



Results from Colorado River Study Site and ongoing population modeling

Annual Reporting for FY13
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U.S. Department of the Interior
U.S. Geological Survey

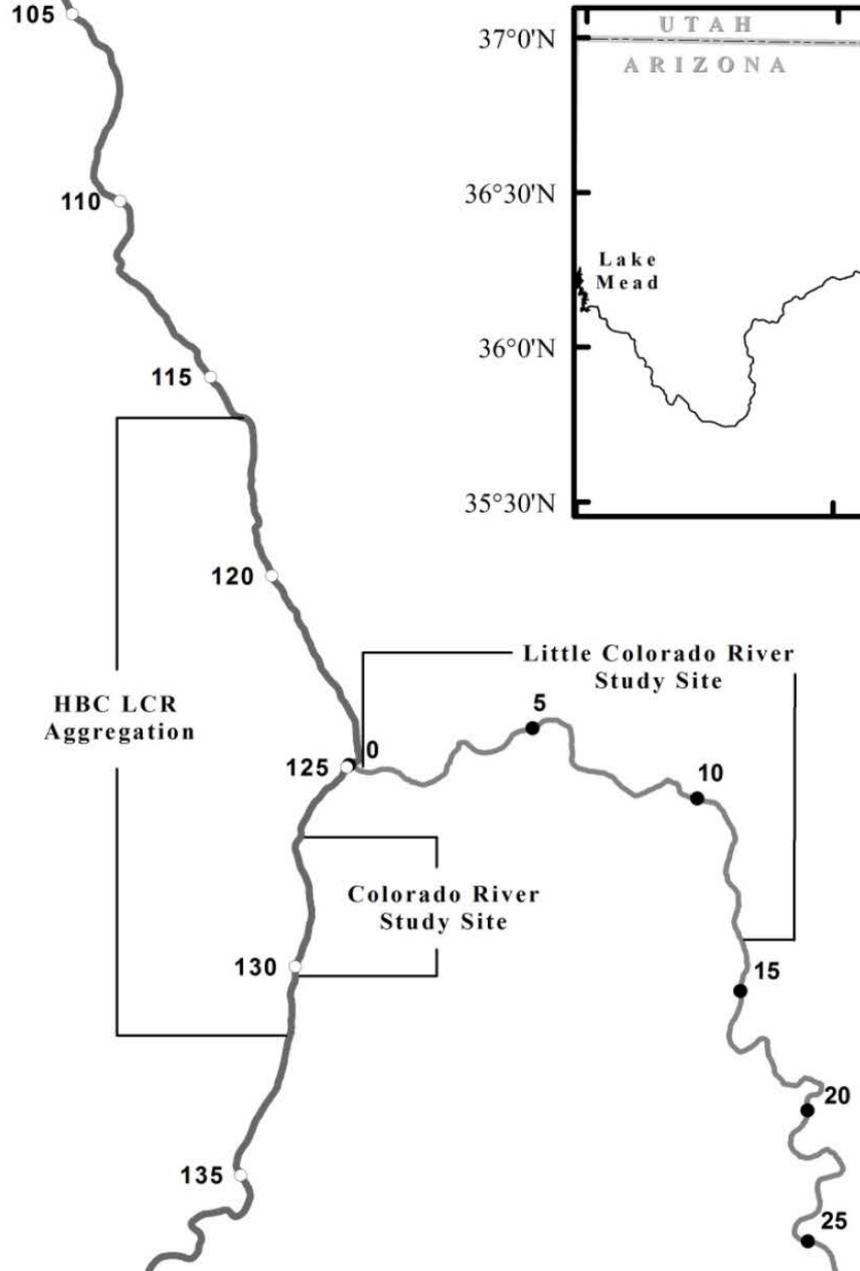
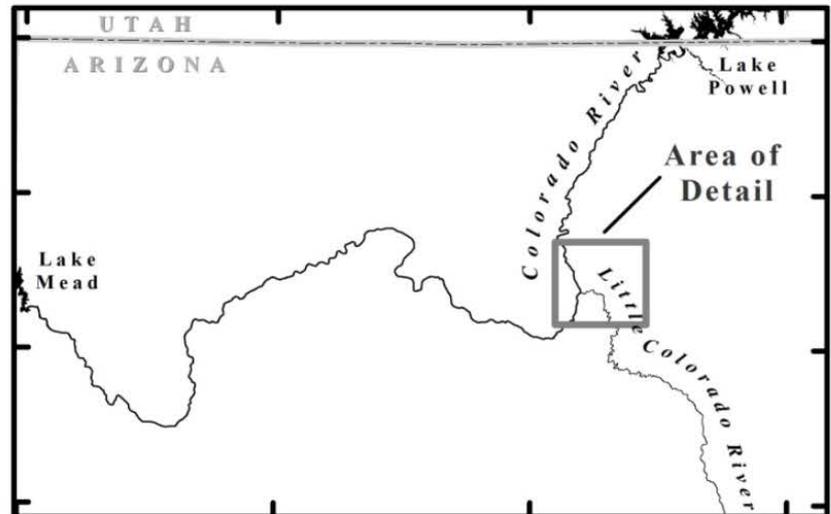


Outline

- Juvenile chub survival and abundance in JCM.
- Humpback chub dynamics - general patterns
- Modeling humpback chub dynamics for LTEMP
- Age 0 recruitment and movement.

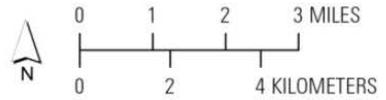
114°0'W 113°0'W 112°0'W 111°0'W

37°0'N
36°30'N
36°0'N
35°30'N

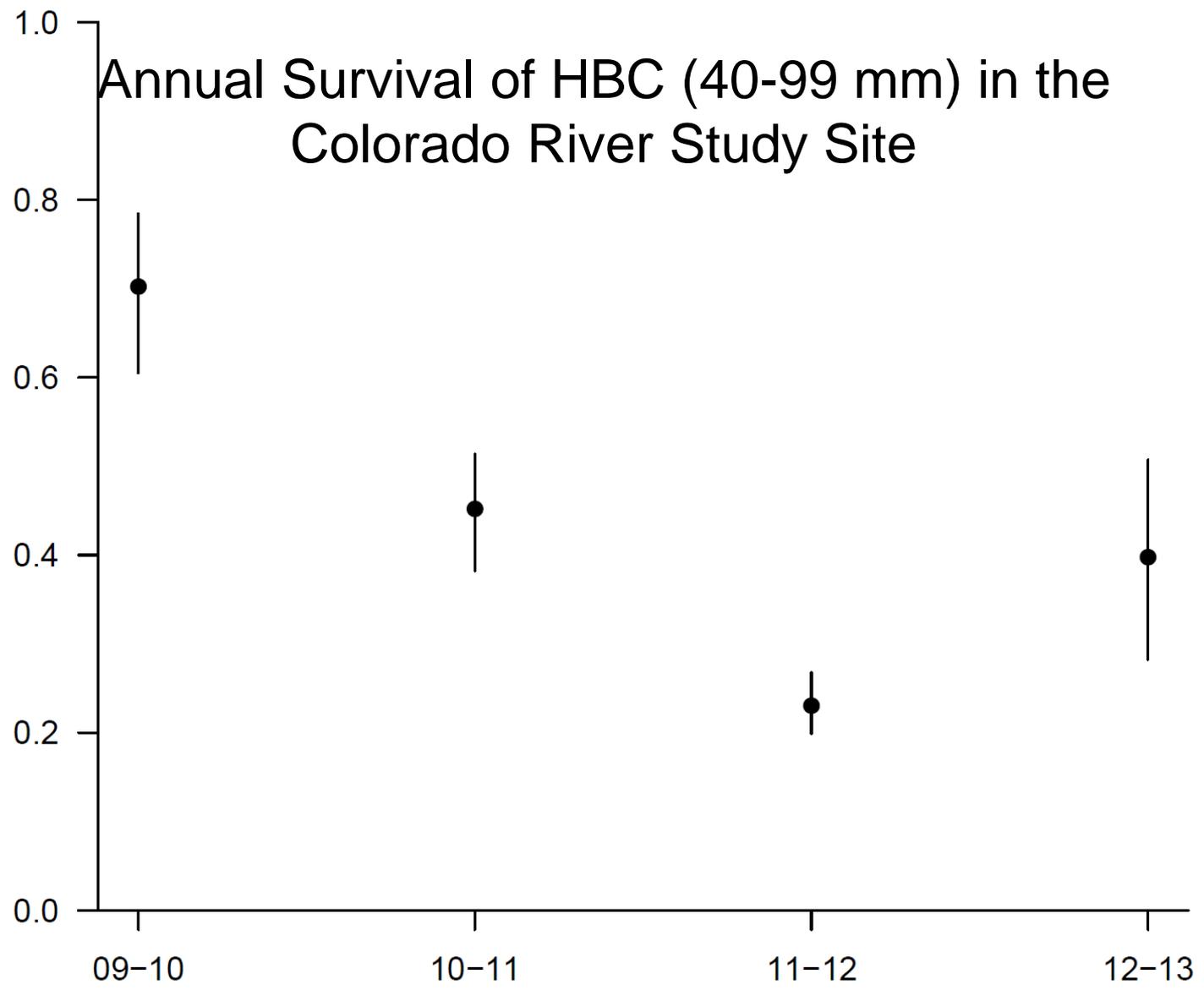


Explanation

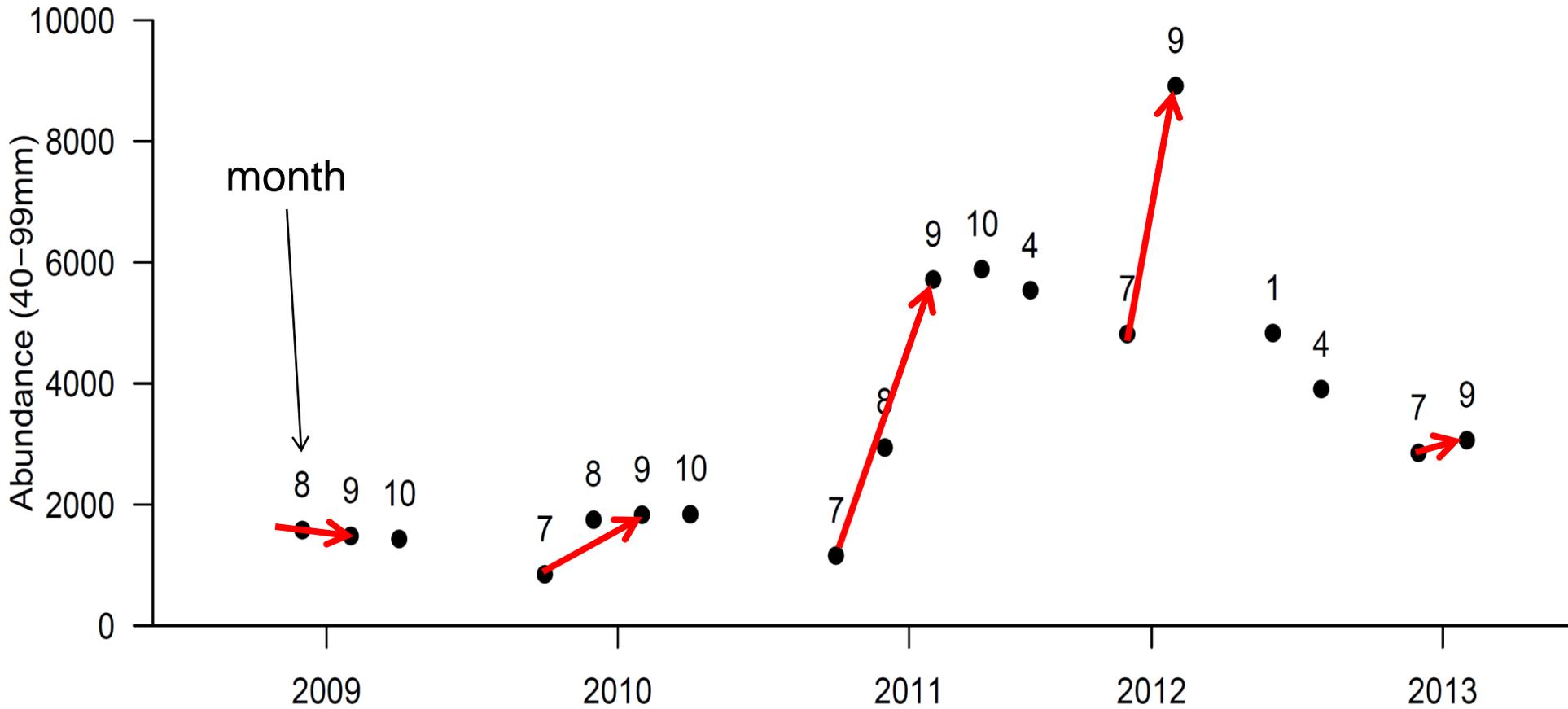
- Kilometers from Glen Canyon Dam
- Kilometers from Confluence



Annual Survival of HBC (40-99 mm) in the Colorado River Study Site

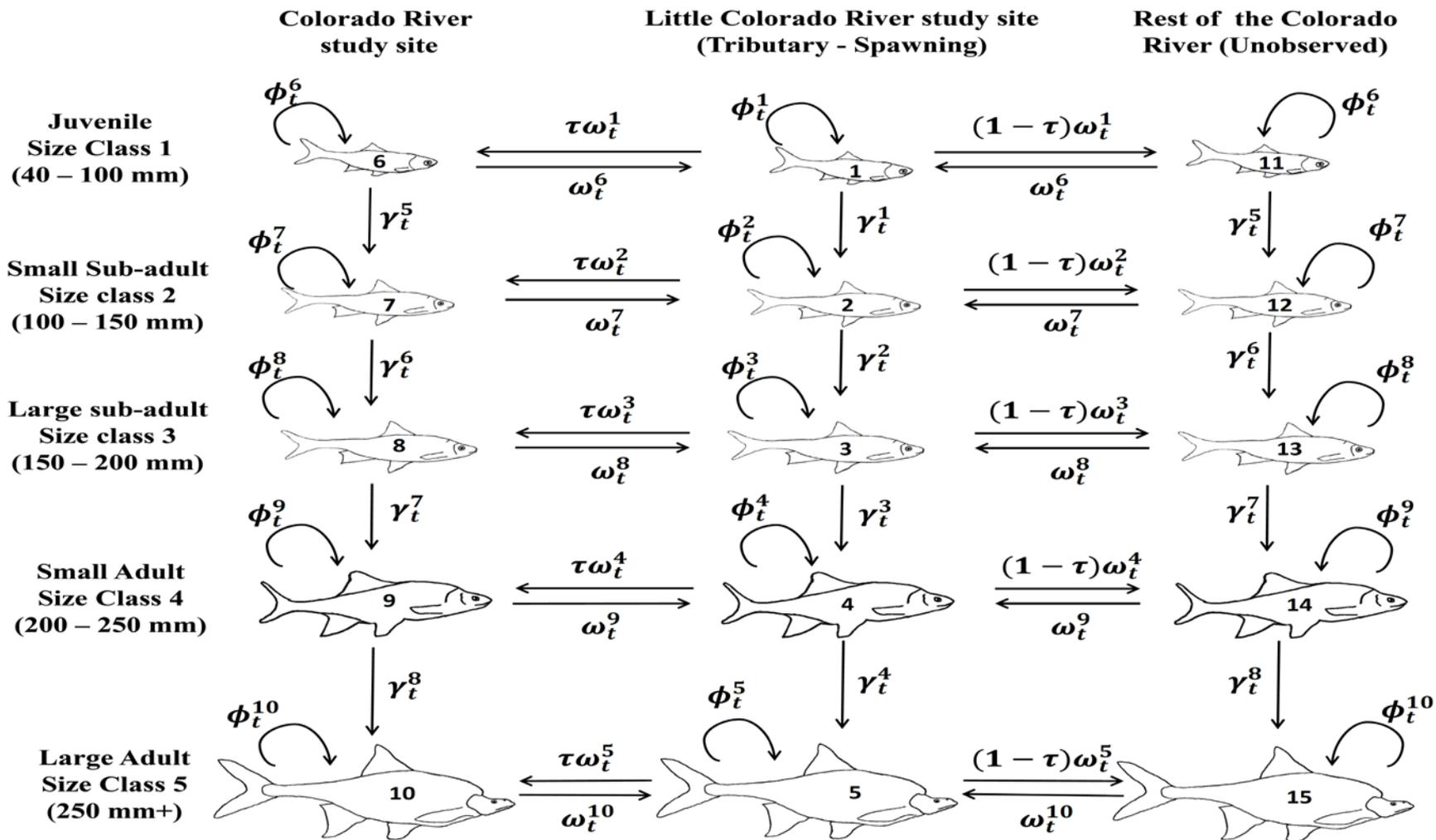


Juvenile Abundance in JCM



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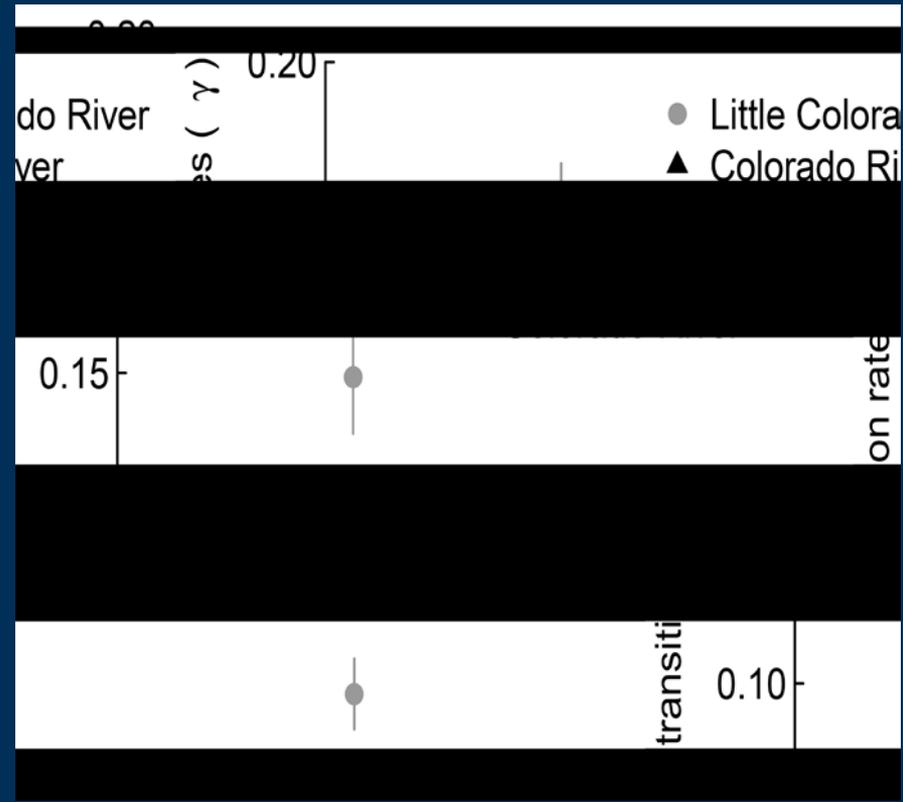
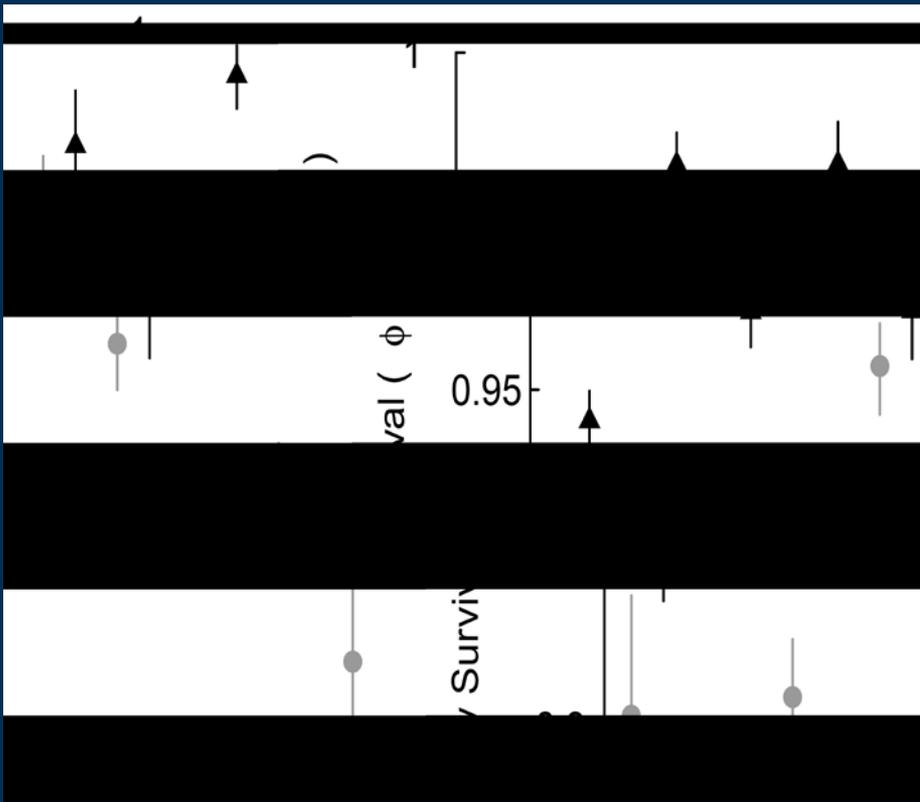


Summary of model parameters

ϕ – survival ω – movement γ – size transition (growth)
 τ – proportion of Colorado River fish in Colorado River HBC monitoring site



The model and its parameters (excluding capture probabilities).
 Yackulic, Yard, Korman and Van Haverbeke, *in press*



- Monthly survival generally increases with size and is higher in Colorado river than in LCR.

- Growth is much faster in LCR.



LCR – typical values based on 2009-2012 data

A.) Quick growth to adulthood

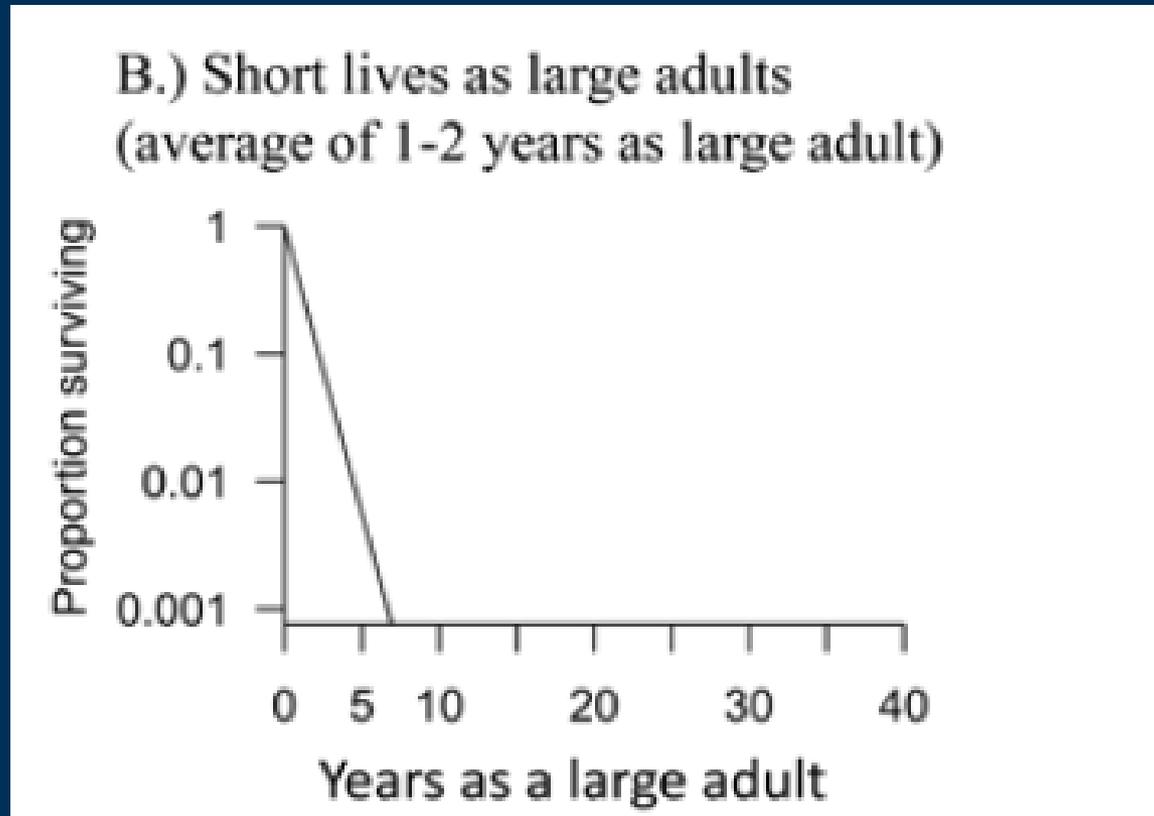
Average number of months spent within size class



Average monthly survival rate

-----> ~11 % chance of reaching 200 mm (from July of year 0)
-----> ~5 % chance of reaching 250 mm

LCR – typical values based on 2009-2012 data



Colorado River – typical values based on 2009-2012 data

C.) Slow growth to adulthood

Average number of months spent within size class

24

24

36

30



Average monthly survival rate

0.94

0.97

0.97

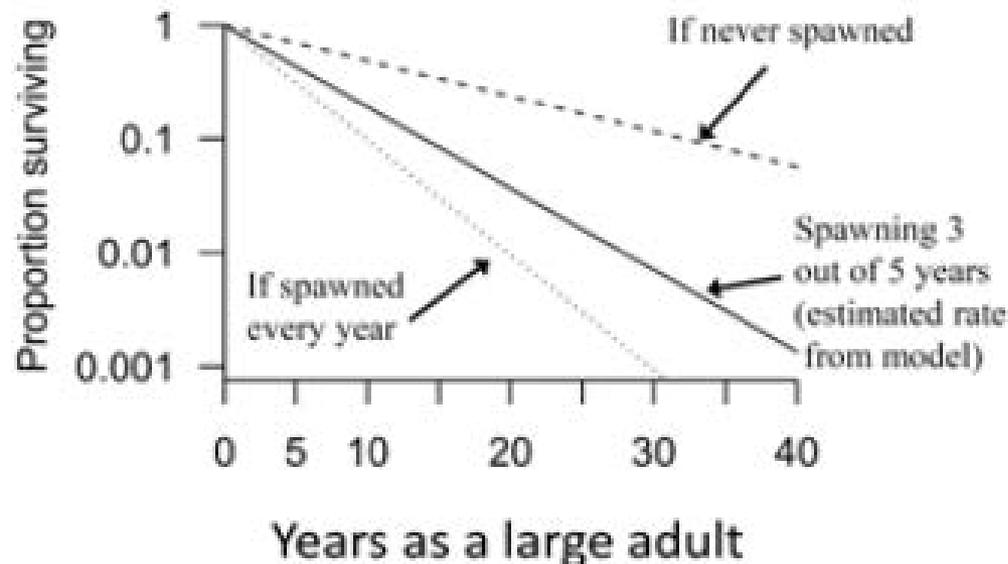
0.98

-----> ~4 % chance of reaching 200 mm (from July of year 0)

-----> ~2 % chance of reaching 250 mm

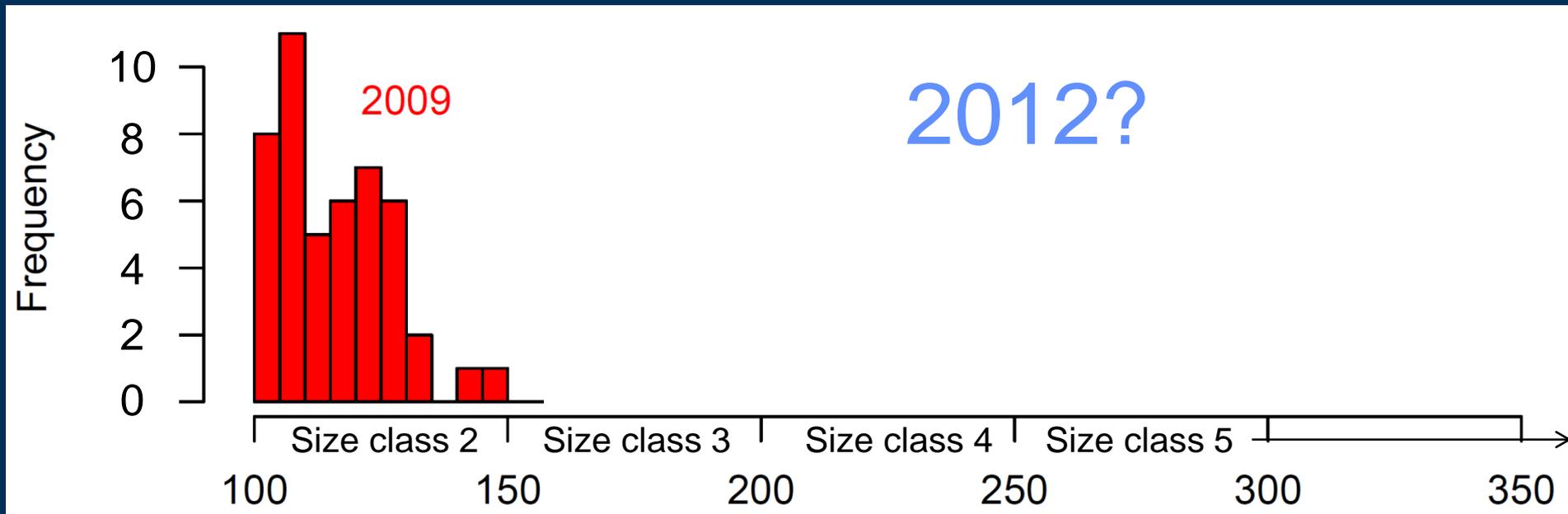
Colorado River – typical values based on 2009-2012 data

D.) Longer lives as large adults
(average of ~6 years as large adult if spawn 3 out of 5 years)



“I don’t trust your black magic models Charles...show me some data.” – skeptic

“Fine, lets look at all fish that were caught in 2009 in size class 2 and also caught (in any size class) in 2012. And let’s do it separately for the LCR and Colorado River.” – me



LCR

Average number of months spent within size class

7

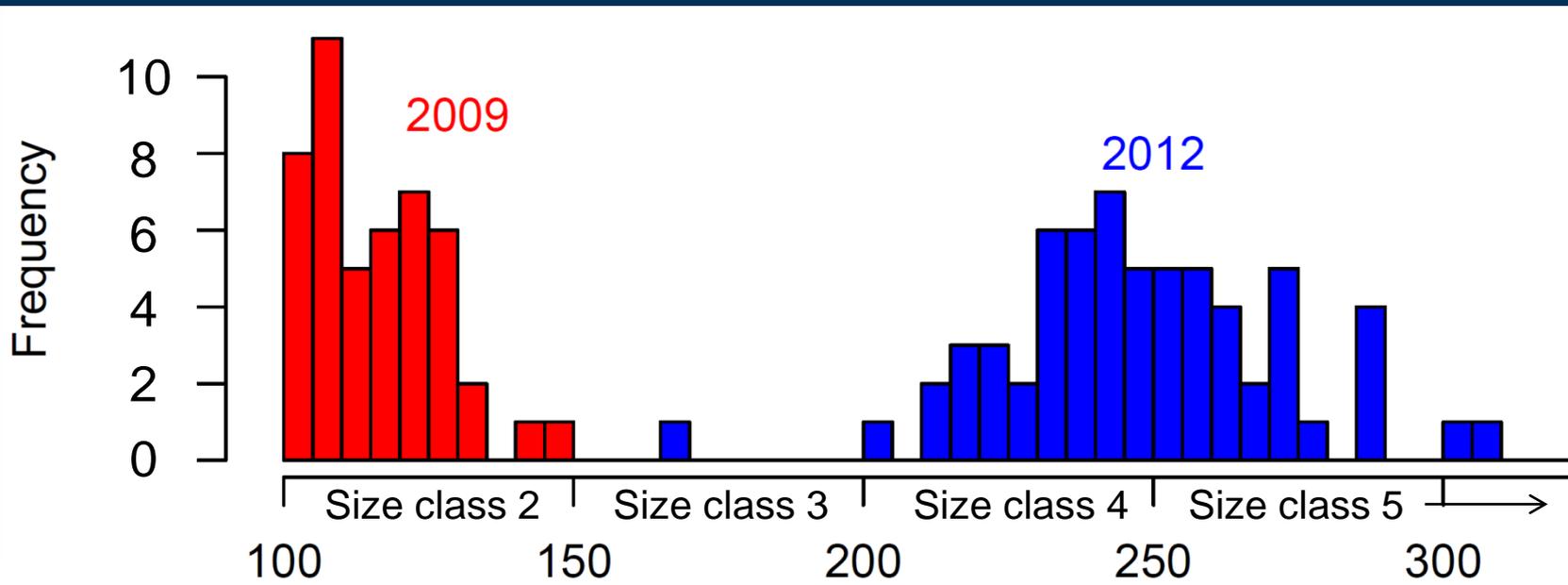
11

17



2009

2012



Average number of months spent within size class

24

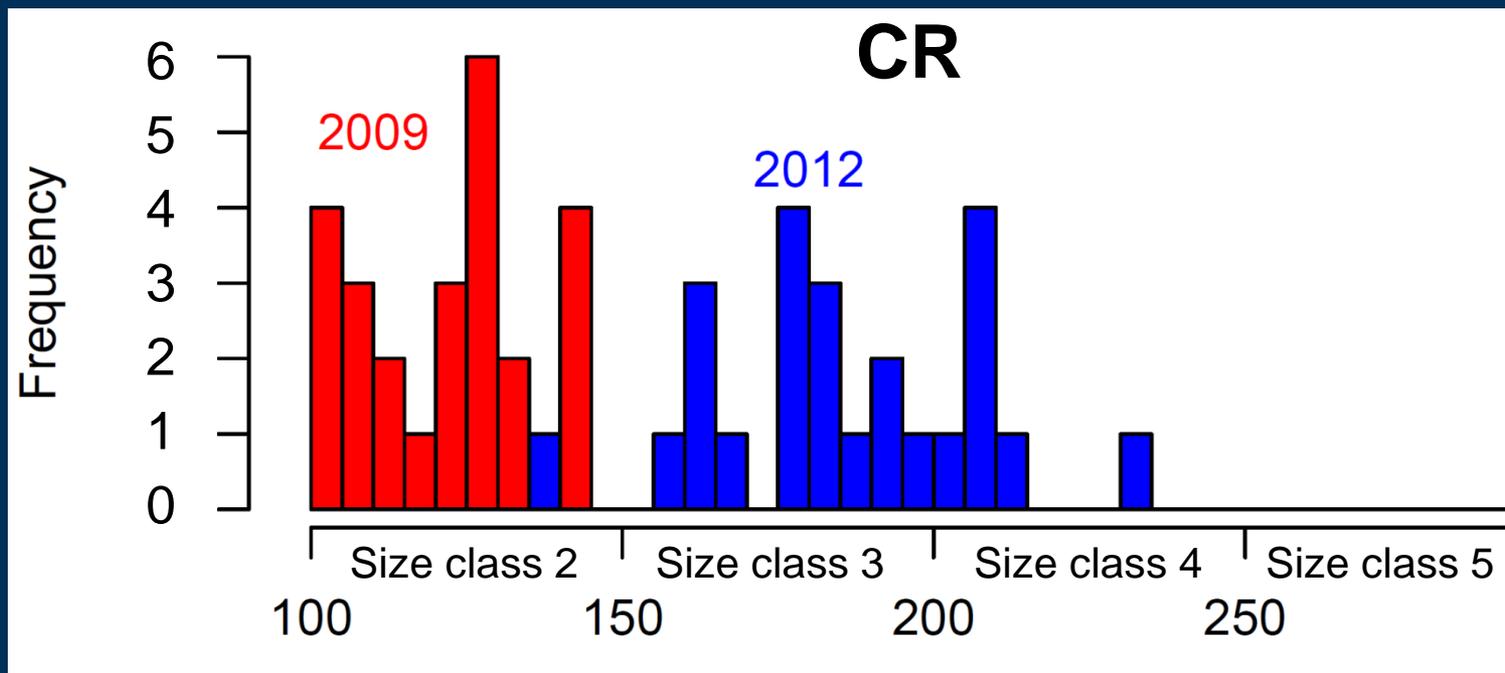
36

30



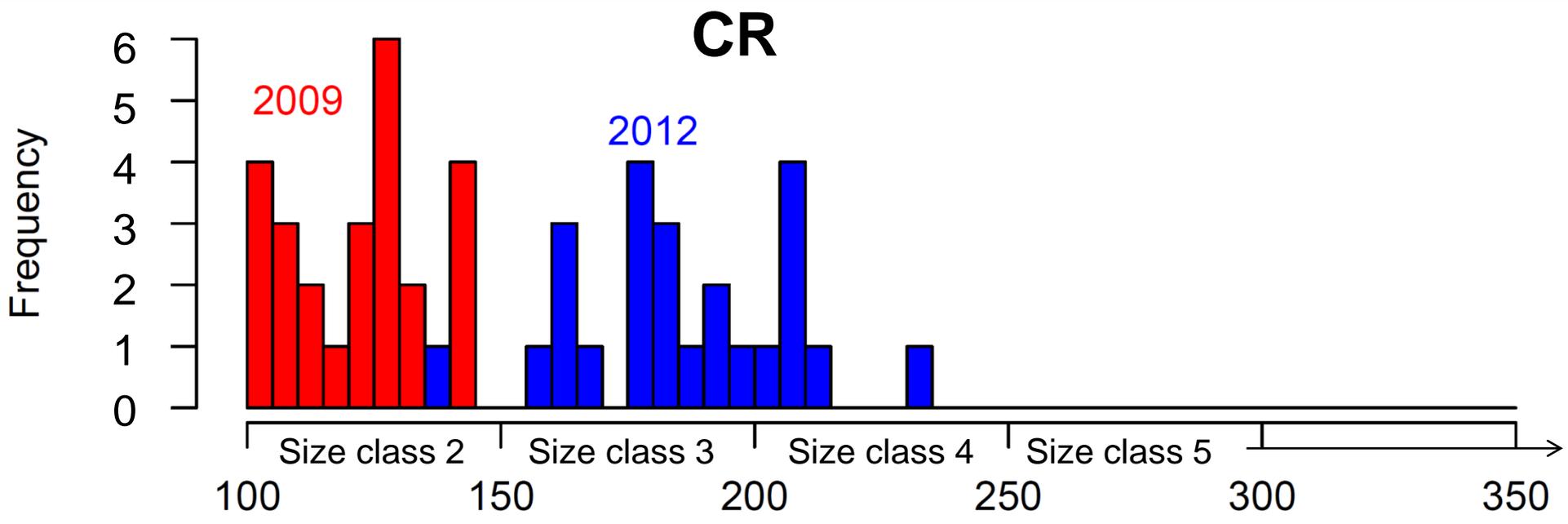
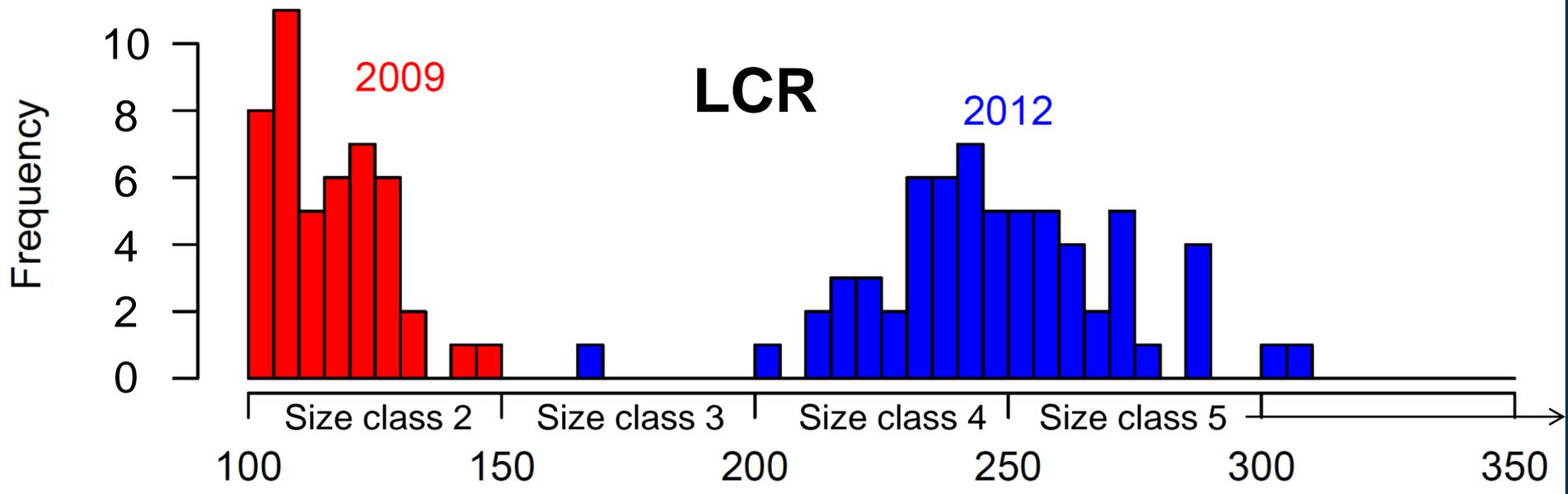
2009

2012



Colorado River Study Site

Yackulic, Yard, Korman and Van Haverbeke, *in press*



Other findings

- Evidence for both skip-spawning and residents.
- Larger adults spawn more frequently.
- Most size class 1 HBC leave LCR during monsoons.
- Adult Abundance – 11K (95% CI: 7-16K)

Outline

- Juvenile chub survival and abundance in JCM.
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- **Modeling humpback chub dynamics for LTEMP**
- **Age 0 recruitment and movement.**

Colorado River

Little Colorado River

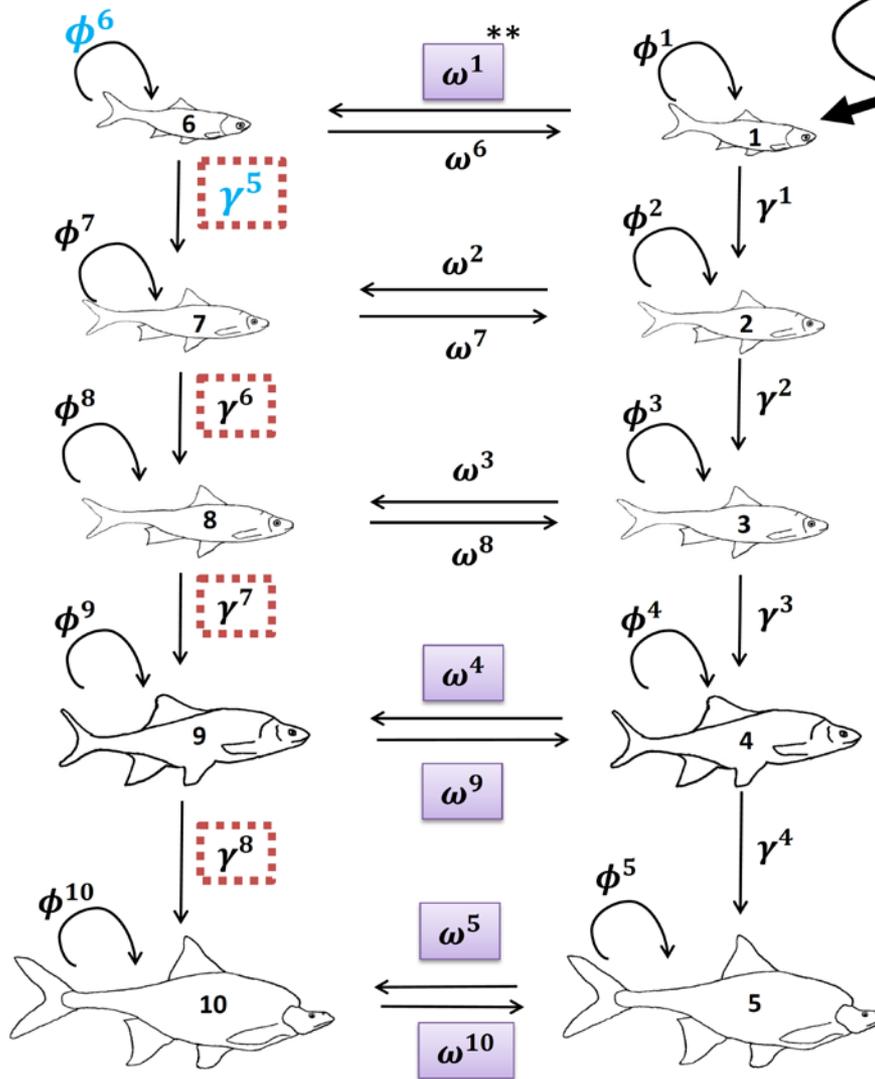
Juvenile
Size Class 1
(40 – 100 mm)

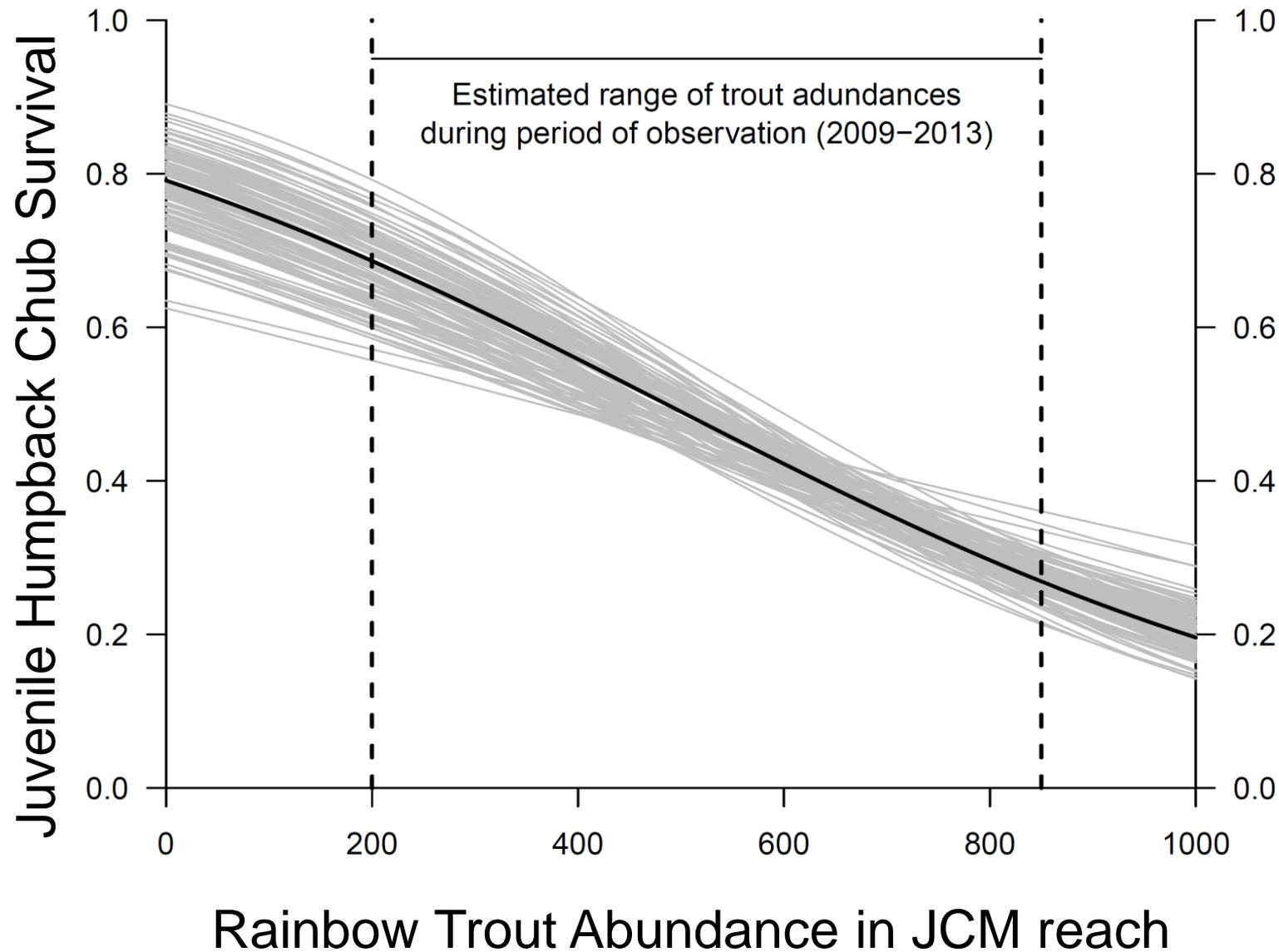
Small Sub-adult
Size class 2
(100 – 150 mm)

Large sub-adult
Size class 3
(150 – 200 mm)

Small Adult
Size Class 4
(200 – 250 mm)

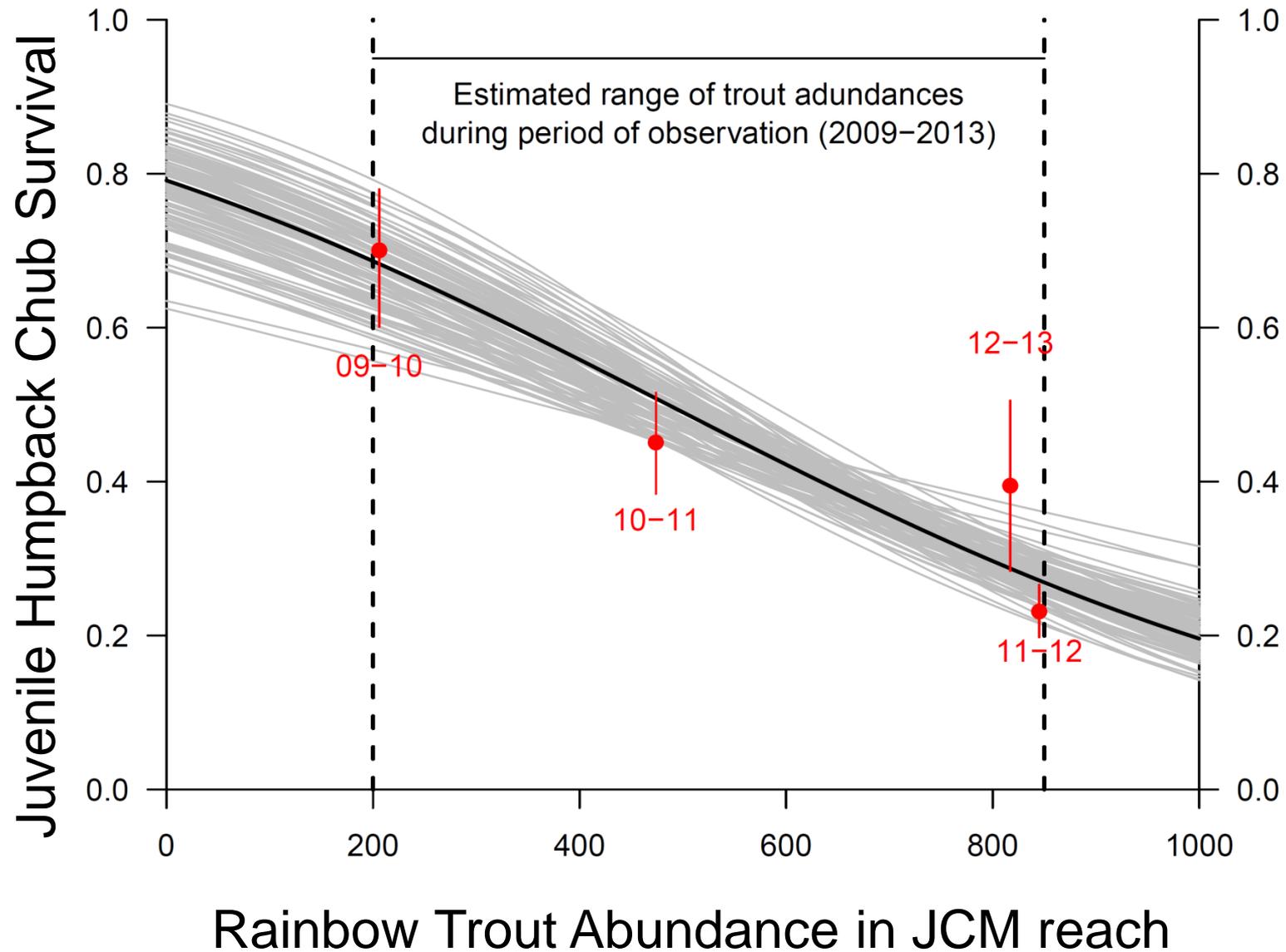
Large Adult
Size Class 5
(250 mm+)





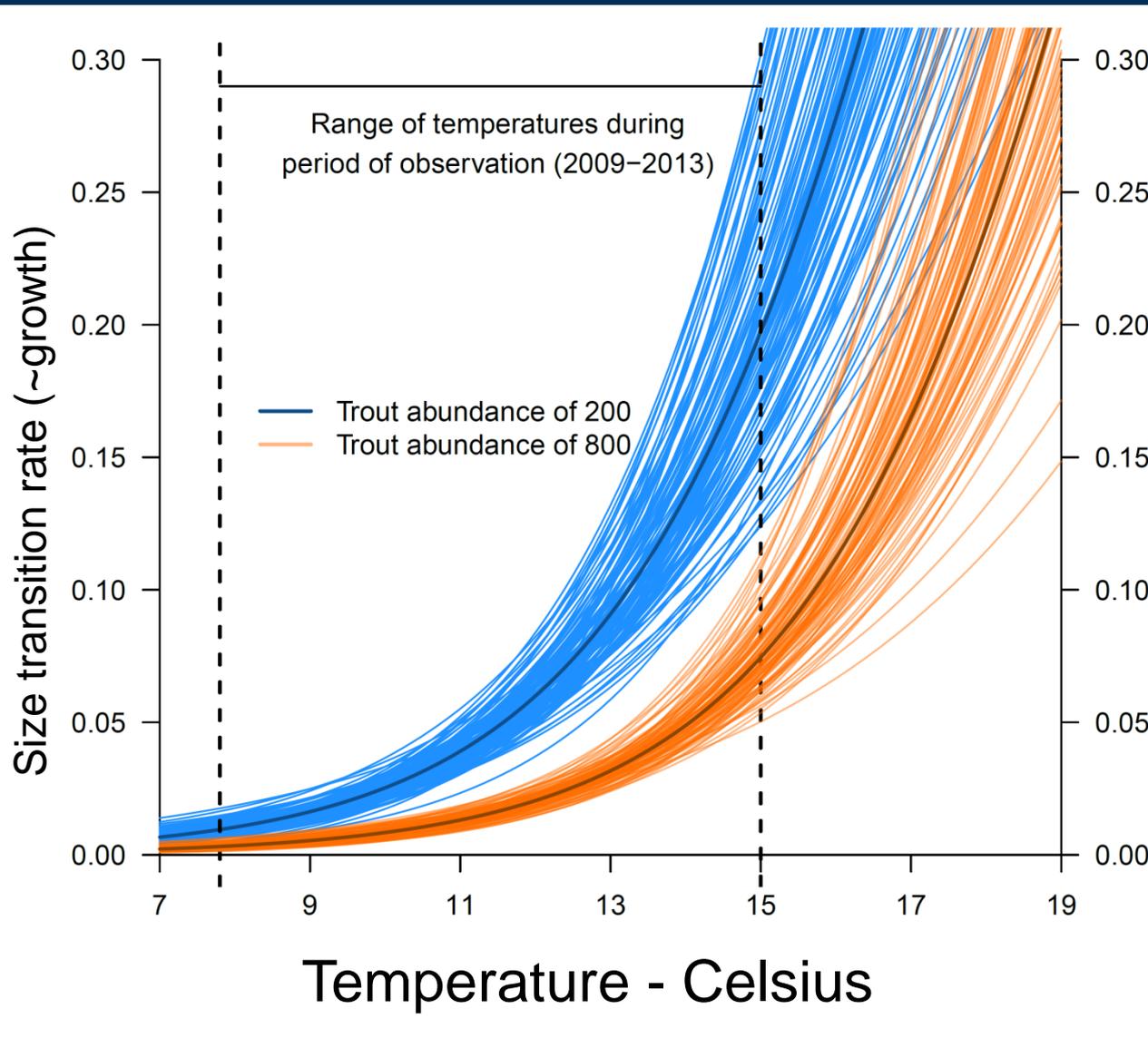
Preliminary Data Do Not Cite

Fitted relationship between Juvenile HBC survival and RBT abundance.

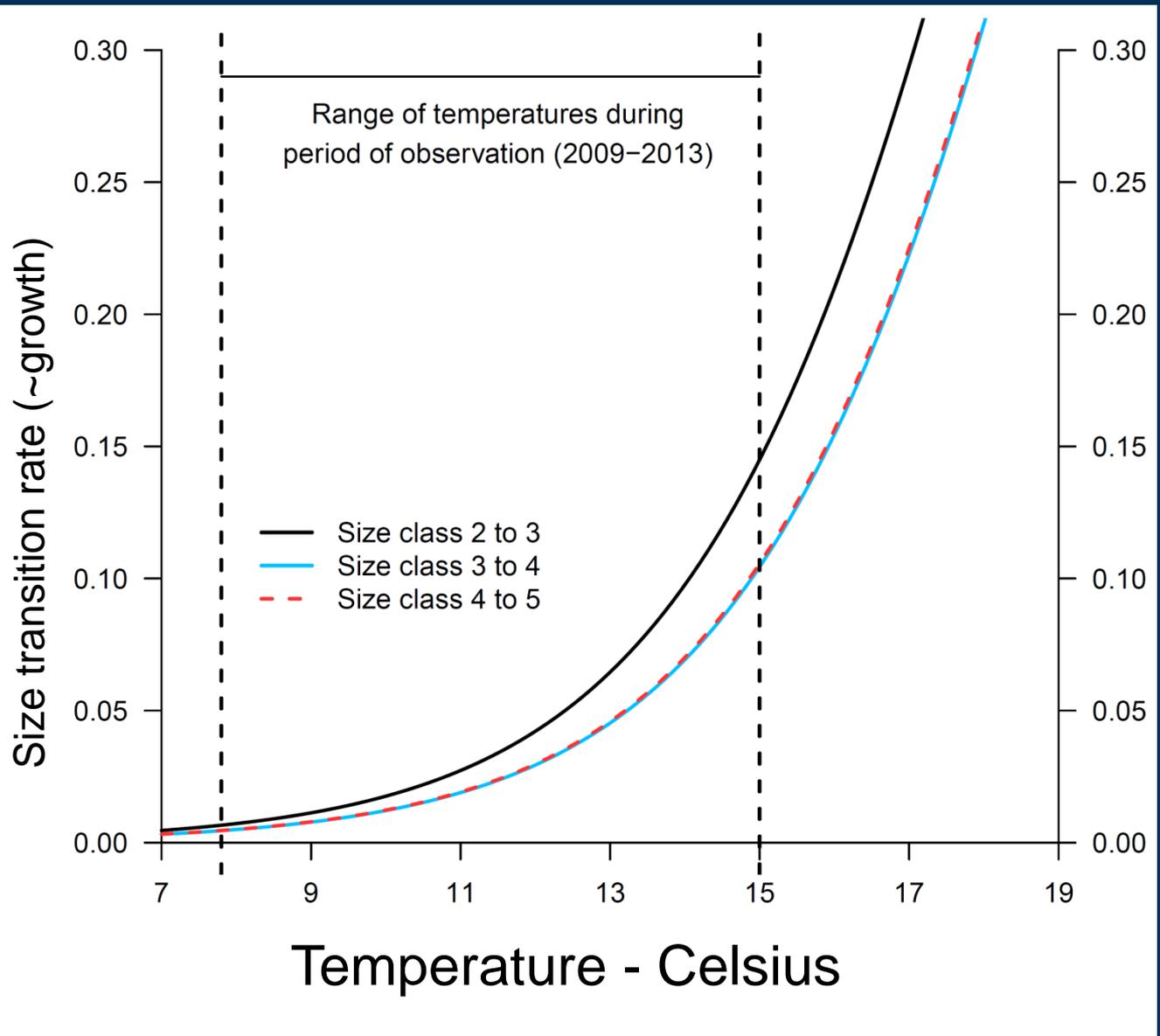


Preliminary Data Do Not Cite

Comparison to annual estimates.



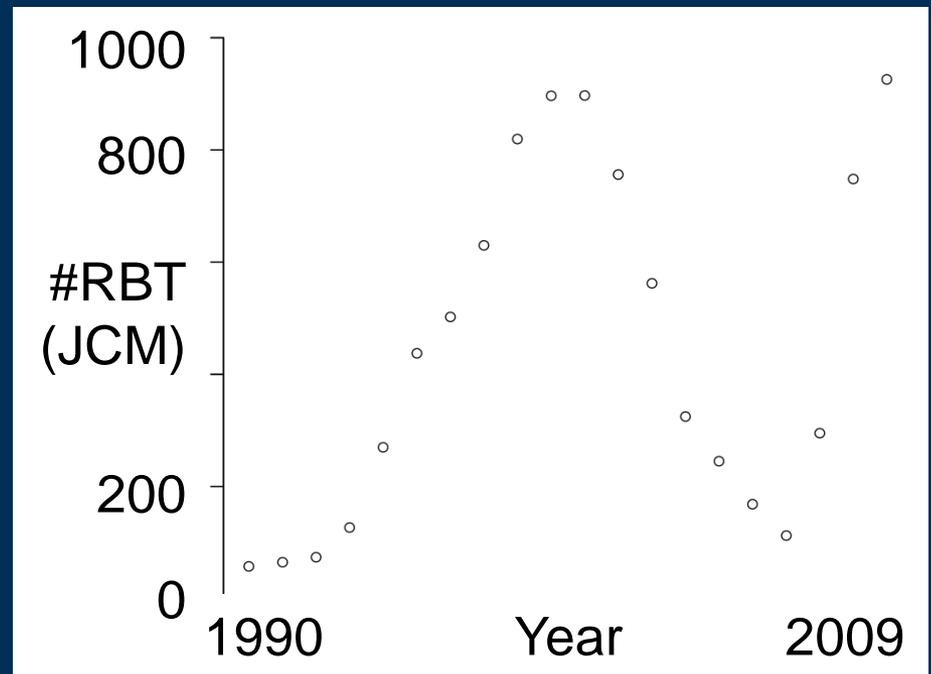
Fitted relationship between monthly size transition rate (~growth) of juvenile HBC and temperature at two different RBT densities.



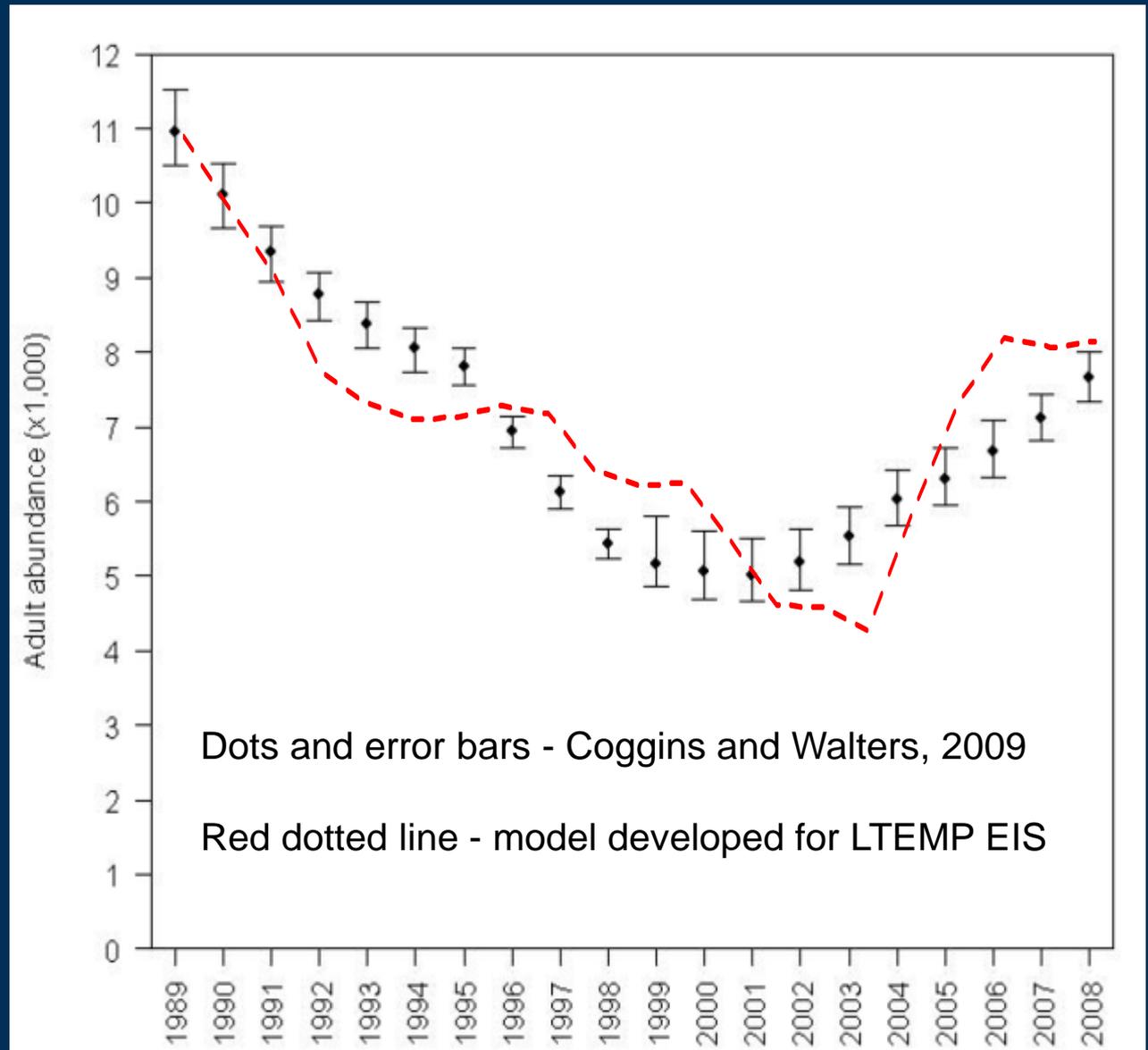
Fitted relationship between monthly size transition rate (~growth) of larger HBC size classes and temperature.

Backcasting

- Relationships I just showed based on 2009 – 2013 data.
- How well do these relationships explain behavior between 1990 & 2009?
- Observed Temp
- Modelled RBT
Abundance at LCR



Back-casted predictions are reasonably close to ASMR estimates (keep in mind that ASMR is known to smooth trends).



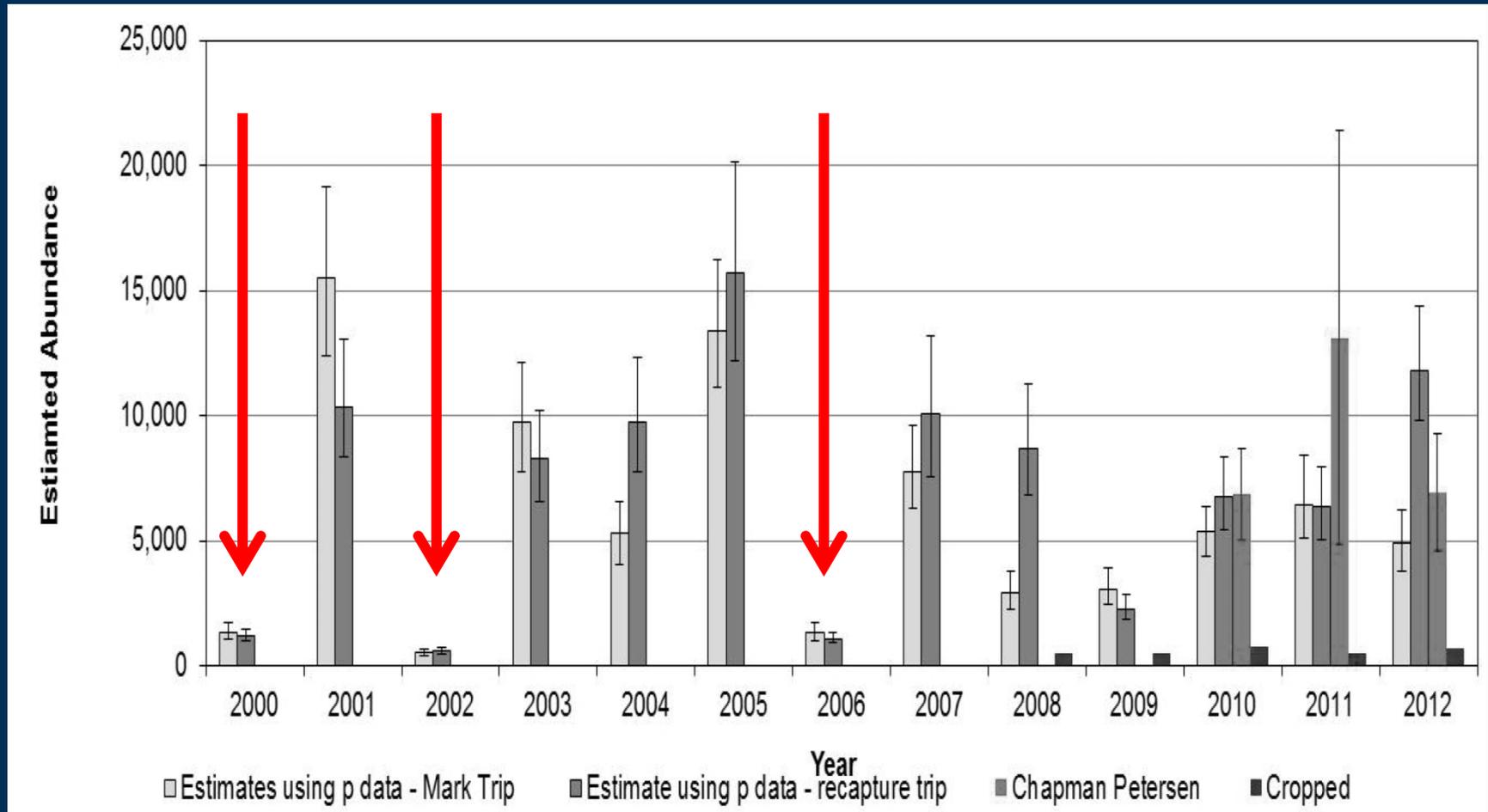
Outline

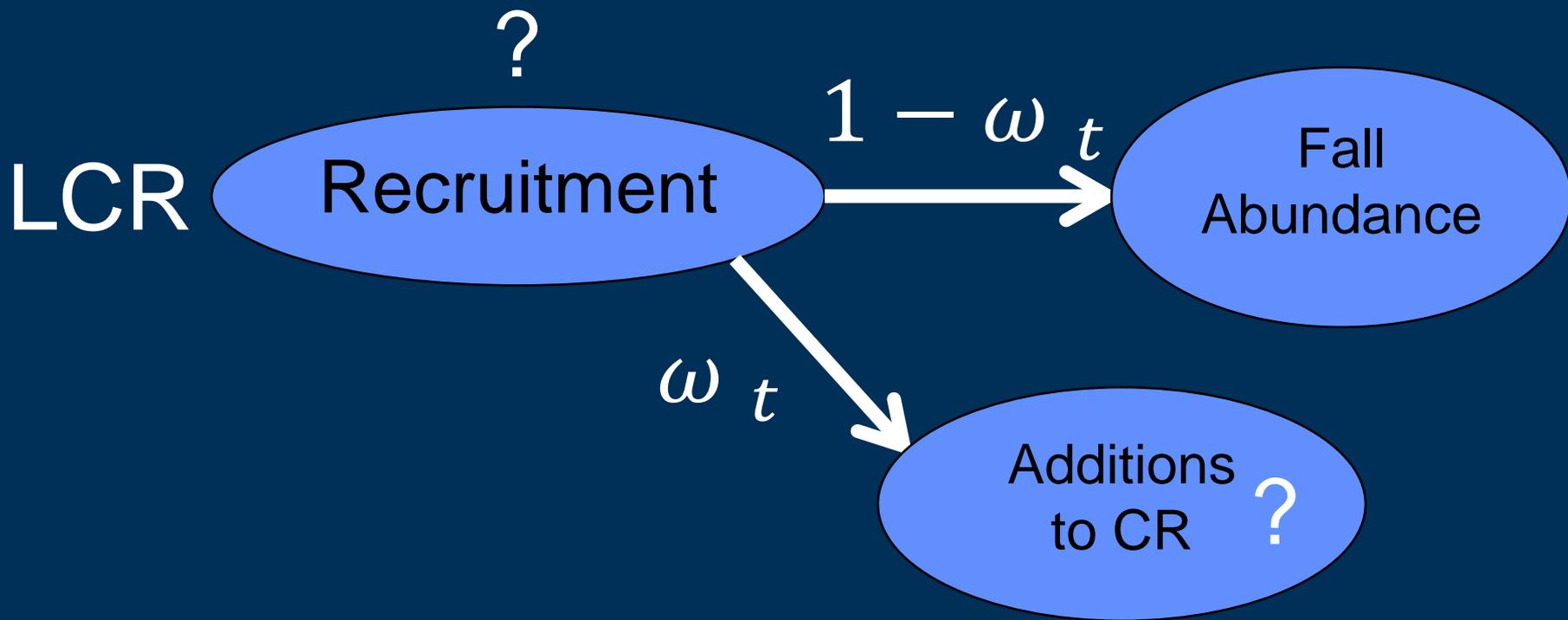
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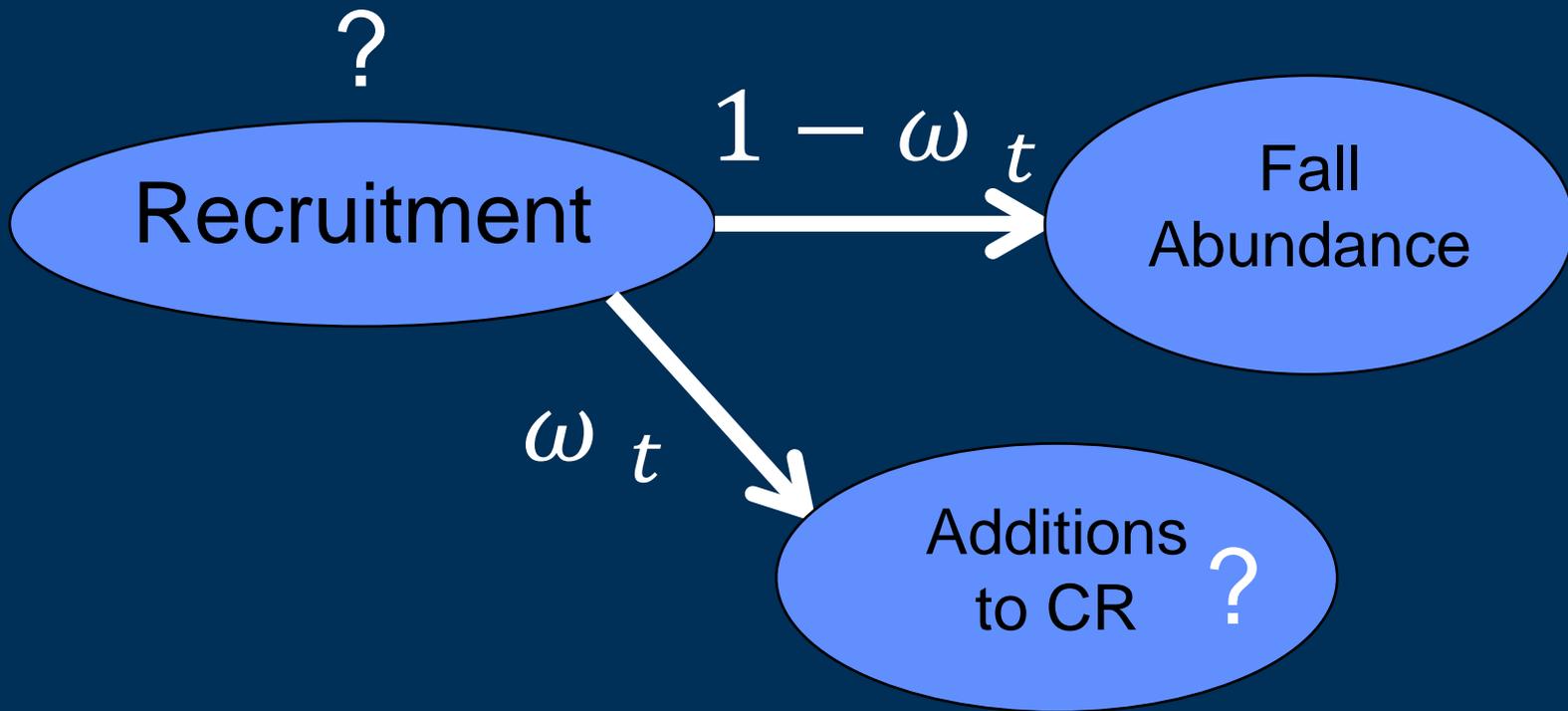
Recruitment in the ASMR context

- Recruitment to age 2
 - combines a number of processes – initial amounts, compensation (density dependence), etc.
 - Ageing issues lead to smoothing

Fall LCR abundance





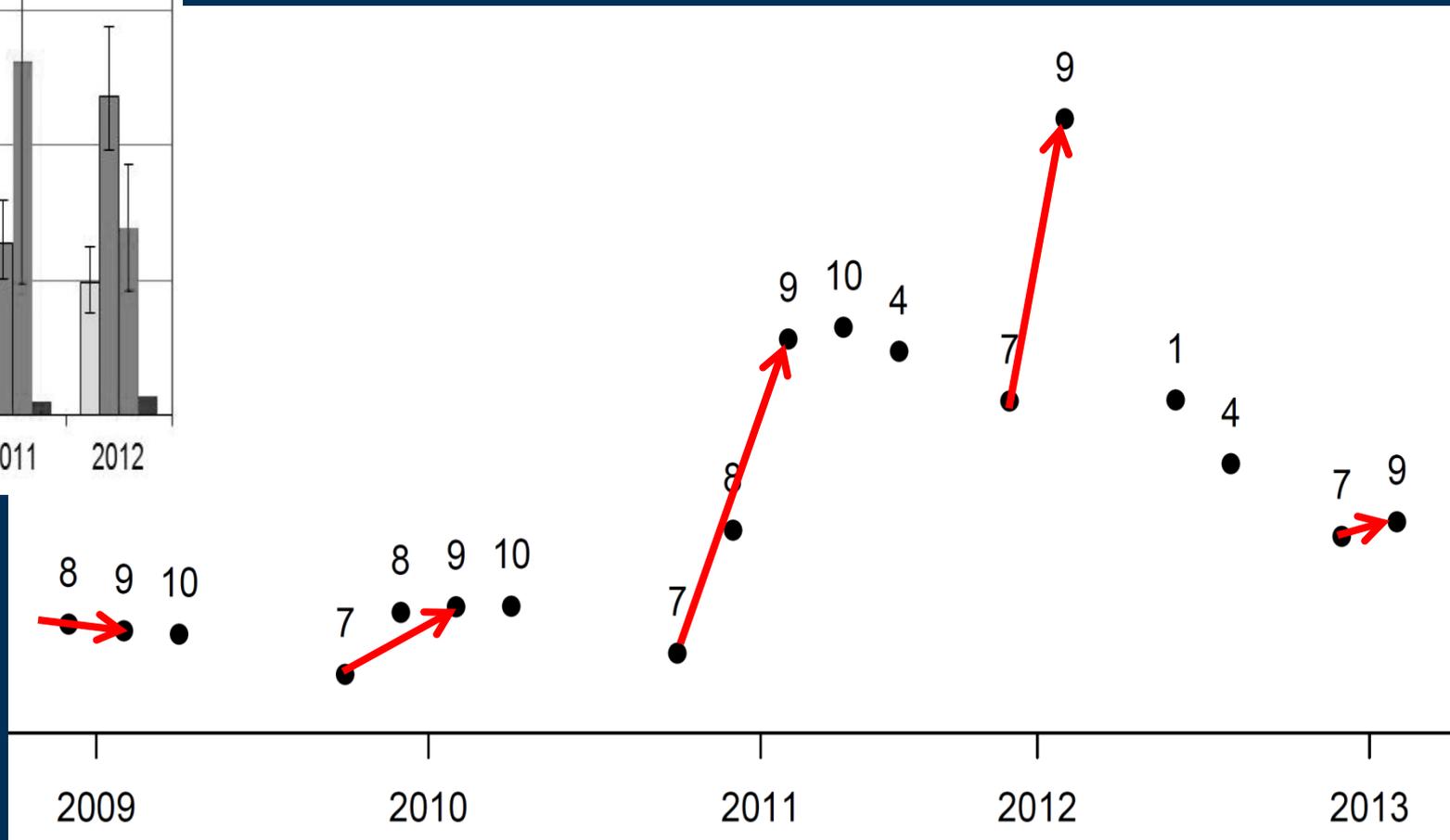
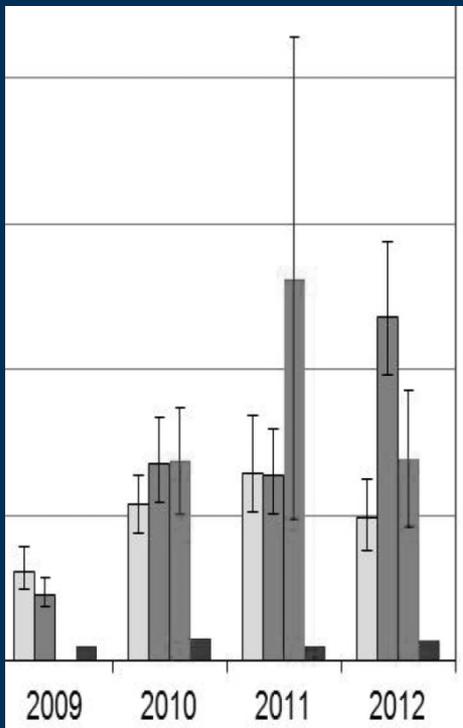


Don't necessarily care about Recruitment per se. But sure would be nice to be able to track (and backcast) additions to Colorado River

If we knew ω_t , we could figure everything else out.

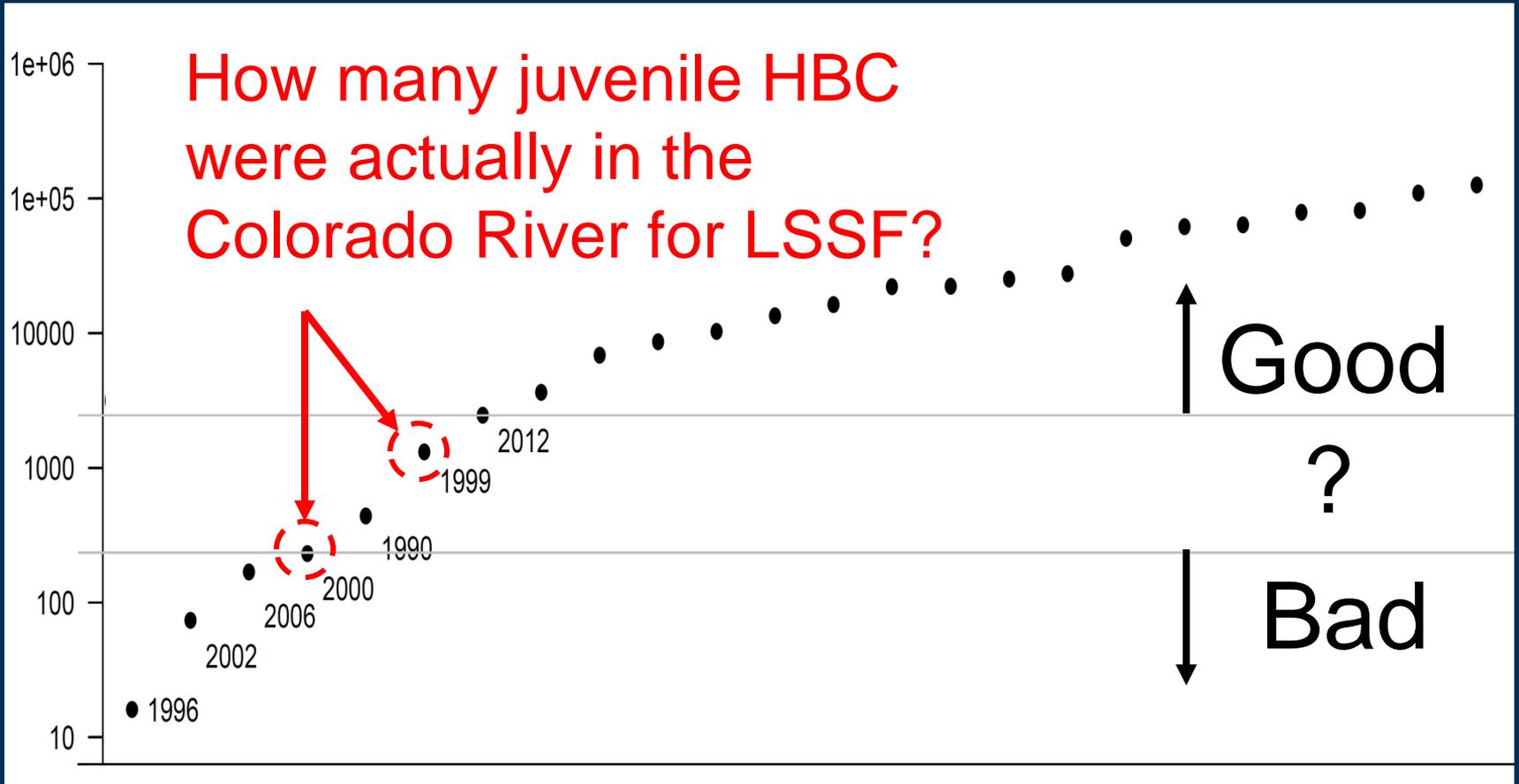
Alternatively, we could estimate additions to JCM and expand for CR.

Analyzing abundances suggests lower (and highly variable) export when compared to estimates based on boulders only marking.



Why knowing additions to CR matters

*LCR Spring Flow



*Sum of daily means between Jan. 1 and May 31 at Cameron gauge.



Preliminary Data Do Not Cite

- **Juvenile chub survival and abundance in JCM.**
 - **N still higher than 2009, but survival fairly low.**
- **Humpback chub dynamics - general patterns.**
 - **Big differences in growth/survival between CR & LCR.**
- **Modeling humpback chub dynamics for LTEMP.**
 - **Mostly data-driven (using 2009-2013 data).**
- **Age 0 recruitment and movement.**
 - **Biggest modeling uncertainty.**
 - **Affects interpretation of previous CR treatments (e.g., LSSF).**
 - **Motivation for July LCR research.**

Acknowledgements

- US Fish and Wildlife Service
- Near Shore Ecology Group
- Mike Yard , Josh Korman, Lew Coggins, Maria Dzul
- Glen Canyon Adaptive Management Group
- Bureau of Reclamation
- Navajo Nation Department of Fish and Wildlife
- National Park Service

