# Tucannon River Spring Chinook

Michael Gallinat, WDFW

# Acknowledgments


- **Funding Sources:**

LOWER SNAKE RIVER COMPENSATION PLAN
*Hatchery Program*

Washington Department of FISH and WILDLIFE

Bonneville Power Administration

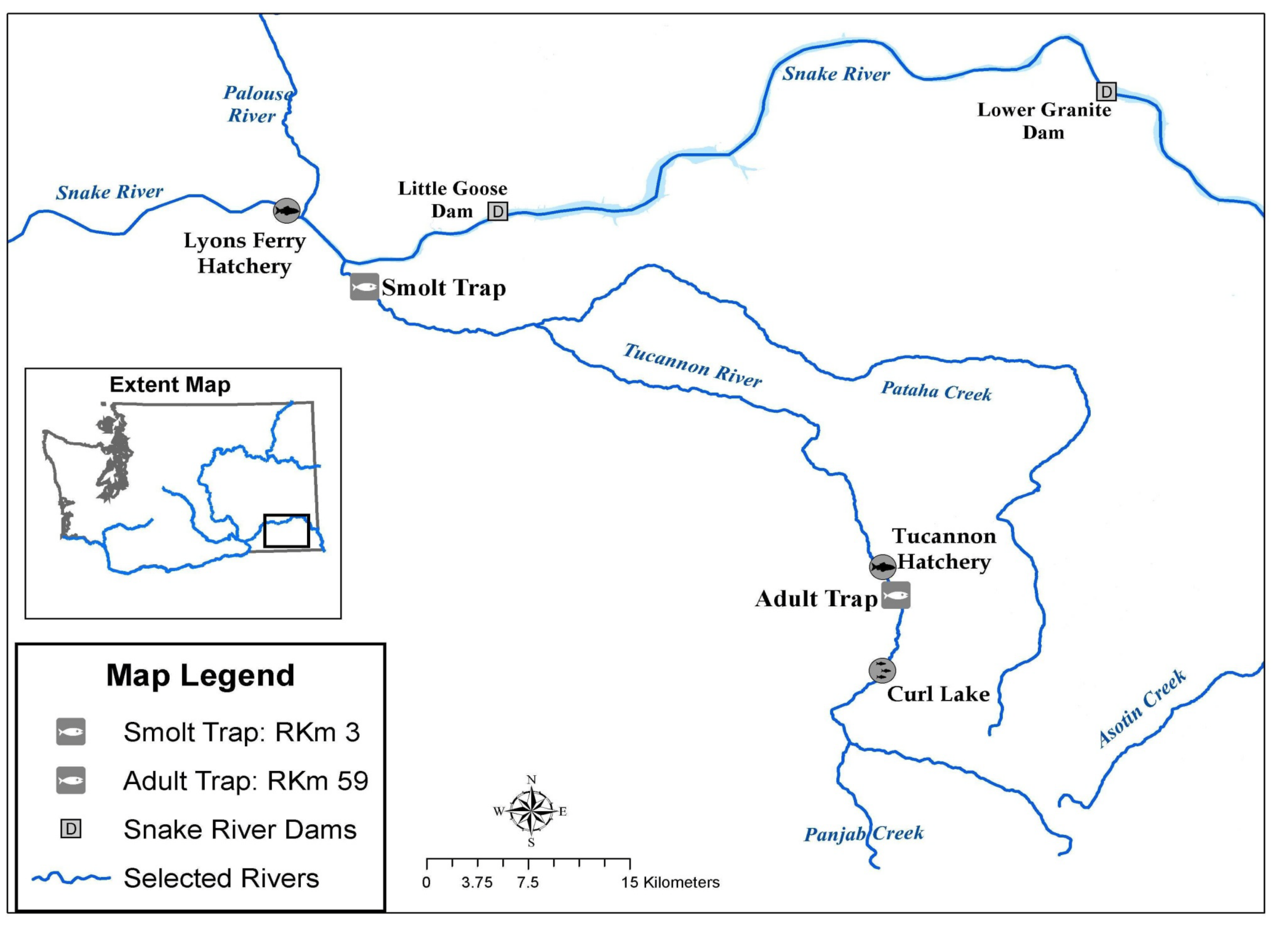
# And…There's no I in Team.

- Past and present staff of the WDFW Snake River Lab, Lyons Ferry Hatchery Complex, WDFW Fish Management, and the Tribal Co-Managers.
- Including but not limited to:

Bob Bugert
Joe Bumgarner
Wan-Ying Chang
Dave Clark
Becky Johnson
Jon Lovrak
Mike Manky
Doug Maxey

Glen Mendel
Todd Pearsons
Steve Roberts
Dick Rogers
Lance Ross
Mark Schuck
Gabe Temple
Brian Zimmerman

# Map of Tucannon River Subbasin



# Mitigation Goal:

- **Hatchery mitigation was for 48% loss (1,152) through the dams with the remaining 52% (1,248) expected to be self-sustaining.**
- **It was also assumed that 4,608 fish would be harvested below the project area.**
- **Mitigation was to be accomplished by the annual release of 132,000 smolts with an assumed SAR of 0.87%.**

# Management Objectives

- Meet the LSRCP mitigation goal.
- Restore and maintain fisheries (long-term goal – 2,400-3,400 hatchery and natural fish).
- Restore and maintain the natural population (Pop. Viable Threshold – at least 750 natural origin fish over a 10 yr. geometric mean).
- Minimize impacts of the hatchery fish on the natural population.

# M & E Objectives

- Determine if the program is meeting its mitigation goals.

- Monitor production, productivity, and life history characteristics of both the hatchery and natural components of the population.

- Evaluate hatchery rearing strategies so that we can maximize adult returns.

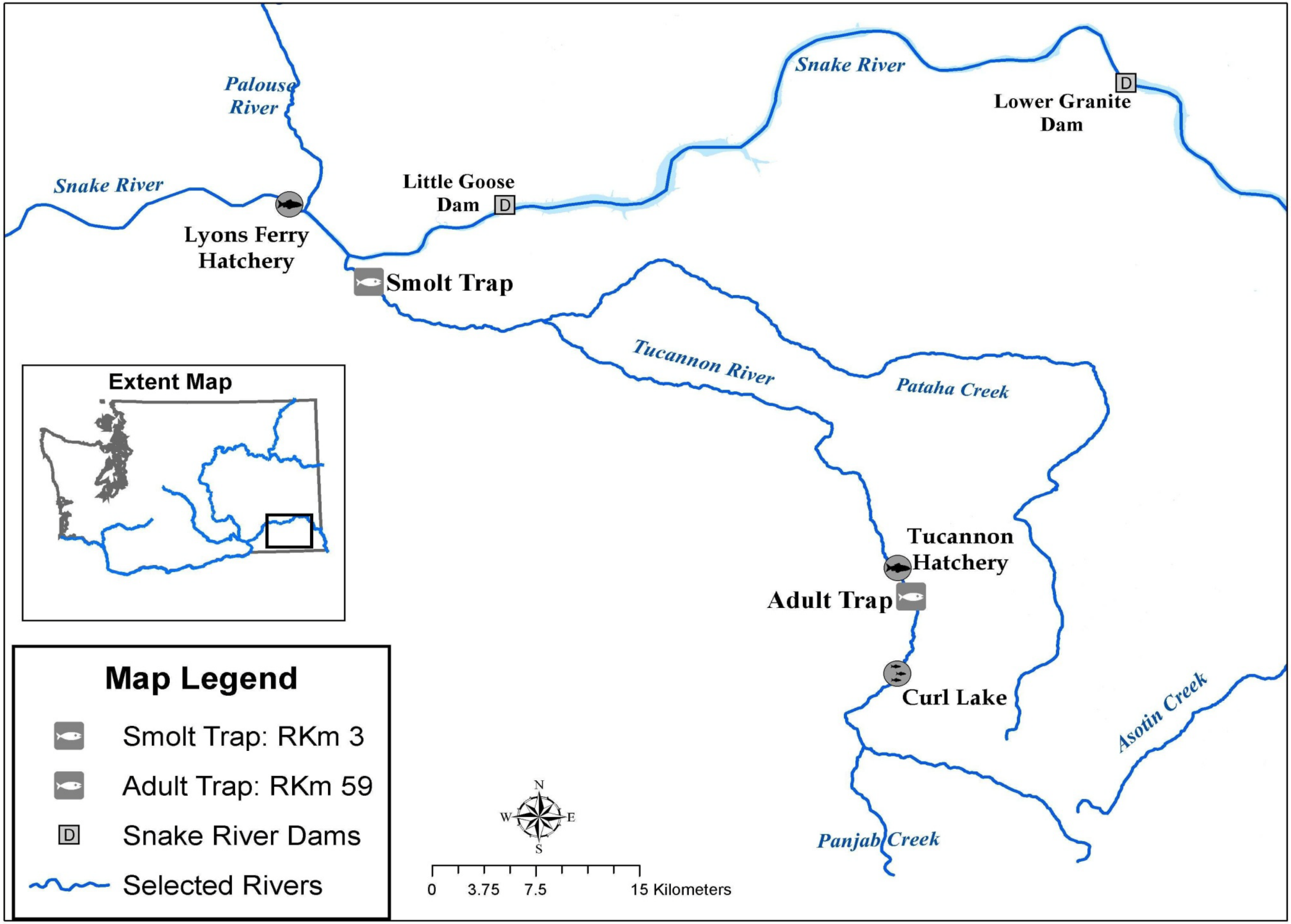
# Brief Program History

- Hatchery production began in 1985 using endemic broodstock.
- Since 1989, hatchery broodstock has consisted of both H & N origin fish (Strive for a minimum 50% N origin).
- Integrated program – There has always been intentional gene flow between the H & N components.

# Current Emphasis on Conservation

- The stock was listed as Threatened under the ESA in 1992.
- Between 1994-1999 the average run declined to 196 fish (range 54-351) from a mean of 550 (1985-1993).
- A captive broodstock program was conducted for one generation (5 brood years – 1997-2001) to mitigate for this bottleneck.

# Quick Look at Facilities



# Tucannon River Adult Trap (rkm 59)

**Broodstock are collected from throughout the run.**

**Fish not collected for broodstock are given an opercle punch and passed upstream.**

**Fin clipped strays are killed outright.**

**Broodstock Targets:**
100 Adults – 132,000 smolts

Beginning w/ 2006 BY
170 Adults – 225,000 smolts

# Lyons Ferry Hatchery

**Collected broodstock are held and spawned here, eggs hatched, and juveniles reared through the fingerling stage before being marked and transferred to TFH.**

**100% marked (currently CWT + VIE).**

**Use 2x2 spawning matrix-
HxW crosses.**

**Well water-
constant 11°C (52°F).**

# Tucannon Fish Hatchery (rkm 59)

**Marked fingerlings transported to TFH in Oct. and reared to pre-smolts.**

**Reared on a combination of well, spring, and river water.**

**River water is the main mixture – allows for a more natural winter temperature profile.**

# Curl Lake Acclimation Pond (rkm 66)

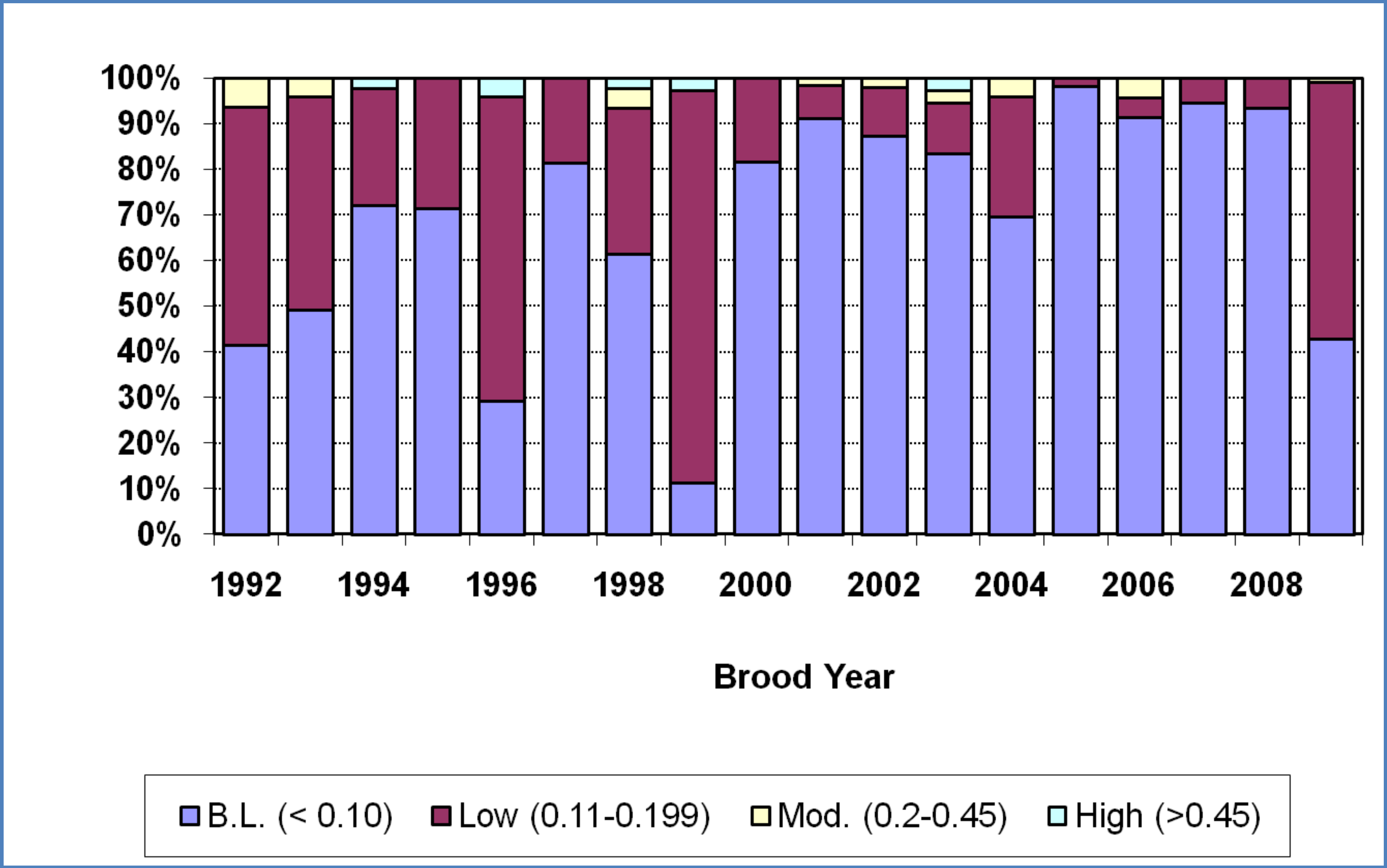
**Pre-smolts moved to Curl Lake AP in February – acclimated on river water.**

**Volitionally released in April.**

# Fish Health Highlights

- During broodstock trapping – injections of erythromycin and oxytetracycline.
- Injections of broodstock with erythromycin on monthly intervals before spawning.
- **No BKD culling or segregation of eggs.**
- Single erythromycin feeding of progeny in the spring.

# BKD - ELISA

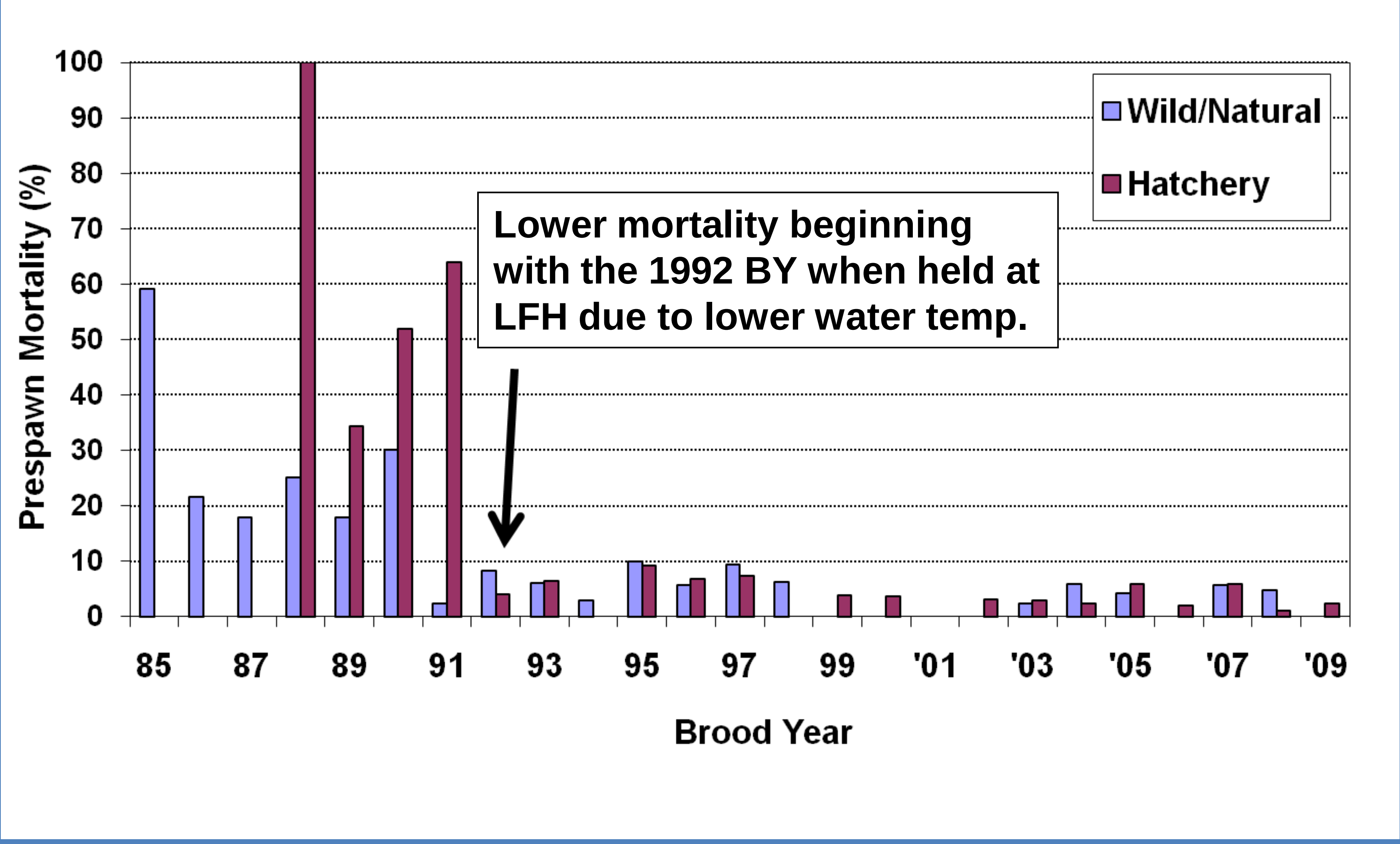


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1992
1994
1996
1998
2000
2002
2004
2006
2008
Brood Year
B.L. (< 0.10)
Low (0.11-0.199)
Mod. (0.2-0.45)
High (>0.45)

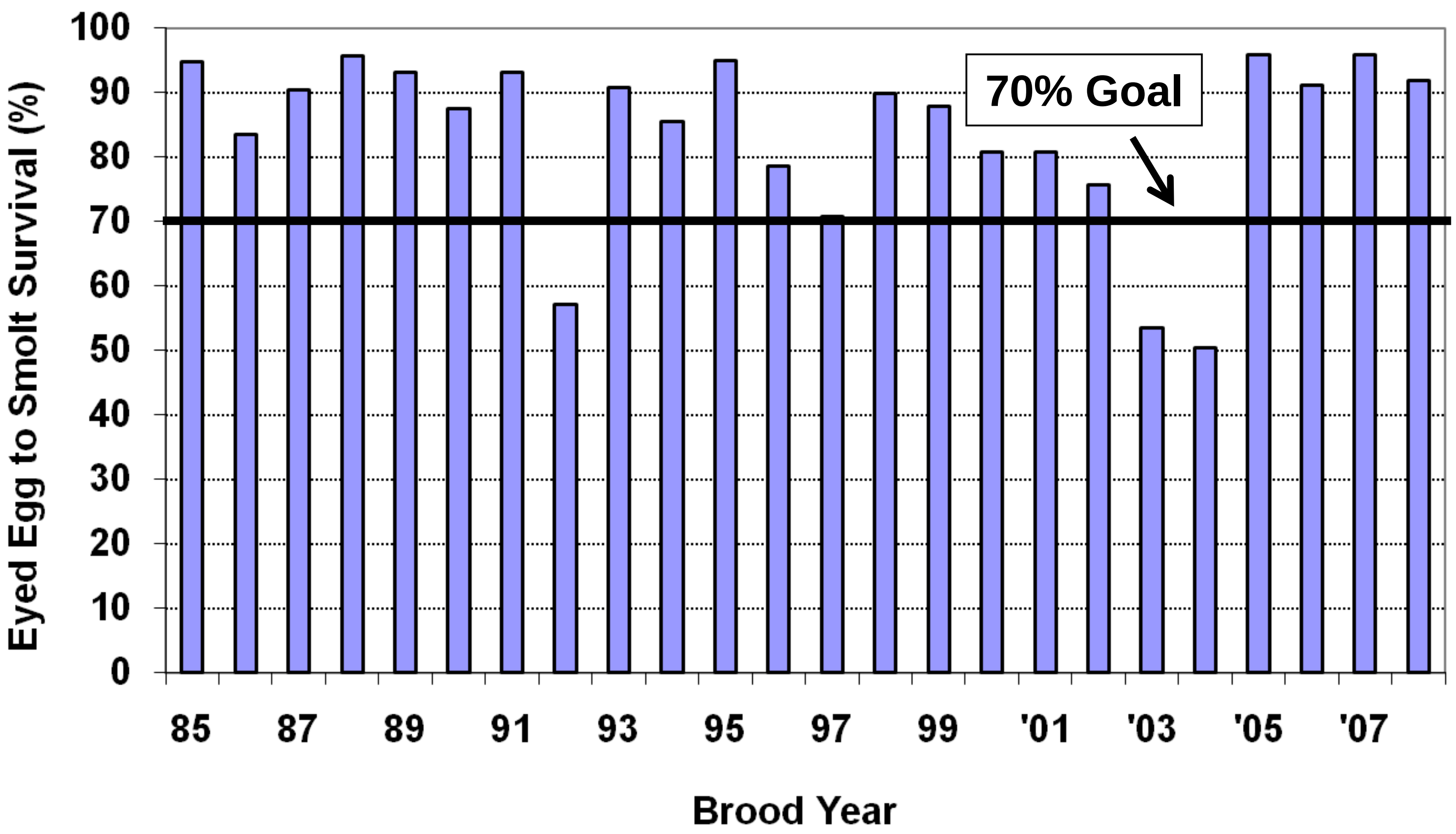
# Results

- Minor BKD losses in juveniles – out of the last ten brood years only the 2000 and 2002 BY's.

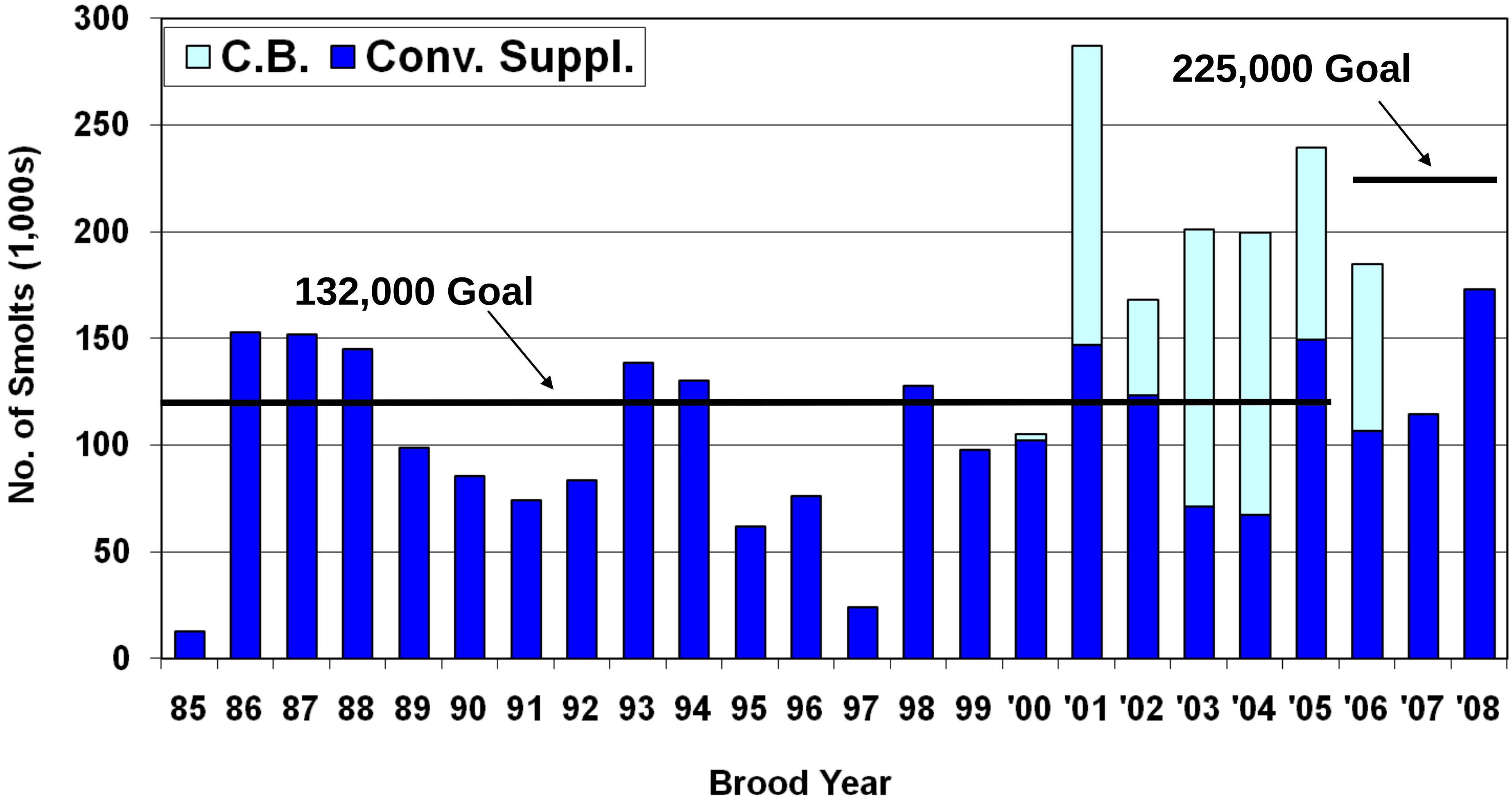
# Broodstock Performance – Pre-Spawn Mortality



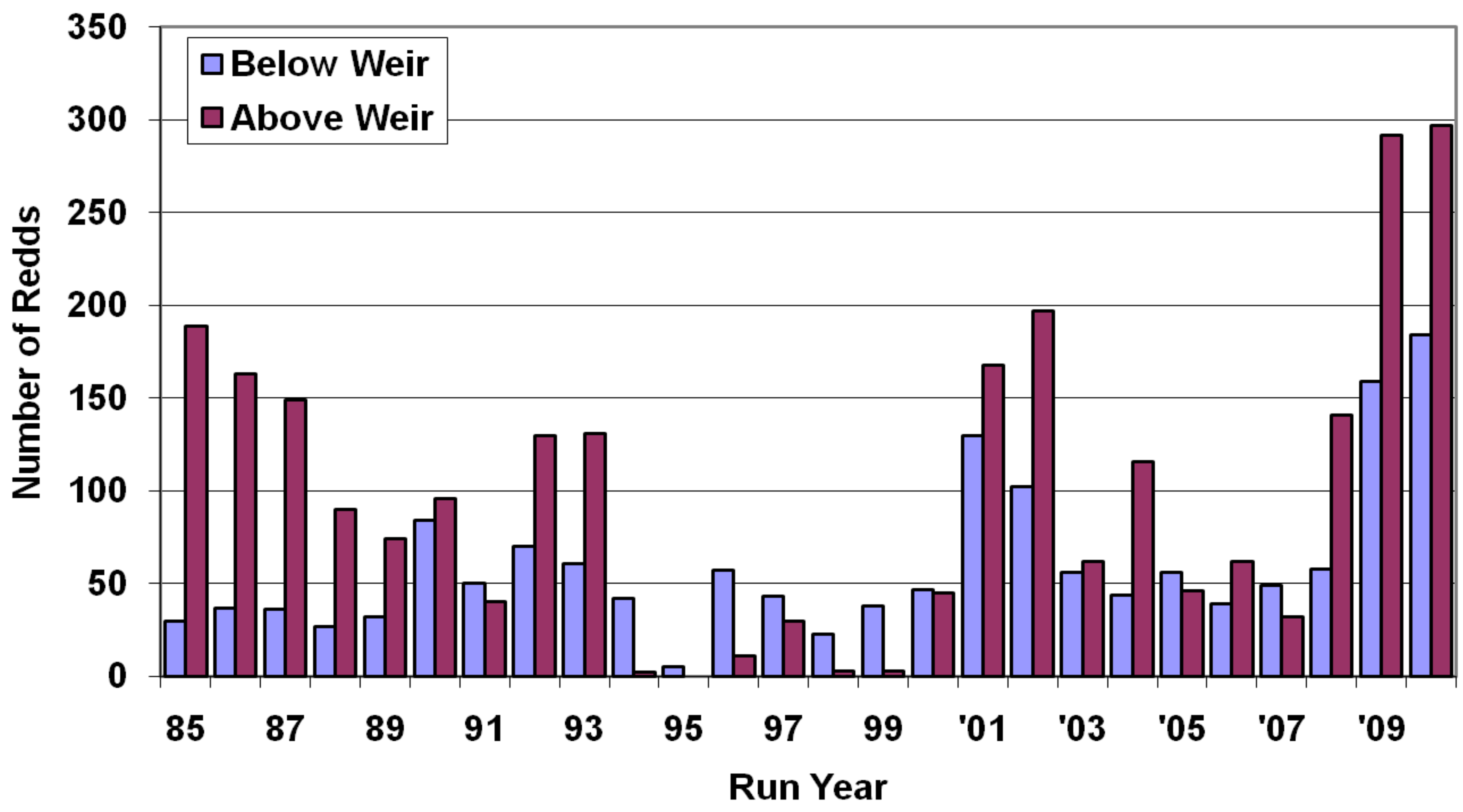
# Eyed Egg to Smolt Survival



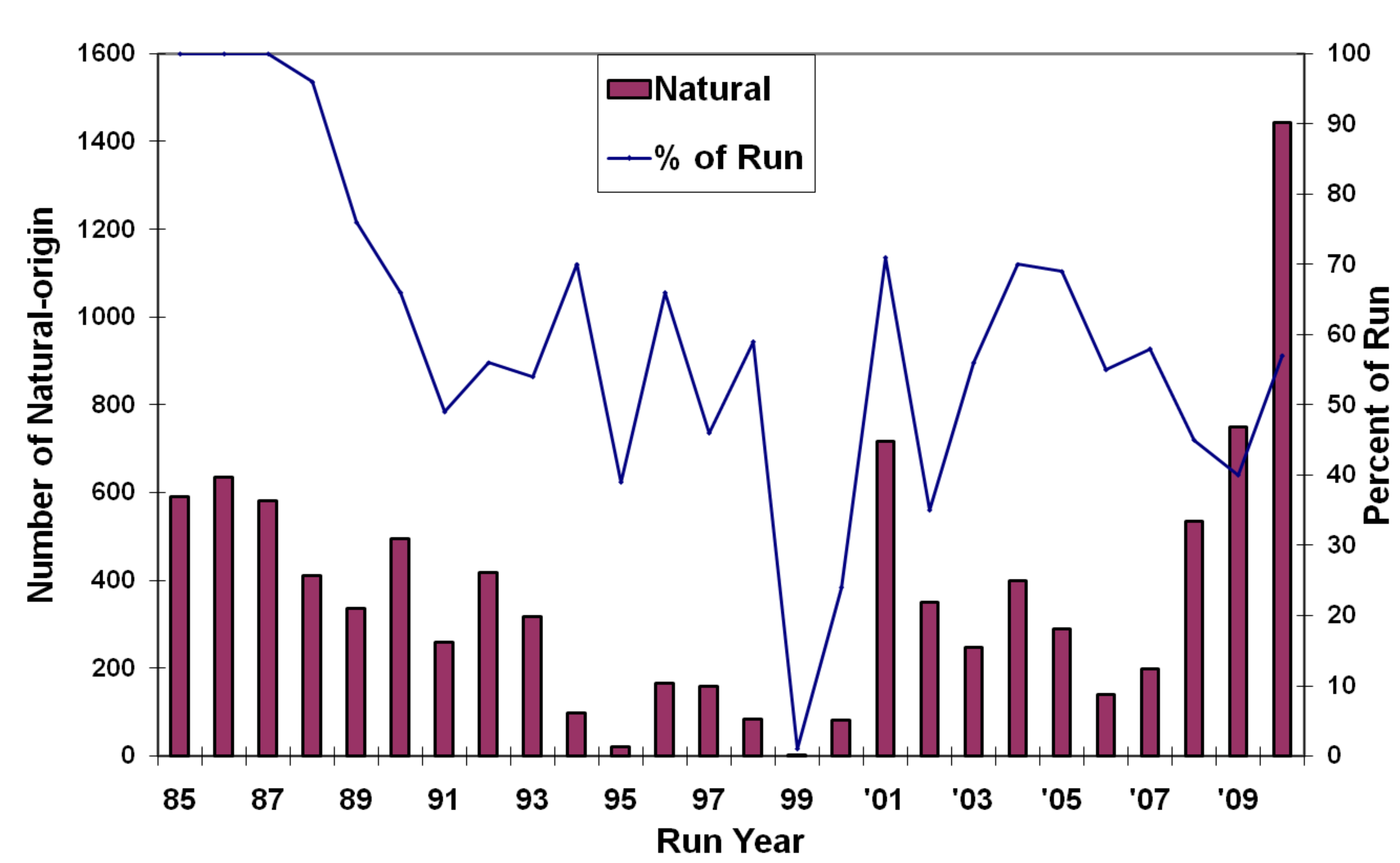
# Number of Smolts Produced



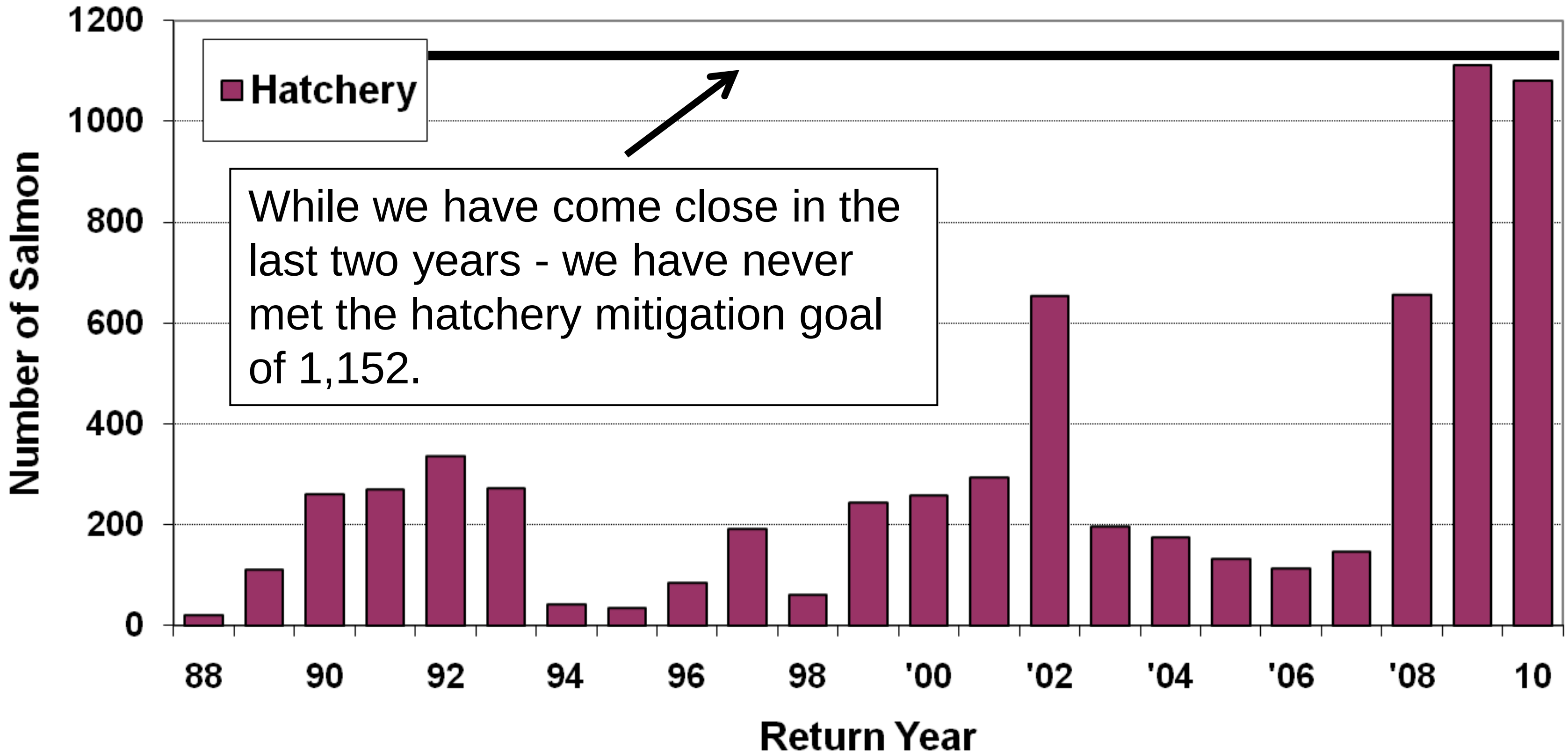
# Total Redd Counts and Distribution



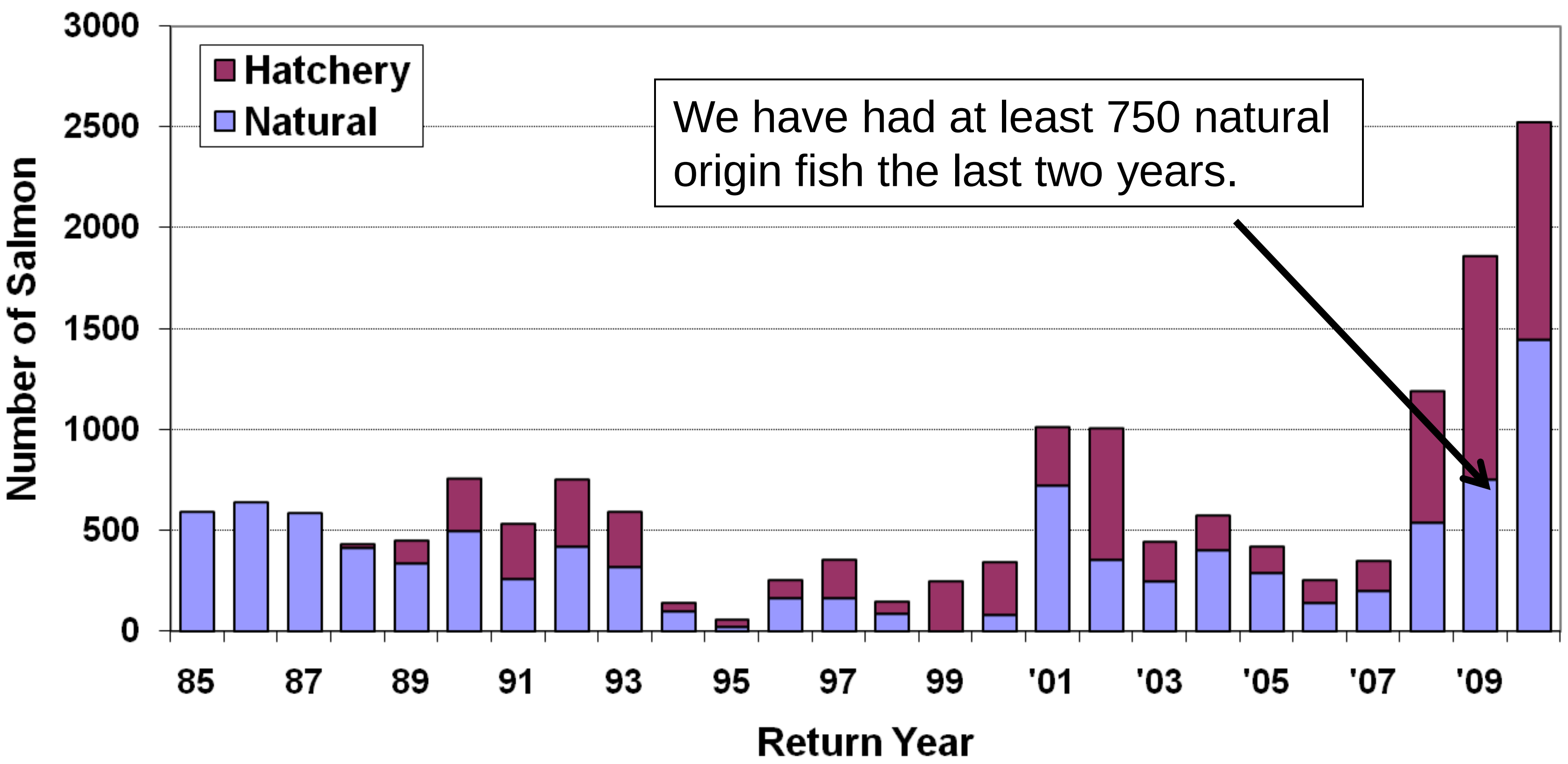
# Natural Component of Run



# Escapement to the Tucannon (Hatchery origin)



# Escapement to the Tucannon



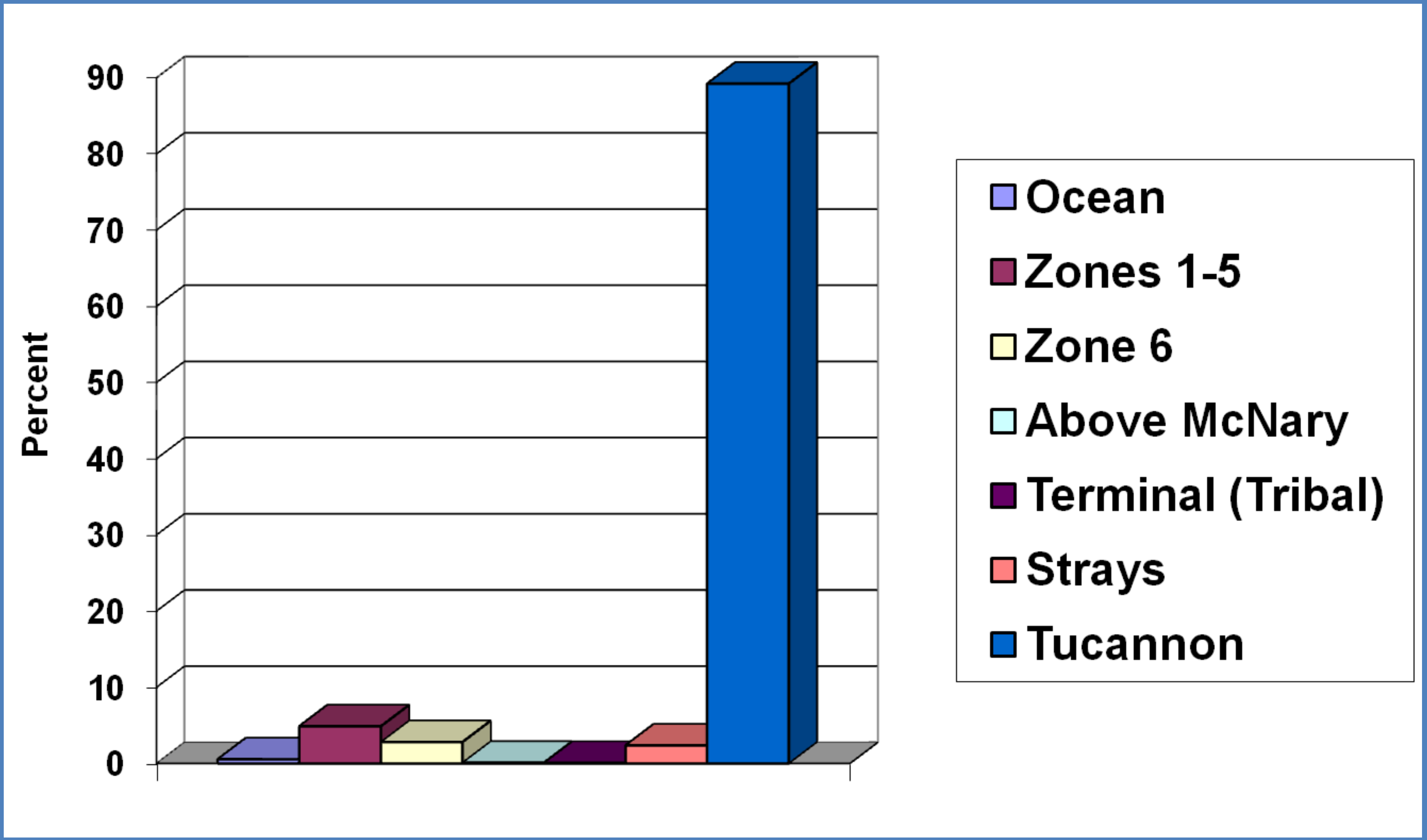
# Strays from Other Systems

- Primarily Umatilla River Hatchery strays.

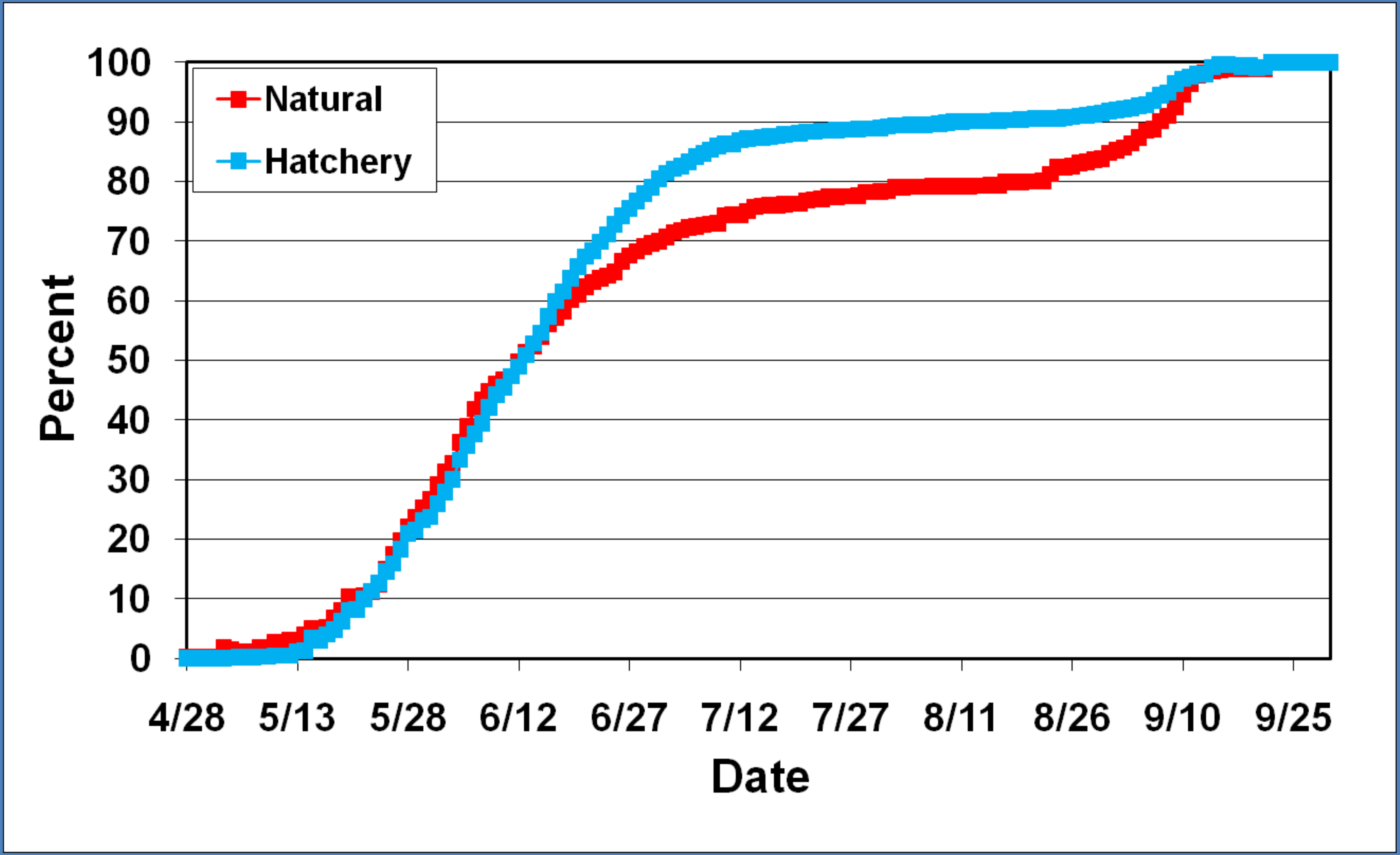
- Have accounted for as high as 8 and 12% of the run (1999 & 2000) but typically below the 5% stray proportion deemed acceptable by NOAA Fisheries.

- Have been able to remove fin clipped strays at the adult trap.

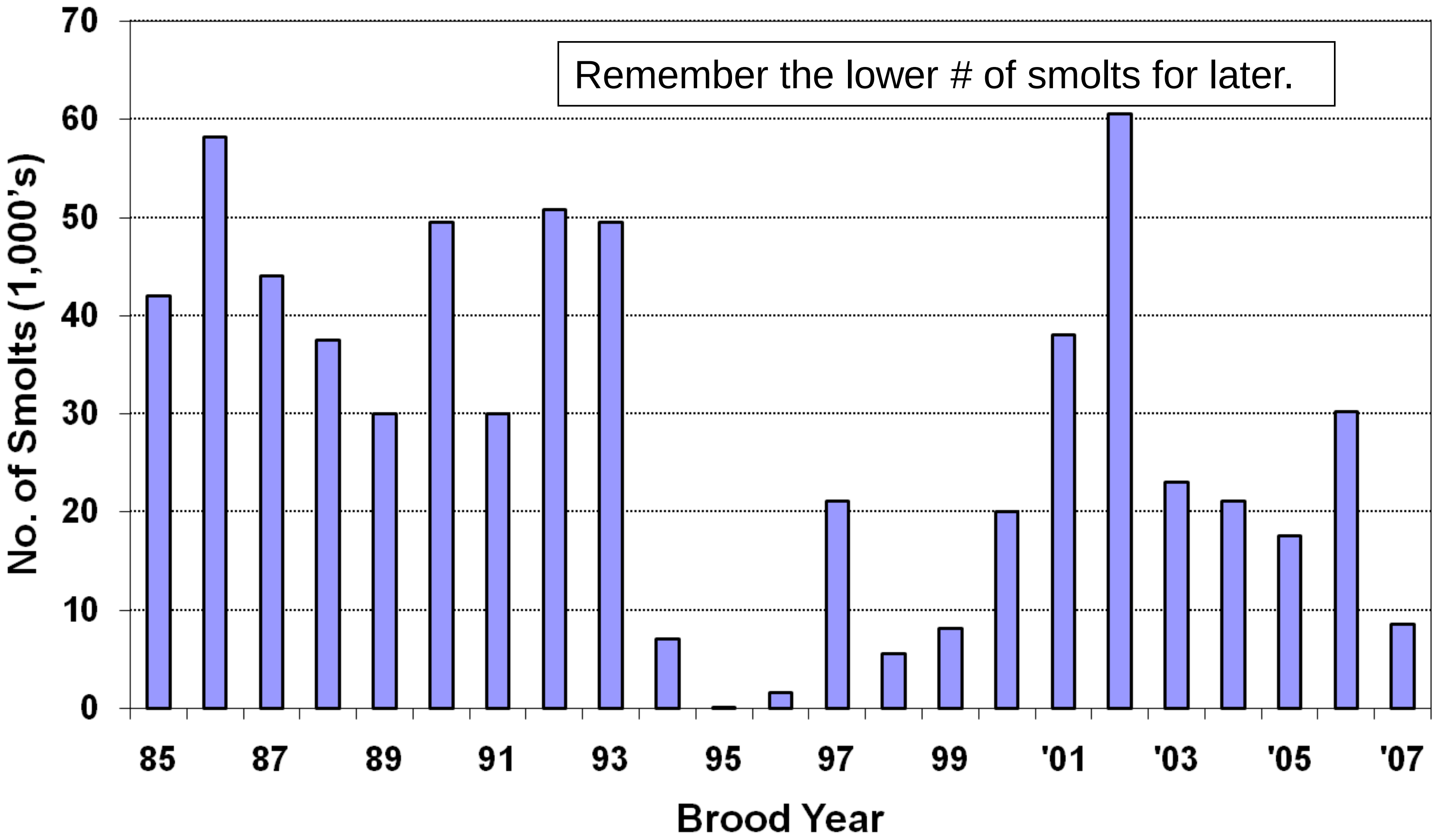
# CWT Recoveries of Tucannon Spring Chinook (No AD clip – 2000 BY+)



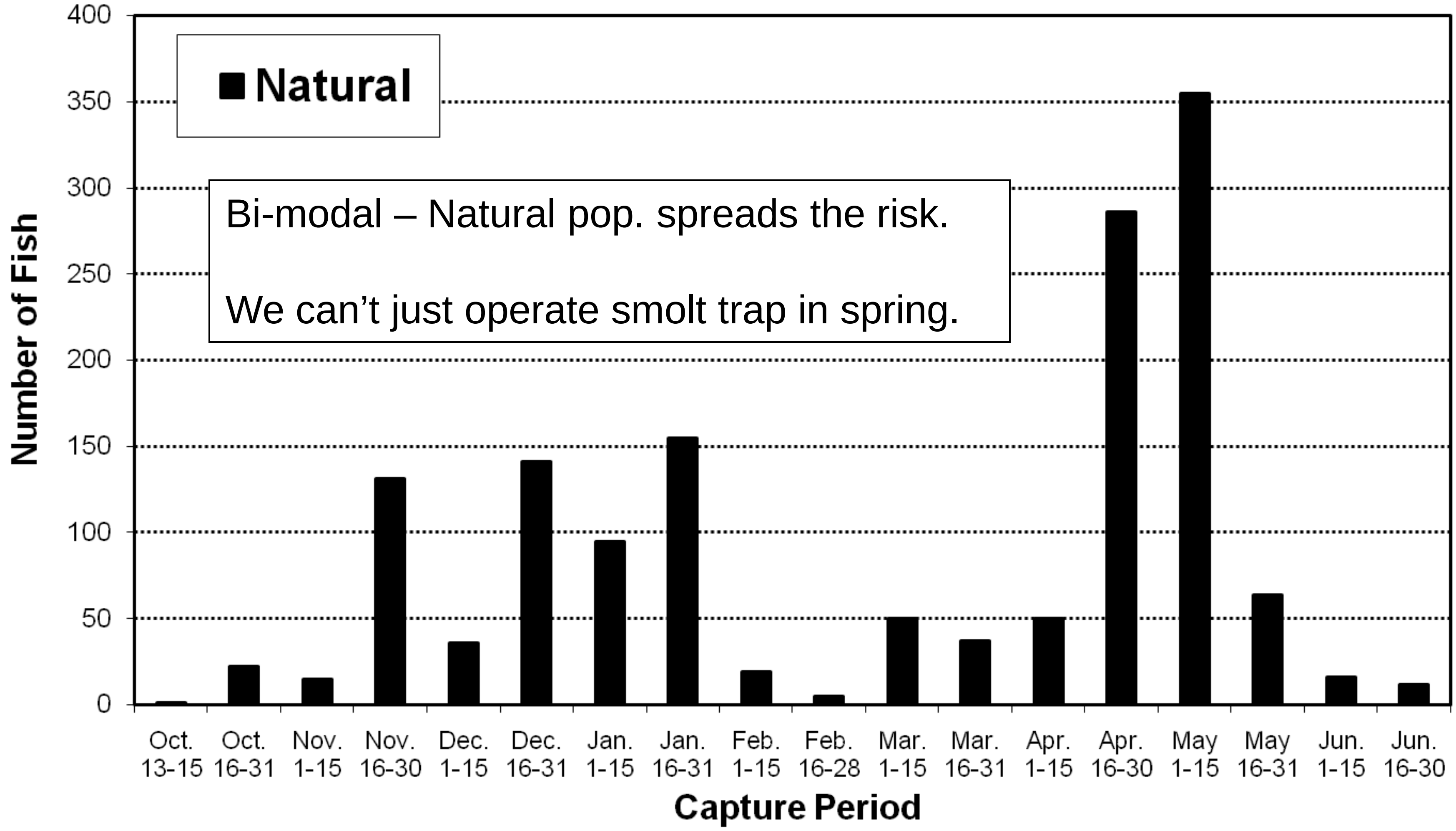
# Run Timing (Arrivals to Trap)
## (1993-2009)



# Natural Smolt Production



# Emigration Timing
## (Smolt Trap Data 08-09)



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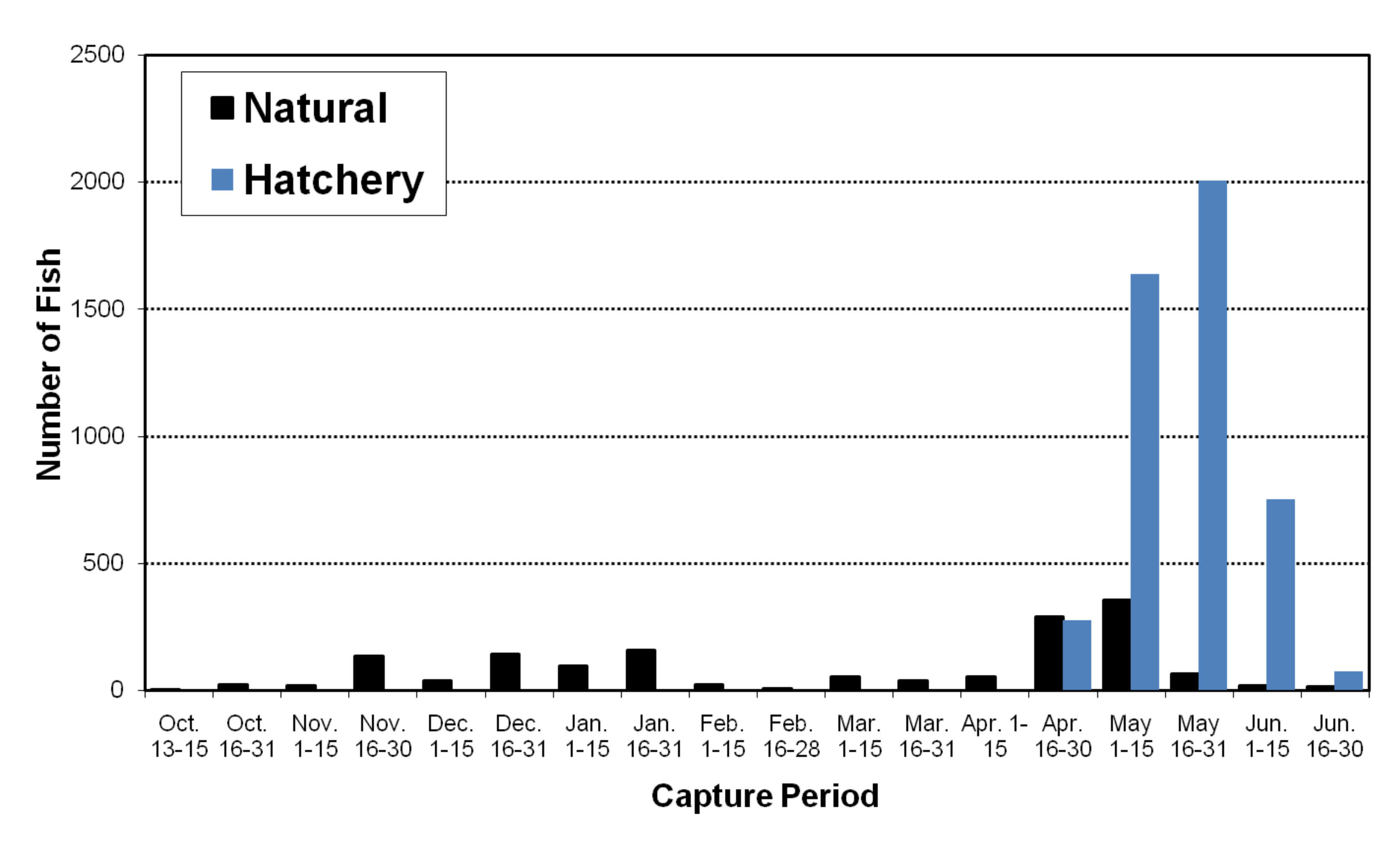
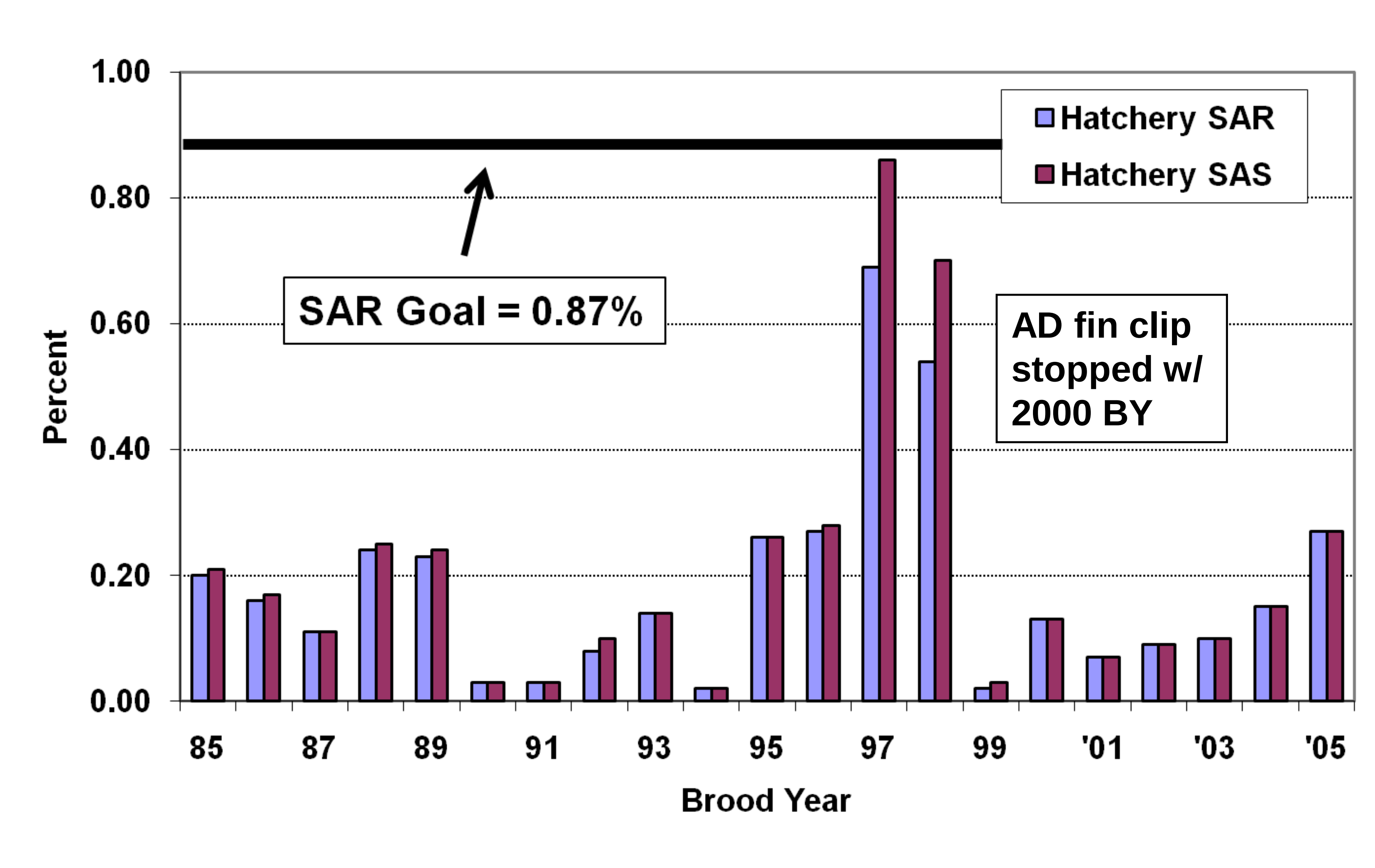
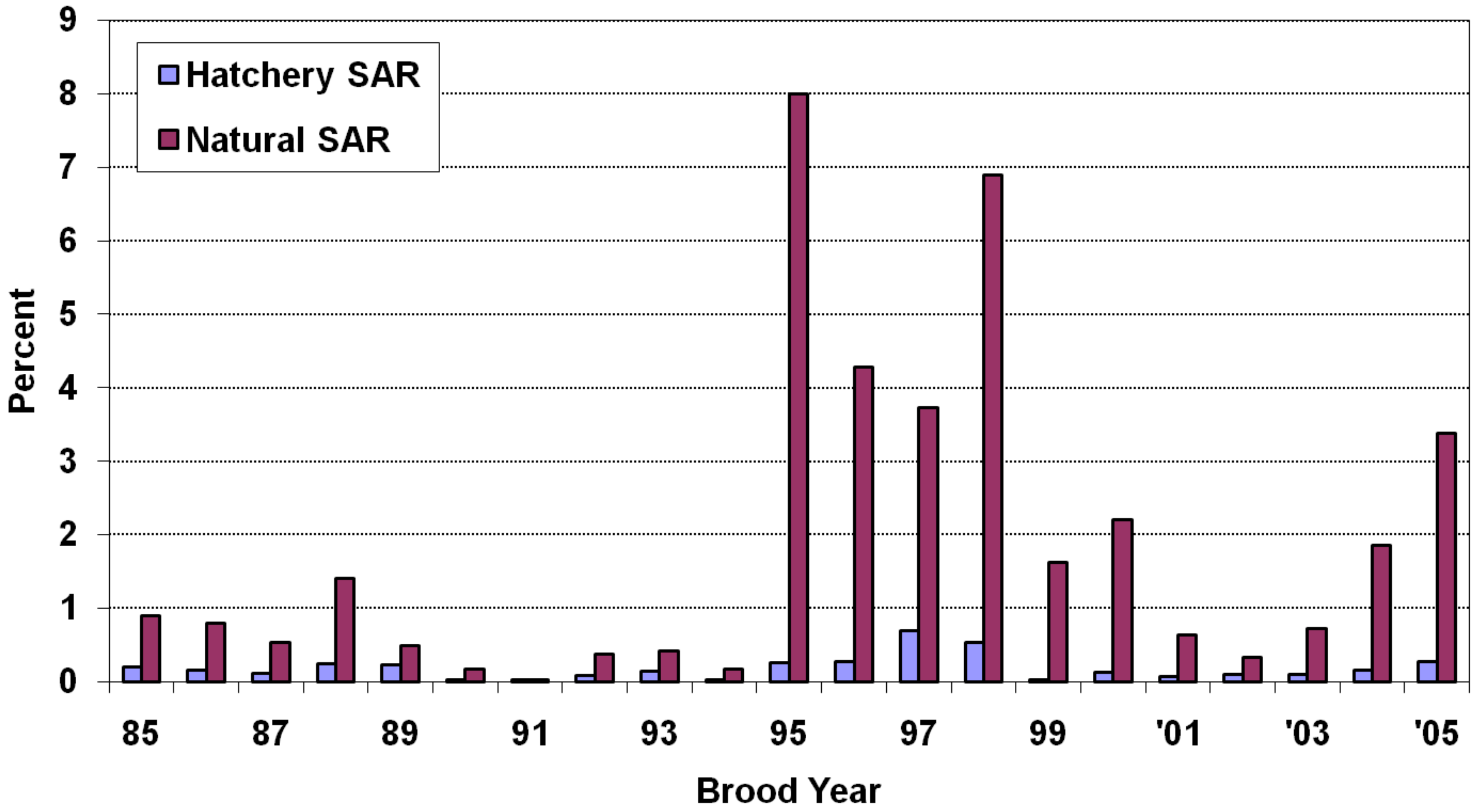
## (Smolt Trap Data 08-09)



# Hatchery Origin SAR and SAS



# Smolt-to-Adult Return by Origin



# Comments on SAR Survival

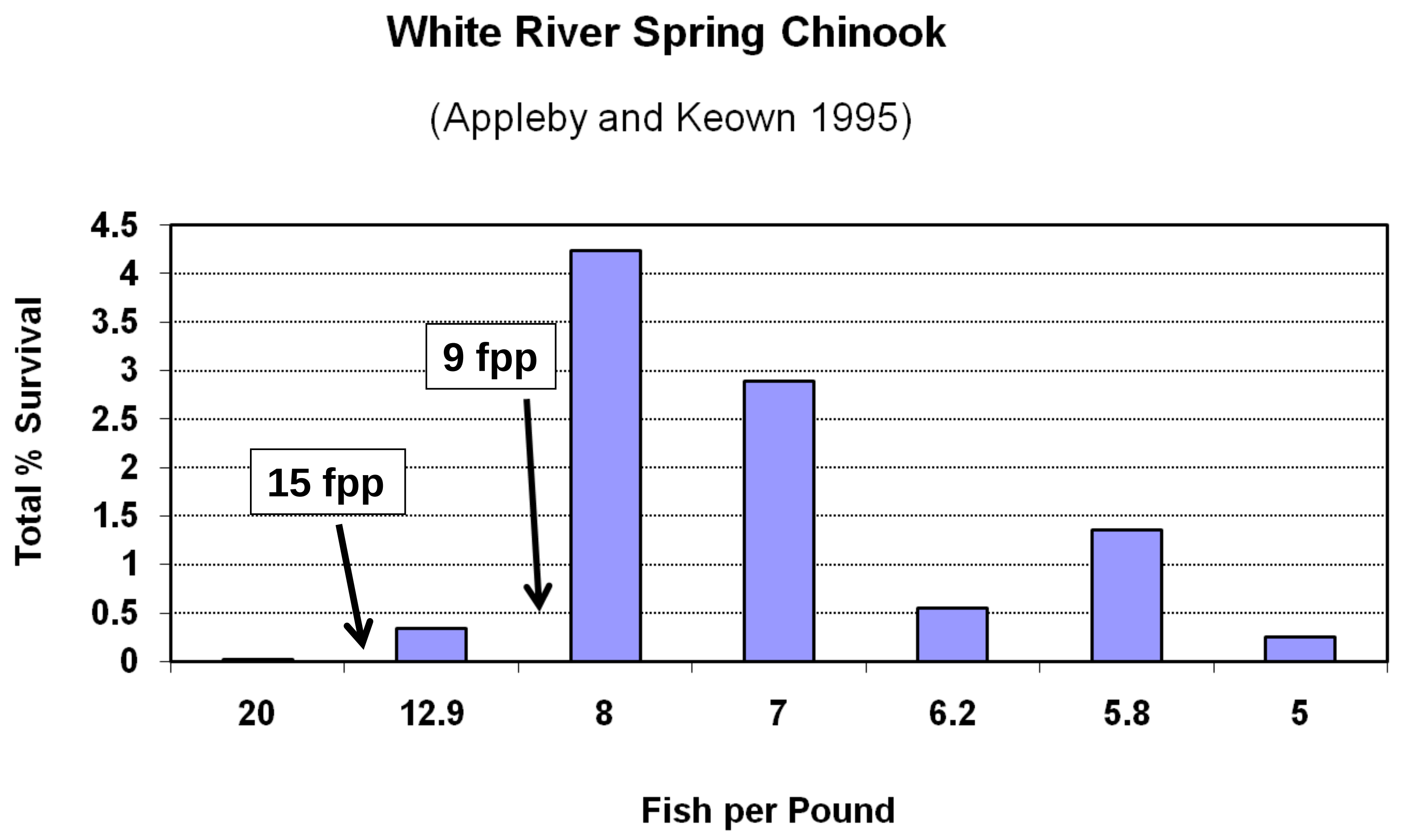
- Based on the current average SAR of 0.21% it would take a hatchery program of over 500,000 smolts to meet the LSRCP mitigation goal of 1,152.

- After discussions with the tribal co-managers it was decided to increase the smolt goal from 132,000 to 225,000 beginning with the 2006 BY.

# Comments on SAR Survival

- We are currently examining size at release to see if we can improve/maximize hatchery smolt survival (2006-2010 BY's).

# Survival vs. Size at Release



# Adult PIT Tag Returns

- Fifty-five adults originally PIT tagged as juveniles (1995-2008 tag years) have been detected returning to the Columbia River System.

- Of those, 24% swam past the Tucannon and were detected at Lower Granite Dam.

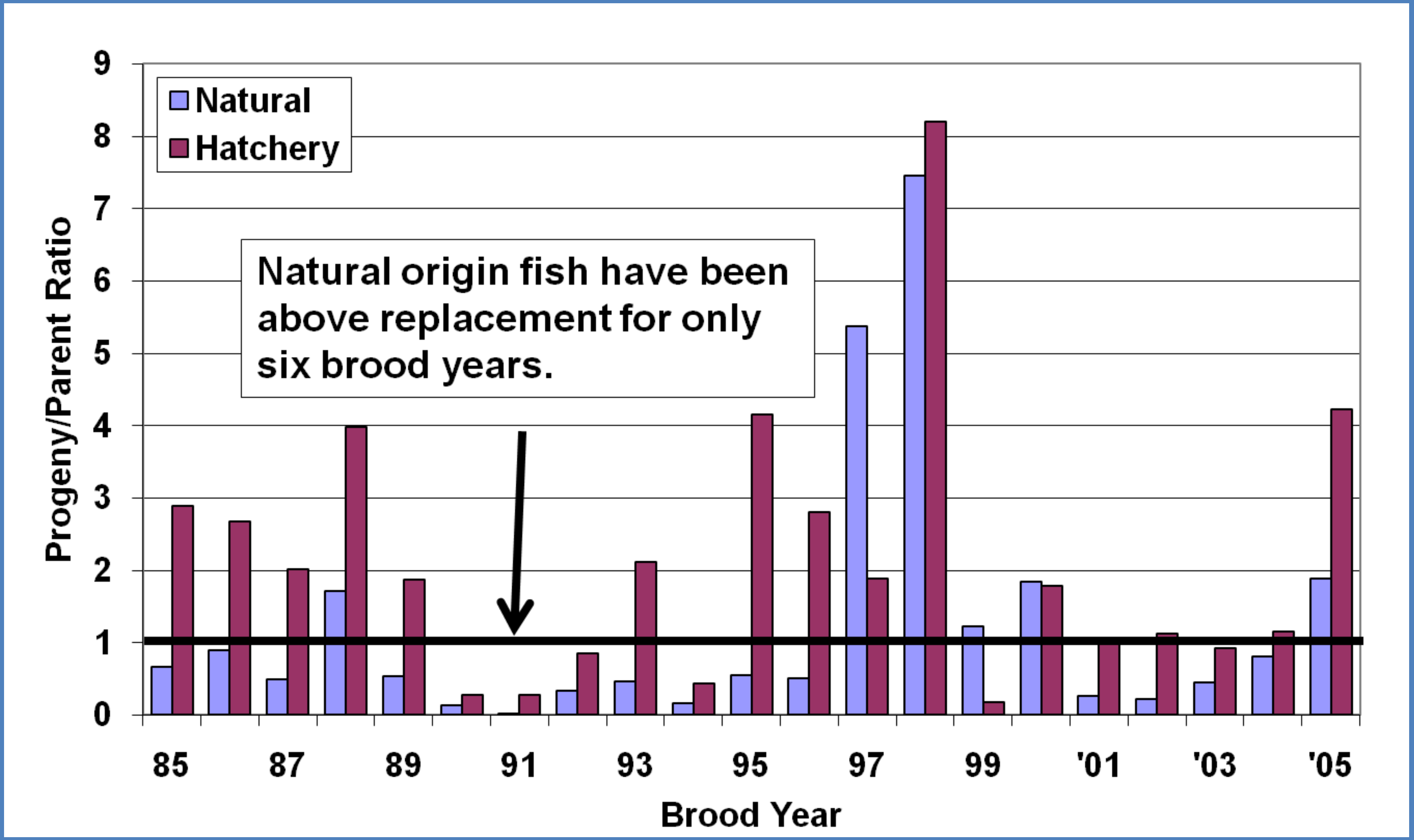
- This behavior does not appear to be a hatchery effect. (23.5% for hatchery origin and 23.8% for natural origin.)

- **Only a small sample size to date but in the process of increasing PIT tag numbers (up to 25,000).**

- **With historic low returns – fish potentially bypassing the Tucannon is a concern.**


Recent construction and operation of a PIT tag array in the lower Tucannon should help provide migration information.

# Progeny-per-Parent Ratios



# Tucannon River Spring Chinook Captive Broodstock Program

# Purpose/Goal of the Program

- **To artificially boost broodstock numbers over the course of one generation (5 brood years – 1997-2001) and supplement the population through a bottleneck situation.**

- **Captive broodstock were selected from the <u>hatchery supplementation program</u> (HxW, HxH, and WxW parents) with a progeny release goal of 150,000 smolts @ 15 fpp.**

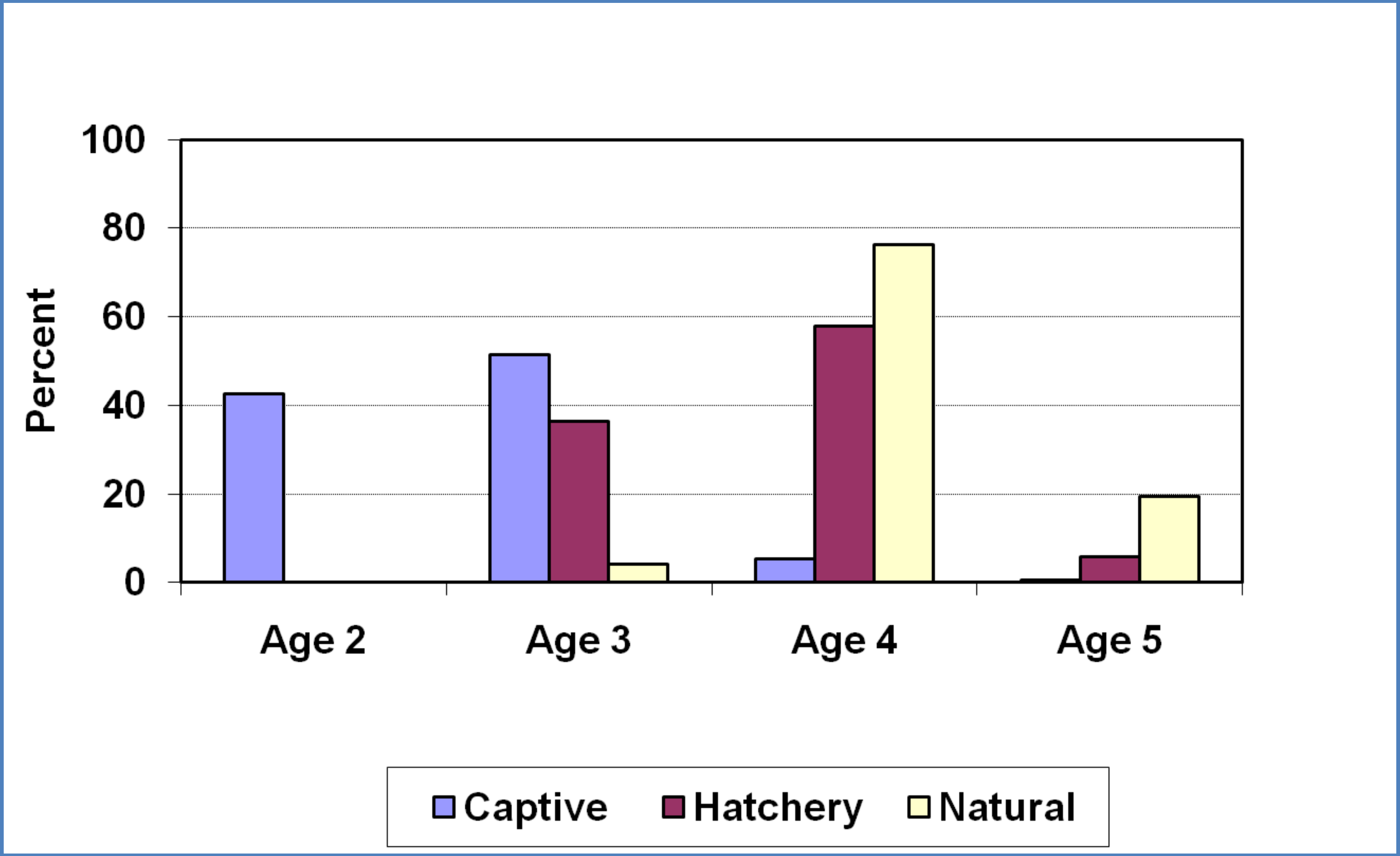
Todd Kassler’s presentation will cover Tucannon River spring Chinook genetics later on in the program.

I will compare phenotypic traits from the three programs…

# With the captive brood program we can look at three levels of hatchery rearing on the same stock…

- Captive brood – Full hatchery influence.
- Hatchery origin – Partial hatchery influence.
- Natural origin – Minimal hatchery influence.

# Male Age Composition by Origin



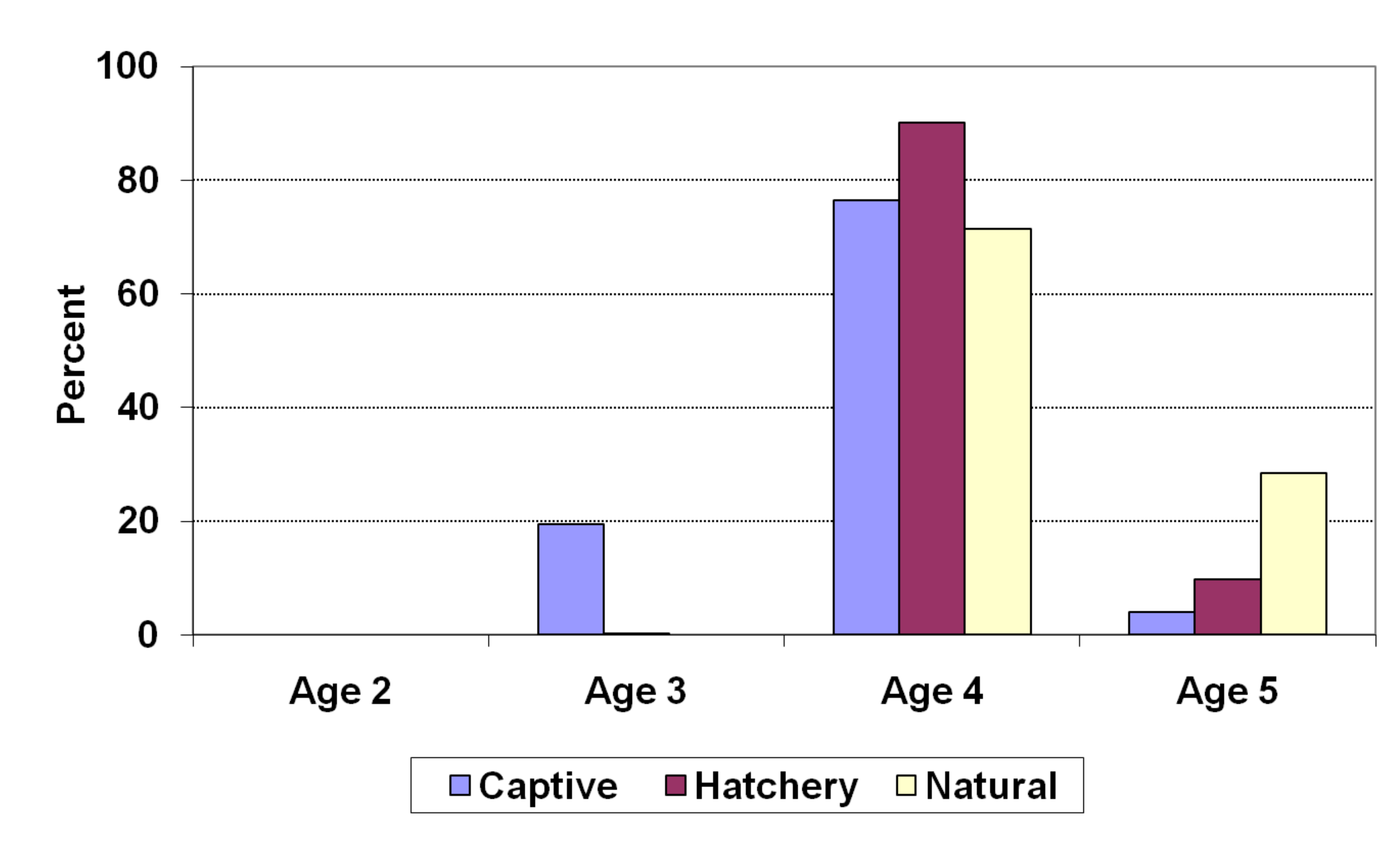

There are other age groups in the spawning population that aren't observed at the adult trap…


GYM

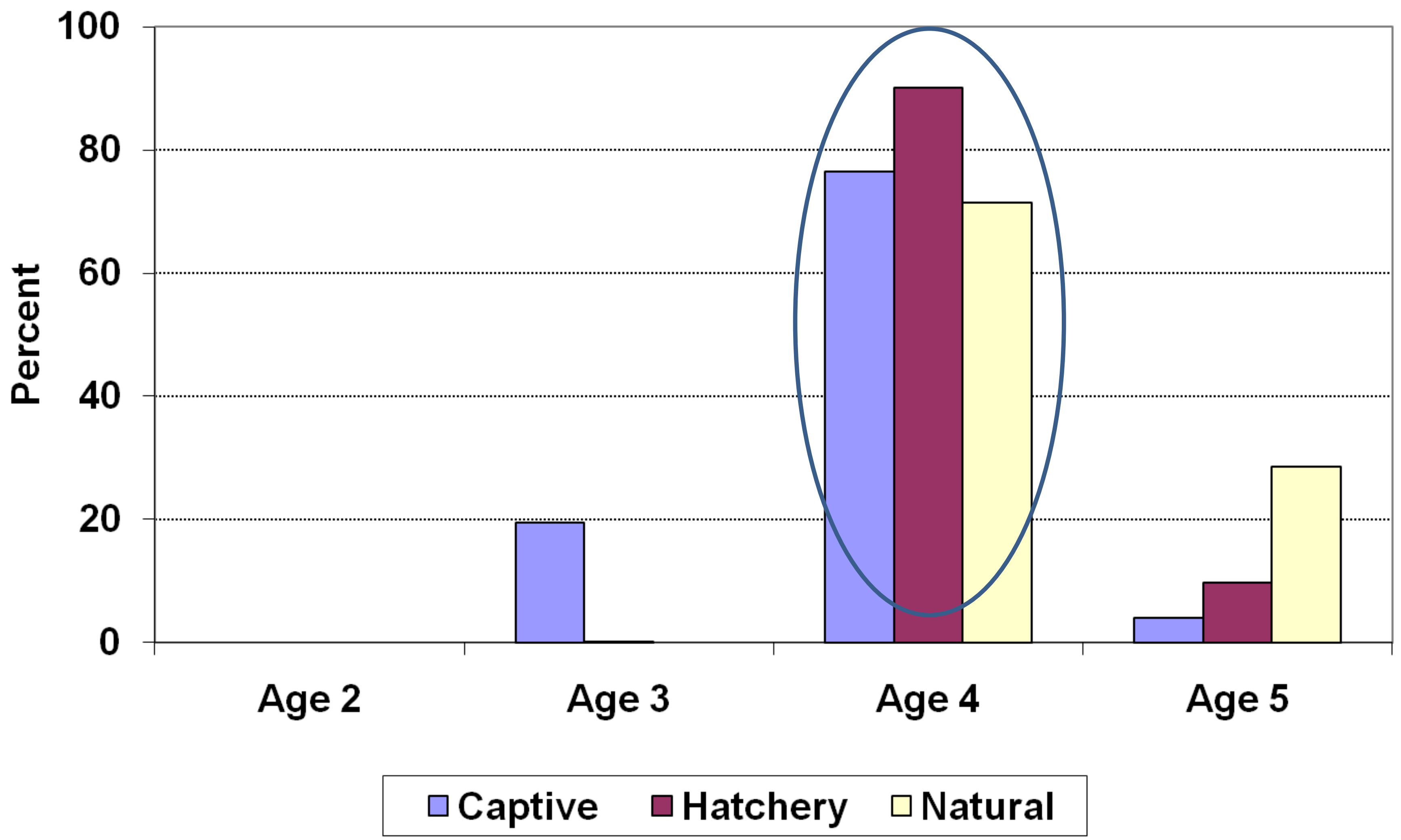
Our current record is 11 in one cast.

Wild Mature Size Range 68-127 mm

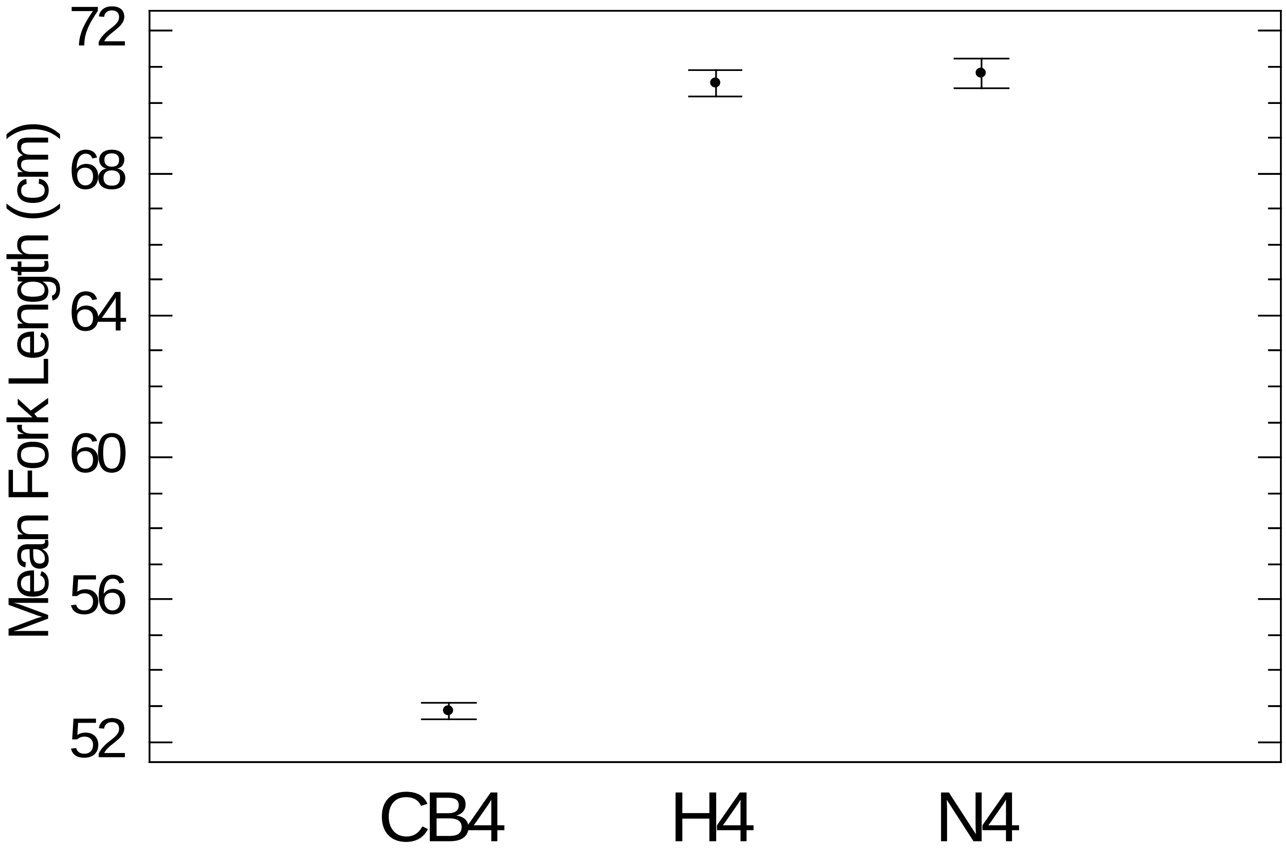
# Female Age Composition by Origin



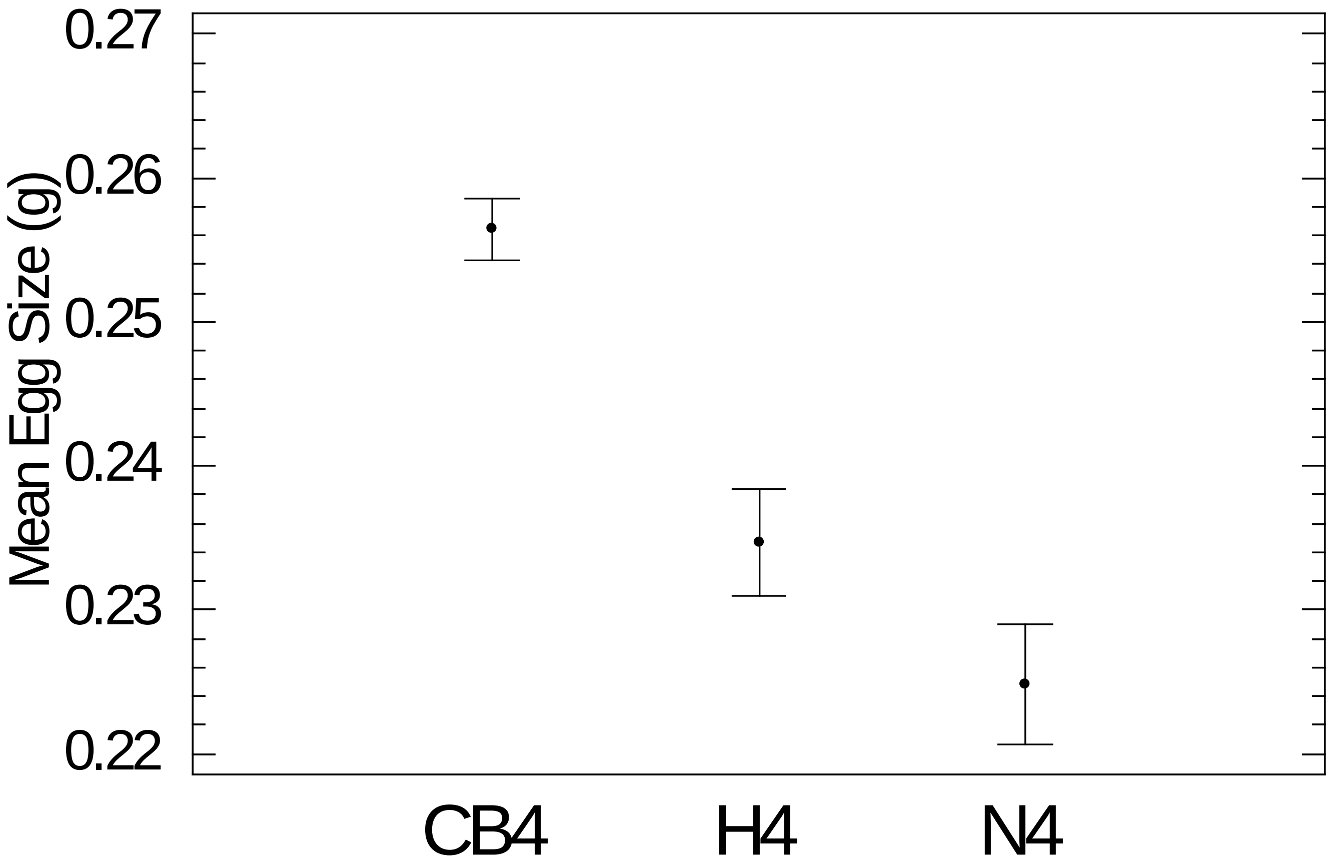
# Female Age Composition by Origin



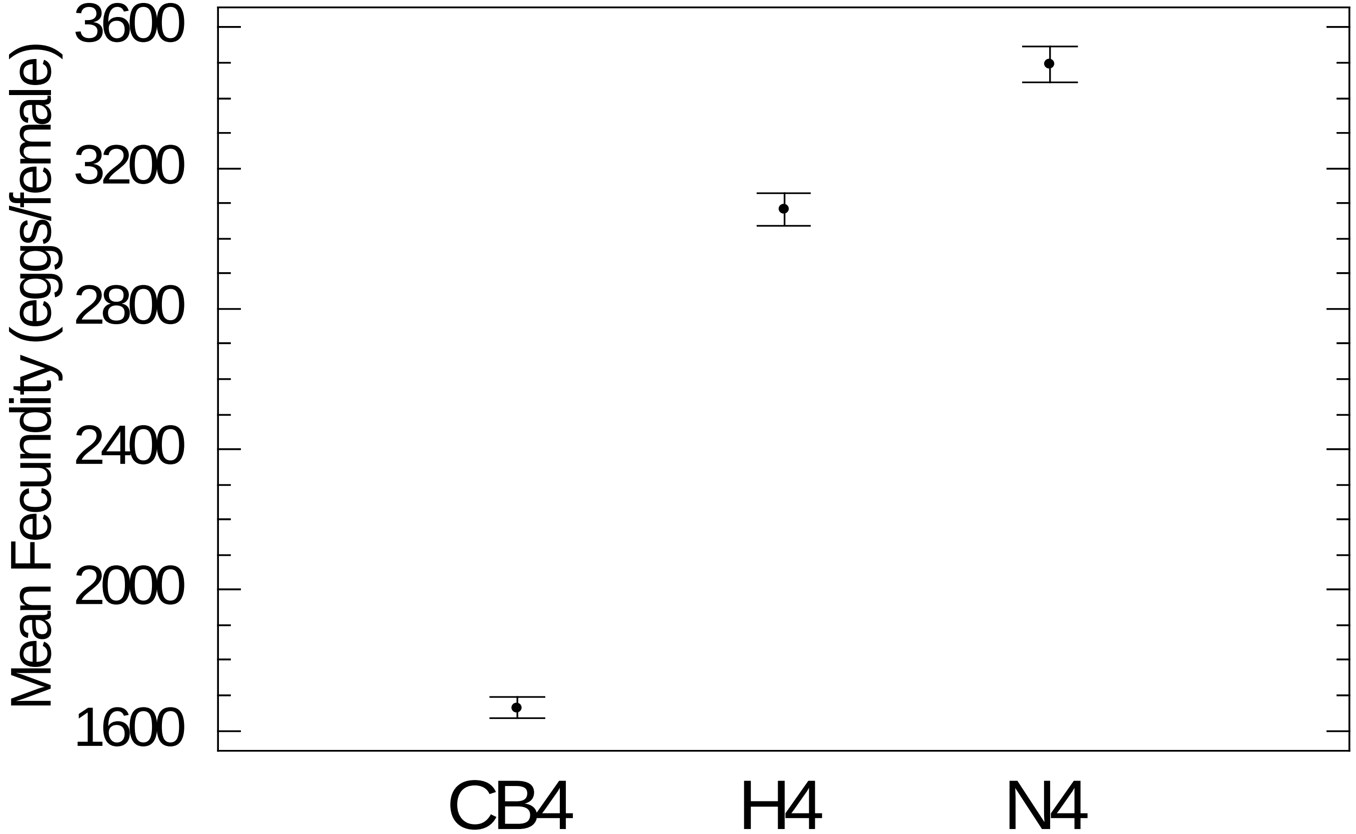
# Age 4 Female Spawner Fork Length



# Egg Size



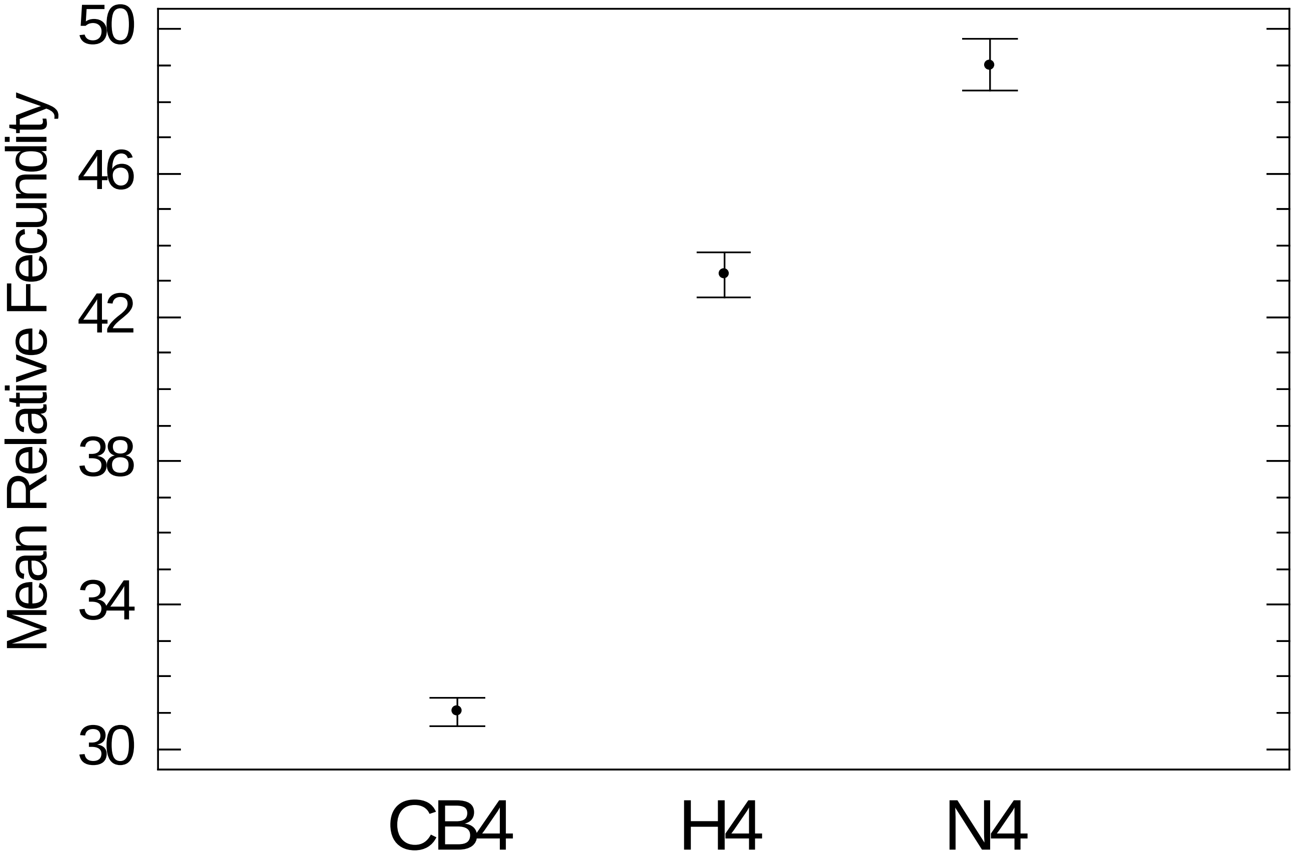
# Fecundity



Mean Fecundity (eggs/female)
3600
3200
2800
2400
2000
1600
CB4
H4
N4

# Index of Relative Fecundity

**Relative Fecundity = Fecundity ÷ Fork Length**

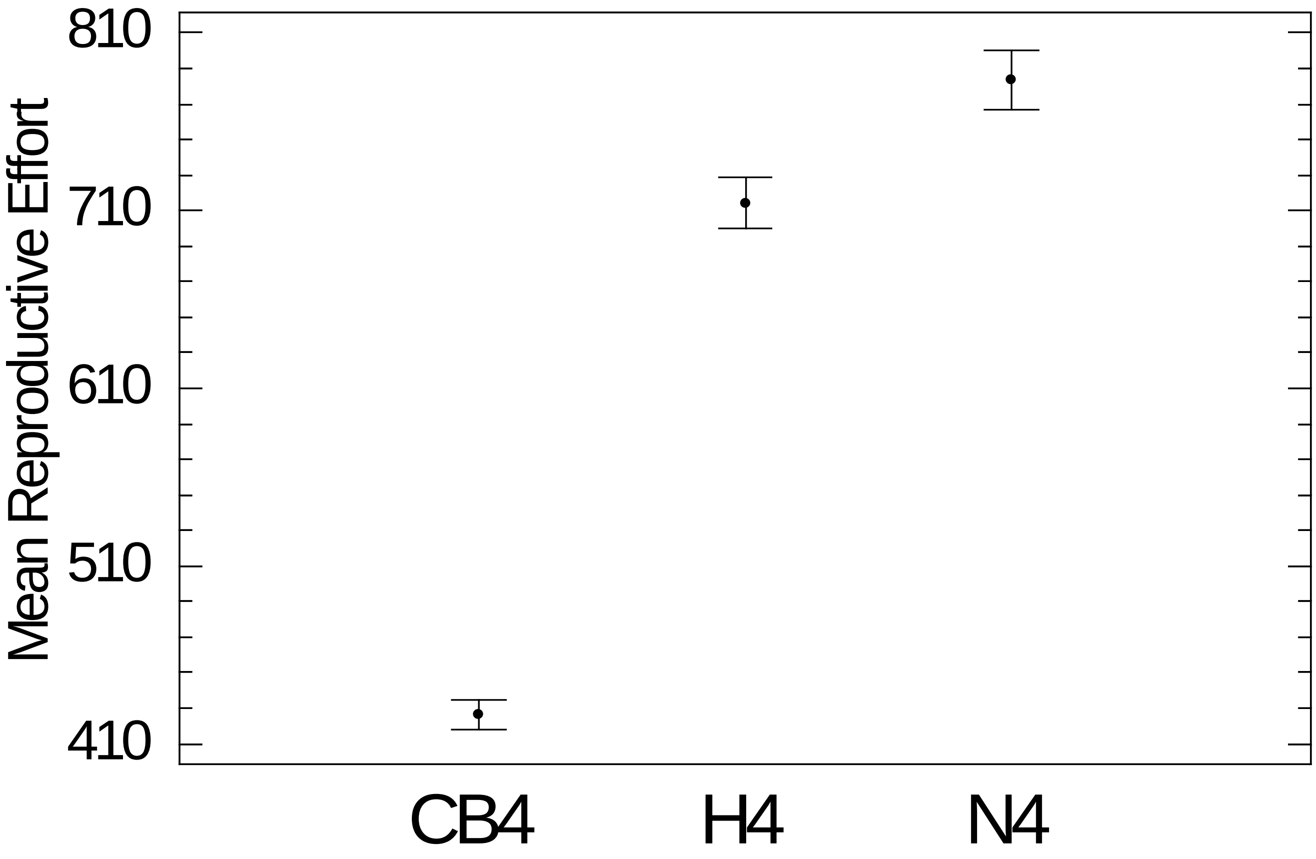


# Maybe they just allocate/partition it differently?

- **Low number of large eggs may be equal to a high number of small eggs?**
- **Index of Reproductive Effort (Mass)**
  **= Fecundity x Egg Wt.**

# Index of Reproductive Effort (Mass)

**Reproductive Effort = Fecundity × Egg wt.**



# Returning Age 4 Female C.B. Progeny vs. Conventional Supplementation

- Both groups released at similar sizes, spent same amount of time in the hatchery environment, and differ only in parentage.

- There was no significant difference ($P > 0.05$) in fork length, egg size, fecundity, relative fecundity, or reproductive mass.
- **However…**

# Smolt-to-Adult (SAR) Returns 2000-2005 Brood Years (Jacks excluded)

| | Captive Brood Progeny | Hatchery Origin | Natural Origin |
|---|---|---|---|
| Mean | 0.05 | 0.14 | 1.52 |
| S.D. | 0.08 | 0.07 | 1.17 |

# Progeny/Parent Ratio Comparisons 2000-2006 Brood Years

| | Captive Brood Progeny | Natural Origin | Hatchery Origin |
|---|---|---|---|
| **Mean** | **0.36** | **0.95** | **2.69** |
| **S.D.** | **0.53** | **0.81** | **2.38** |

# Captive Brood Program Summary

- **Program had problems with high egg losses and low fecundity.**
- **Program did not contribute much to adult returns.**
- **Program was discontinued as originally planned after one generation.**

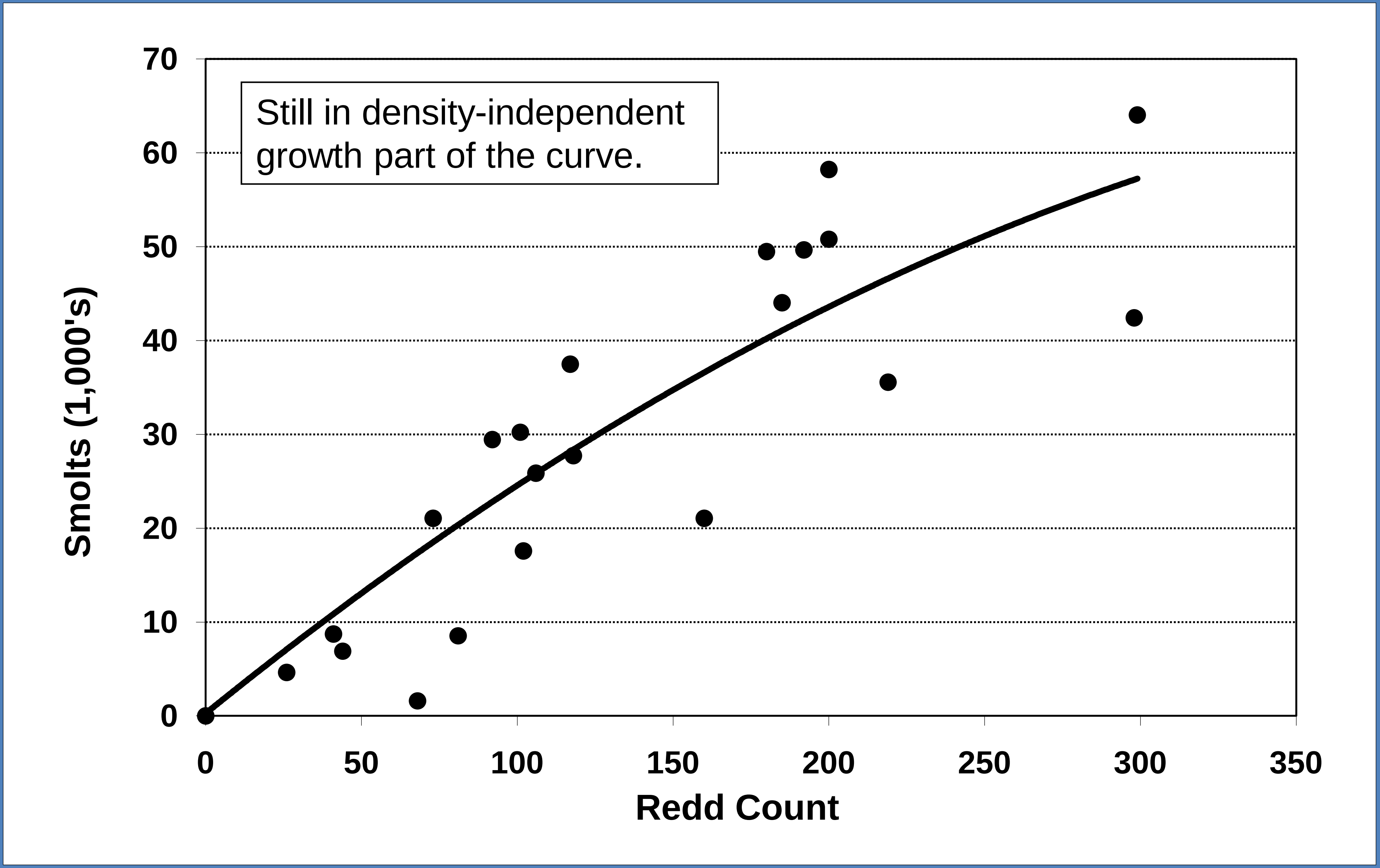
# Tucannon River Productivity

- Stock-Recruit Analysis – Estimate Capacity (K)
- Smolts/Redd
- Smolts/Spawner
- Take stab at looking at effects of hatchery fish.

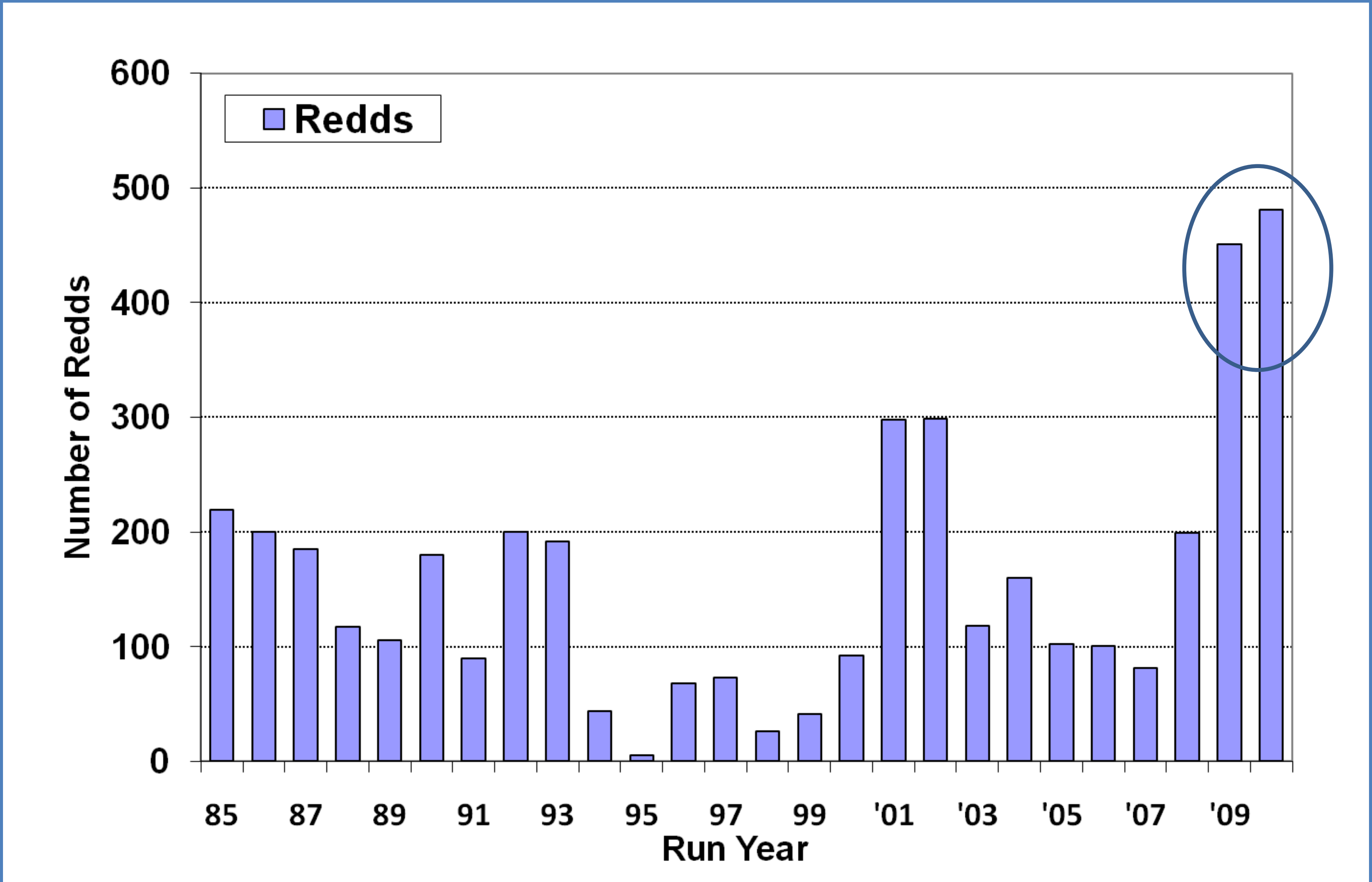
# Stock-Recruit Analysis

- I define K as the minimum number of adults that produce the asymptotic number of progeny (not the maximum number of adults that the environment can support).
- I used redd counts, with the assumption that one female produces one redd, to reduce the potential variance between parents and progeny.

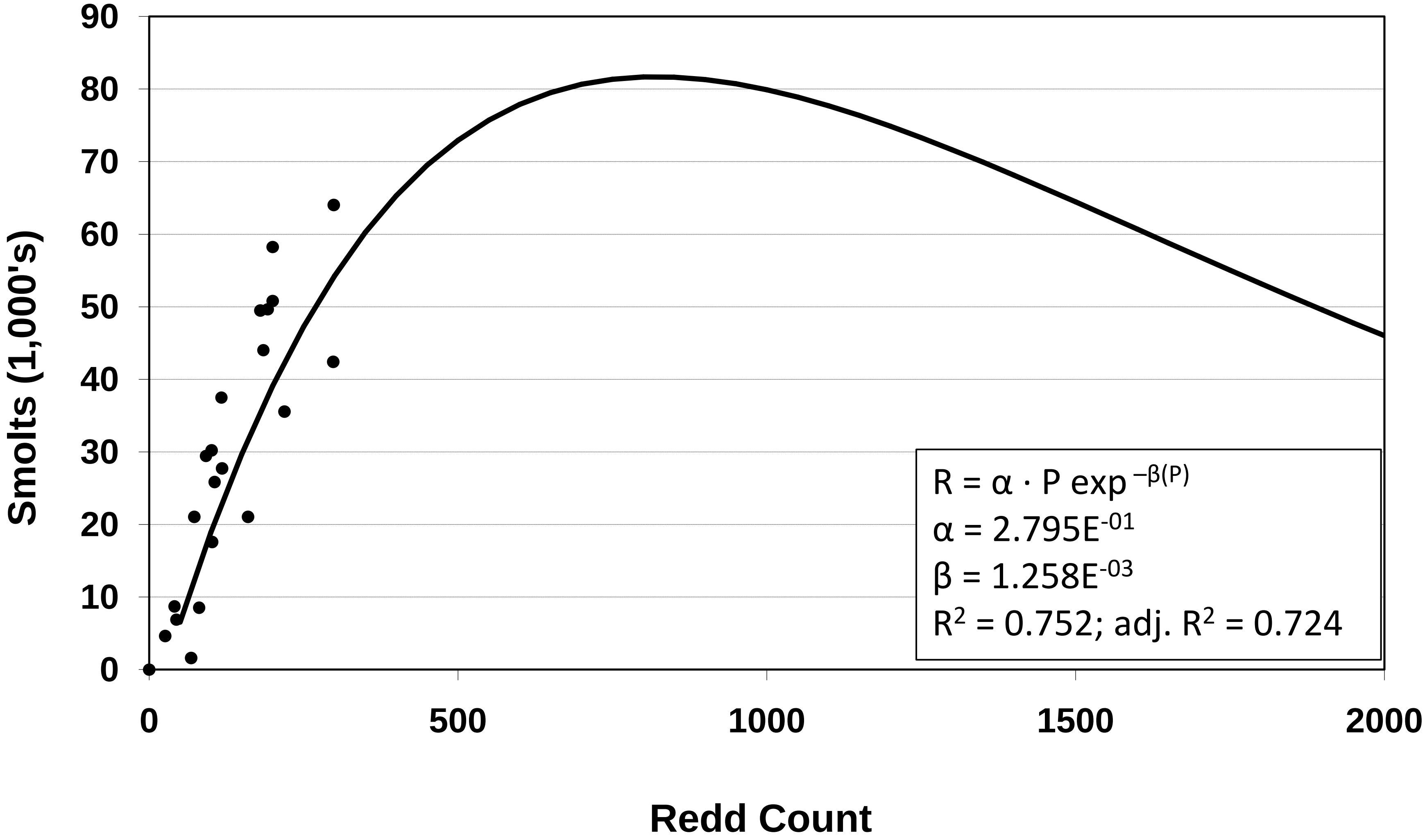
# Stock-Recruit Analysis



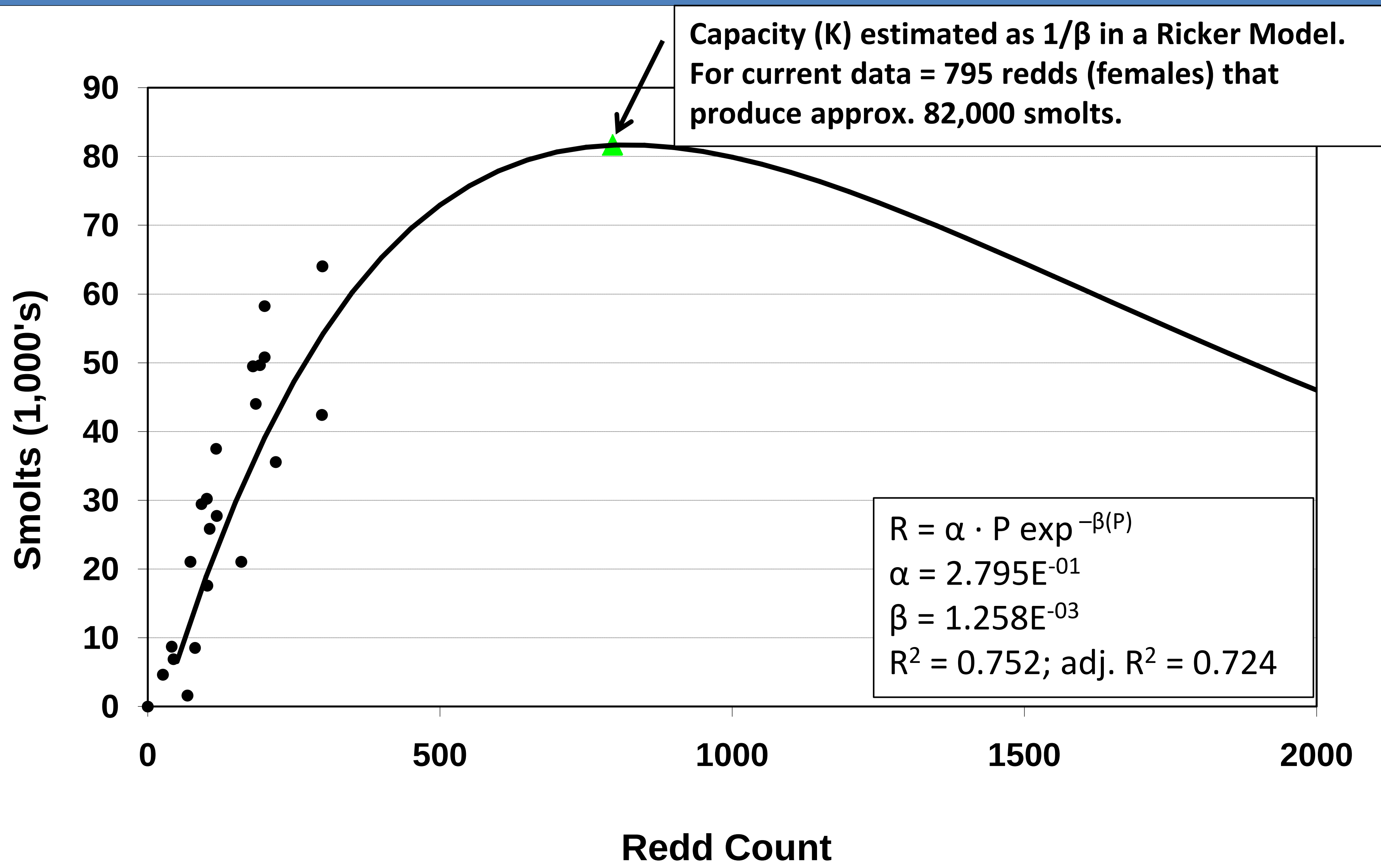
# Total Redd Counts



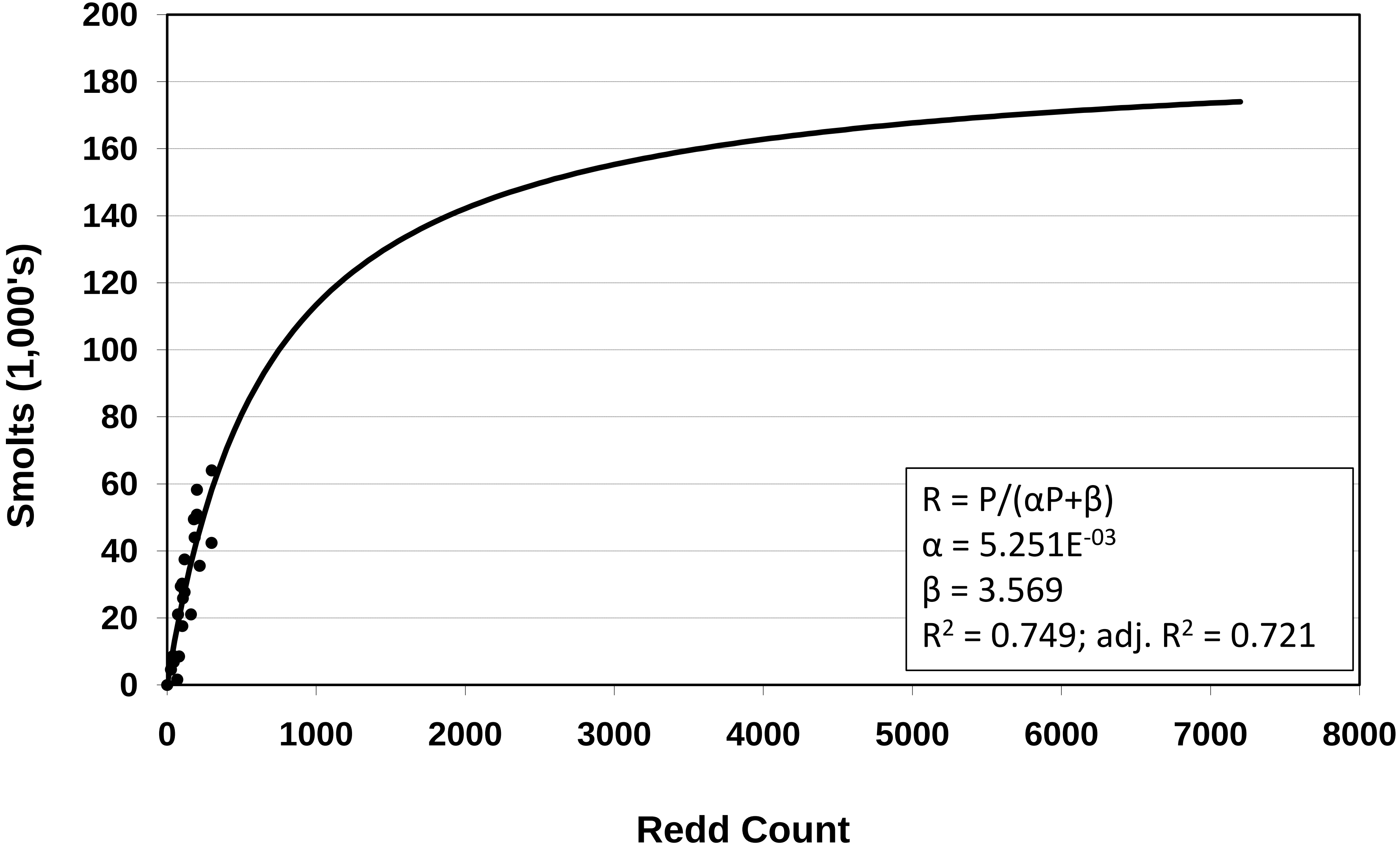
# Ricker Stock-Recruit Function



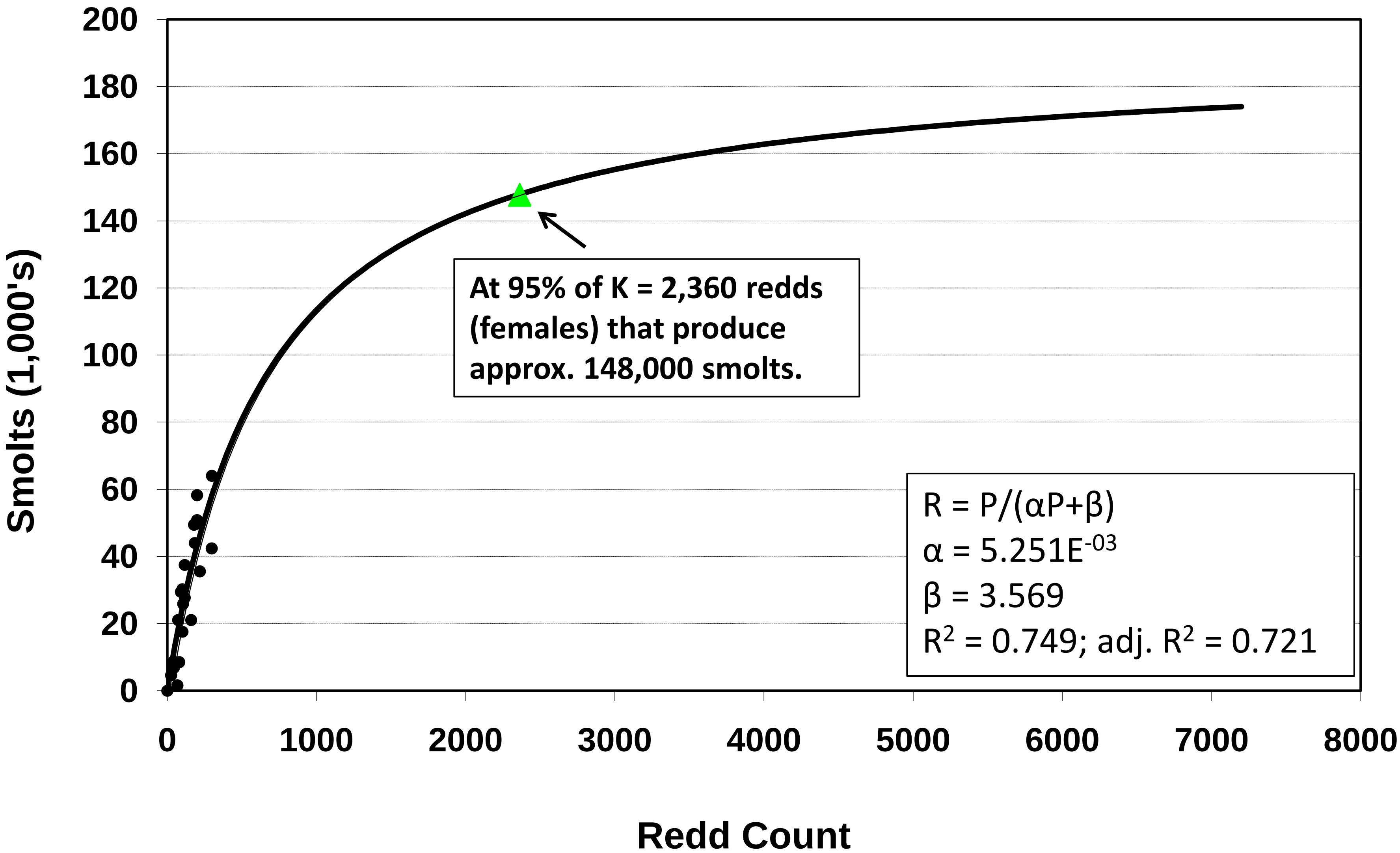
# Ricker Stock-Recruit Function



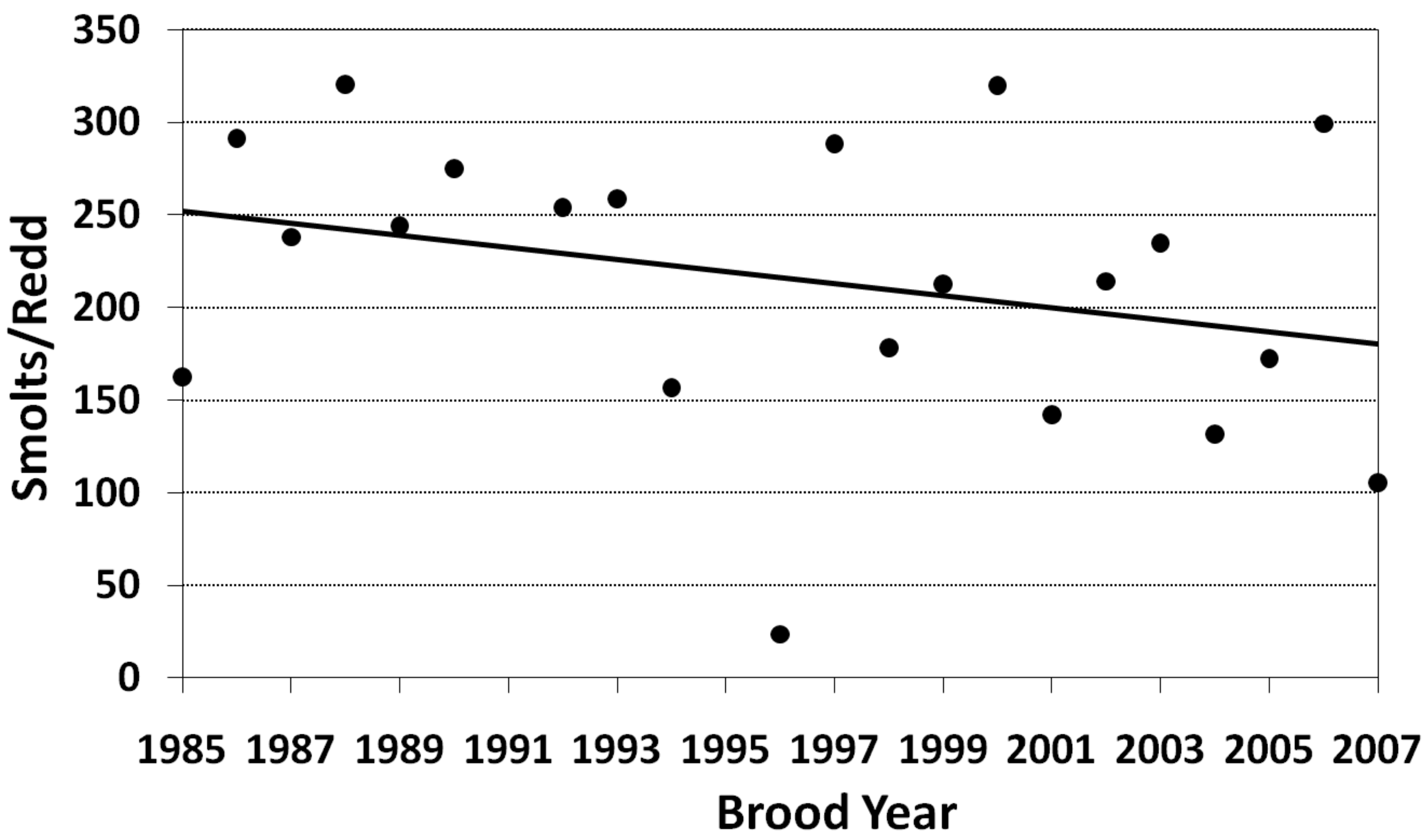
# Beverton-Holt Stock-Recruit Function



# Beverton-Holt Stock-Recruit Function



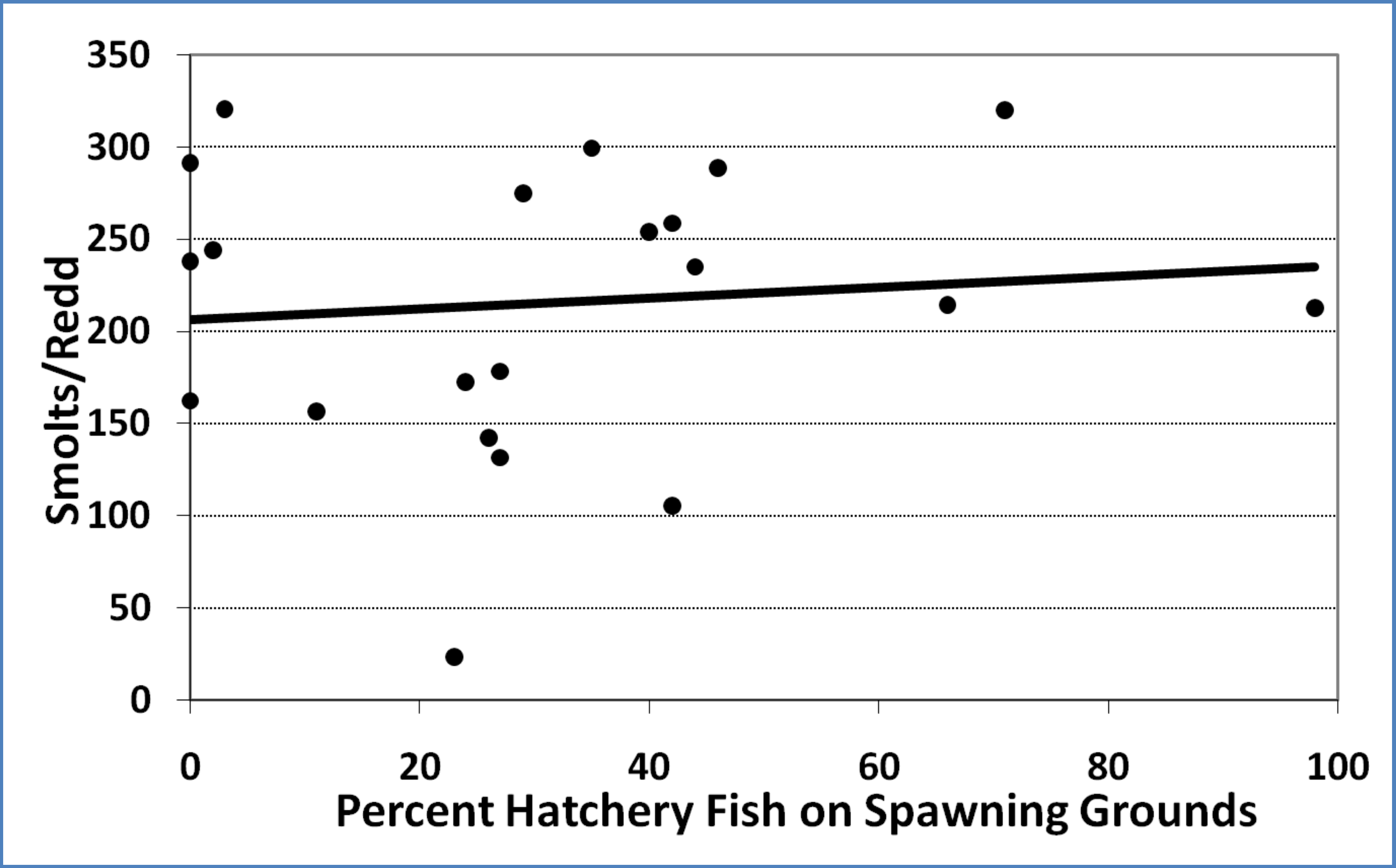
# Smolts/Redd



350
300
250
200
150
100
50
0
Smolts/Redd
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
Brood Year

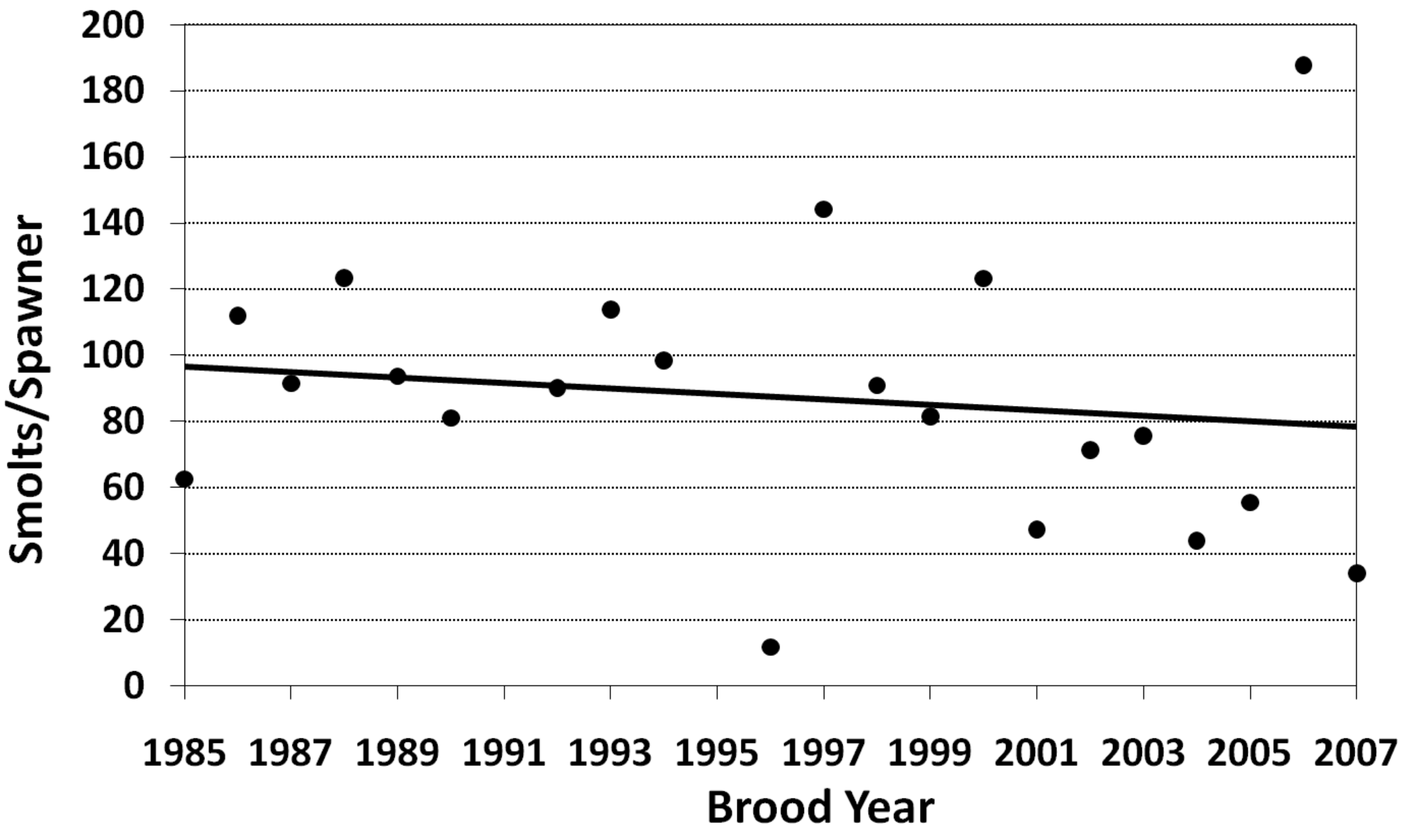
**Hatchery origin fish are less fecund with fewer older, larger fish – could this be the reason for the lower smolts/redd?**

# Smolts/Redd

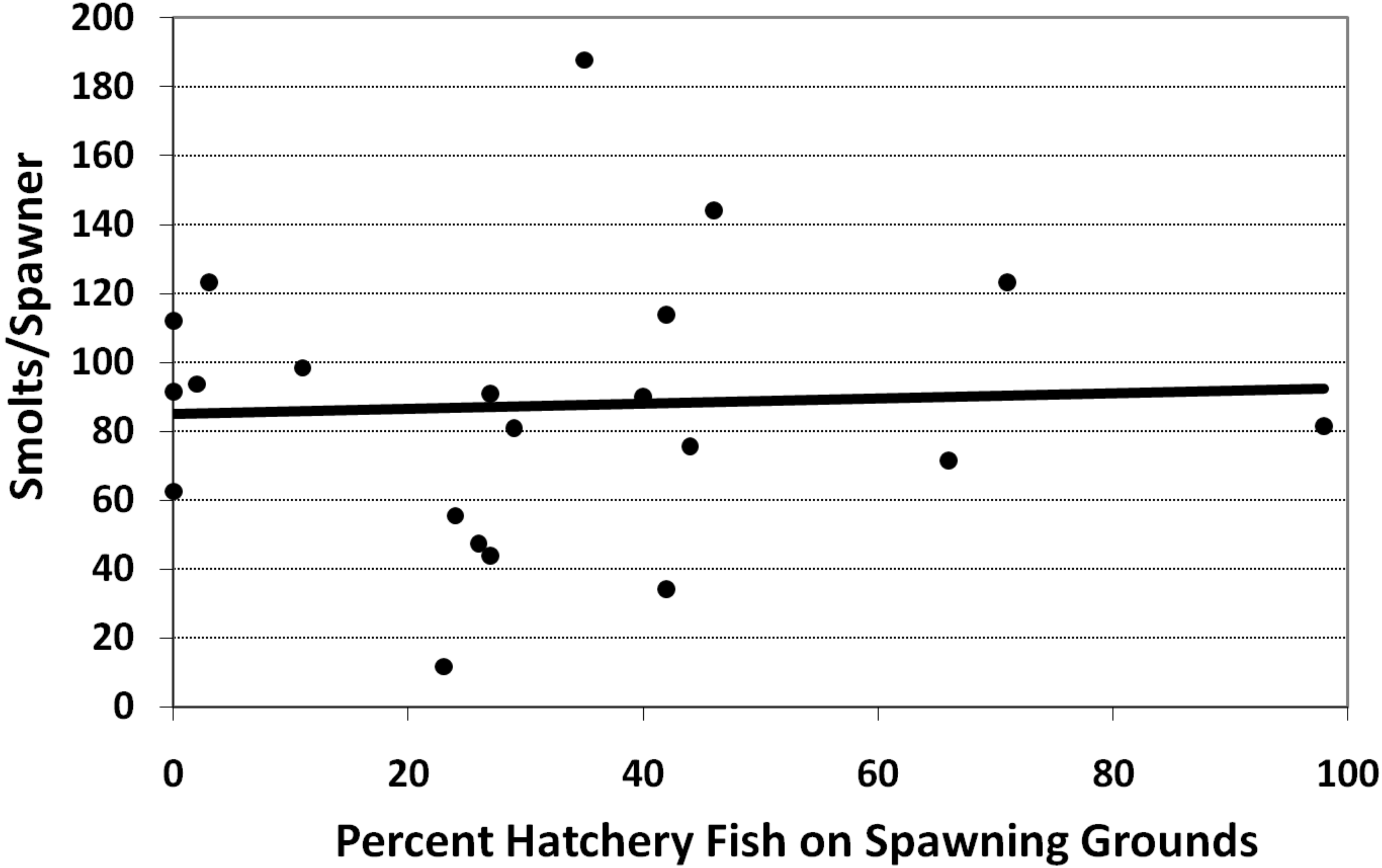


350
300
250
200
150
100
50
0
Smolts/Redd
0
20
40
60
80
100
Percent Hatchery Fish on Spawning Grounds

# Smolts/Spawner

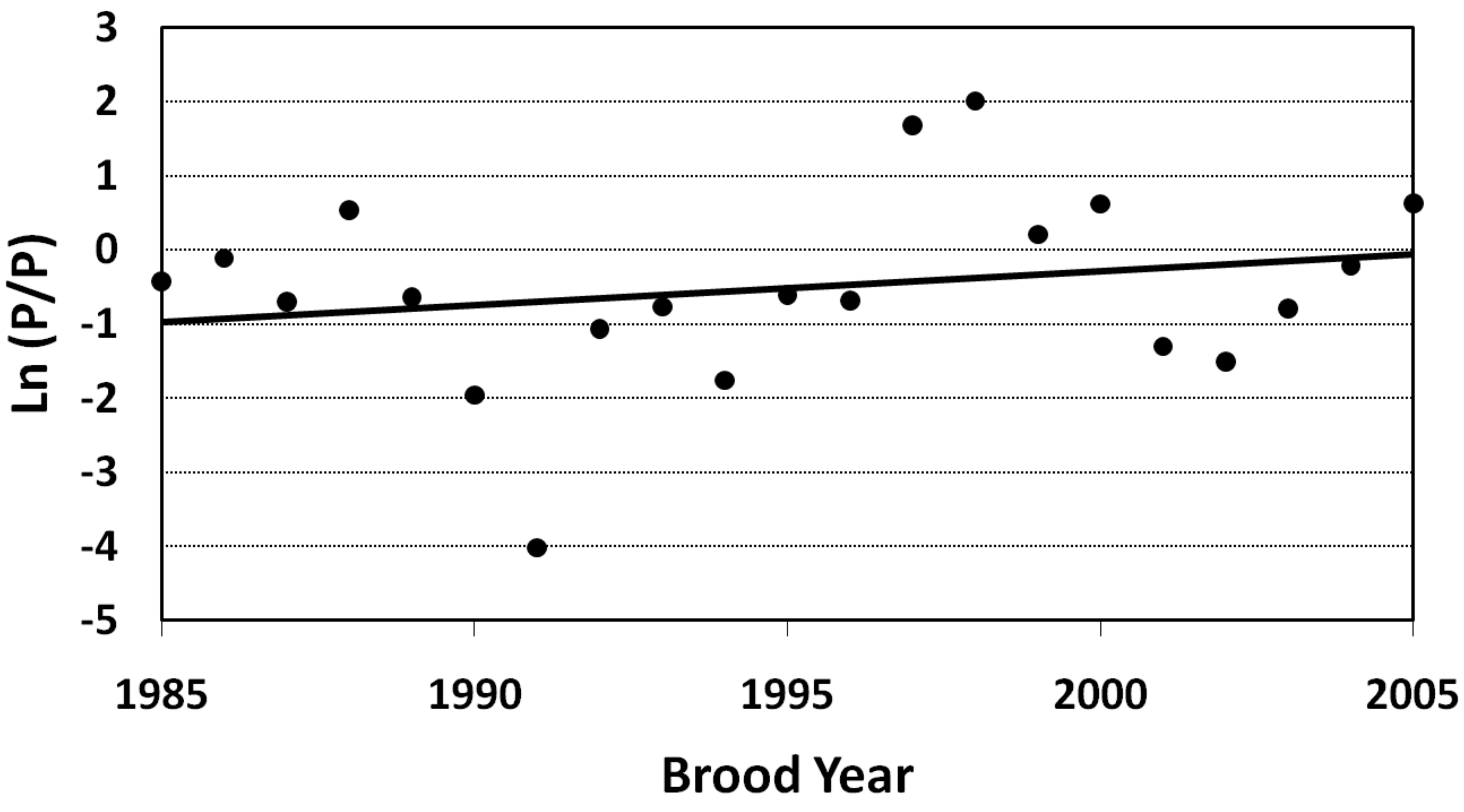


# Smolts/Spawner

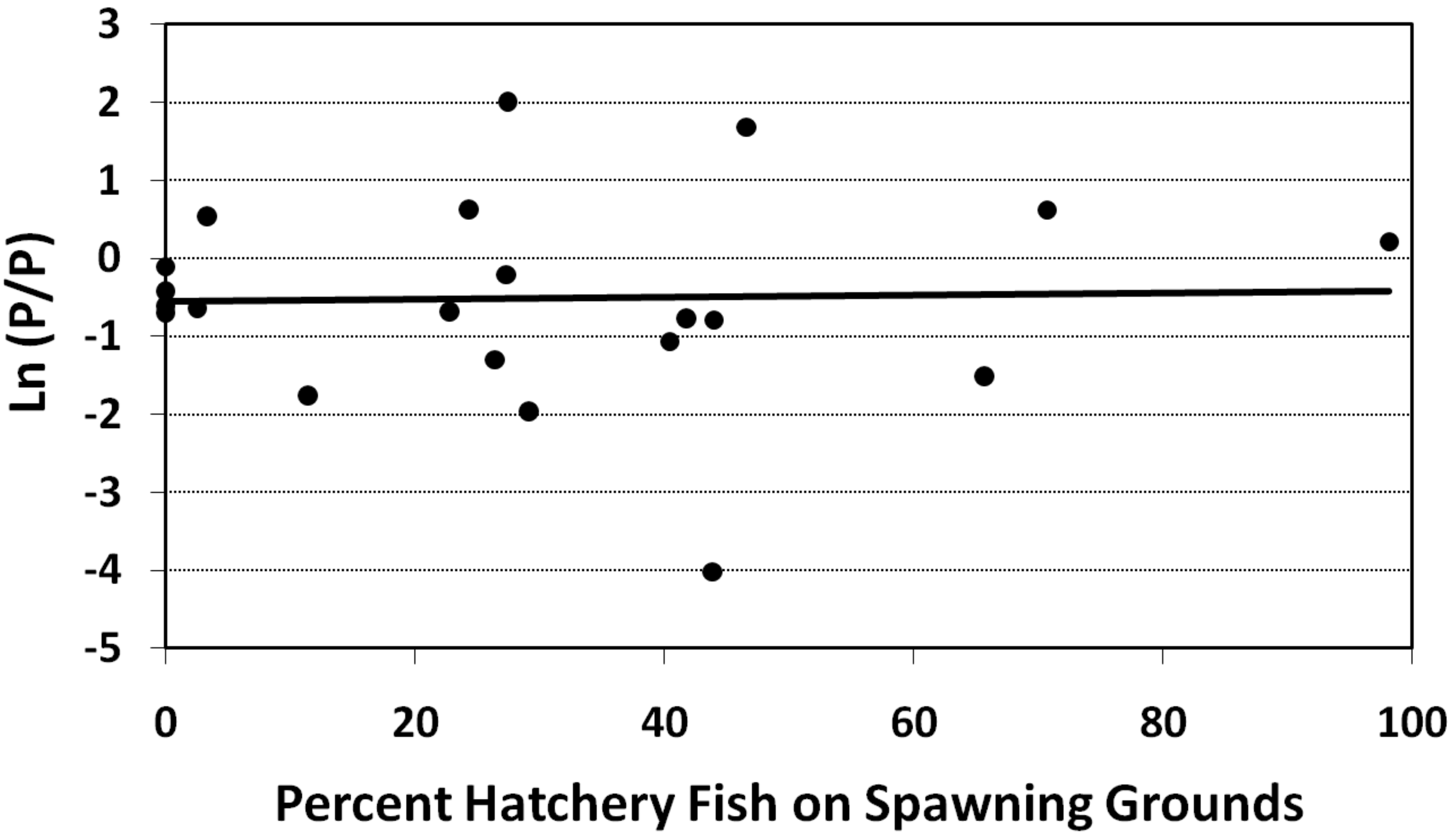


# In-River Progeny/Parent Ratio (Adult)

## (Now is the time to remember N smolt Production)



# In-River Progeny/Parent Ratio (Adult)

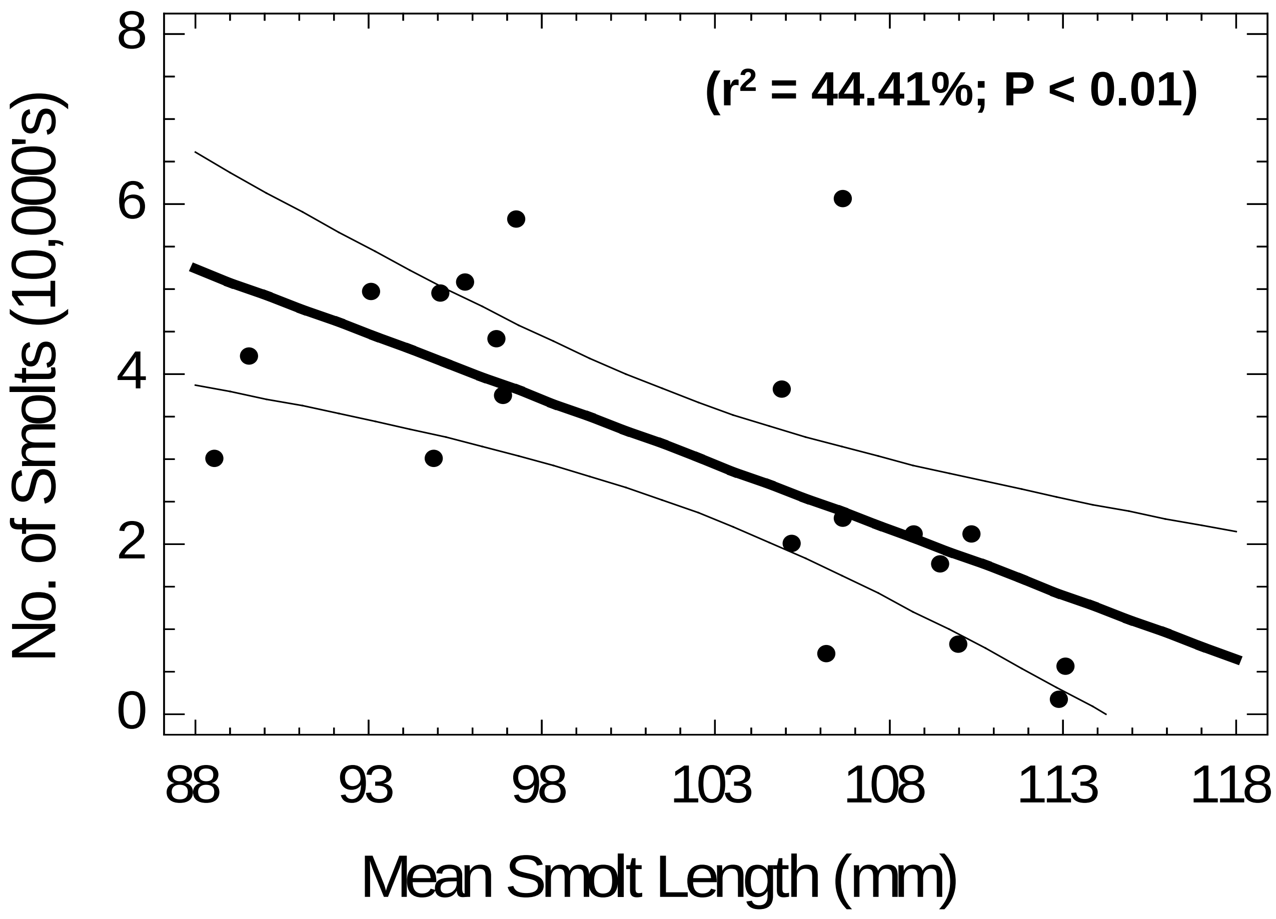


**Why aren’t our natural fish replacing themselves? This would appear to be the most pressing question.**

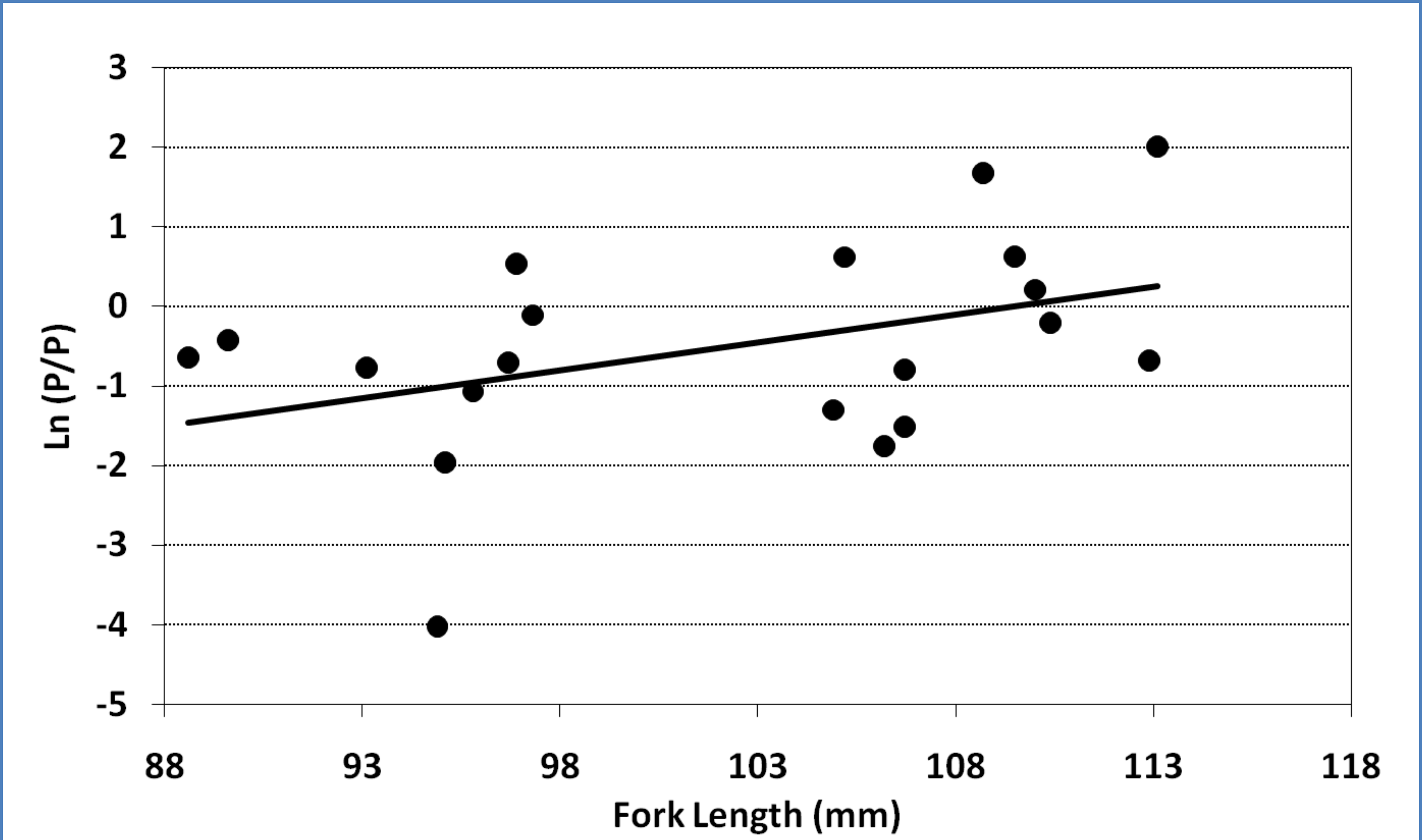
**How come years with large runs didn’t produce big returns?**

**Did you notice that when the trend of smolts/redd and smolts/spawner went down the progeny/parent ratio trend went up? (Suggesting density issues.)**

# Number of Smolts vs. Fork Length



# In-River Progeny/Parent Ratio (Adult)




# Good Luck!!

# Summary

- The assumptions made at the beginning of the mitigation program have not been realized and the program has failed to meet expected returns to the Lower Snake area.

- - Not meeting hatchery adult return goal.
- - Not meeting natural return goal.
- - Average progeny to parent ratio of in-river spawners is below replacement. (Hence – ESA listing).

# Summary (cont.)

- We continue to pursue hatchery production methods to maximize hatchery fish survival in order to reach the mitigation goal.

- More research is needed to identify the underlying reasons for the failure of the natural population to replace itself and correct them if possible. (We need a good reference population!)