

# **Marine perspectives on Chinook salmon hatchery production in the Columbia River Basin**

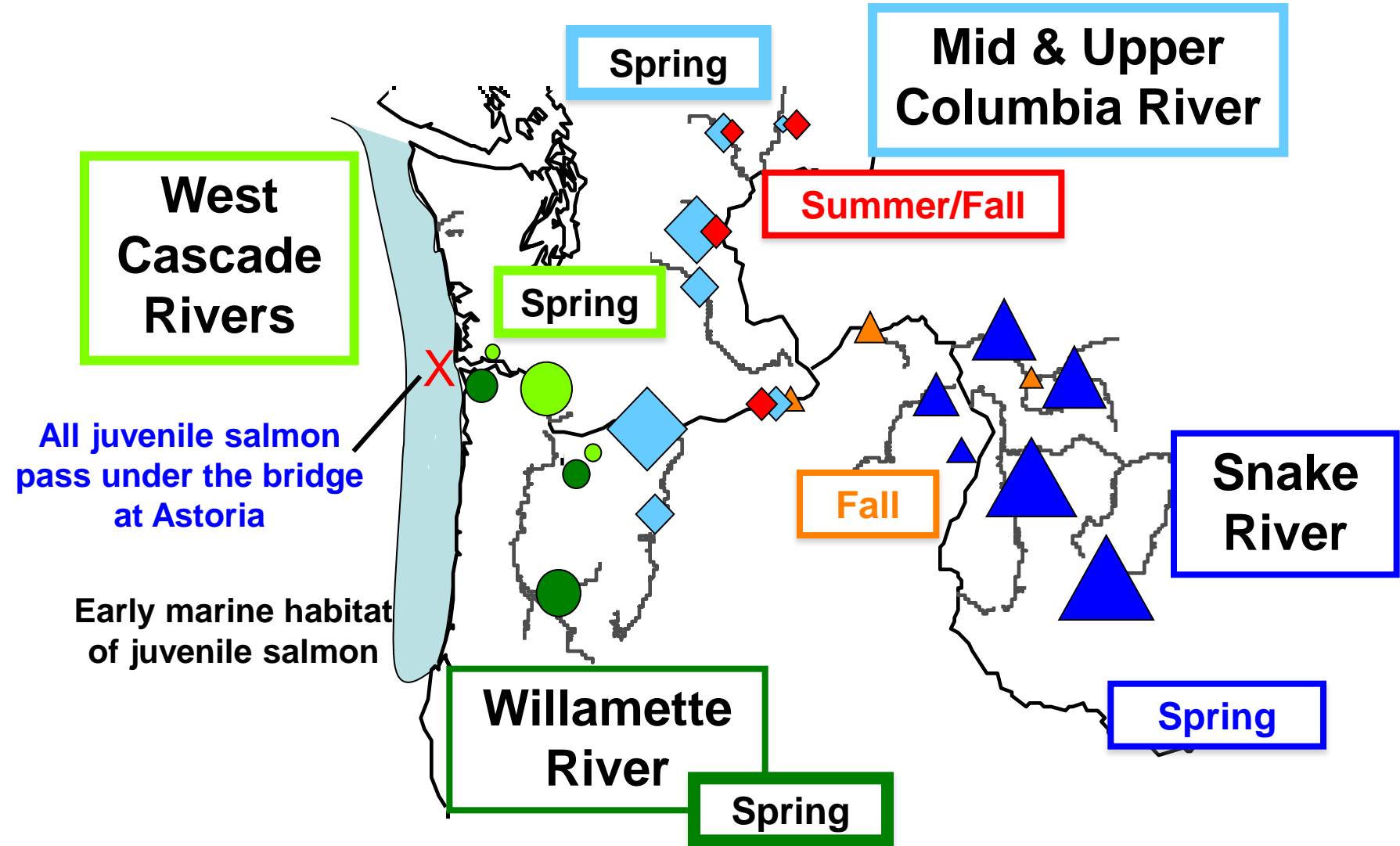
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# Yearling Chinook salmon Columbia River hatchery production ~ 33 million/year



**Current Columbia River Basin  
management paradigm #1:**

**more smolts = more adults**

**New Columbia River  
hatchery programs  
will release an additional  
12 million smolts, 2014 - 2016  
(all species)**

**Chief Joseph 2.9M spr/sum Chinook smolts**

**Springfield Hatchery 1.0M sockeye smolts**

**Penticton Hatchery 1.0M sockeye fry**

**Walla Walla Hatchery 0.5M spring Chinook smolts**

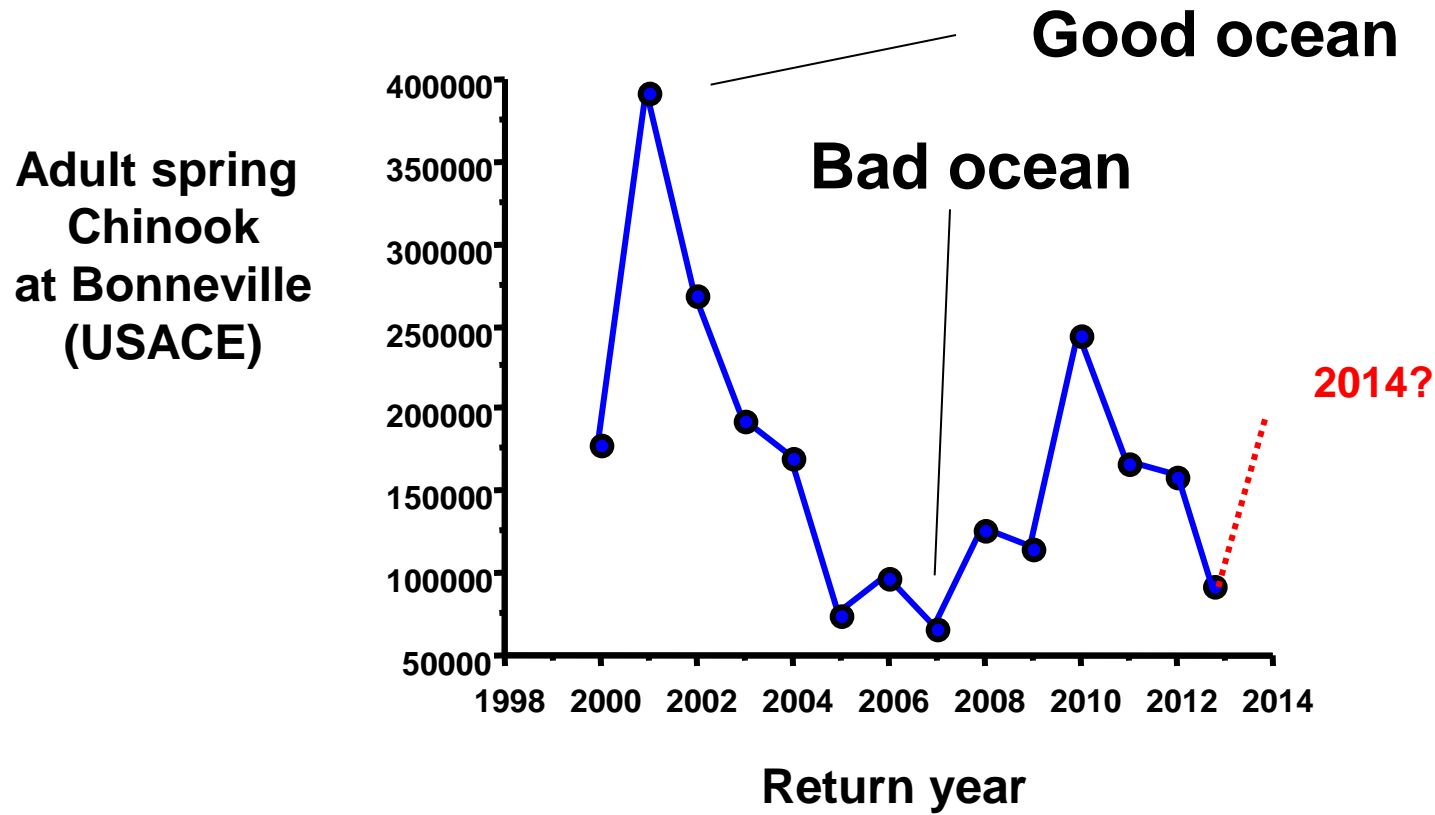
**Nason Creek Hatchery 0.2M spring Chinook smolts**

**John Day mitigation 6.0M fall Chinook smolts**

**Holmes Hatchery 0.7M coho parr/smolts**

# Abundance of Columbia River Spring chinook salmon adults varies

Smolt production relatively constant during this period



**Current Columbia River Basin  
management paradigm #2:**

**Ocean variability is unpredictable  
and production responses  
are unmanageable**

**Manage for good or bad ocean?**

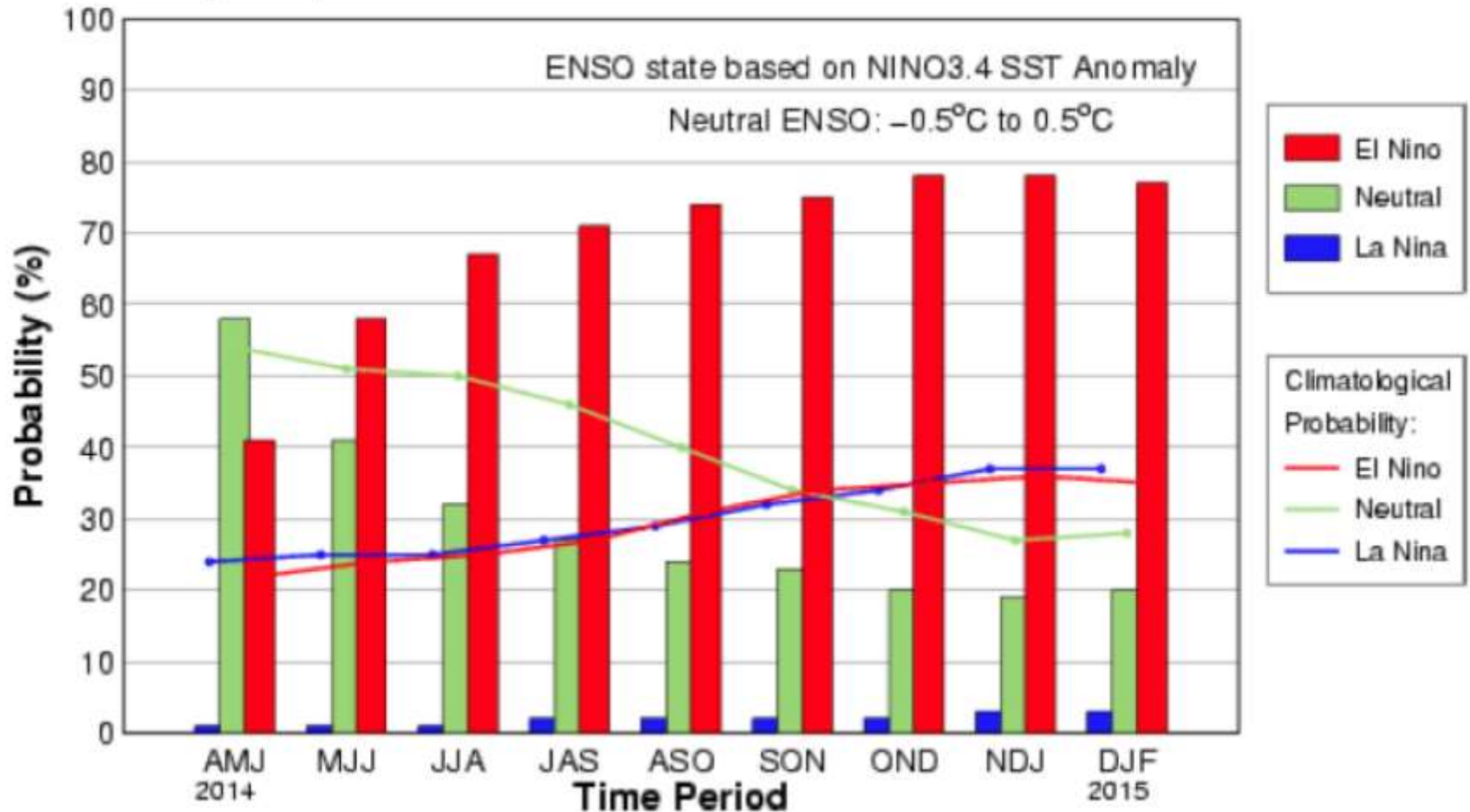
**Manage for optimal production in  
good years or bad years?**

**Manage for total salmon return or  
return of selected stocks/species?**

**Note: El Nino prediction for 2015?**

# El Nino ?

## Early-May CPC/IRI Consensus Probabilistic ENSO Forecast





**Goal: generate discussion on interactions between ocean resources, smolt abundance and smolt size**

**Outline:**

**marine growth and survival**

**varying size-biased survival of  
hatchery smolts**

**size and marine growth**

# What about salmon in the ocean?

**NOAA Juvenile Salmon Ocean Survey**

**1998 - present**

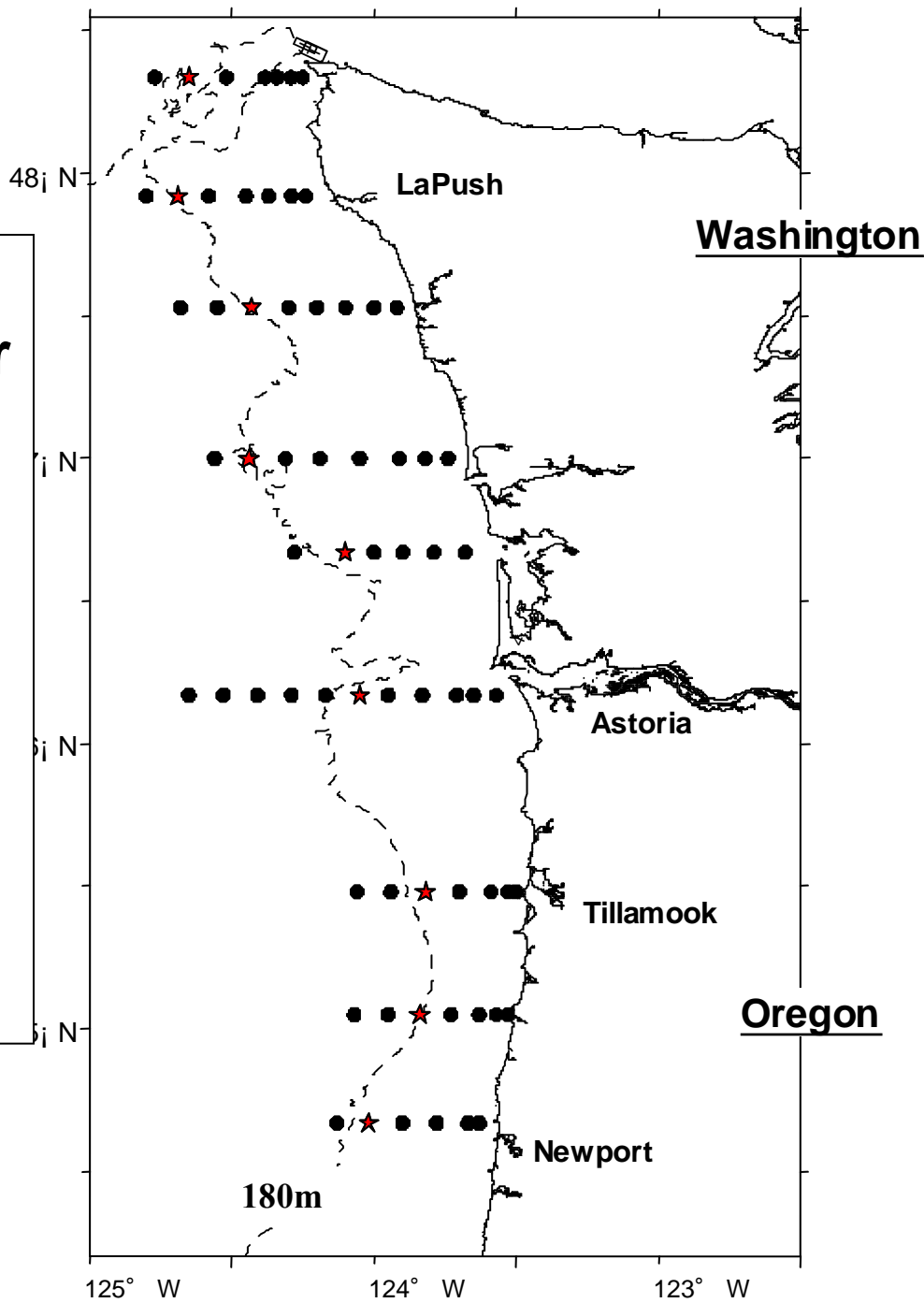


**NOAA Salmon Survey  
May, June and September  
starting in 1998**

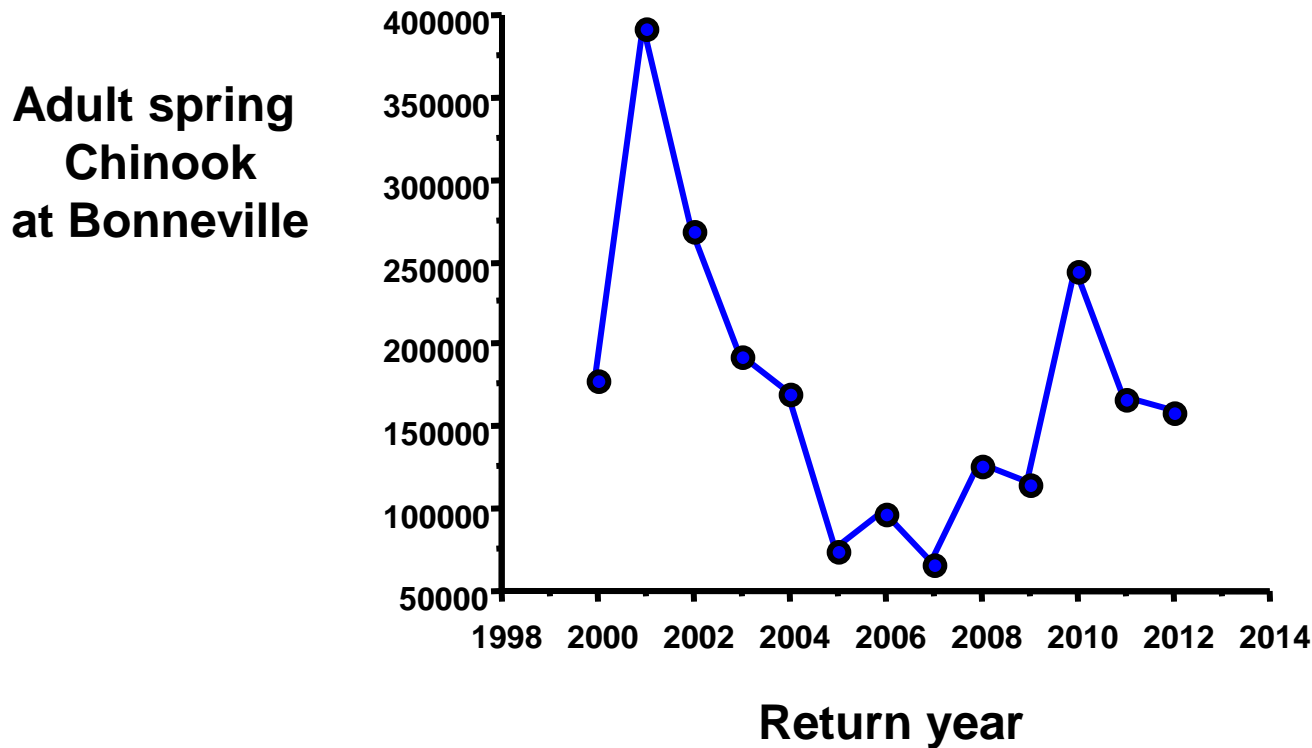
**2013, June only**

**This talk:  
May and June data**

**Yearling Columbia River  
Chinook salmon**

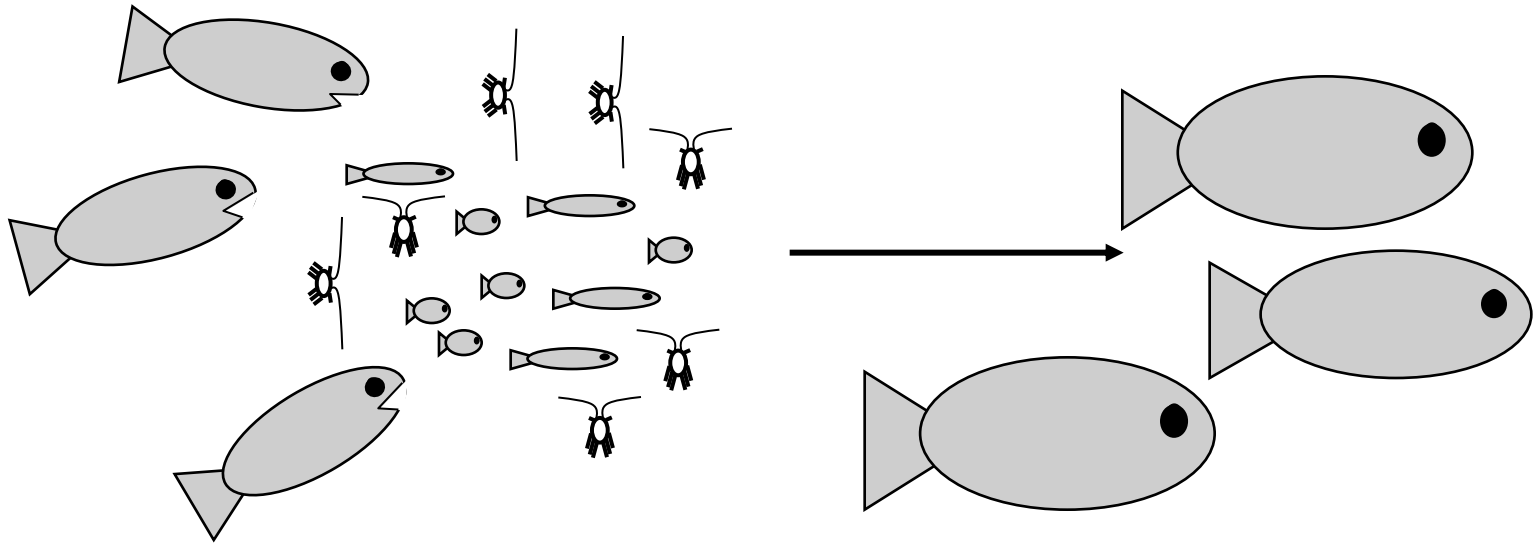


# Why does marine survival vary?



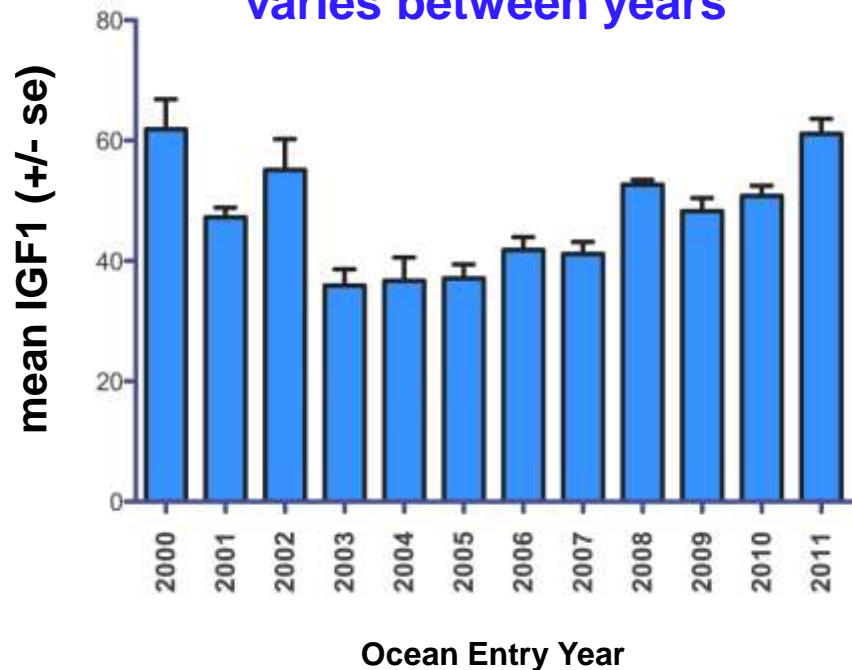
# What do salmon do in the ocean?

## Eat & Grow

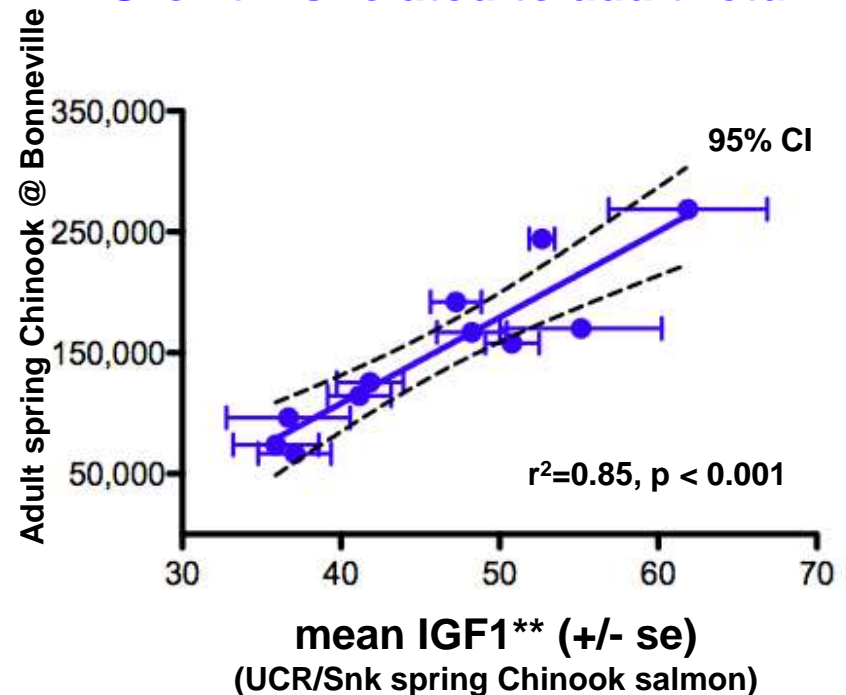


# Marine growth\* varies between years, growth is related to survival (Columbia River spring Chinook Salmon)

Growth\* of UCR/SnkR Spring Chinook  
varies between years



Growth is related to adult return



\*Growth in June ~ 2 - 6 weeks post-ocean entry

\*\* IGF1 is a hormone that reflects growth rate

**Growth varies**

**=> Food is limited in some years**

**If food is limited**

**=> there is competition for food**

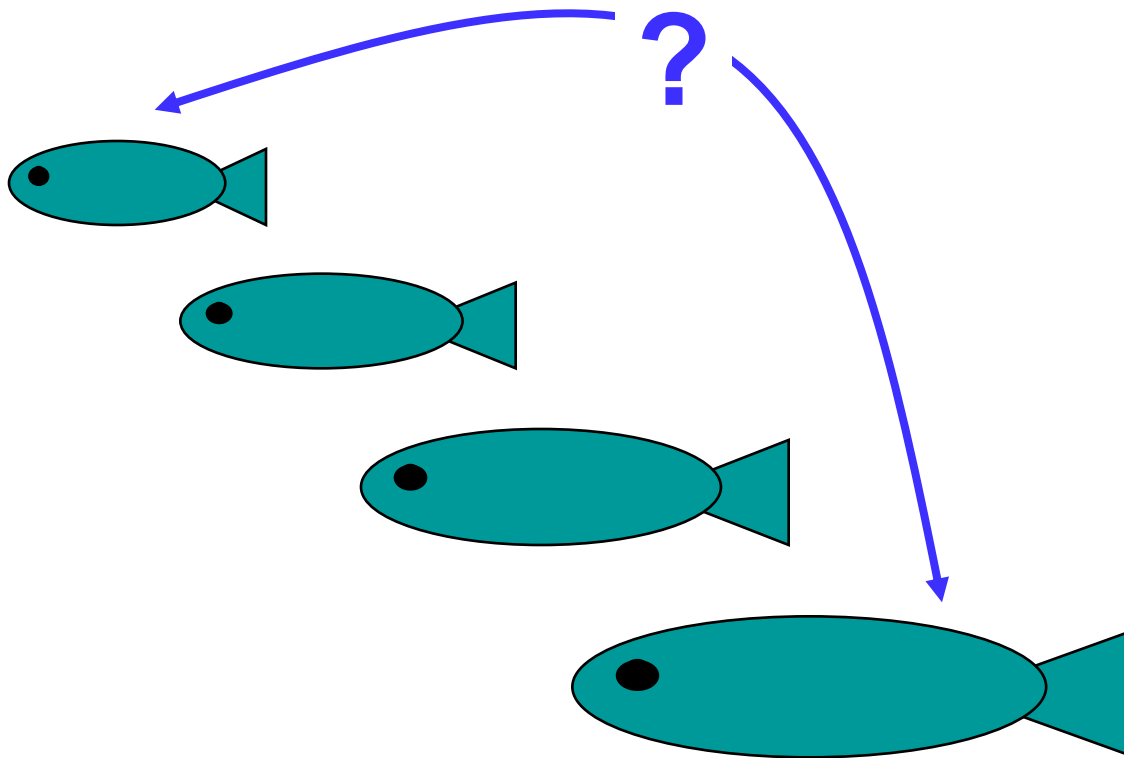
# Change focus from the ocean to hatcheries

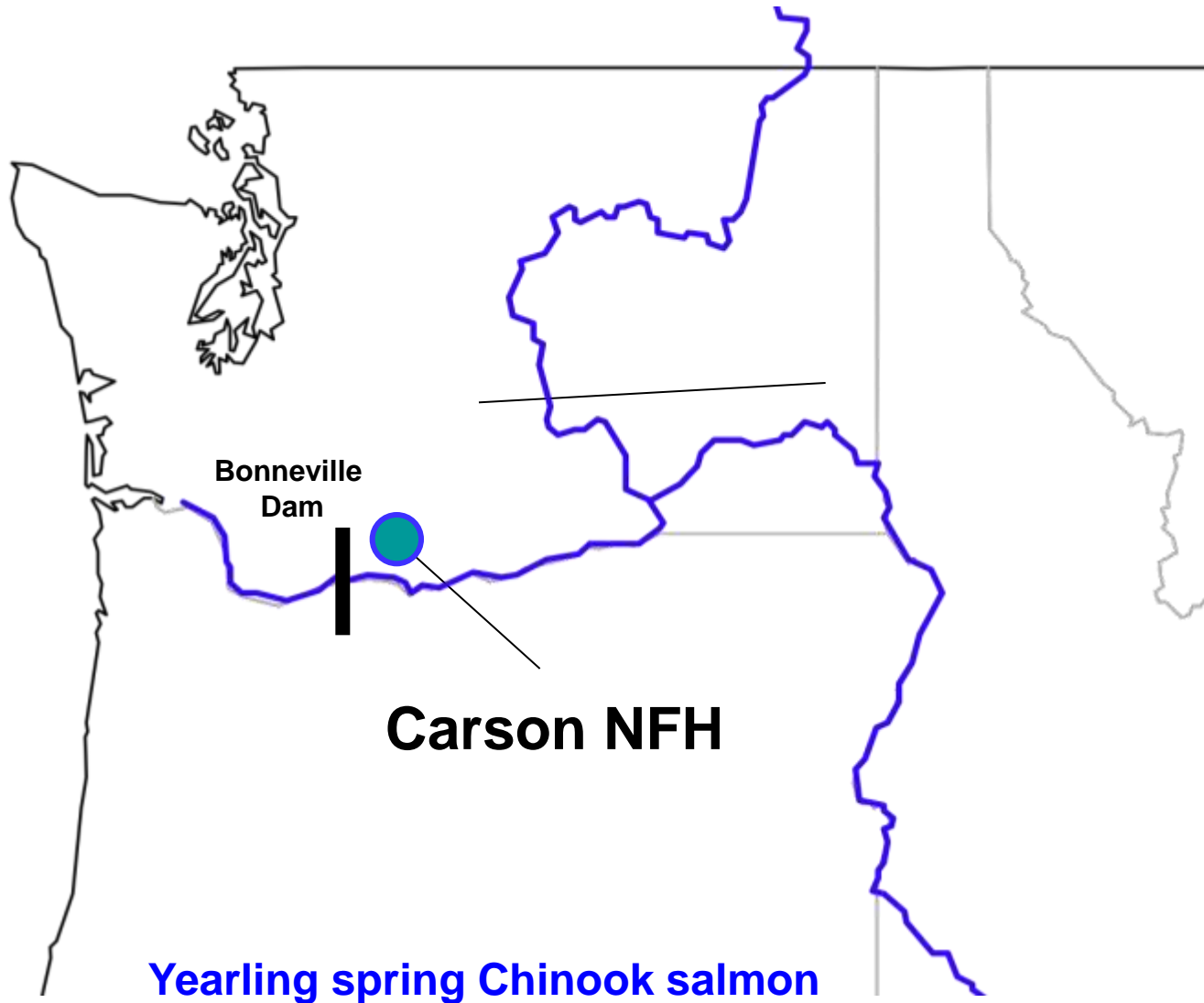




**Most (all?) hatcheries have size @  
release targets**

**How does smolt size at release  
relate to marine survival?**





# How does smolt size of surviving adults vary between years?

## Queried PTAGIS

Adults: **PIT-tags at Bonneville Adult Ladder by release yr**  
minijacks (age 2)  
jacks (age 3)  
age 4

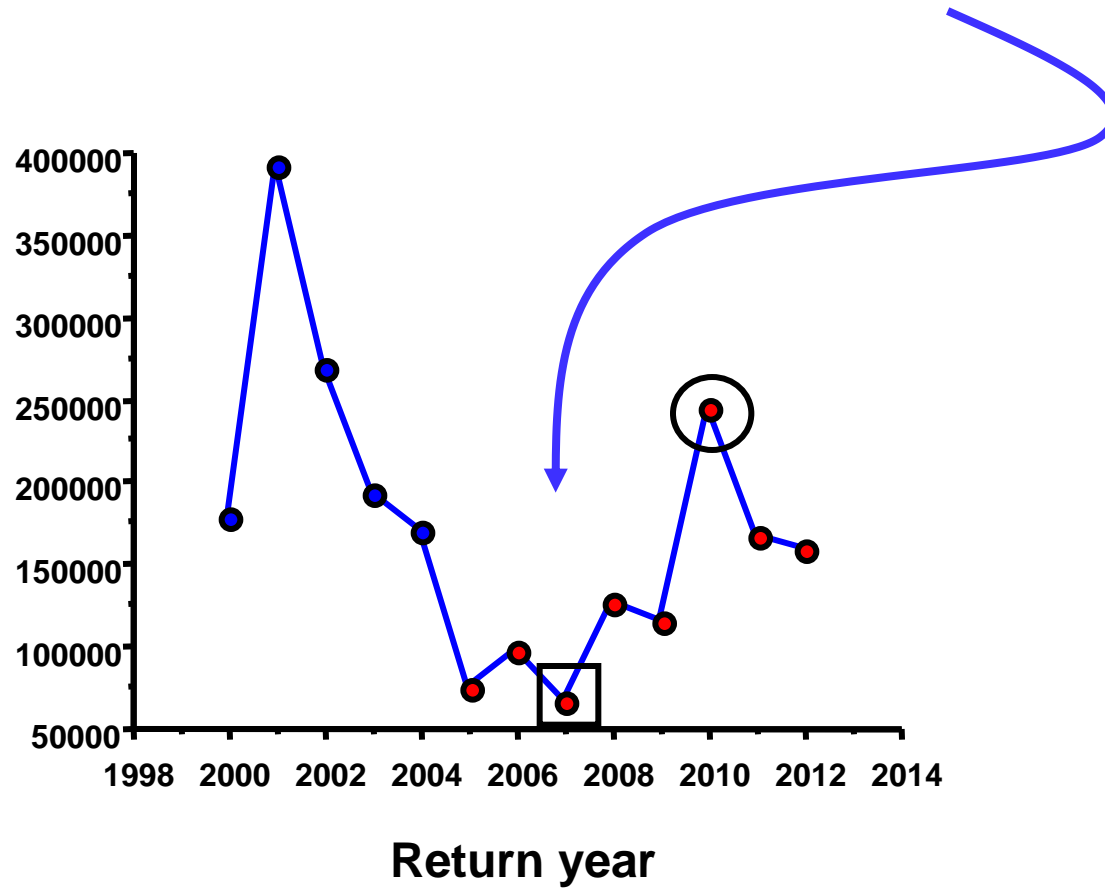
Smolts: **generated mean size at tagging by release yr**  
minijacks  
jacks  
age 4

mean size at tagging is a surrogate for smolt size

=> related mean size at tagging of surviving adults to ocean conditions

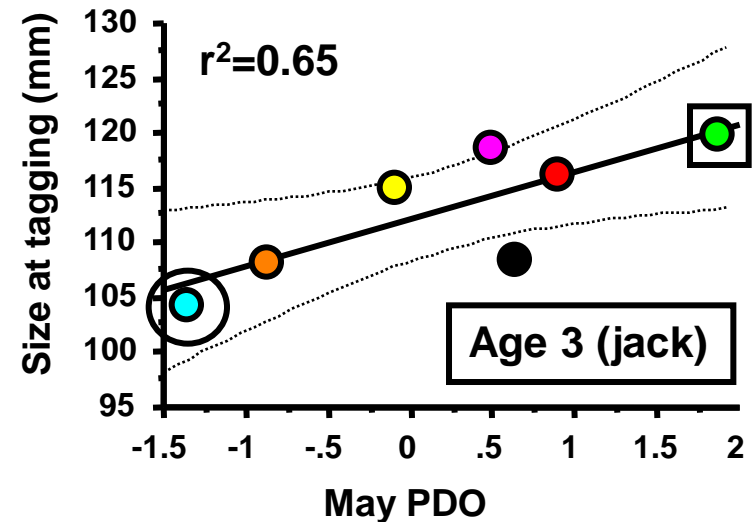
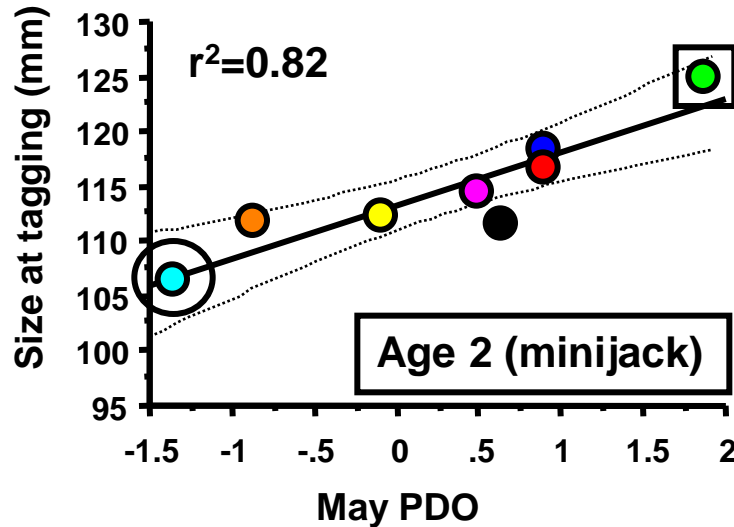
# Carson data

Adult spring  
Chinook  
at Bonneville

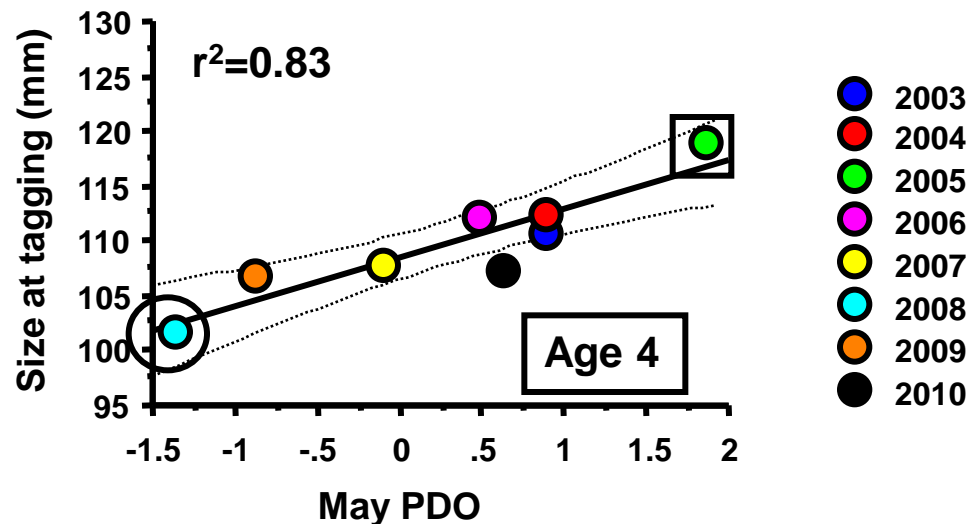


# Size selective mortality is more intense during “bad” ocean years

(-PDO = “good” for salmon)



Slopes similar  
=> Suggests  
common mechanism  
between age classes

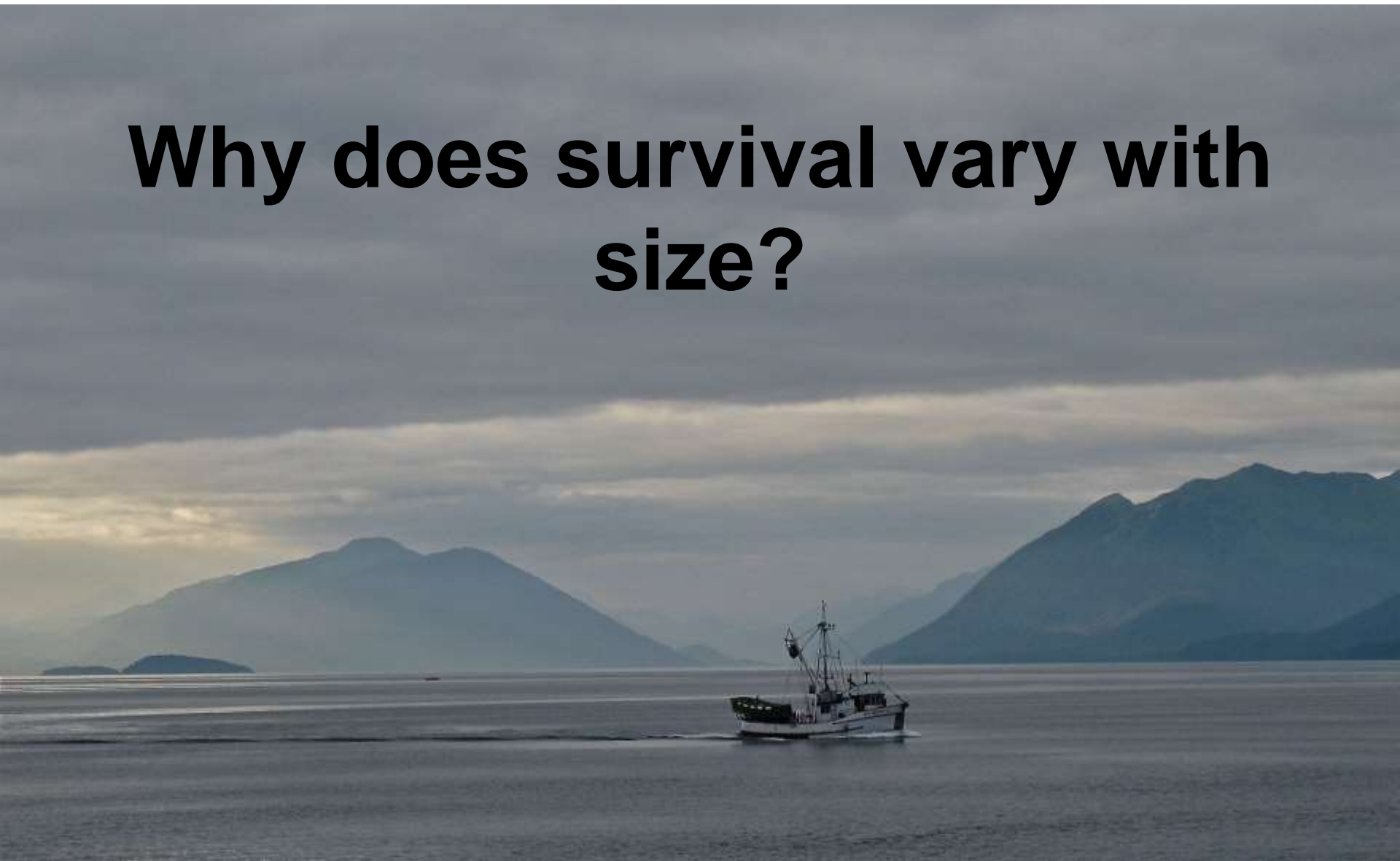


- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010

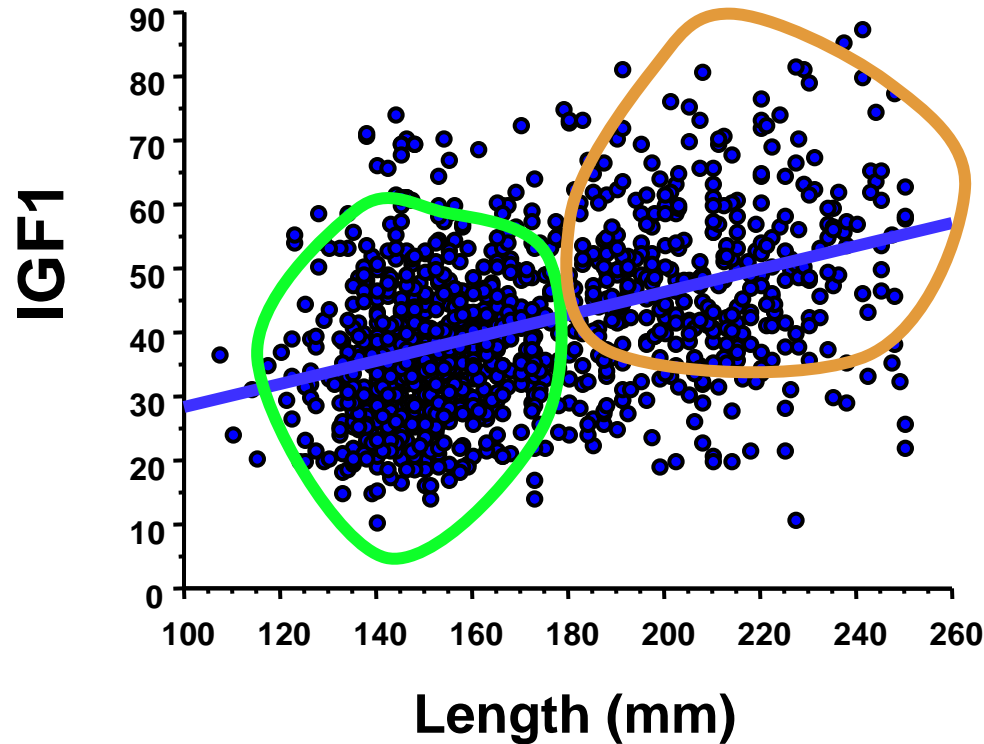
**Size selective mortality occurs  
(in 1st ocean year)**

**More intense selection in “bad” ocean  
years**

# Why does survival vary with size?



# Yearling Columbia R Chinook salmon: marine growth varies with size



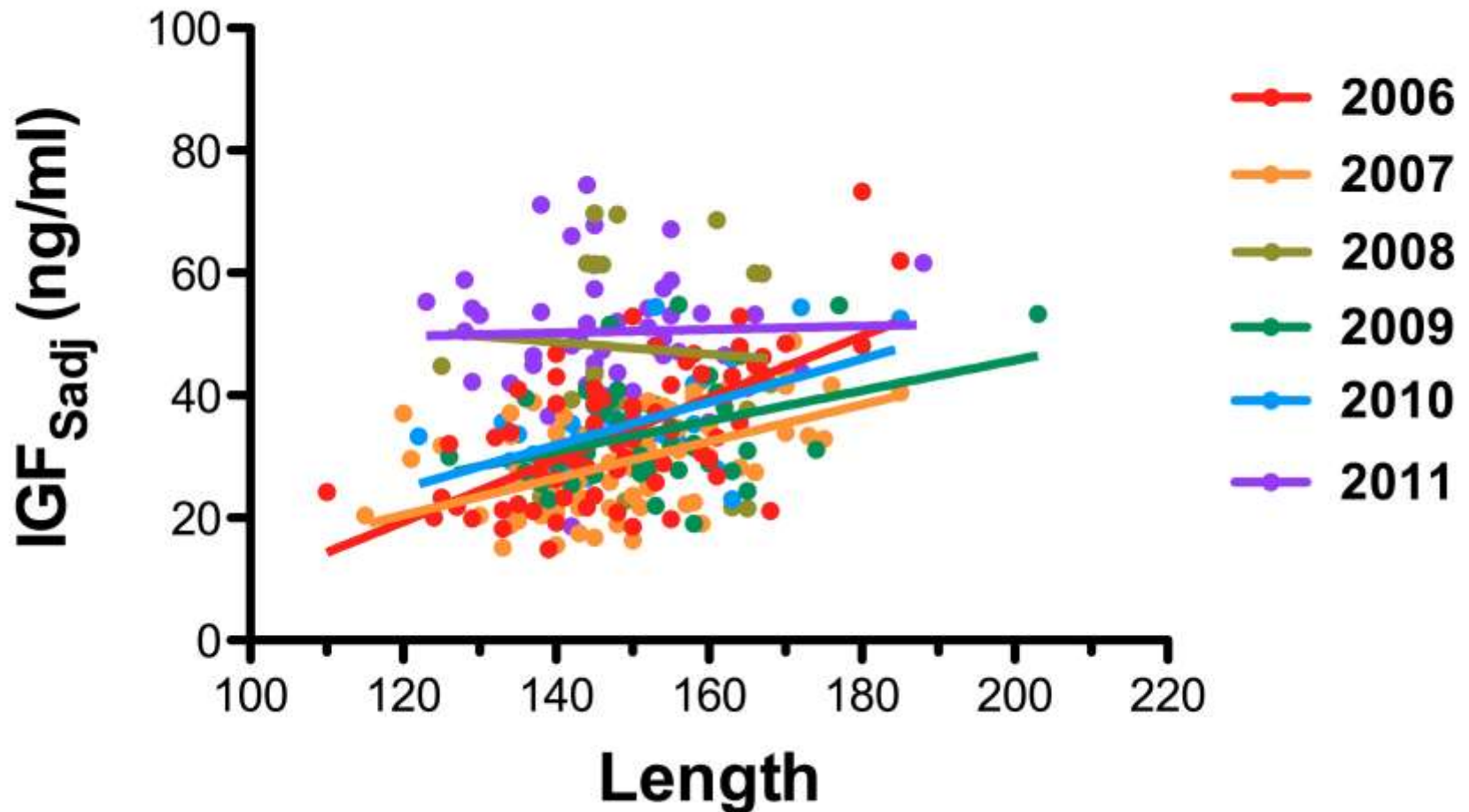
$p < 0.001$ ,  $r^2 = 0.20$

2006 - 2011, May, all stocks



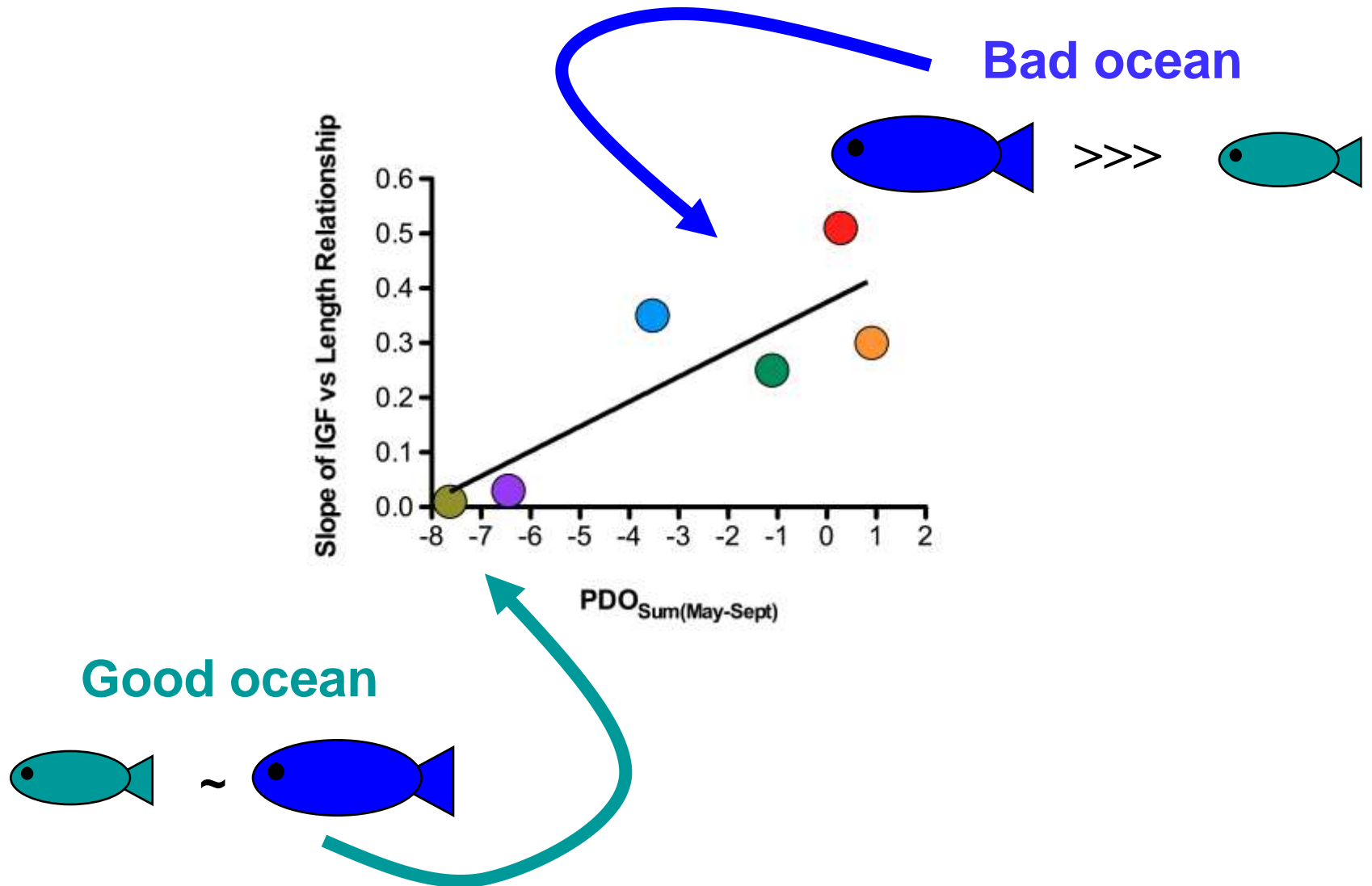
# IGF1 - size relationships vary between years

(slope of regression line)

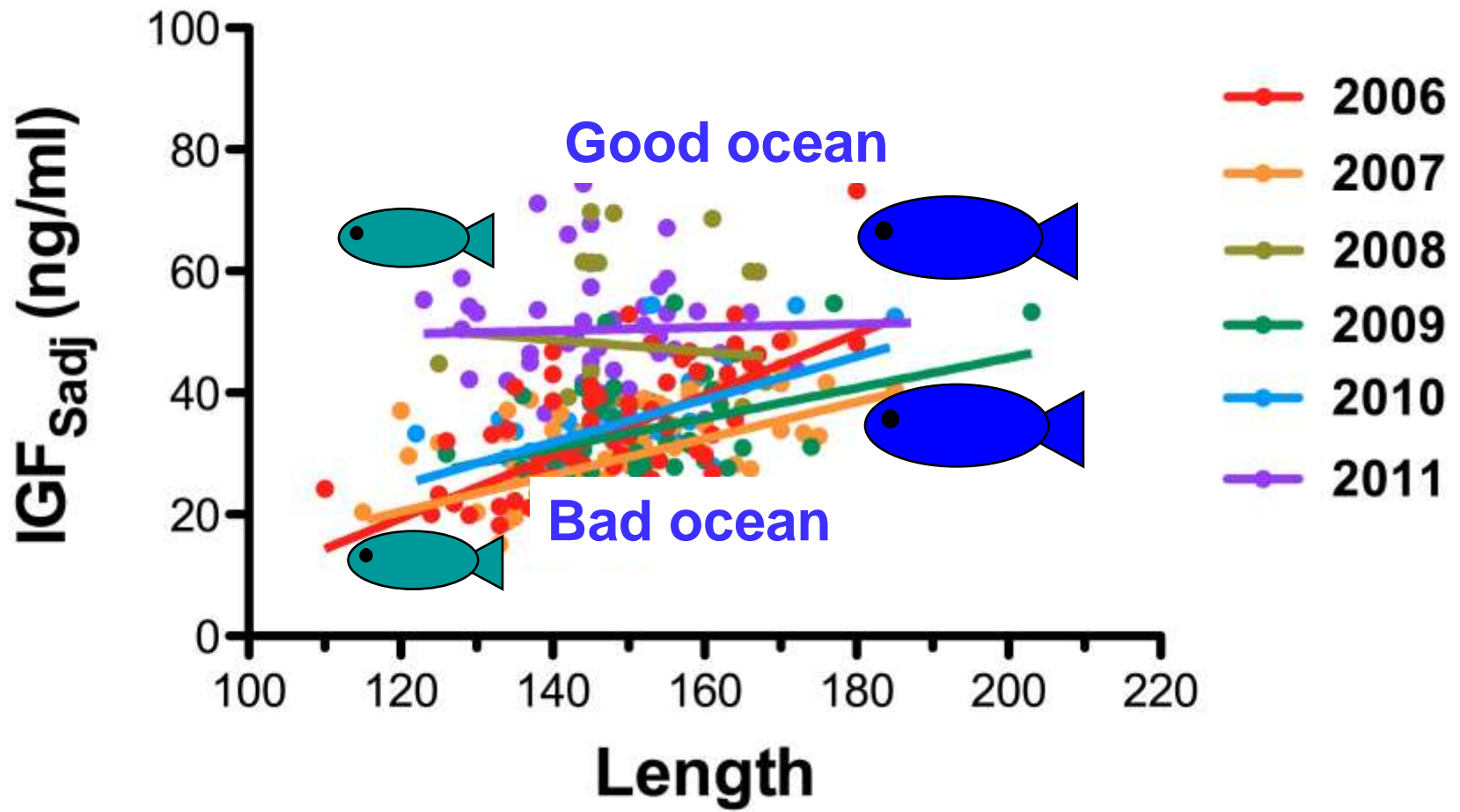


Snake River spring Chinook salmon

# IGF vs Length slope varies with ocean conditions



# IGF1 - size relationships vary between years due to varying ocean conditions



Snake River spring Chinook salmon

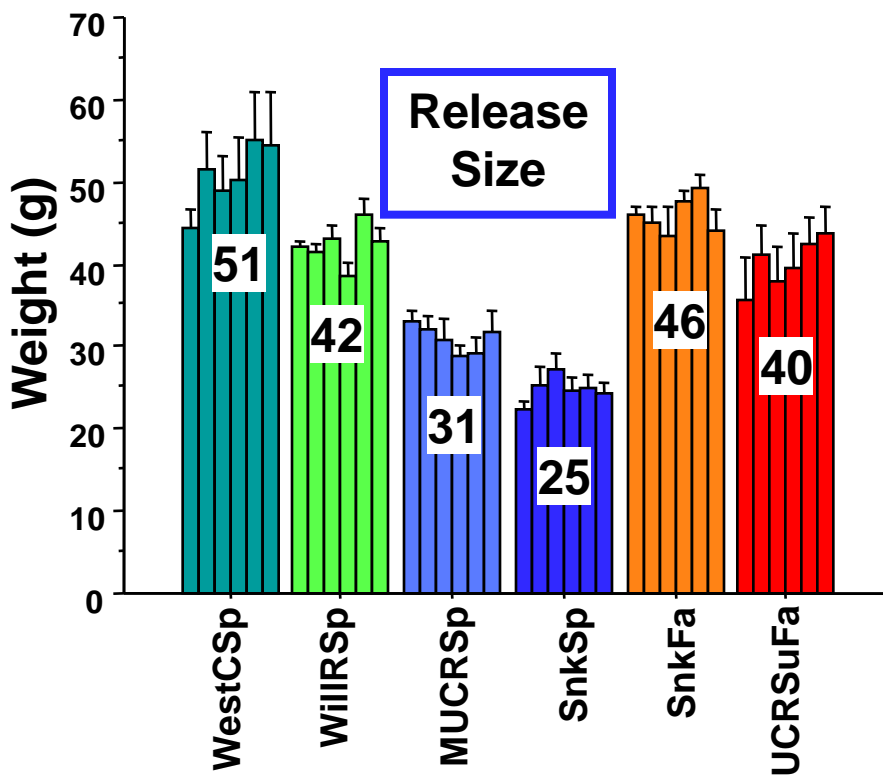
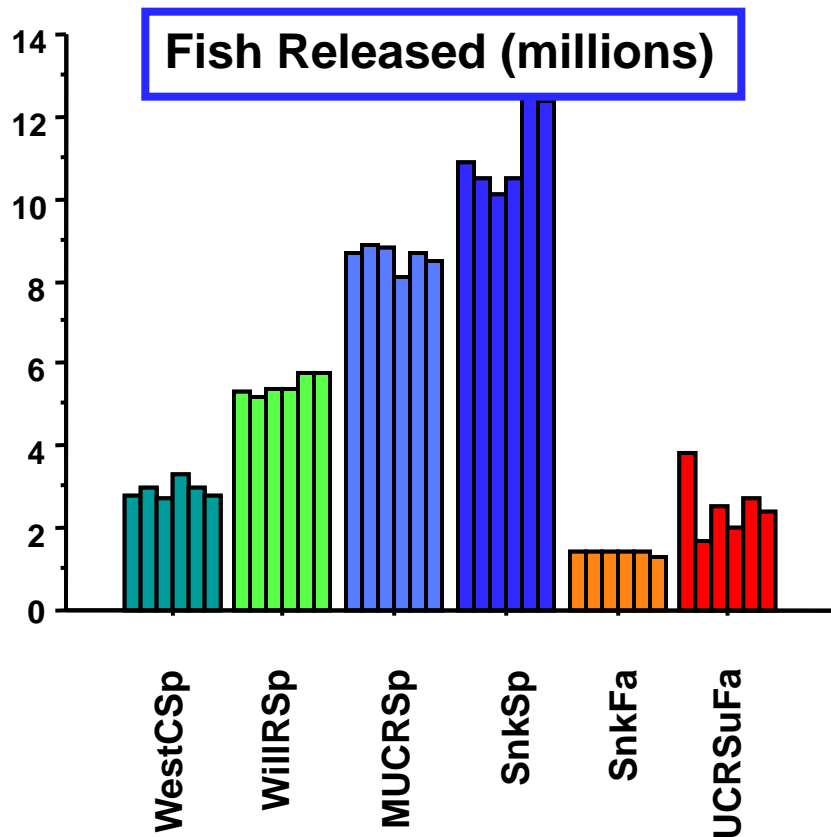
**Size- biased growth occurs**

**Big fish have higher growth  
than smaller fish  
in “bad” ocean years**

## More hatchery data



# Release size of yearling Chinook salmon varies 2-fold by stock



**Fish Passage  
Center**

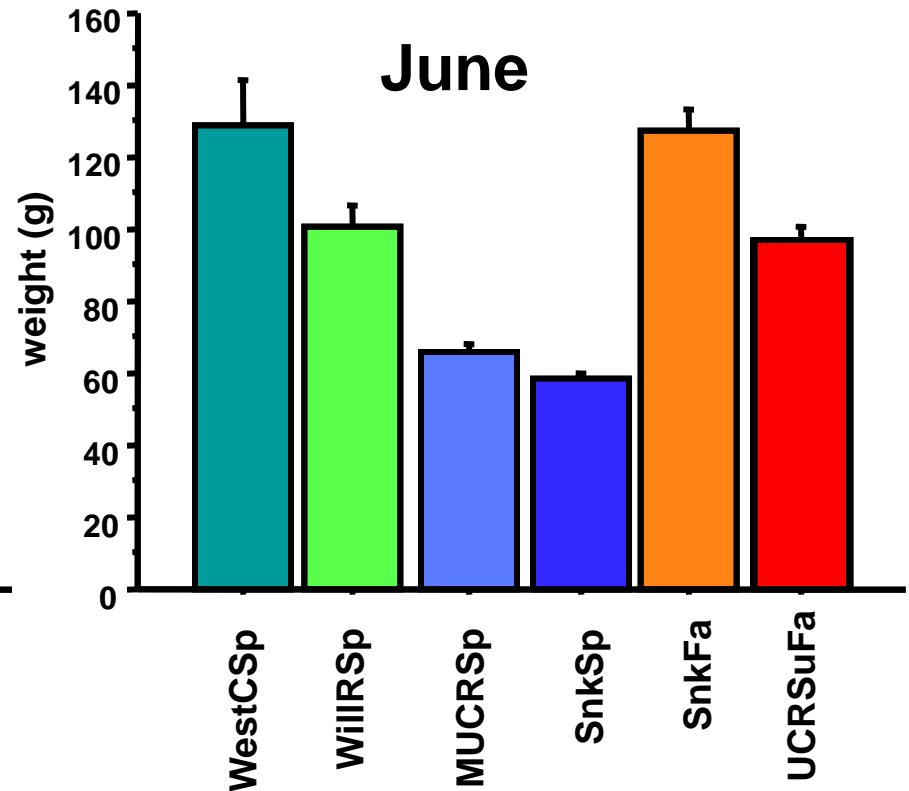
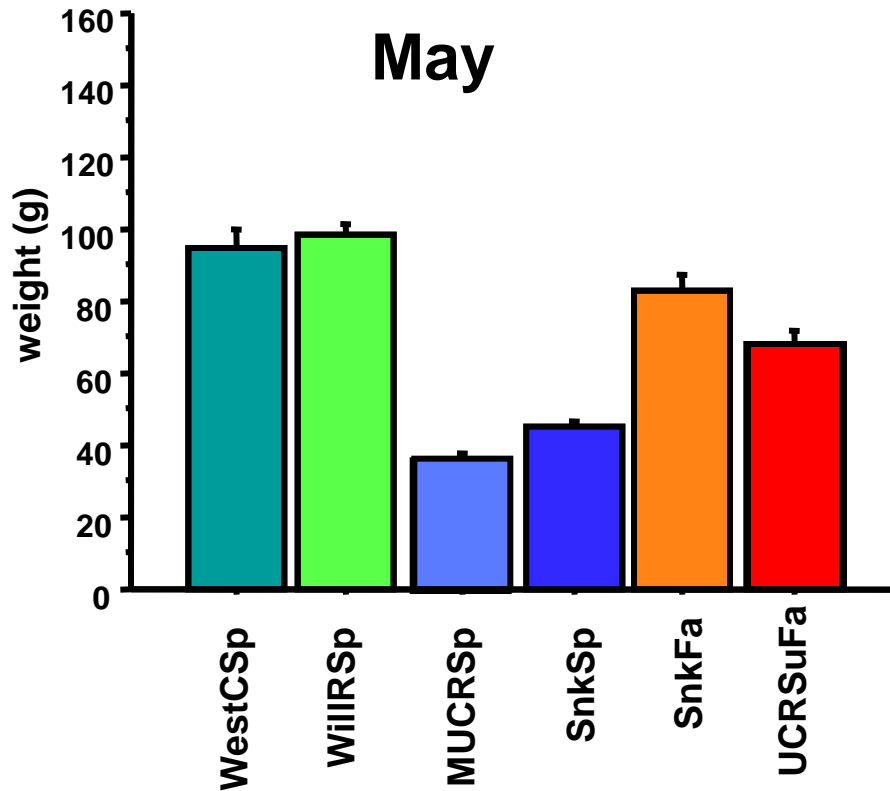
# What about salmon in the ocean?

## NOAA Juvenile Salmon Ocean Survey



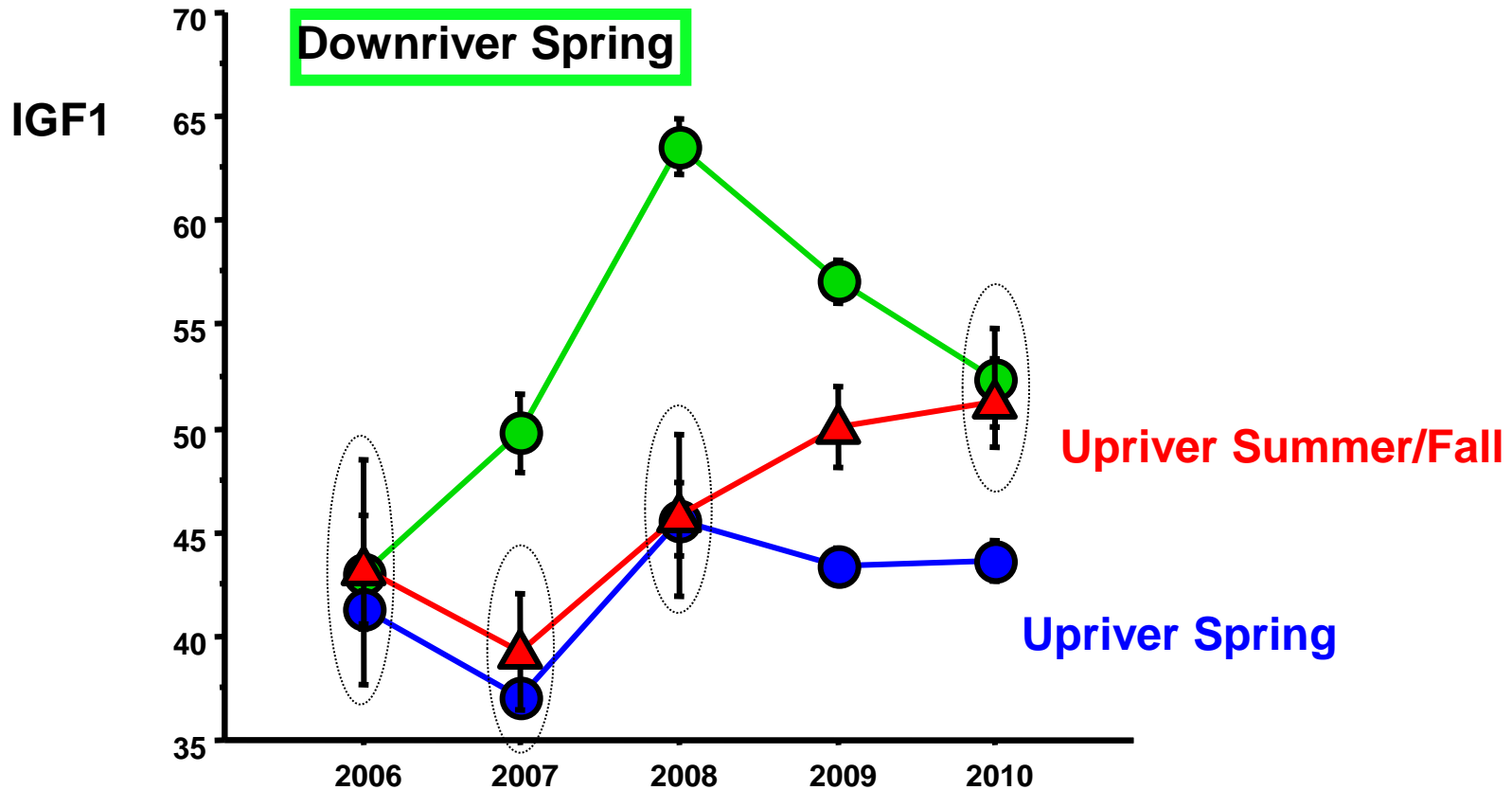


# Weight of fish caught in the ocean varies > 2-fold by stock





# “Upriver” spring yearlings have lower growth in May



**Different stocks have  
differing smolt sizes**

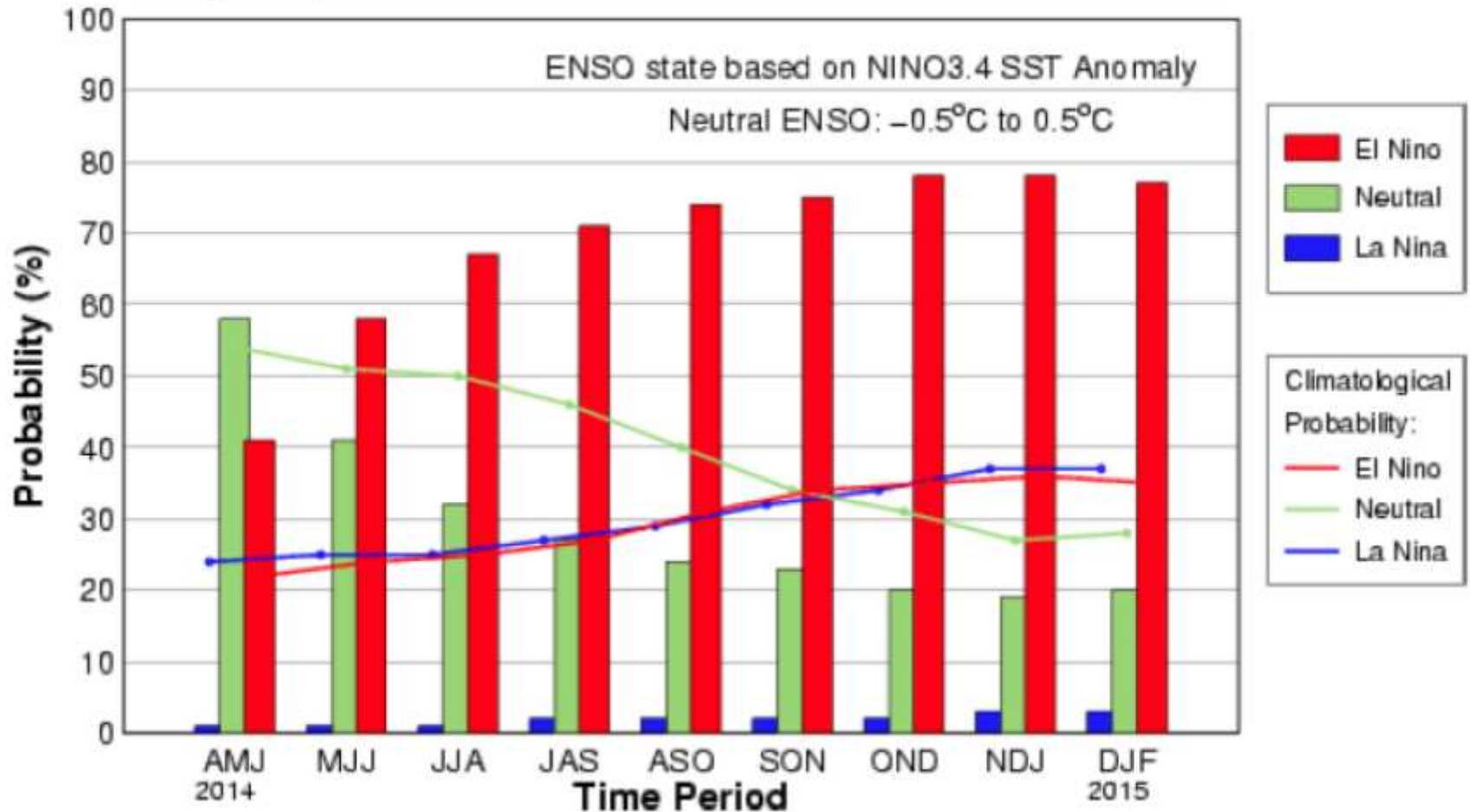
**Different stocks have  
differing early marine  
growth rates**

**Do different stocks have  
differing size-based marine  
mortality rates?**

**Do stock specific size-  
based mortality rates vary  
with ocean conditions?**

# El Nino ?

## Early-May CPC/IRI Consensus Probabilistic ENSO Forecast



## Summary:

- marine growth is limited in some years
- marine survival is related to marine growth
- size selective marine mortality occurs
- more intensive marine size selection in low marine growth years
- differences in growth between big and small fish are greater in years with low marine growth
- size varies among stocks
- **El Nino 2015?**

# Acknowledgements

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