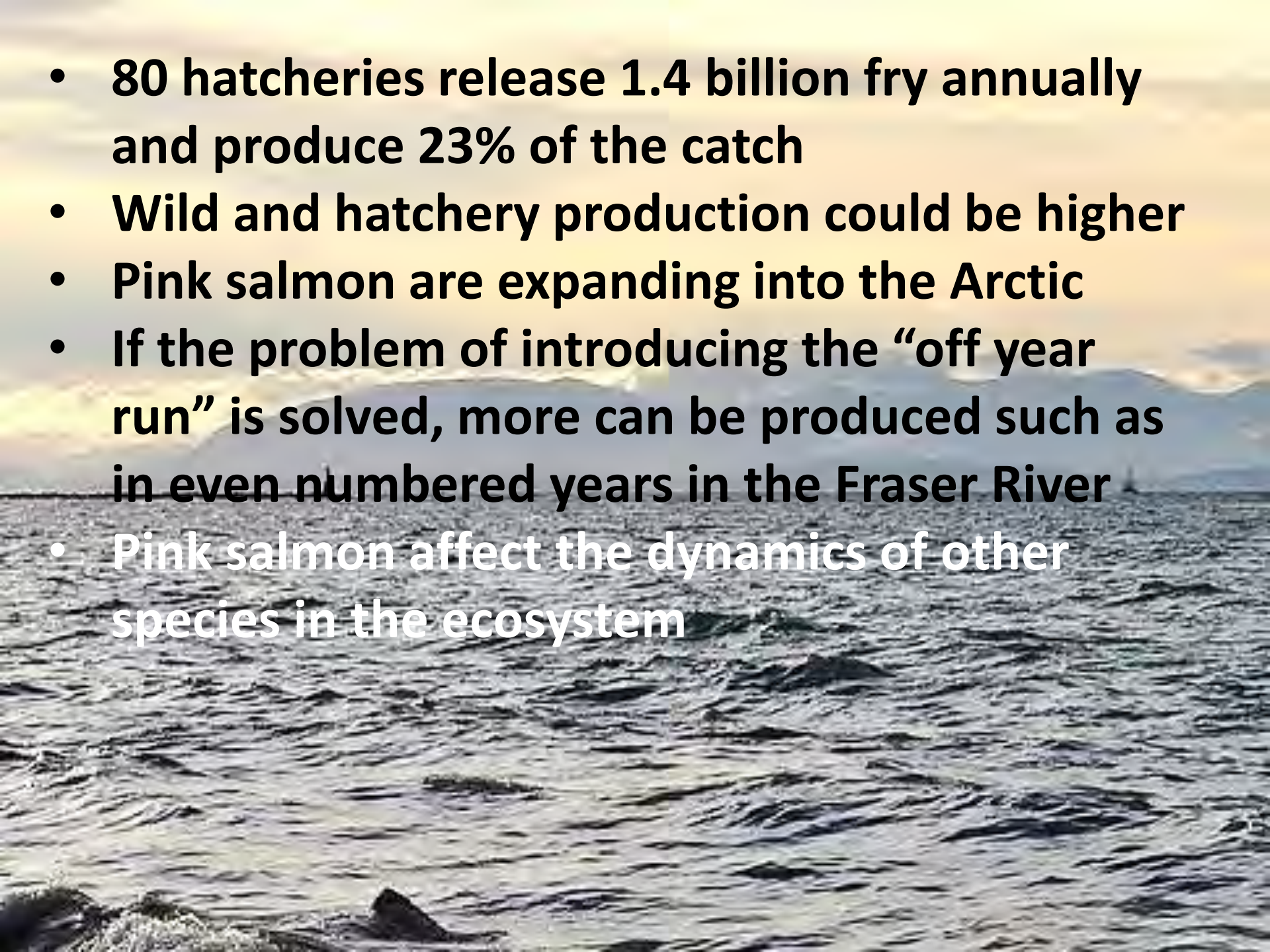
Annual pink salmon catch from 1960-2011 for Russia and Alaska



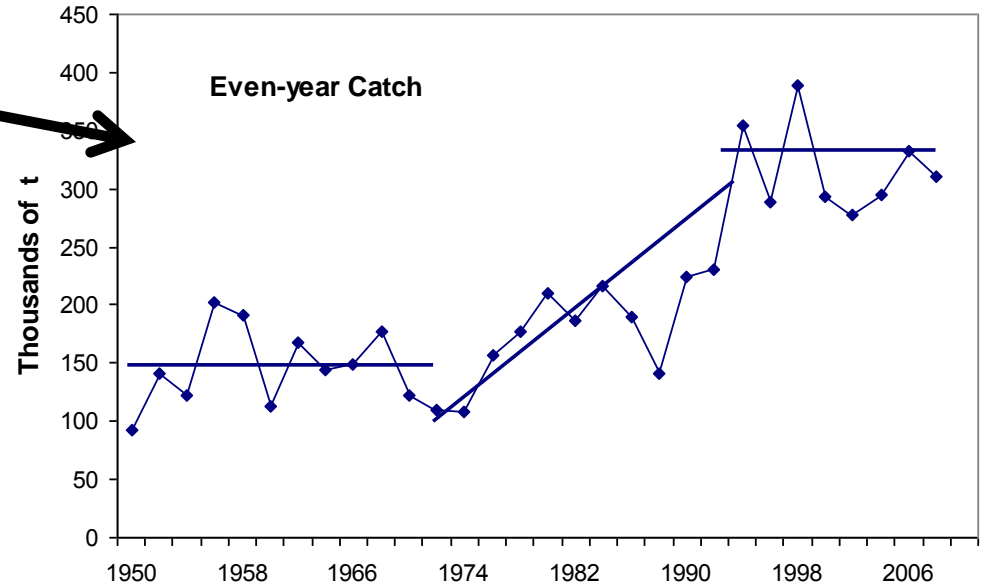
Total returns of Fraser River pink salmon from 1963-2013



- **80 hatcheries release 1.4 billion fry annually and produce 23% of the catch**
- **Wild and hatchery production could be higher**
- **Pink salmon are expanding into the Arctic**
- **If the problem of introducing the “off year run” is solved, more can be produced such as in even numbered years in the Fraser River**
- **Pink salmon affect the dynamics of other species in the ecosystem**

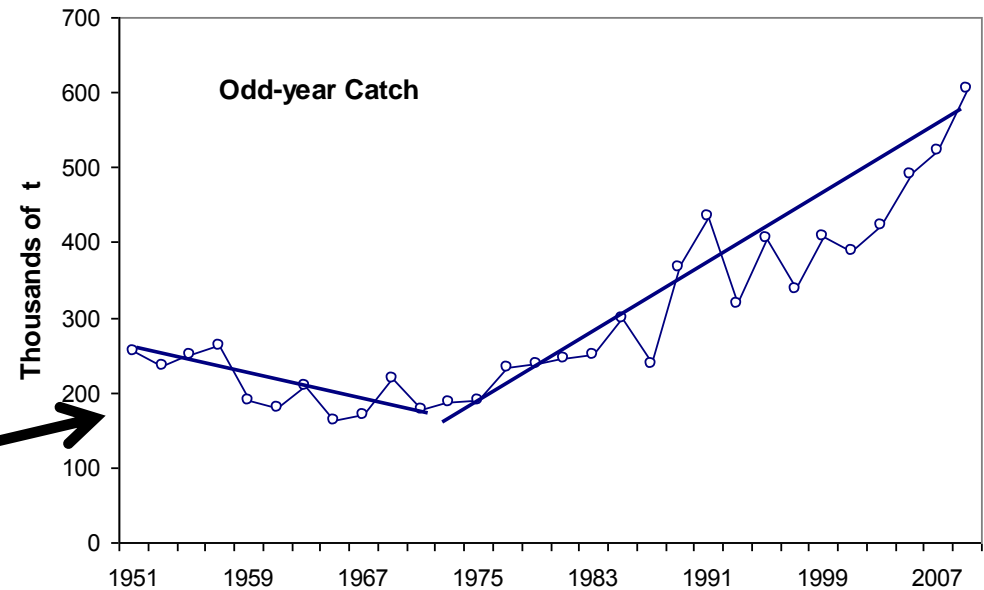


Even year



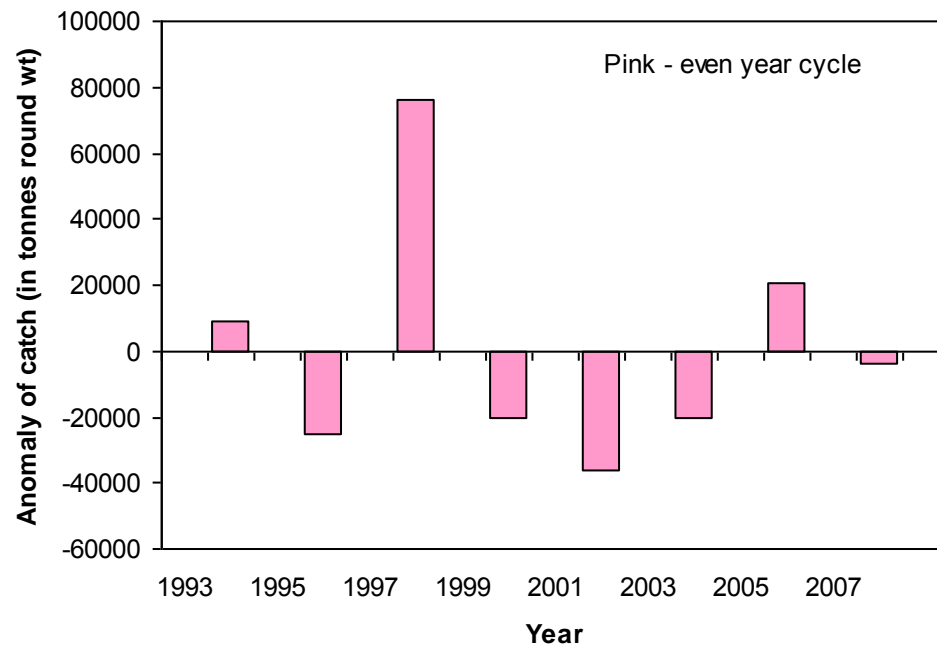
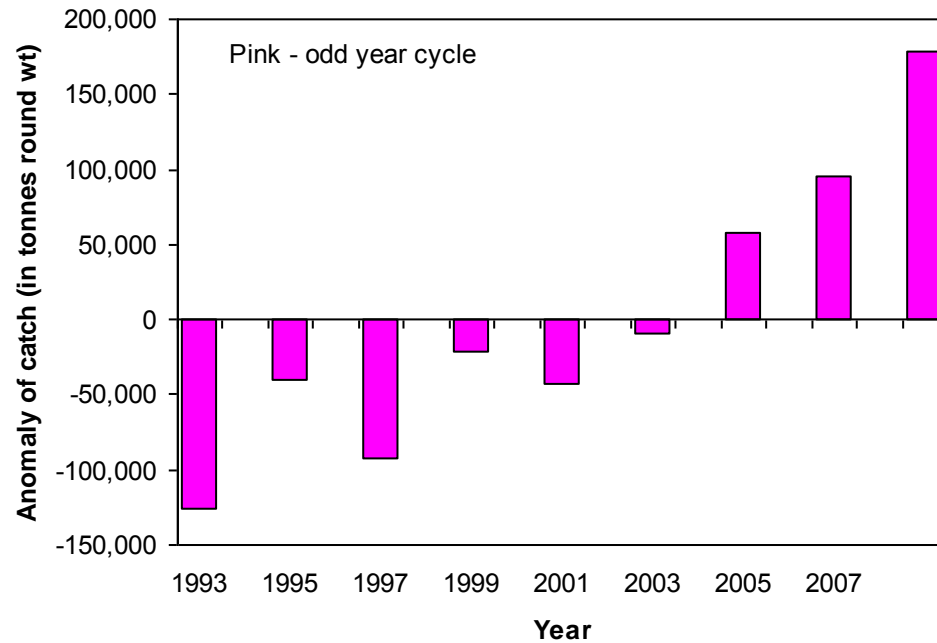
**North Pacific  
catch of pink  
salmon,  
1950-2009**

Odd year





# Anomaly of all country catch pink salmon (1993-2009)



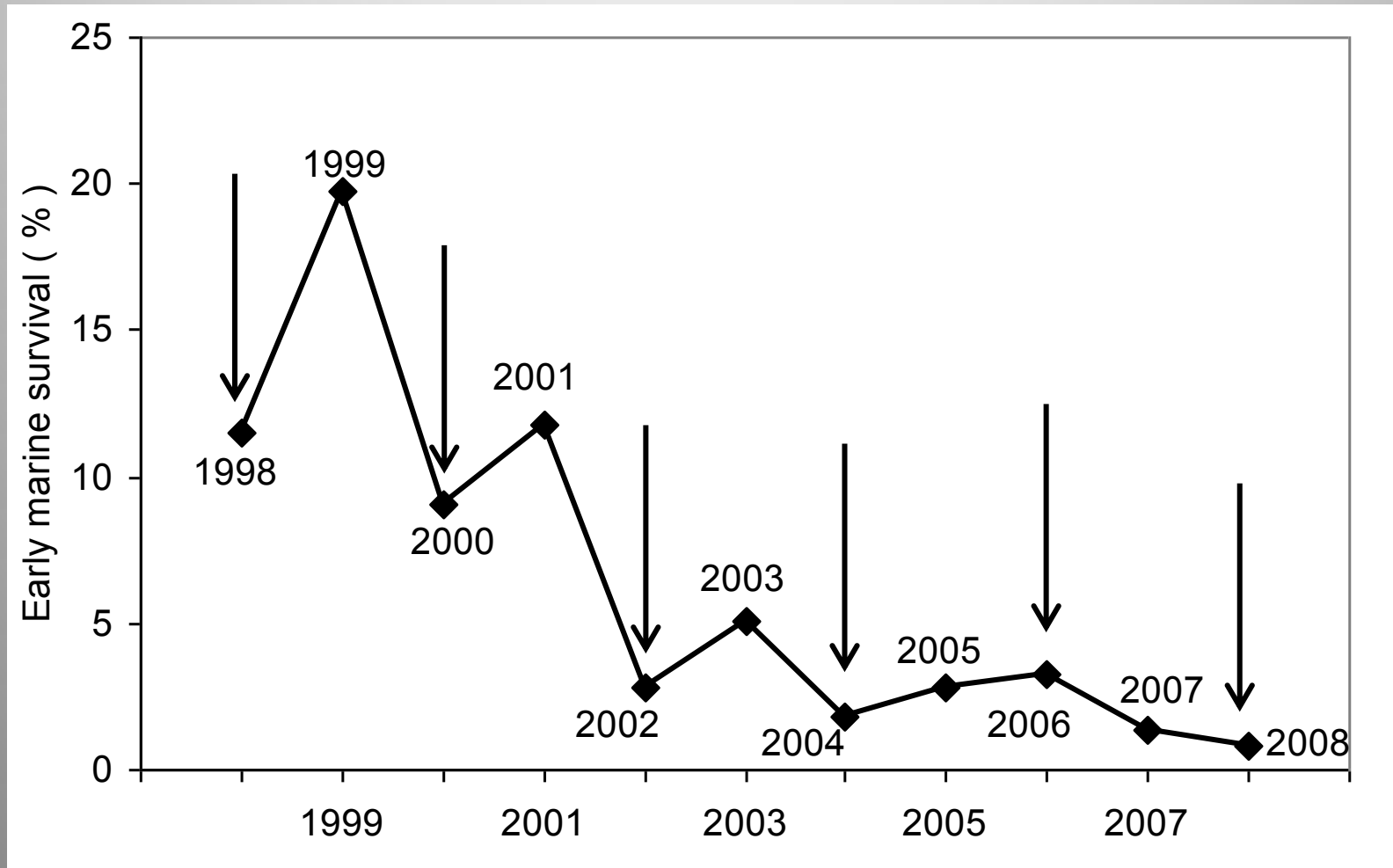
**Ricker et al. (1978) noted that pink salmon tend to be larger in odd-numbered years than in even-numbered years and the differences increased from Alaska to the Strait of Georgia.**

Ricker, W.E., H.T. Bilton, and K.V.Aro. 1978. Causes of the decrease in size of pink salmon (*Oncorhynchus gorbuscha*). Fisheries and Marine Services Technical Report 820, 93p.

Beacham et al. (2012) reported that:

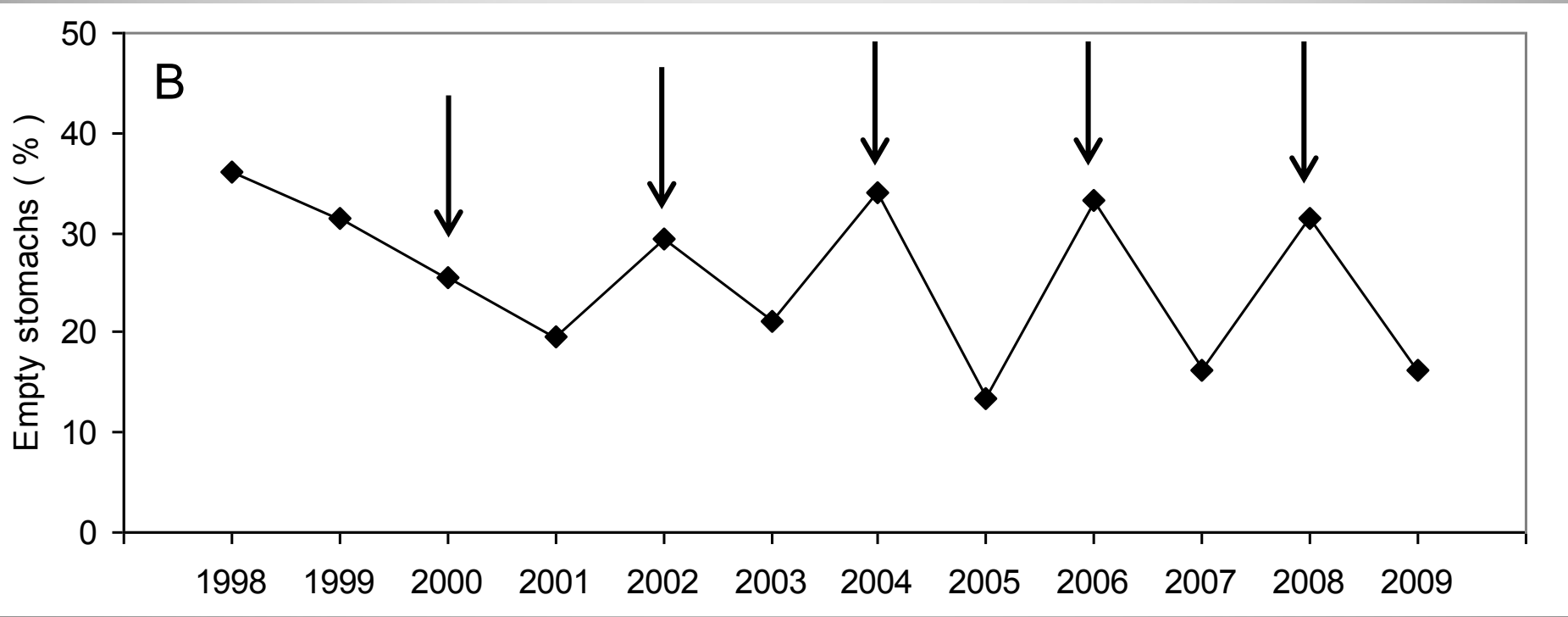
- Variation at 16 microsatellite loci was surveyed for approximately 46,500 pink salmon sampled from 146 localities in the odd-year broodline and 116 localities in the even-year broodline
- Differentiation in pink salmon allele frequencies between broodlines was approximately 5.5 times greater than that of regional differentiation within broodlines
- Greater genetic diversity was observed in the odd-year broodline

# Marine survival from ocean entry until the September survey for hatchery coho salmon in the Strait of Georgia





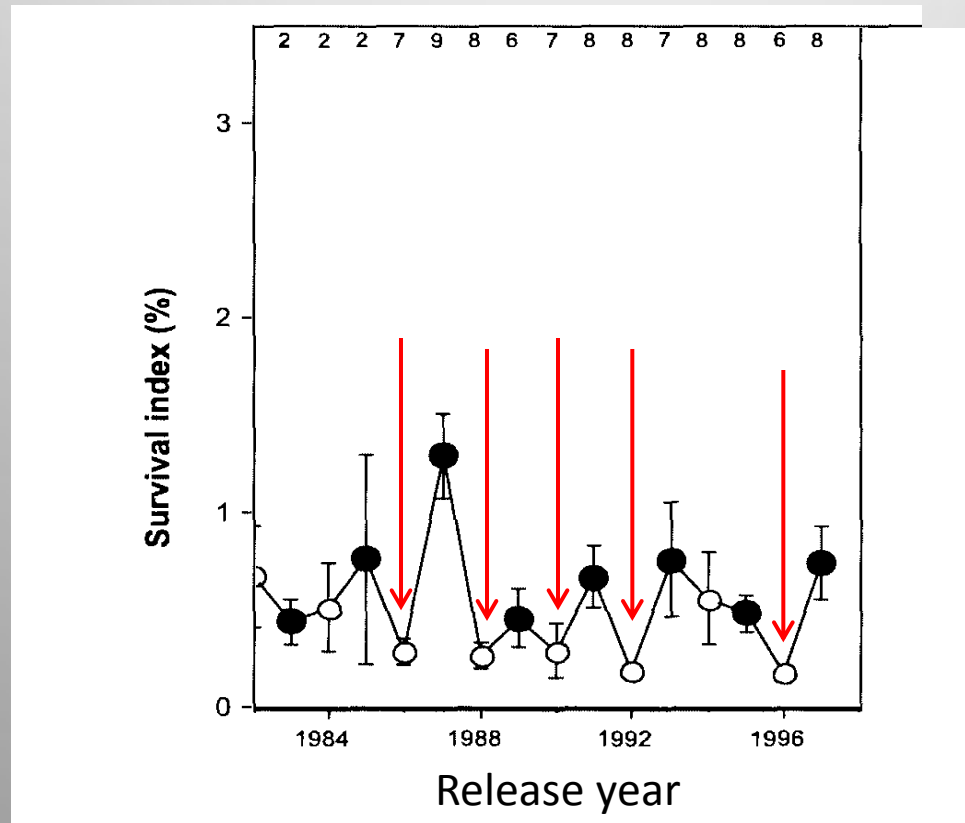
# Percent empty stomachs for juvenile coho in the September trawls, 1998 to 2009



**C**

Empty stomachs ( % )

# Survival index of sub-yearling chinook salmon released into Puget Sound streams during even ○ and odd years ● 1984-1997



From: Ruggerone and Goetz. 2004. Survival of Puget Sound chinook salmon (*Oncorhynchus tshawytscha*) in response to climate-induced competition with pink salmon (*Oncorhynchus gorbuscha*). CJFAS 61: 1756-1770.

# Speculation

- The lack of synchrony between the odd and even lines of pink salmon could indicate a fundamental genetic difference in the use of energy for growth and lipid storage between the two lines during the early marine period and the marine winter.
- Odd-year pink salmon would use most of their energy in the early marine period for growth and would store less lipids in the first marine summer than even year pink salmon.
- This strategy would place a dependency on finding adequate prey during the winter and recent climate changes are resulting in more frequent production of optimal feeding conditions in the winter.

- **PICES could identify a team of international researchers within and outside PICES to determine what affects the abundance of odd and even-year pink salmon and what is the future carrying capacity of the ocean and the ecosystem consequences.**





# Community based research- Forecasting Coho Salmon abundances and behaviour in the Strait of Georgia



North Pacific Marine Science Organization





Alaska

British Columbia

★ Vancouver

★ Seattle

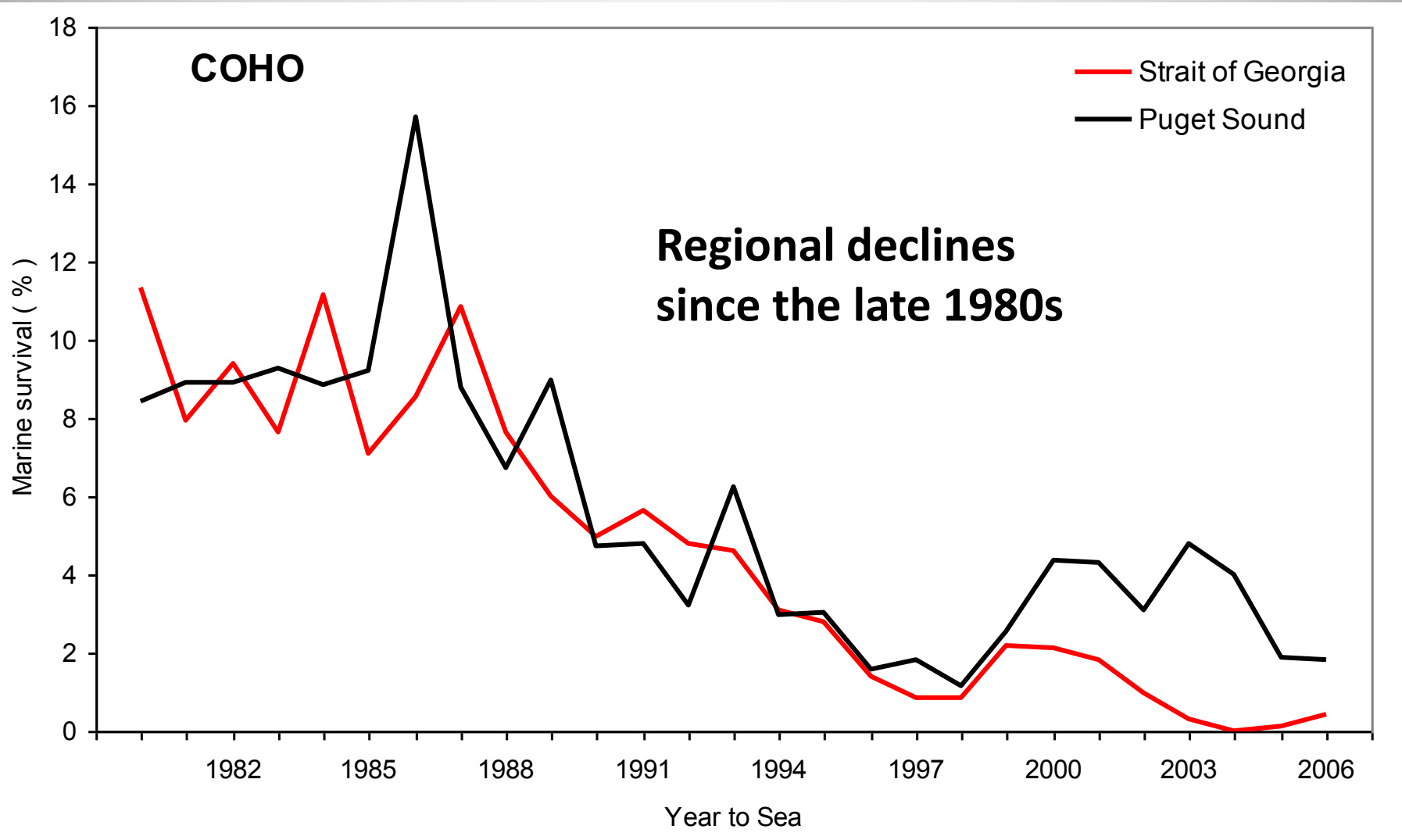
# Strait of Georgia and Vancouver Island



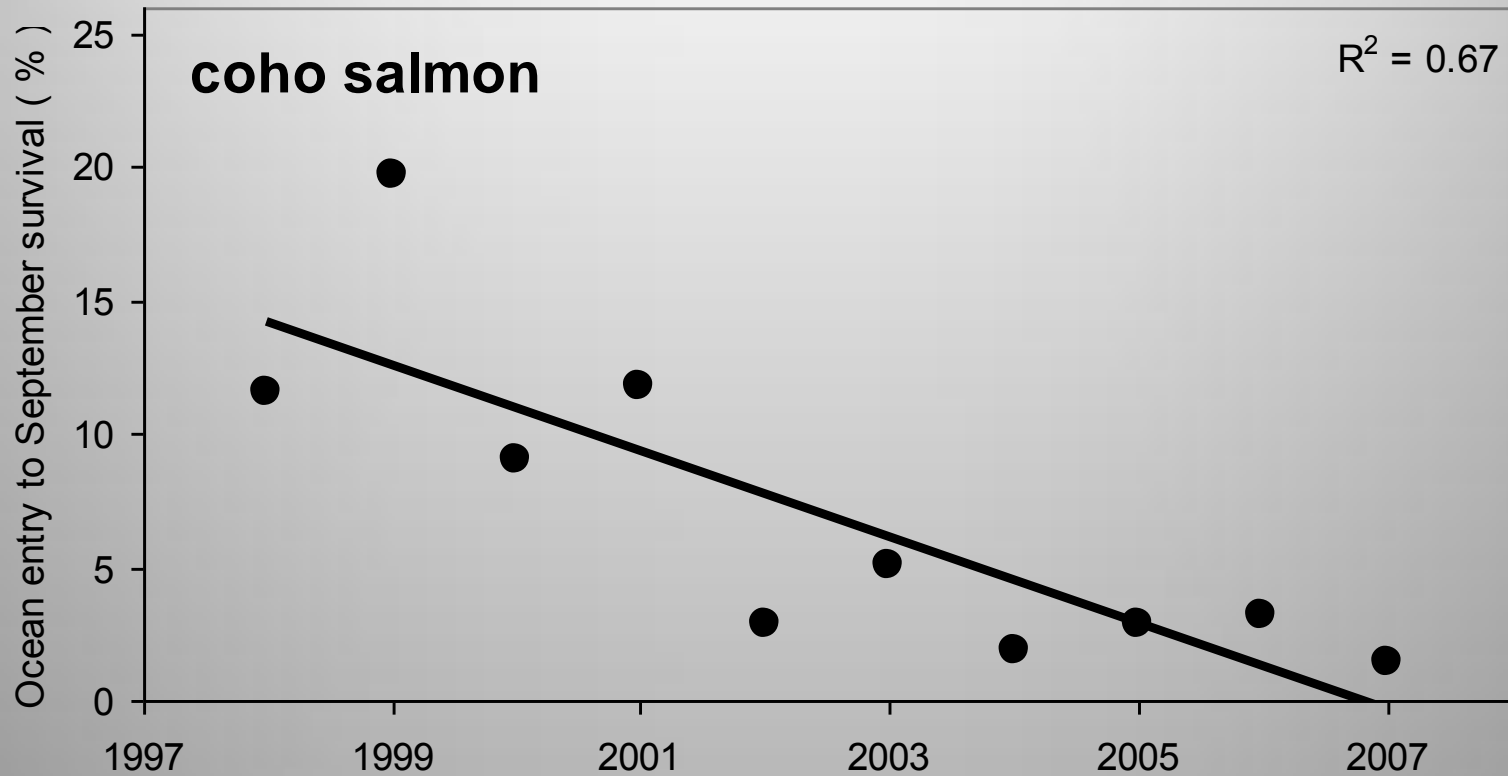
Vancouver

Seattle

# Coho salmon marine survival in the Strait of Georgia and Puget Sound

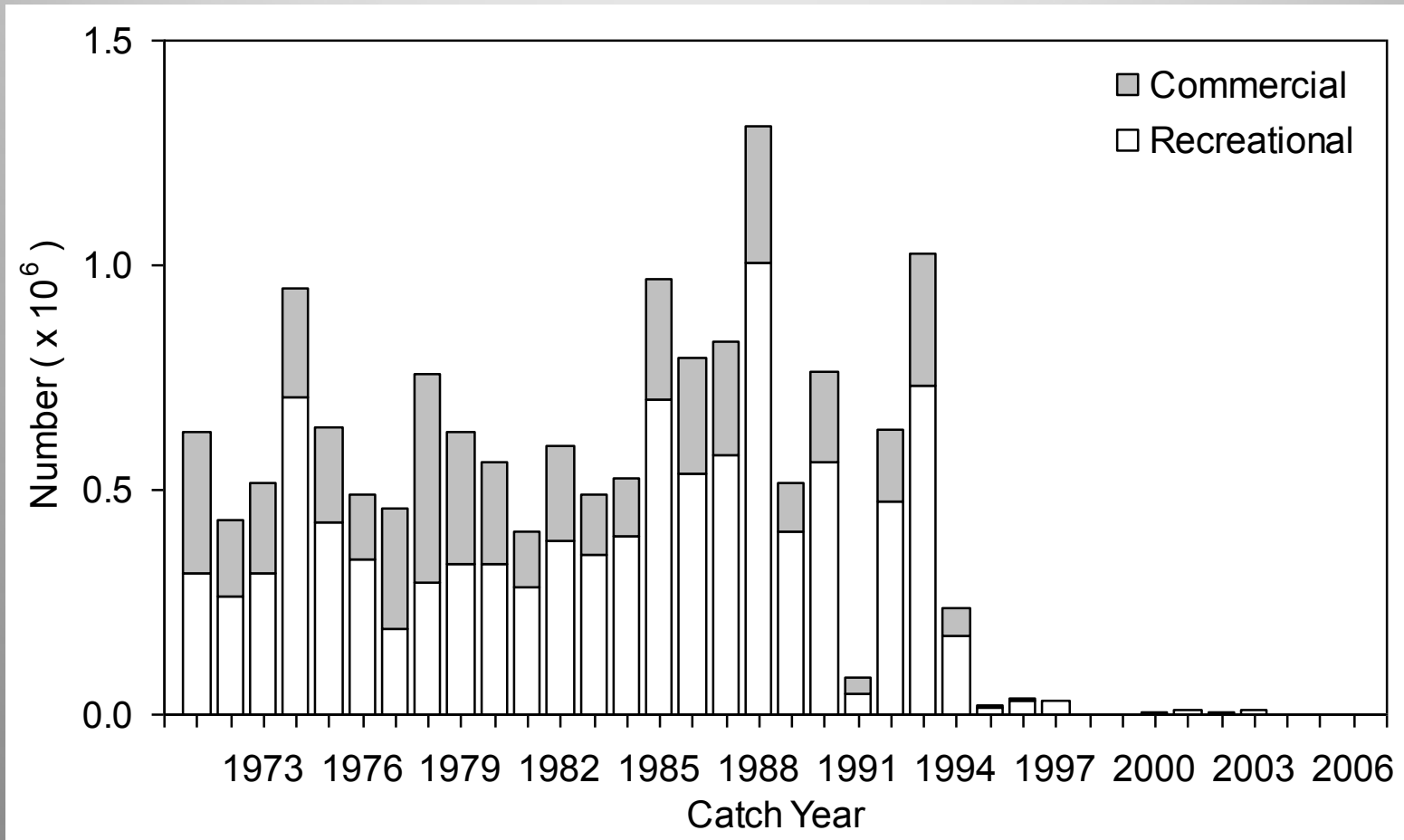


# The early marine survival of coho salmon (May-September) is declining

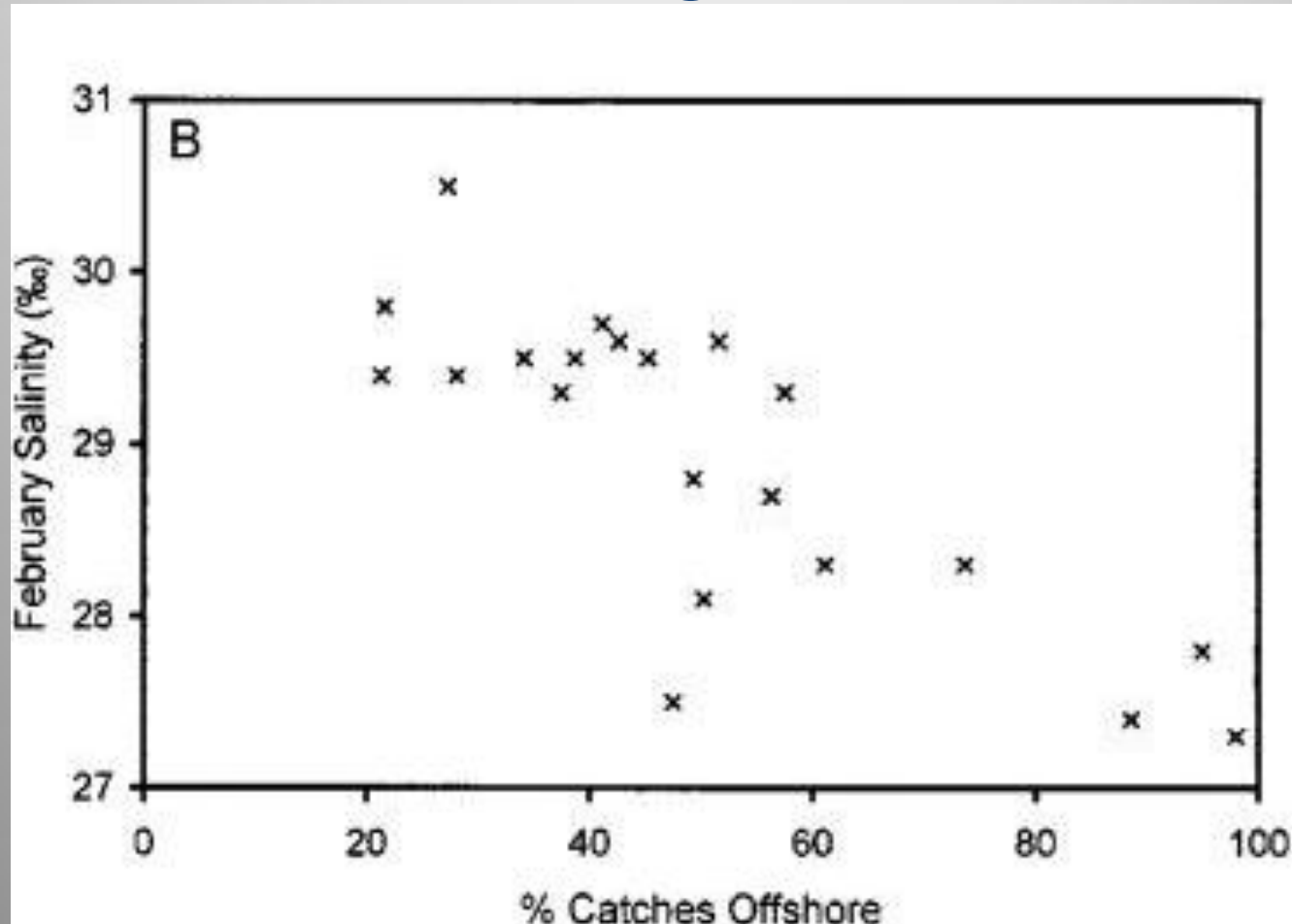




# Percentage of Strait of Georgia coho salmon caught in commercial and recreational coho catch showing a change in behavior about 1994



# Average February surface salinity in the Strait of Georgia compared with the percentage of coho salmon caught offshore





**Coho fishing returns to the Strait of Georgia**

# Strait of Georgia Coho Study Team

Paul Ricard	Sports fisherman
Clyde Wicks	Sports fisherman
Jeremy Maynard	Fishing Guide
Wayne Harling	Sports fishing advocate
Wilf Luedke	Manager
Terry Beacham	DNA analysis scientist
Chrys Neville	Biologist
Rusty Sweeting	Scientist
Dick Beamish	Retired Scientist
Rick Thomson	Ocean Scientist



- **PICES could recognize the importance of regional marine research and publicise the results on their web page. An objective is to improve the recognition of the name PICES as well as to help solve regional issues.**



# Crowd funding and Crowd Sourcing

- The public is attracted to fund your project or a company may solicit the public for explanations and new ideas
- Kickstarter claims to have found 220,000,000 for 61,000 projects
- Crowd funding is an example of the need to focus some of our marine science on issues of importance to the public.

# Things to do

- PICES needs a new publication for the public – PICES – PUBLIC – PRESS

# Conclusion

- Marine science needs to engage the public.
- We need to market marine science by taking on projects that solve regional and international issues that are important to the public and patrons
- We need a leader as determined as Warren Wooster.

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**When the funding  
gets tough,  
marine science  
needs to get going**





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**END**

