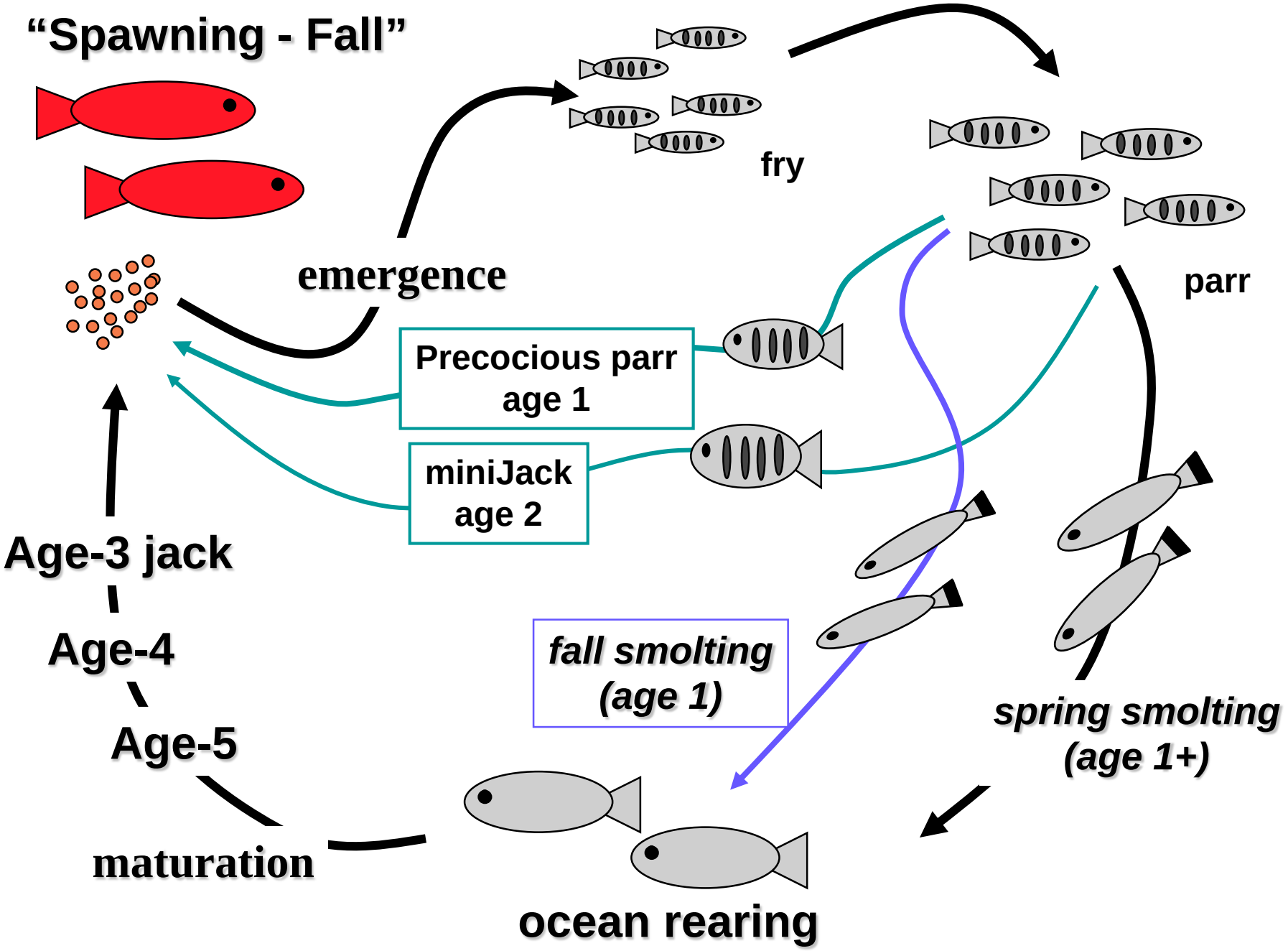
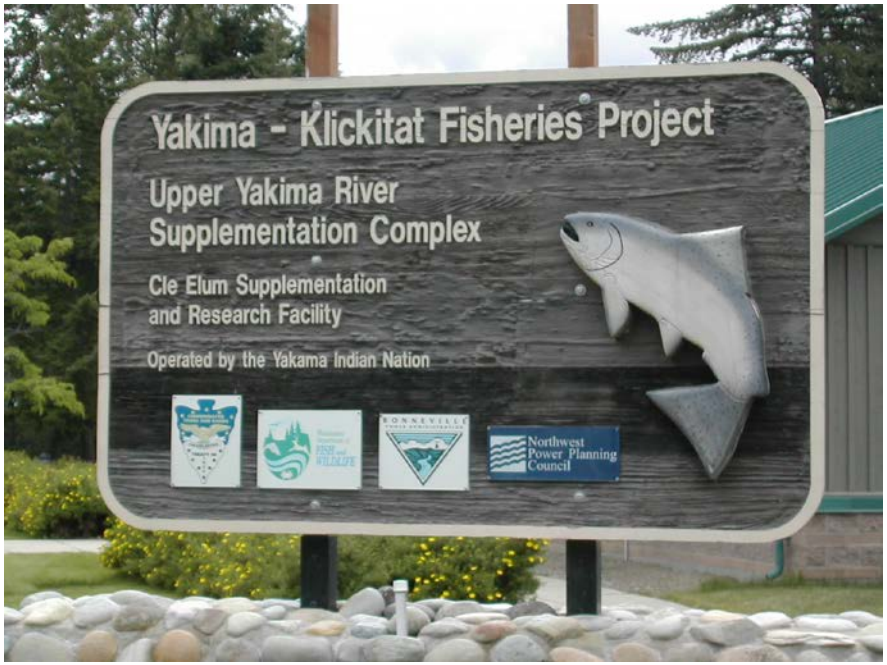
Variation in emergence timing promotes variability in smolting and early male maturation in Yakima river spring Chinook salmon

Brian Beckman, Don Larsen, Deb Harstad, Kathy Cooper, Dina Spangenberg and Paul Parkins

NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA

Yakima Basin Science and Management Conference
June 2008


"Spawning - Fall"
fry
emergence
parr
Precocious parr
age 1
miniJack
age 2
Age-3 jack
Age-4
Age-5
fall smolting
(age 1)
spring smolting
(age 1+)
maturation
ocean rearing



10 years of sampling, >12,000 fish = 2 precocious parr (<0.02%)

Two important points:

1). this appears to be quite low

data from other hatchery and wild populations

2). most of the fish were sampled for Ray Brunson

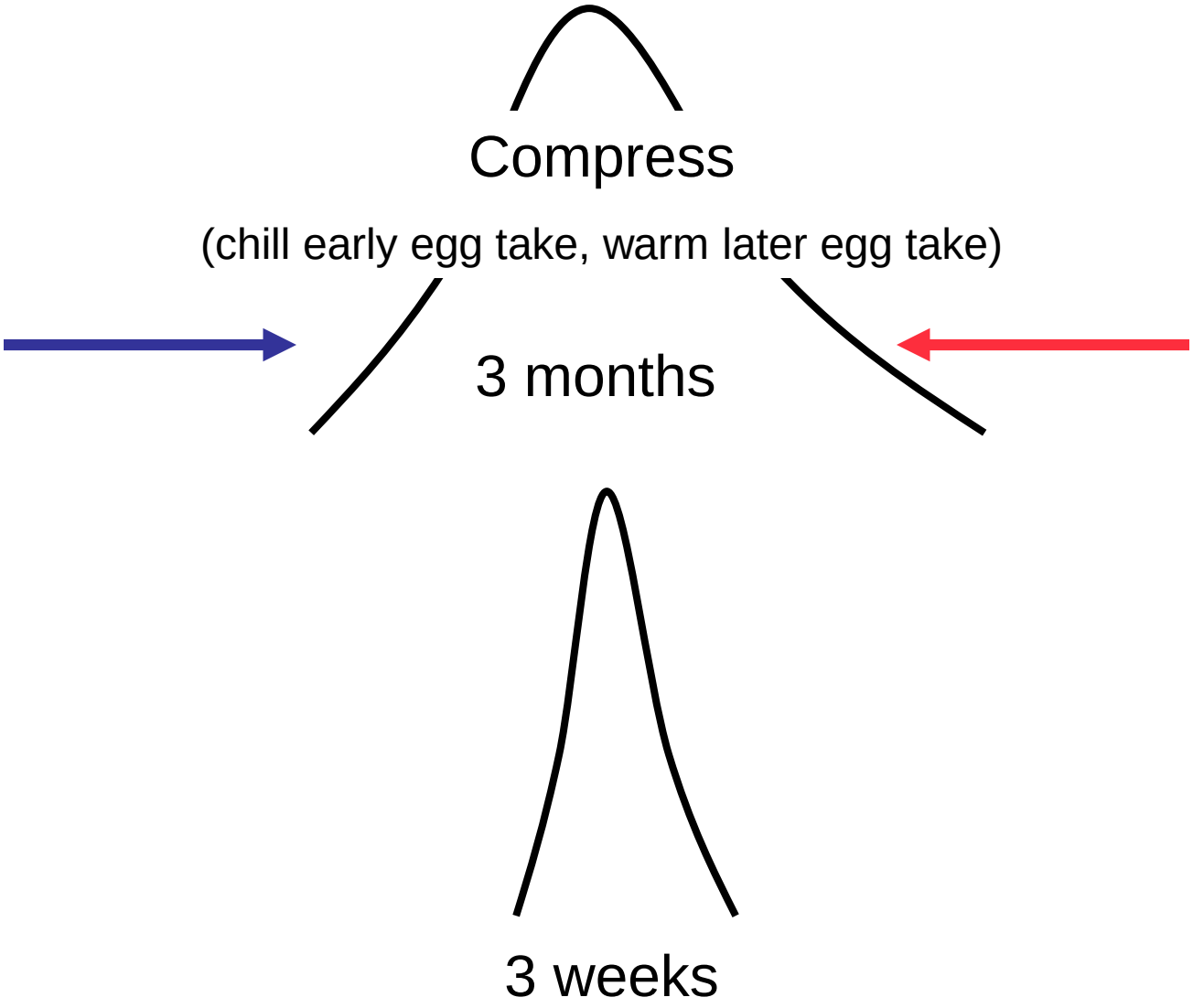
Why so few precocious parr?

One of the reasons CESRF is special: (there are many)

Seasonal timing for ponding fry

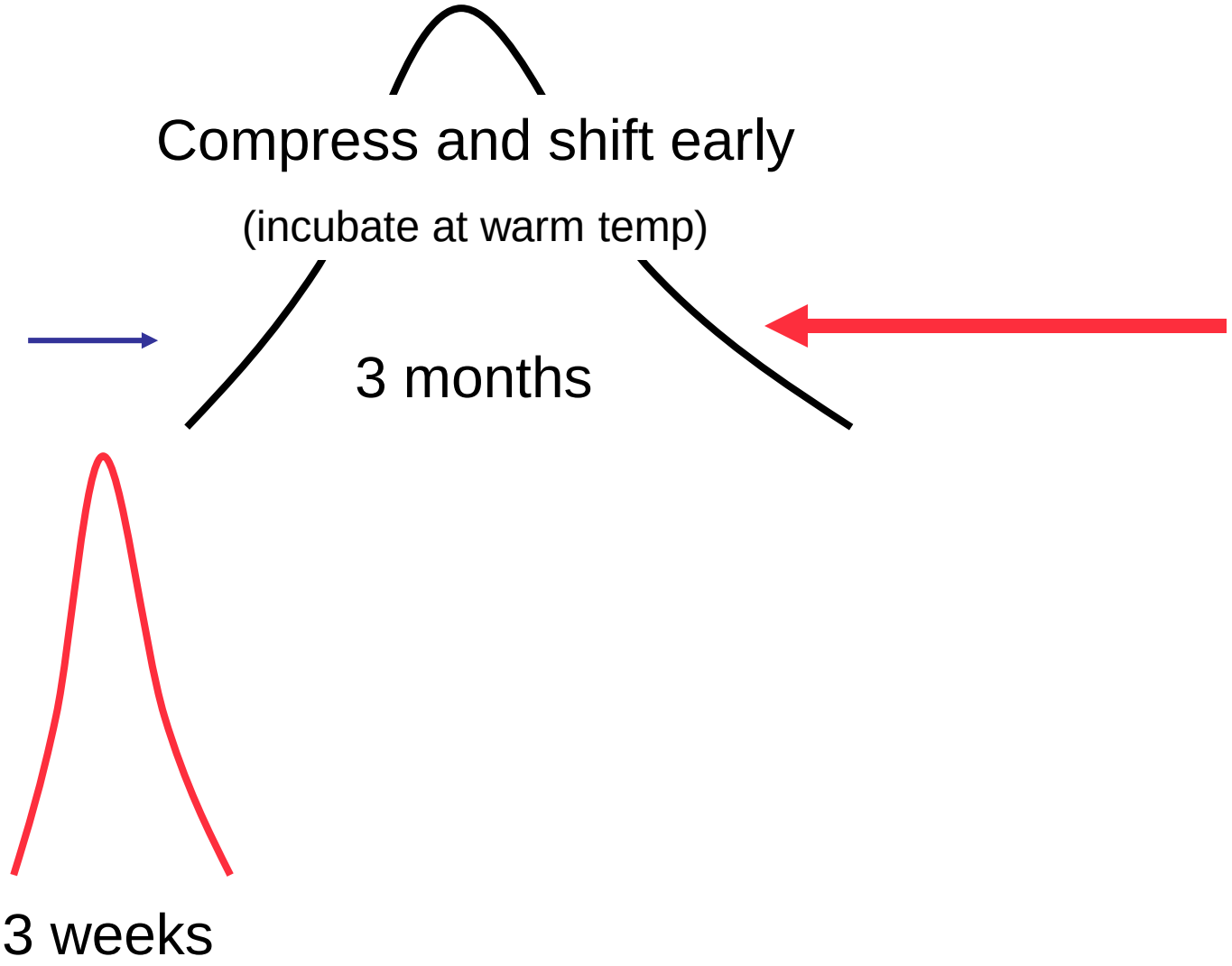
Many hatcheries alter emergence (ponding)

I). synchronize ponding



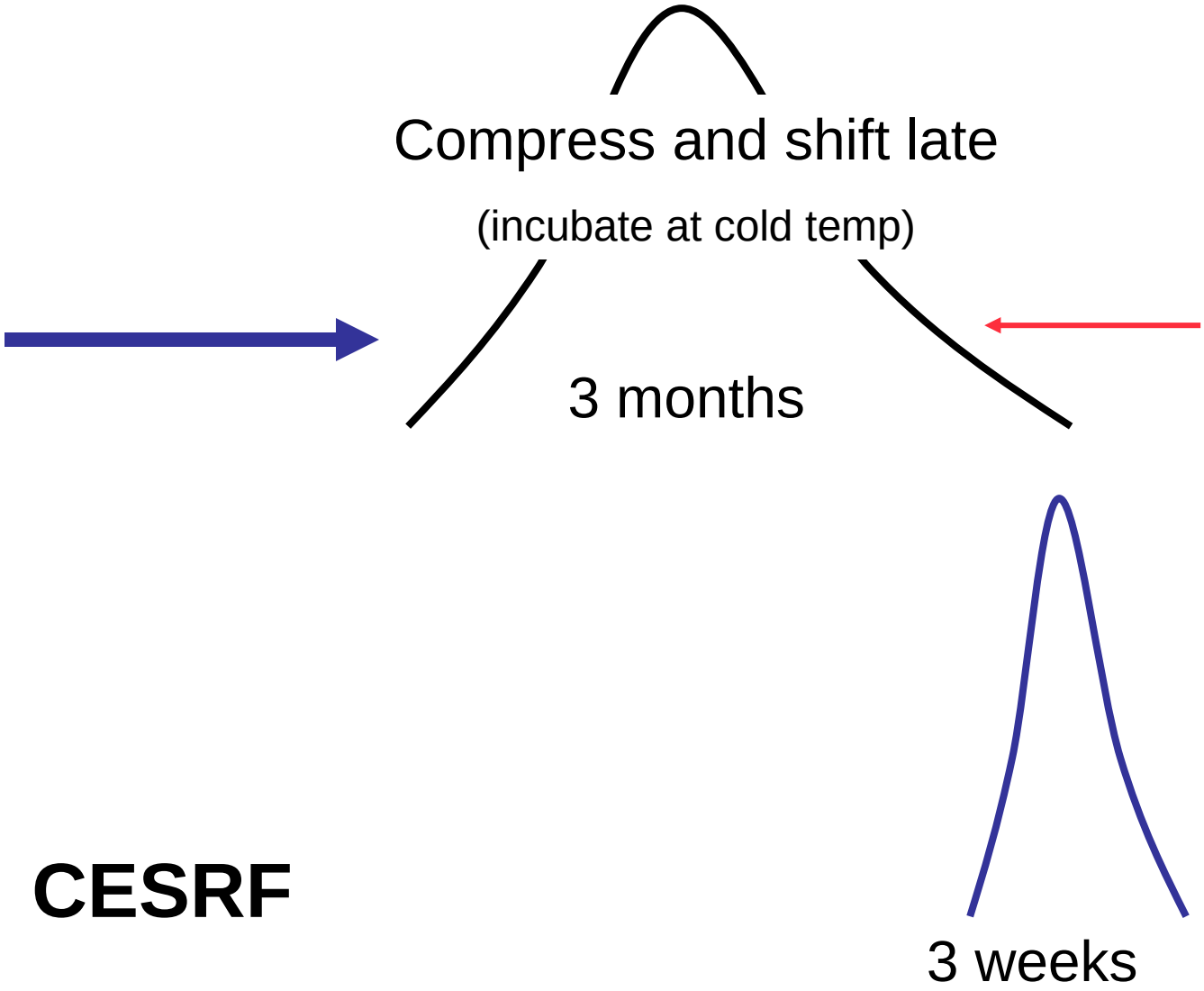
Many hatcheries alter emergence (ponding)

II). Pond “early” - longer growth period, clear egg stacks



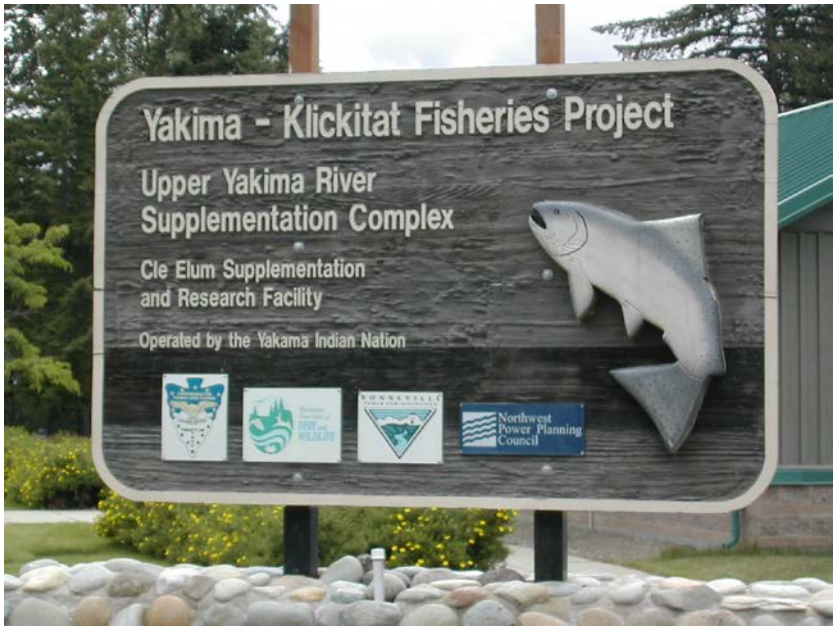
Many hatcheries alter emergence (ponding)

III). Pond “late” - avoid silting of ponds, smaller size

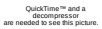


CESRF

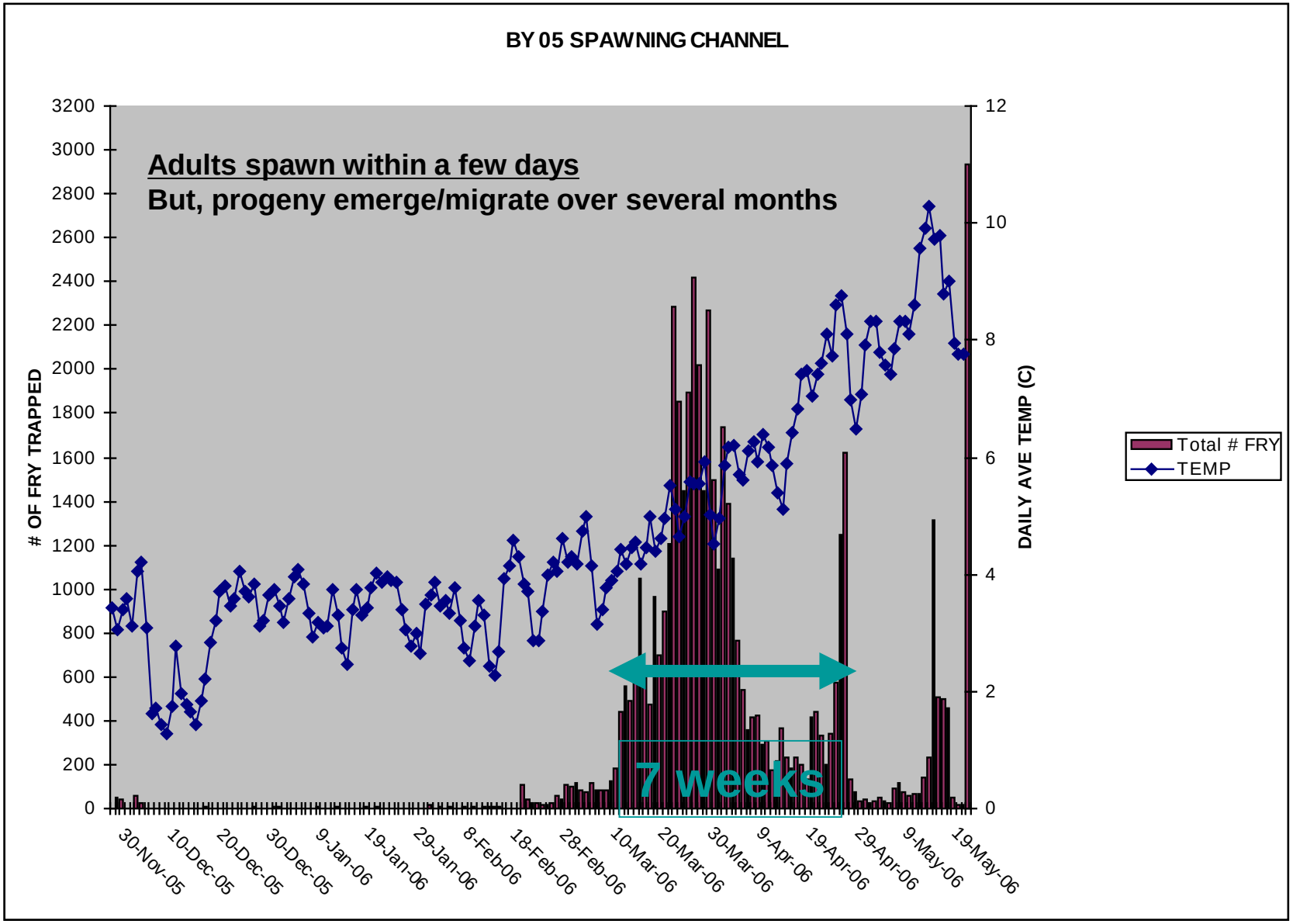
What is “Natural Emergence Timing”?



QuickTime™ and a
decompressor
are needed to see this picture.


QuickTime™ and a
decompressor
are needed to see this picture.


QuickTime™ and a
decompressor
are needed to see this picture.



Data kindly provided by Steve Schroder,Todd Pearsons, Anthony Fritts, Jen Scott, Jordan Vandal, Gene Sanborn (WDFW) and Curt Knudsen (Oncorh Consulting).

Experimental Question:

What is the effect of emergence timing on life-history decisions?

Experimental approach:

Pond fry at 3 different photoperiods

1 December (early)
15 February (middle)
1 May (late)

Important!!

Purpose of experiment is to investigate life history variation;

not, to develop protocols for CESRF.

Growth rate is also important (Don Larsen *ad nausea*):

Larsen, D.A., Beckman, B.R., Strom, C., Parkins, P., Cooper, K.A., Fast, D., and Dickhoff, W.W. 2006. Growth modulation alters the incidence of early male maturation and physiological development of hatchery reared spring Chinook salmon: a comparison with wild fish. Trans. Am. Fish. Soc. 135:1017-1032.

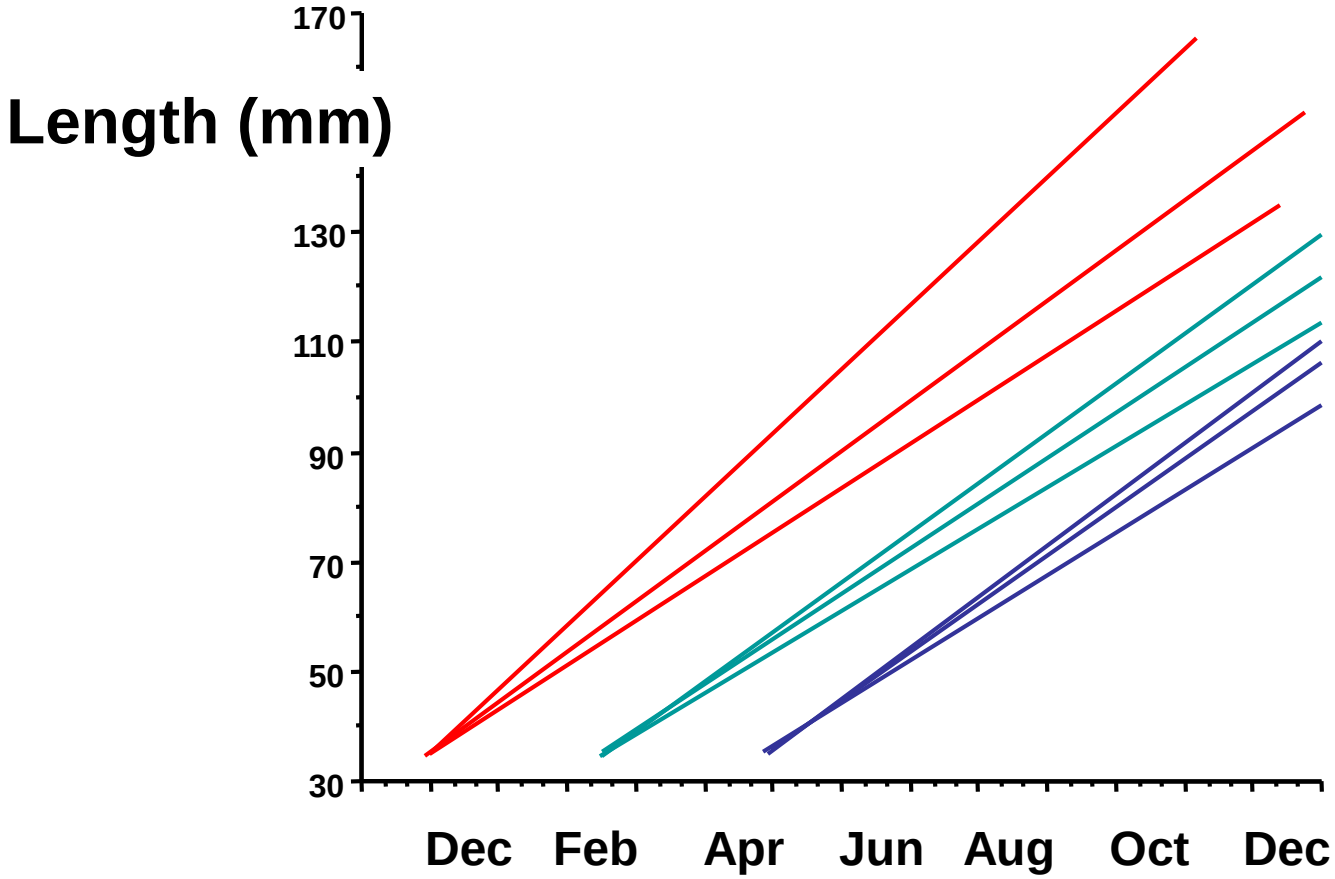
Larsen, D.A., Beckman, B.R., Cooper, K.A., Barrett, D., Johnston, M., Swanson, P., and W.W. Dickhoff. 2004. Assessment of high rates of precocious male maturation in a spring chinook salmon supplementation hatchery program. Trans Am. Fish Soc. 133:98-120.

Experimental approach II:

feed fry at 3 different rates

Low
High
Satiation

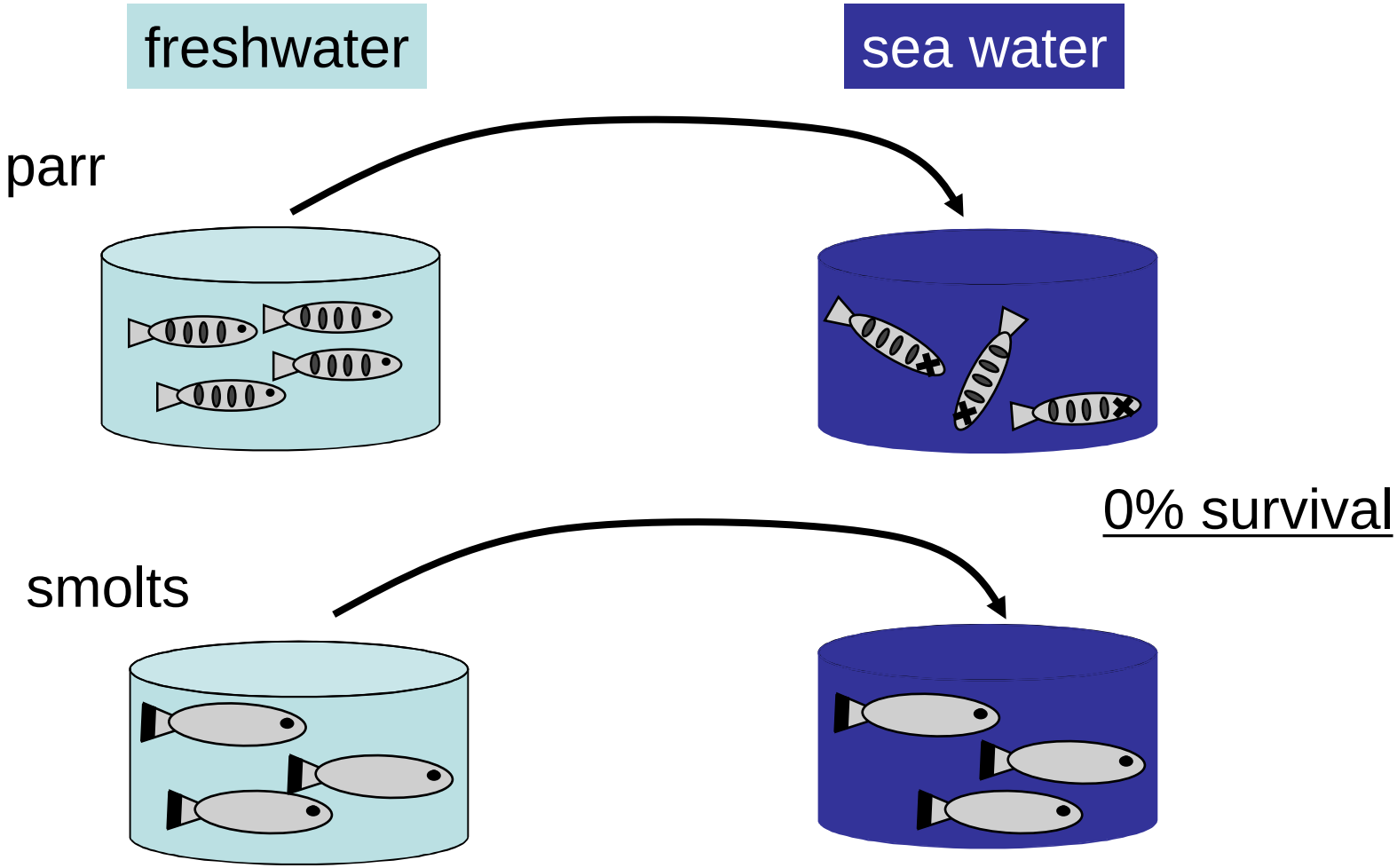
Emergence time, growth and size were varied experimentally



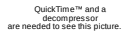
Fish grown in experimental tanks NOAA Montlake

Monitor Autumnal Smolting:

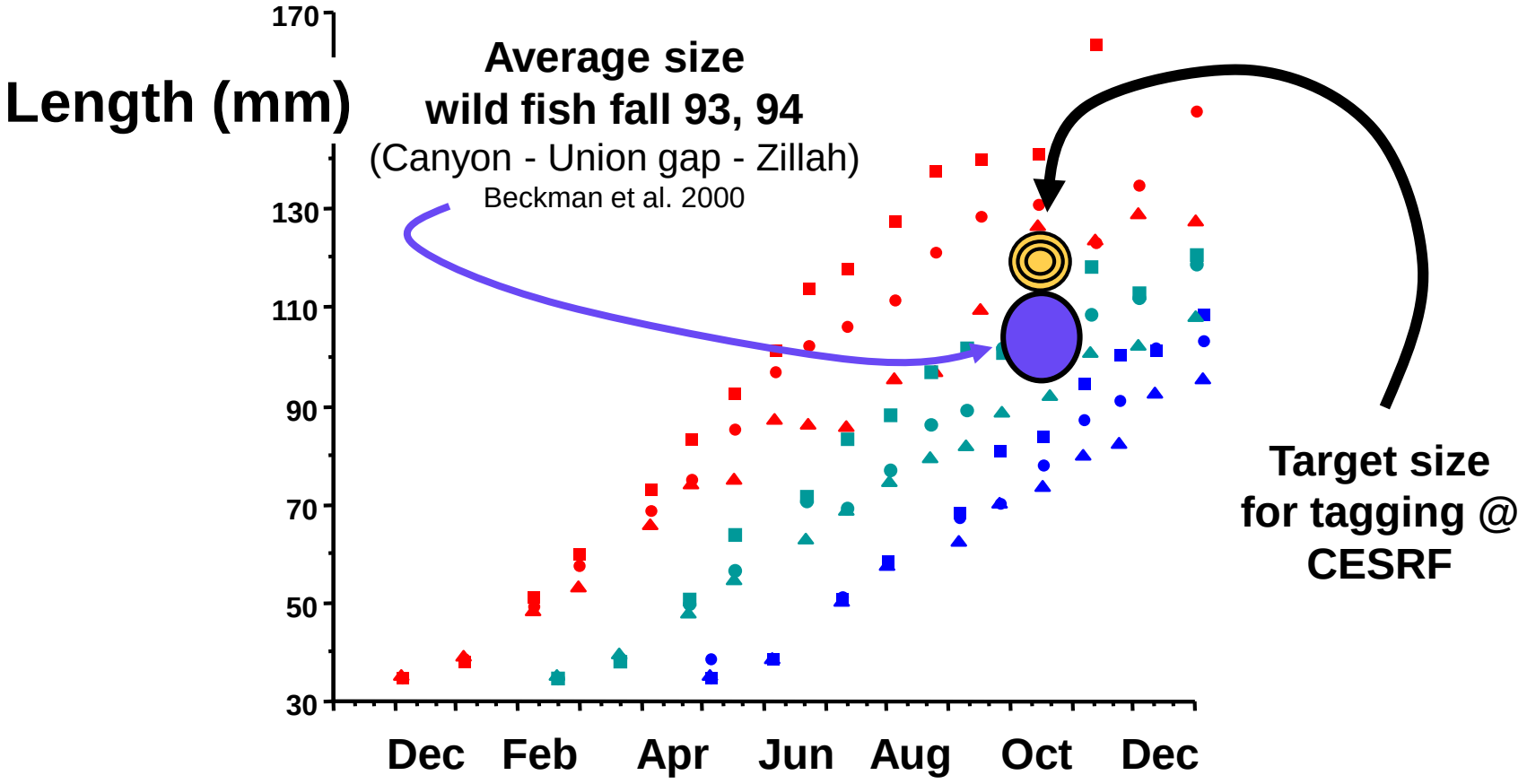
24 hour seawater challenge



Monitor Age-1 (precocious parr) Maturation:
milt expression or simple dissection

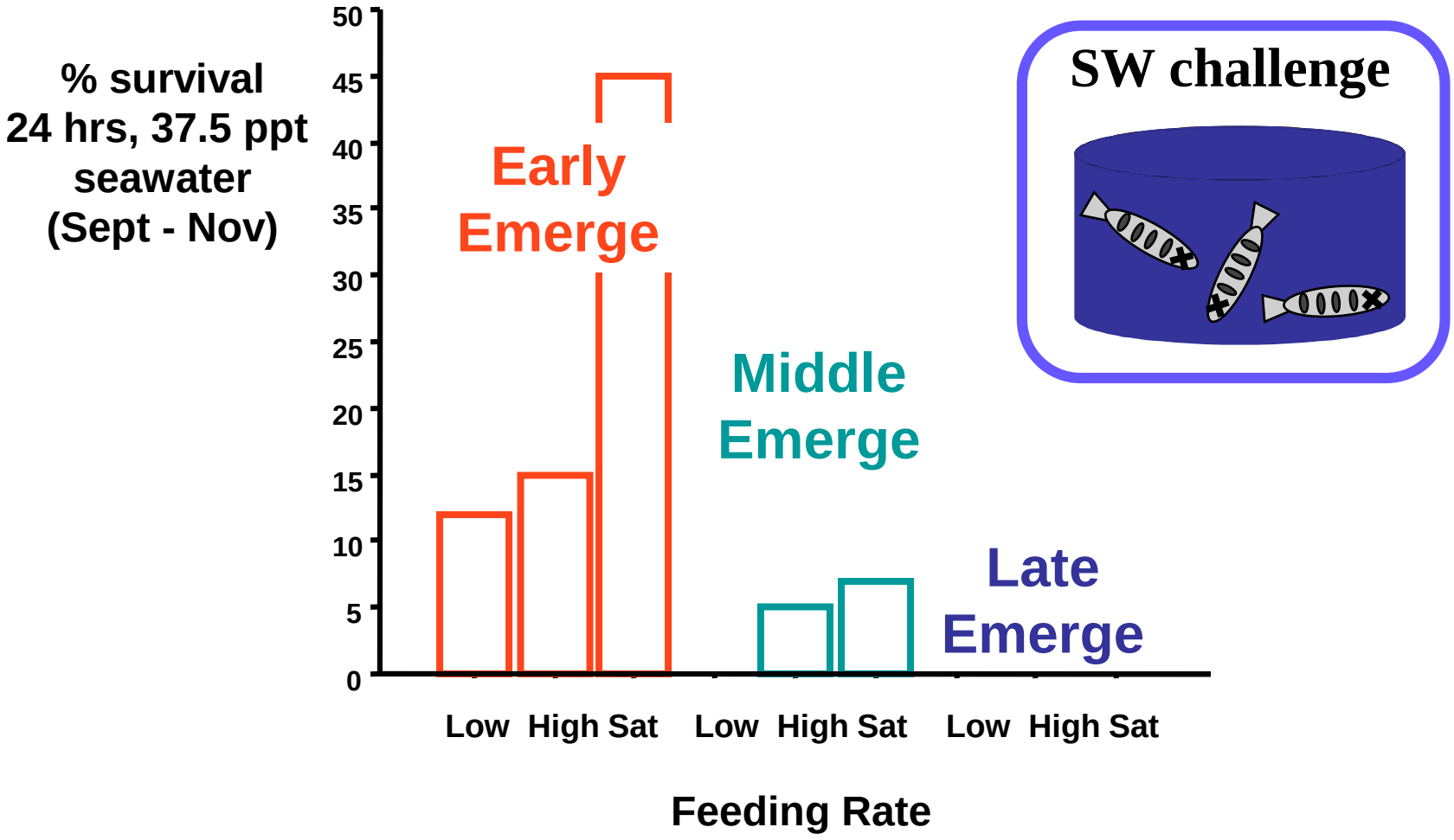


Emergence and growth of fish did vary



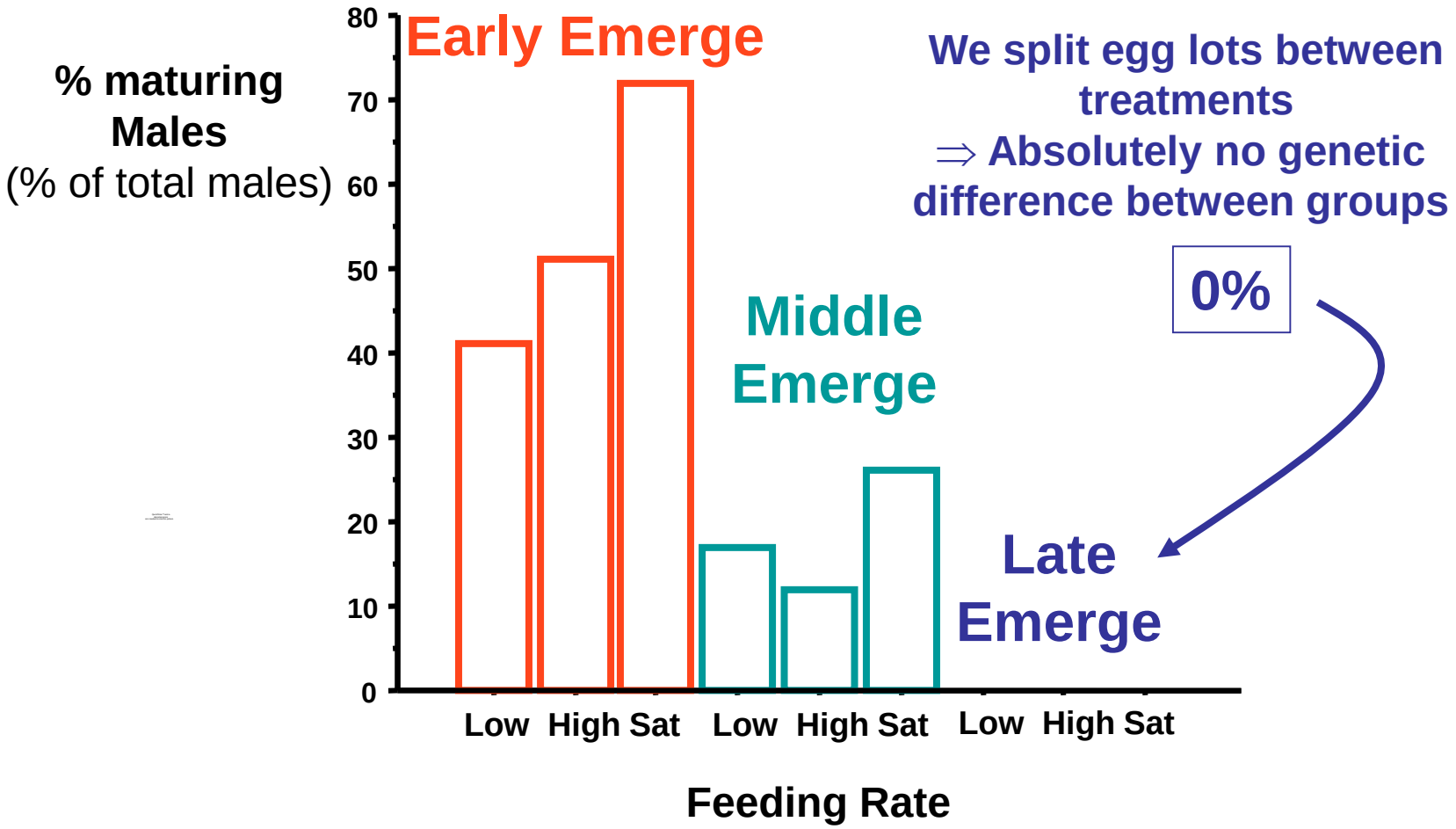
Thanks to Charlie Strom and CESRF staff for eggs

Early emerging fish smolt in the autumn
Later emerging fish do not

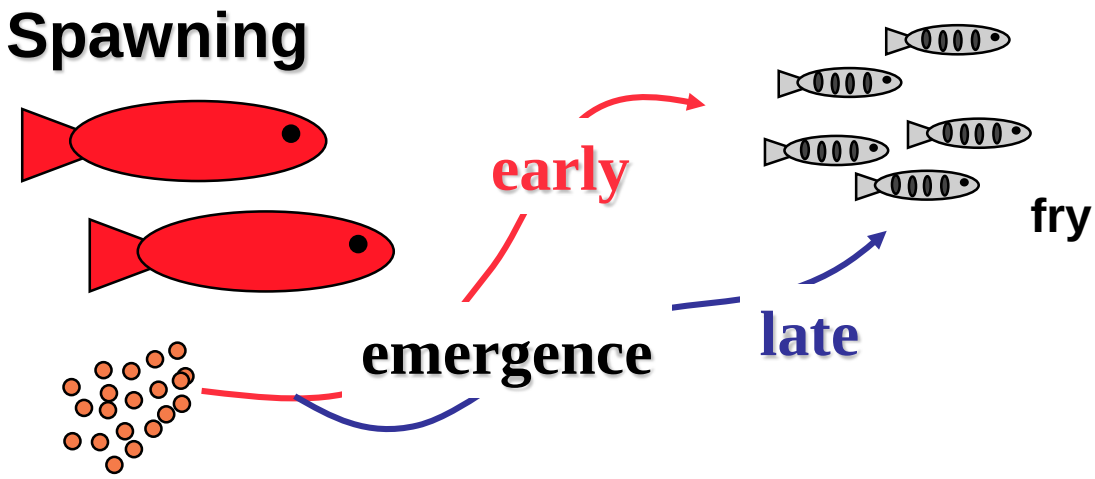


Early emerging fish have a high propensity for early male maturation (age 1)

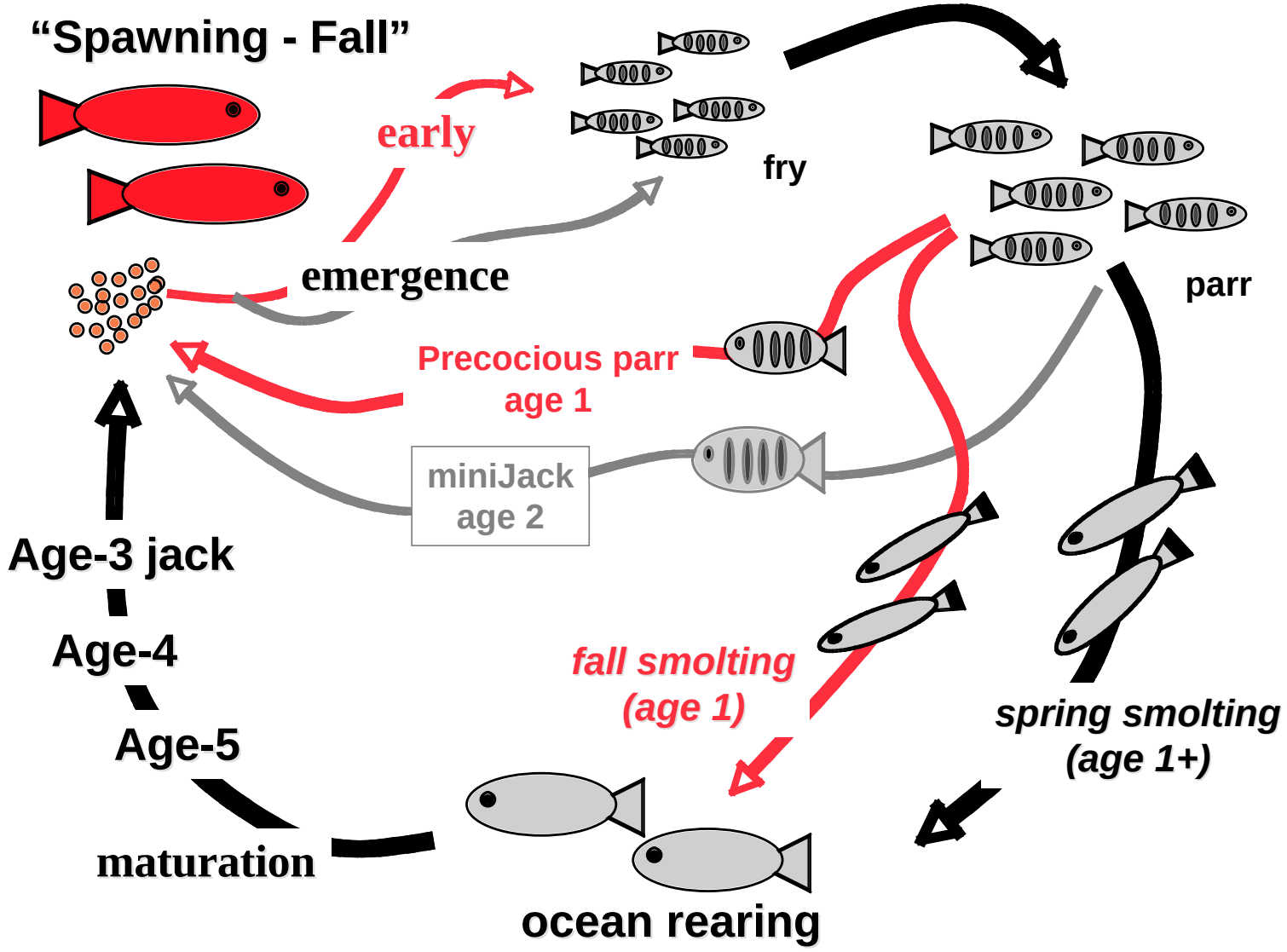
(precocious parr)



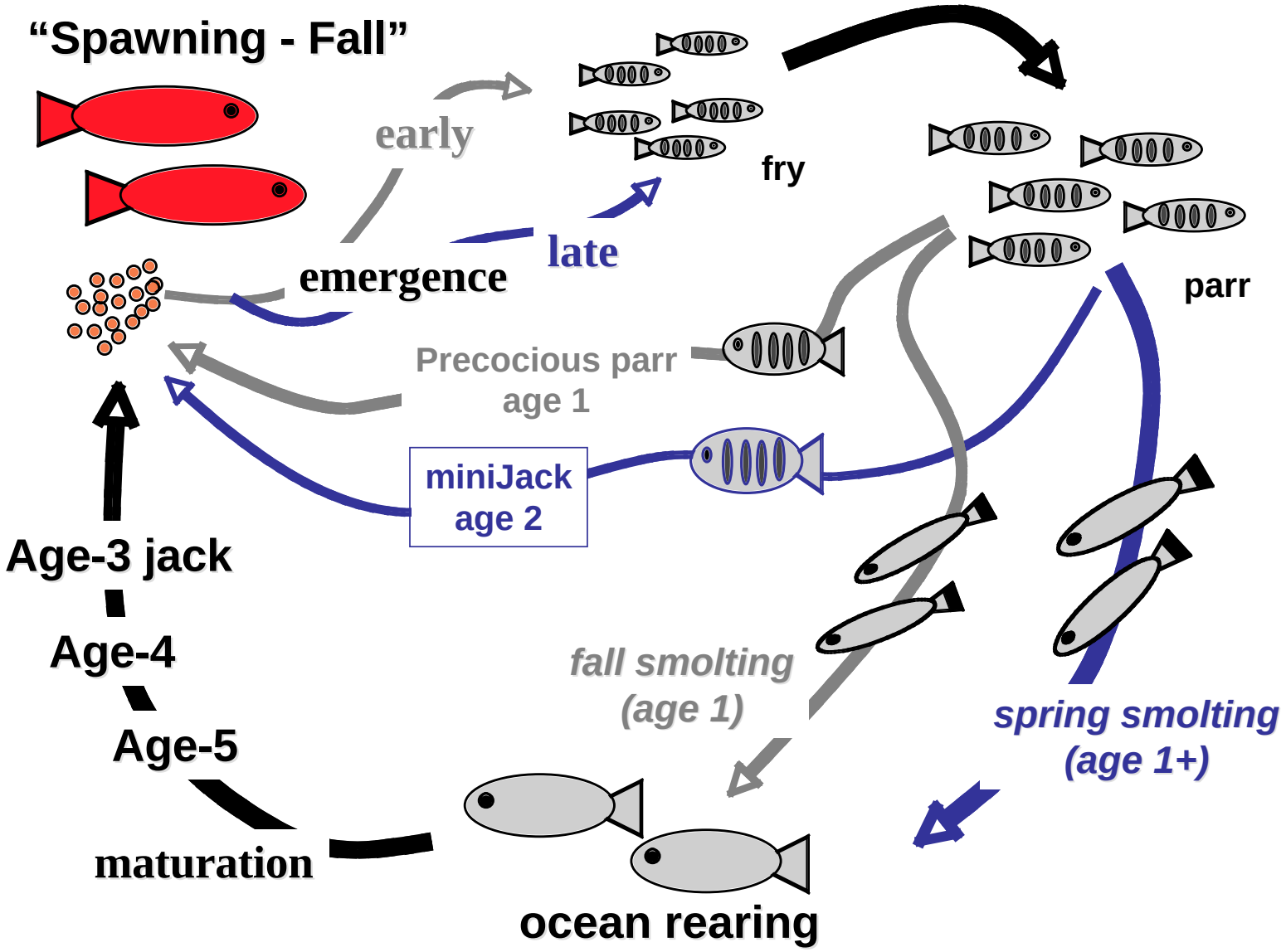
Conclusion: Emergence timing may provide another axis for life history variability



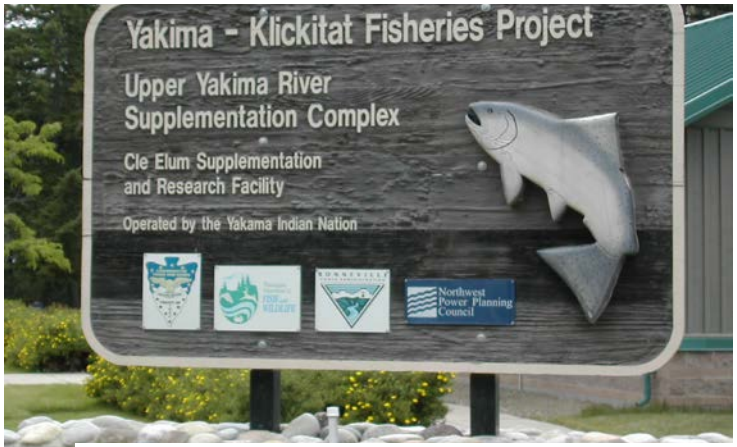
Early emergence accelerates life history



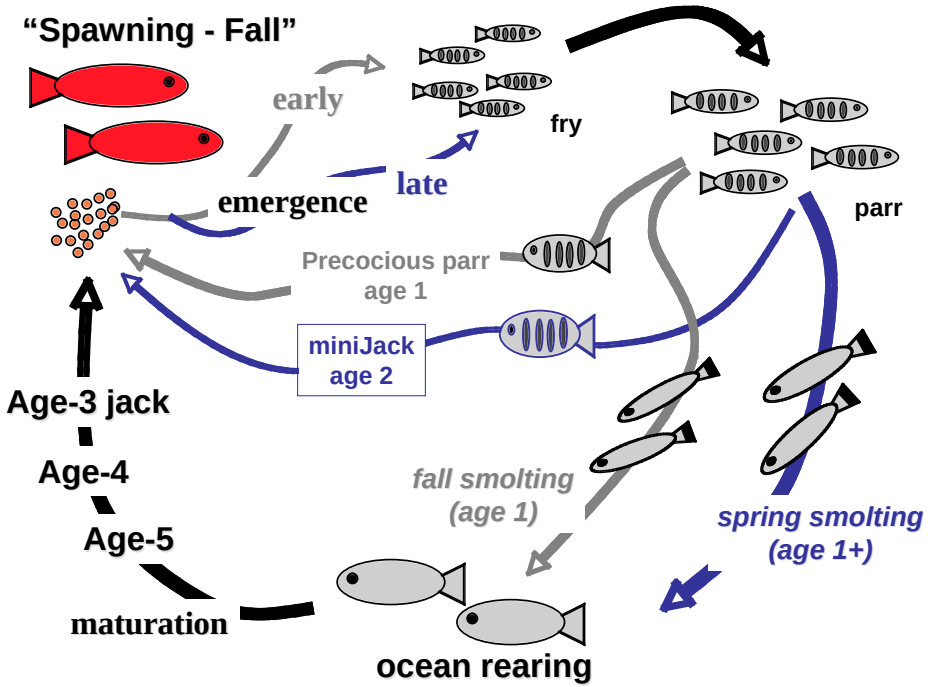
Late emergence delays life history



10 years of sampling, >12,000 fish = 2 precocious parr (<0.02%)



Late emergence delays life history



Implications

What happens in the hatchery does not stay in the hatchery, long-term life history implications for altering emergence (ponding) time exist.

No easy answers for “best” rearing program - a series of trade-offs between male maturation, size (tagging targets), smolting and SAR.

Current rearing program (late ponding) mimics conditions found in head water streams (high elevation, cold - late emergence) and is favorable for yearling releases.