



*Effects of Domestication on Hatchery  
and Wild Spring Chinook Phenotypic and  
Demographic Traits:  
What Have We Observed So Far?*

**Curtis M. Knudsen<sup>1</sup>, Steve L. Schroder<sup>2</sup>,  
Mark V. Johnston<sup>3</sup>, Todd N. Pearsons<sup>2</sup>,  
C. A. Busack<sup>2</sup>, William J. Bosch<sup>3</sup>, and David E. Fast<sup>3</sup>**

<sup>1</sup> Oncorh Consulting

<sup>2</sup> Washington Department of Fish and Wildlife

<sup>3</sup> Yakama Nation

# Purpose:

- Overview of what we've observed in terms of domestication's effects on demographic and phenotypic traits
  - Size at age
  - Spawn timing
  - Jack production
  - Gametic traits





≠



## **The YKFP spring chinook hatchery program was designed to minimize domestication effects.**

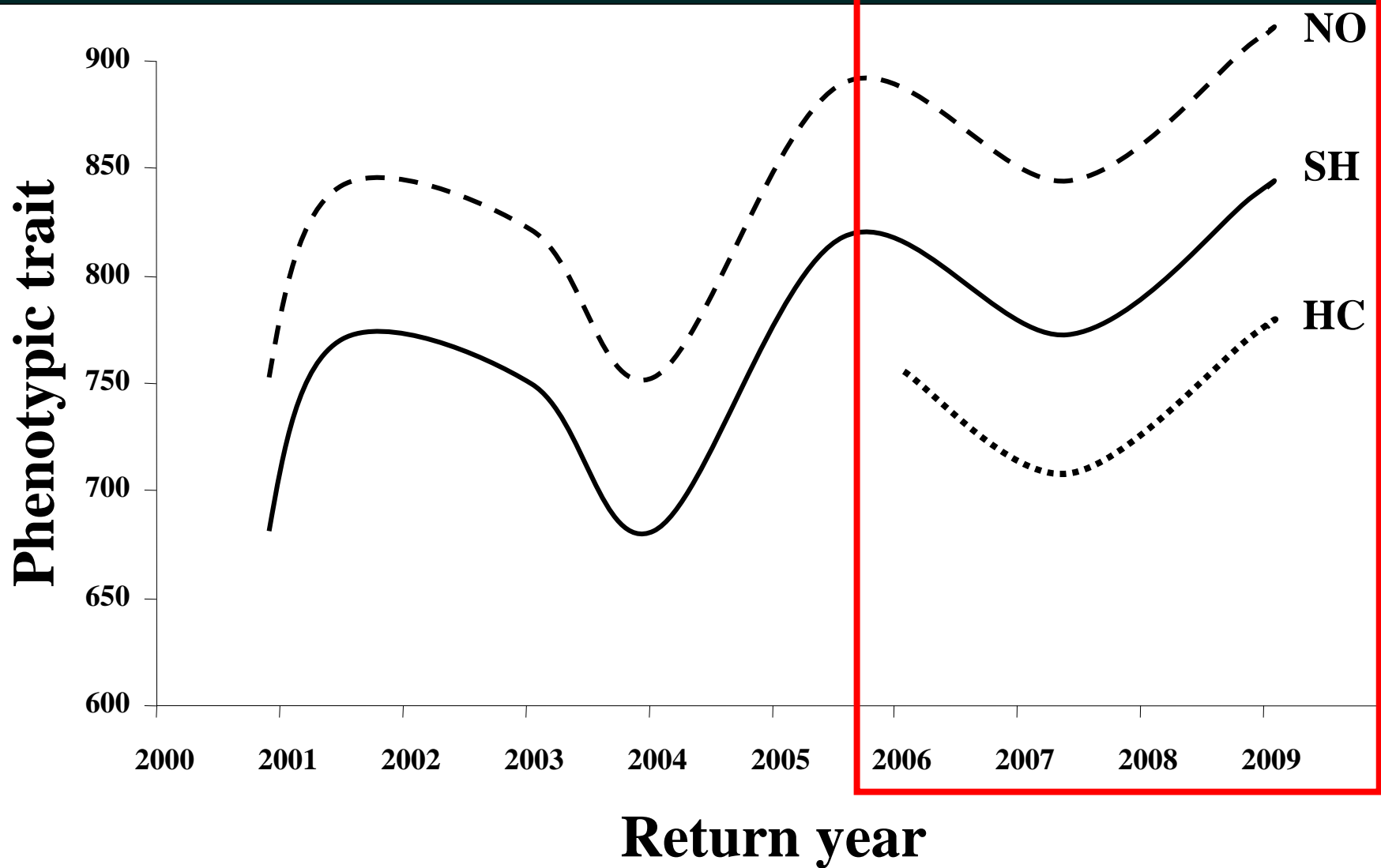
- **use only wild-origin broodstock**
- **limit the size of the program so as not to overwhelm the naturally spawning population (mean 52%; 20-76%)**
- **take no more than 50% of the wild returns into the hatchery**
- **utilize factorial crosses during artificial matings**
- **limit the proportion of jacks in the broodstock**
- **randomly mate individuals**
- **use “best culture practices” such as relatively low rearing densities**
- **volitionally release juveniles at sizes larger than, but comparable to, wild-origin smolts**



# Hatchery Control vs SH Comparisons

- Both share common hatchery and post-release environments
- SH returns experienced one generation of hatchery selection
- HC returns experienced two generations of hatchery selection (BY2002 to BY2005)
- Differences in their phenotypic traits should be expressions of genetic differences due to the one additional generation of hatchery selection experienced by the HC line

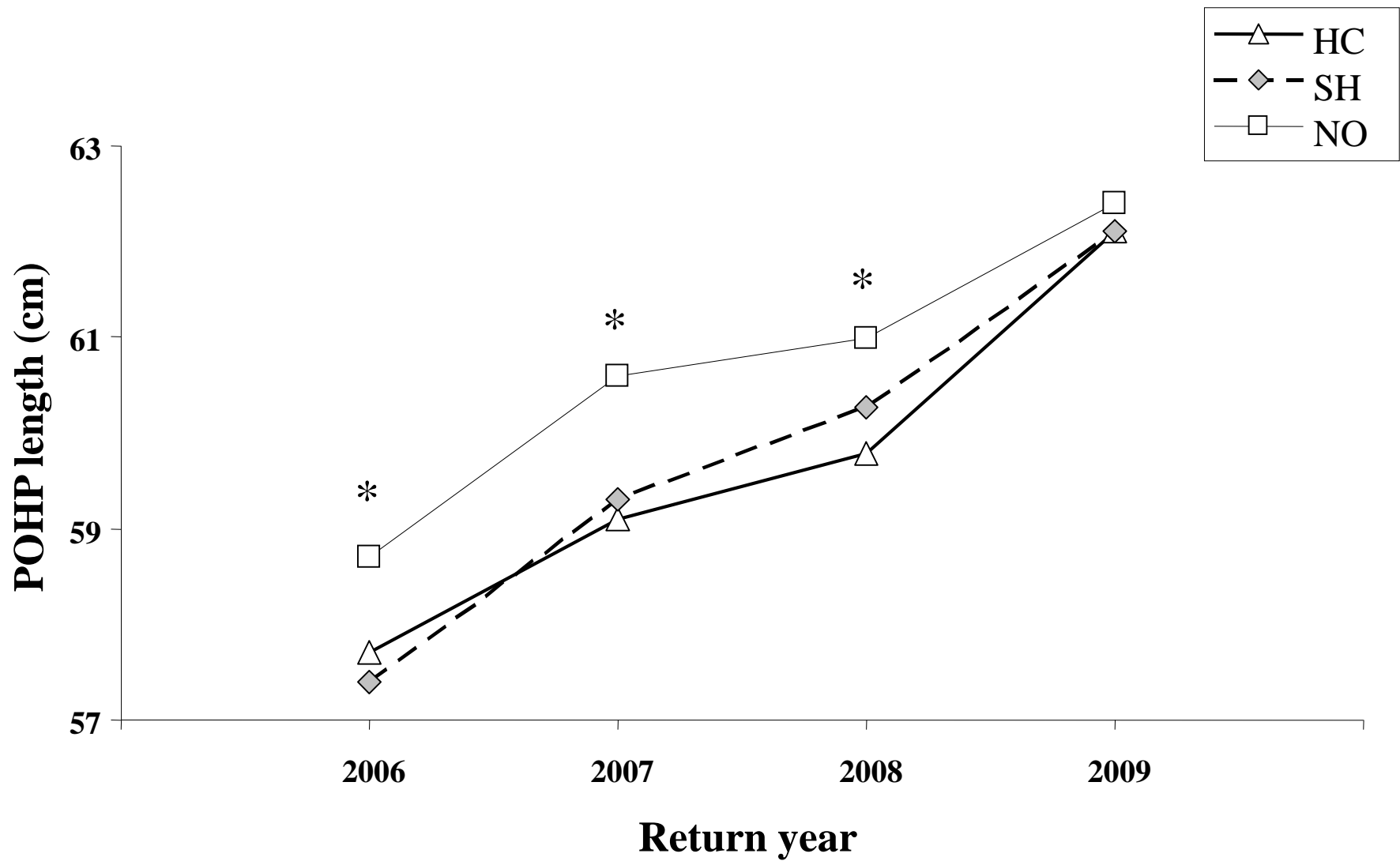
# Hypothetical Trends



# Size-at-Age (reflecting growth rates)

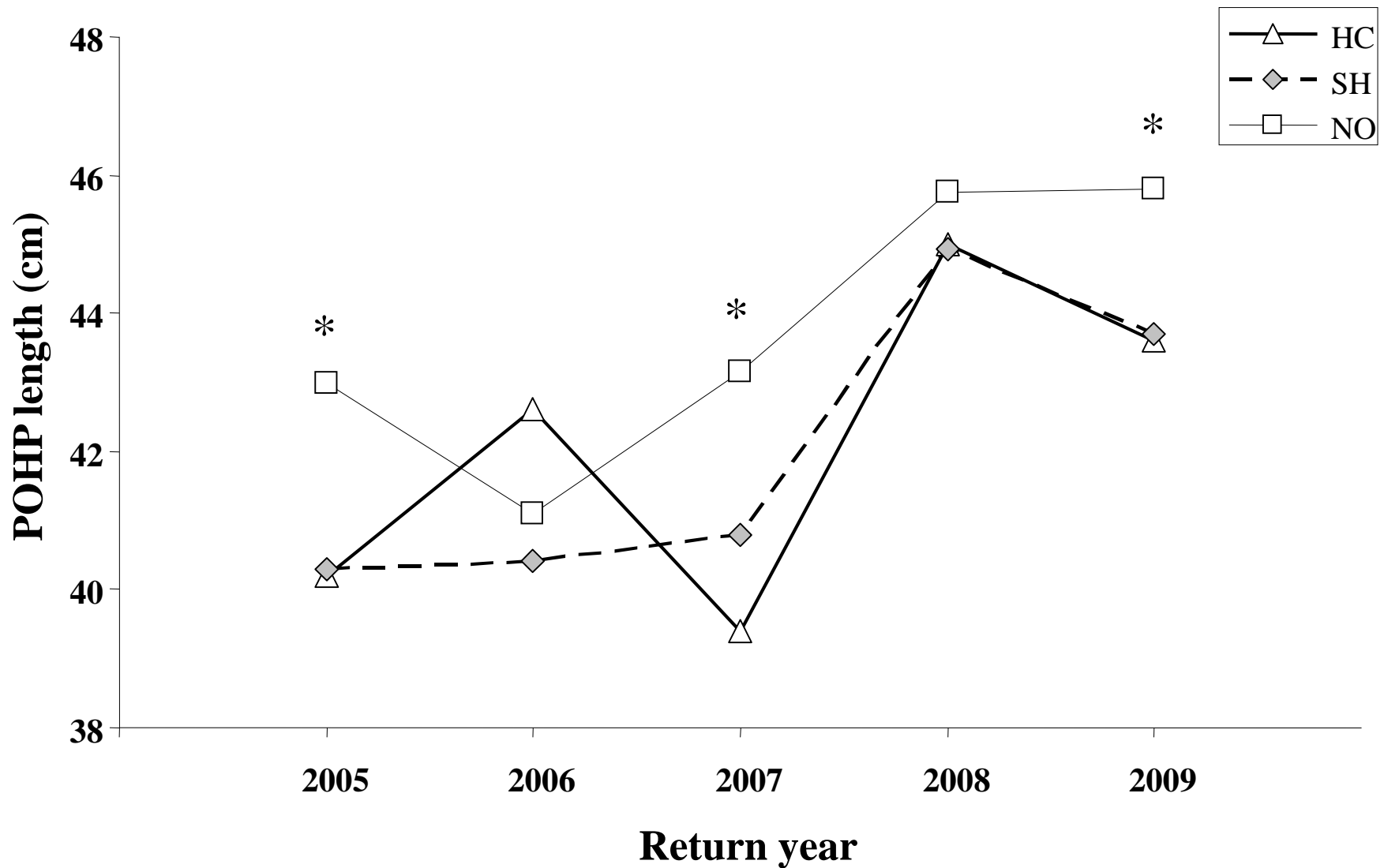


# Age 4 POHP length

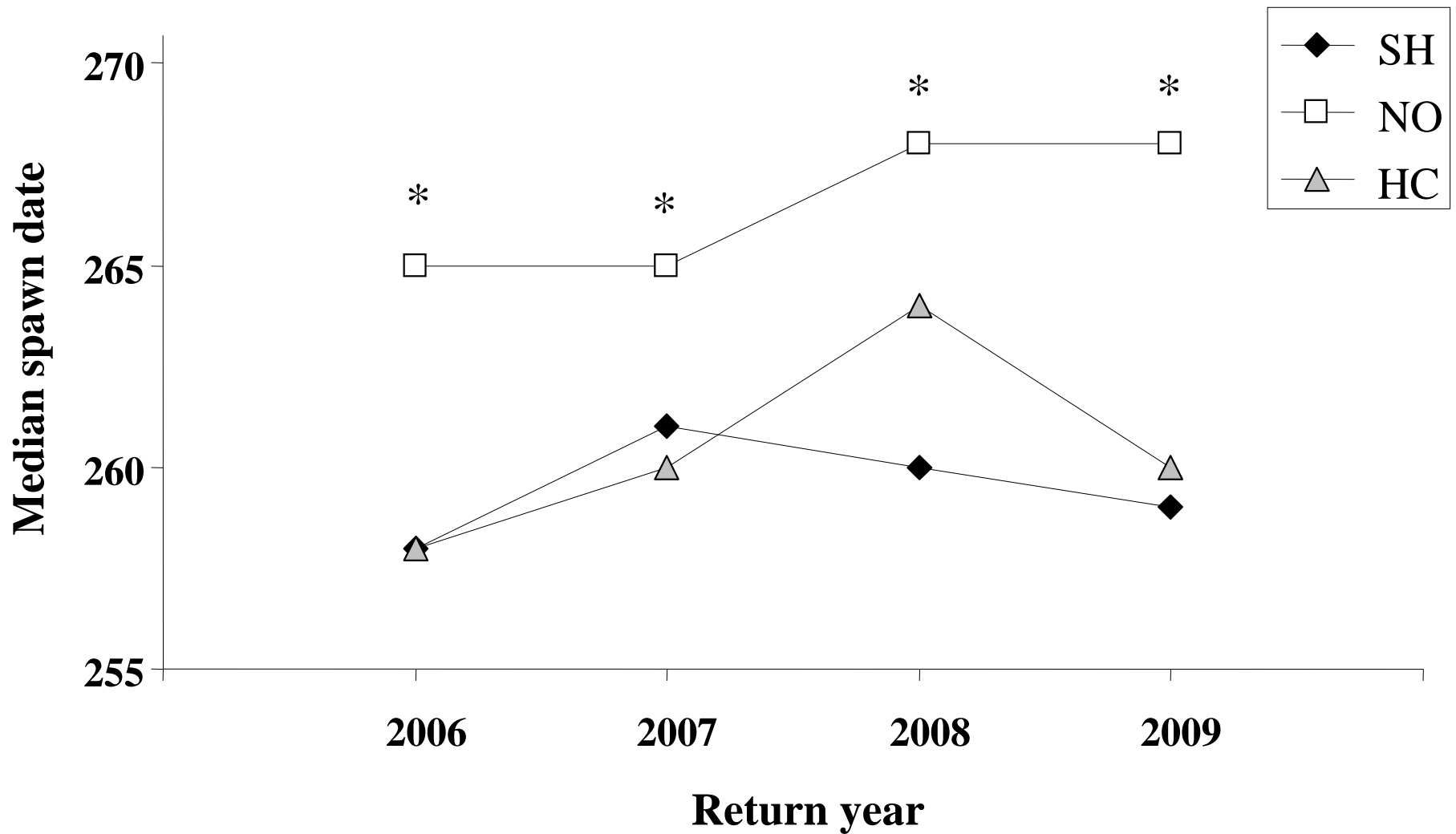




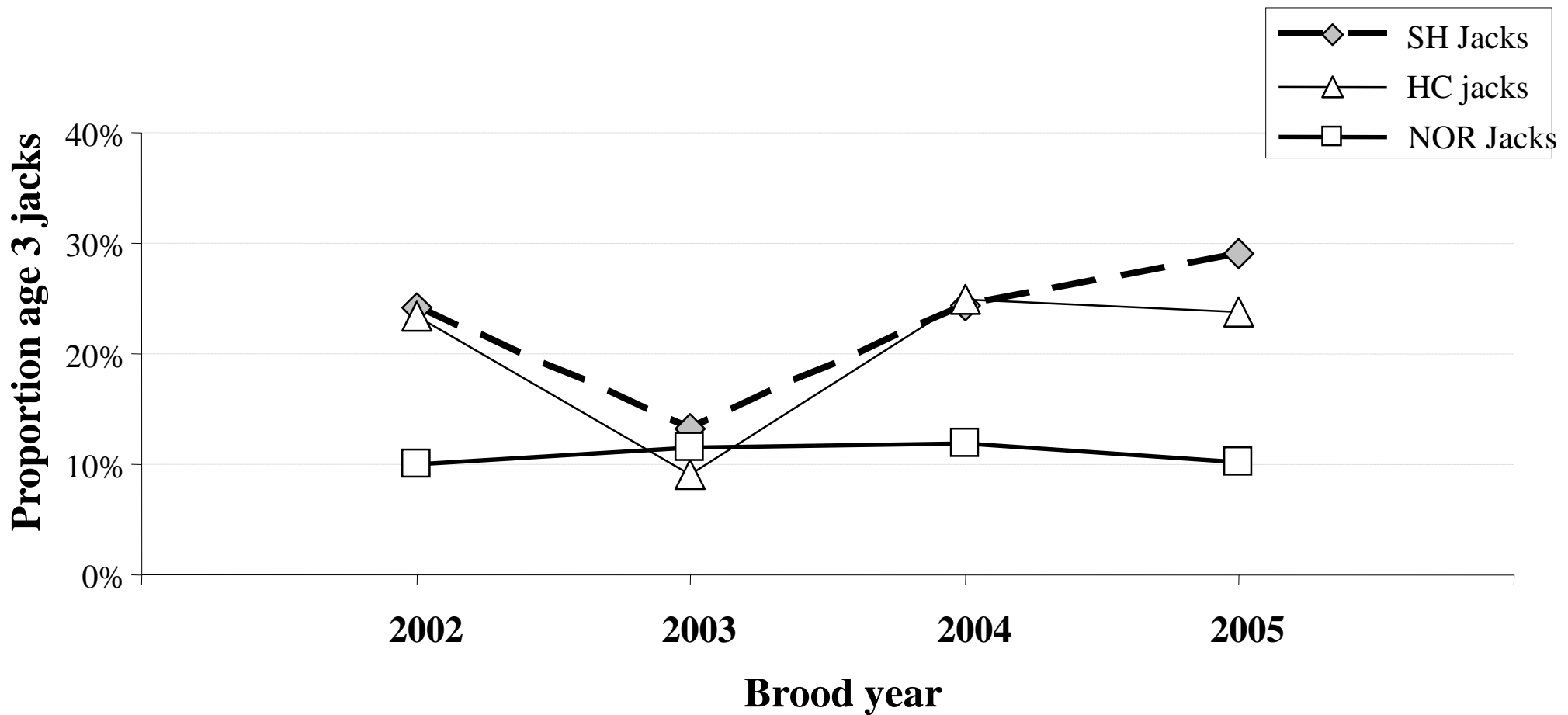
# Age 3 POHP length



# Median Spawning Date CESRF



# Proportion Jacks Produced by Broodyear





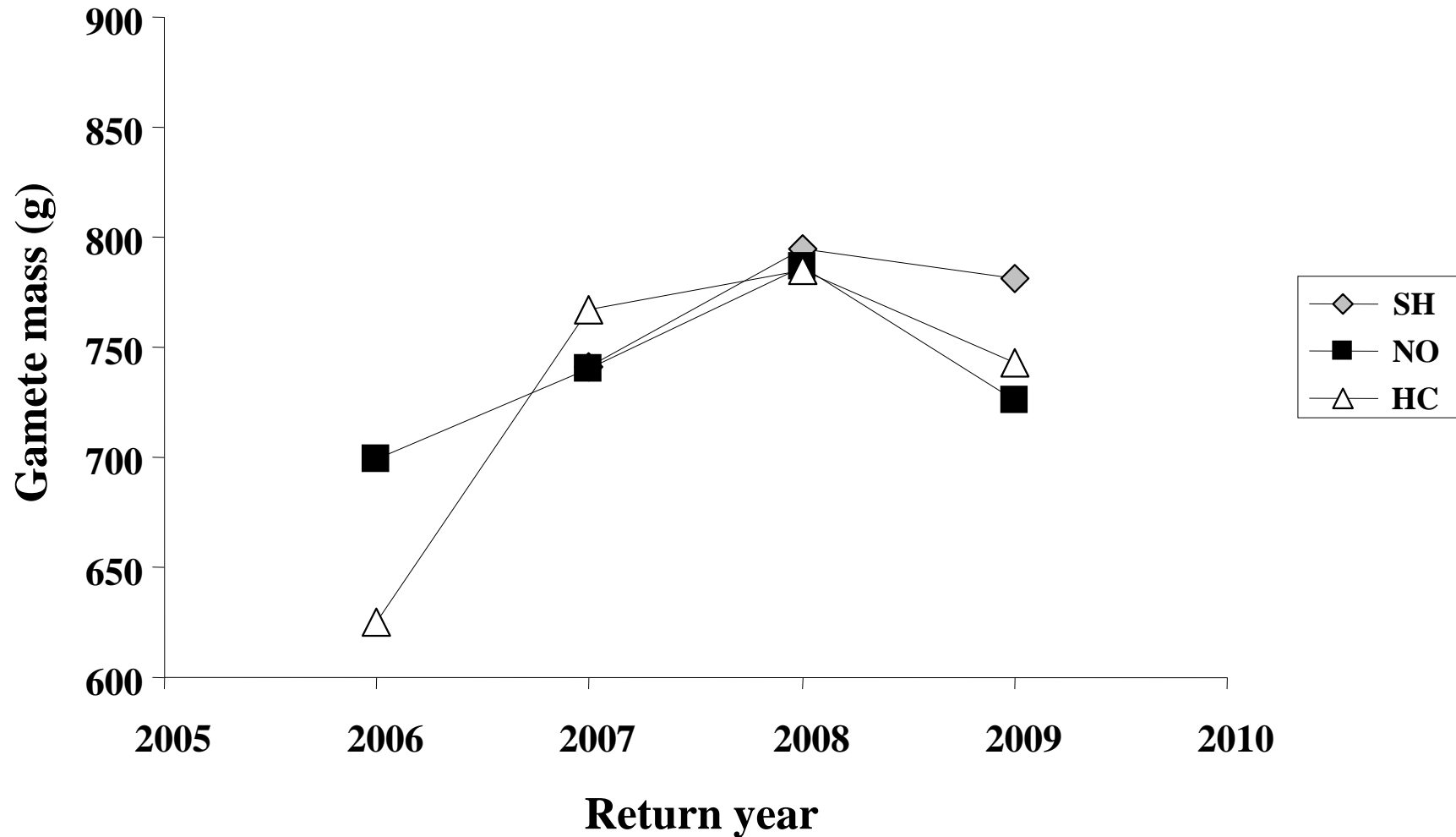
# Gametes



# Gonadosomatic Index

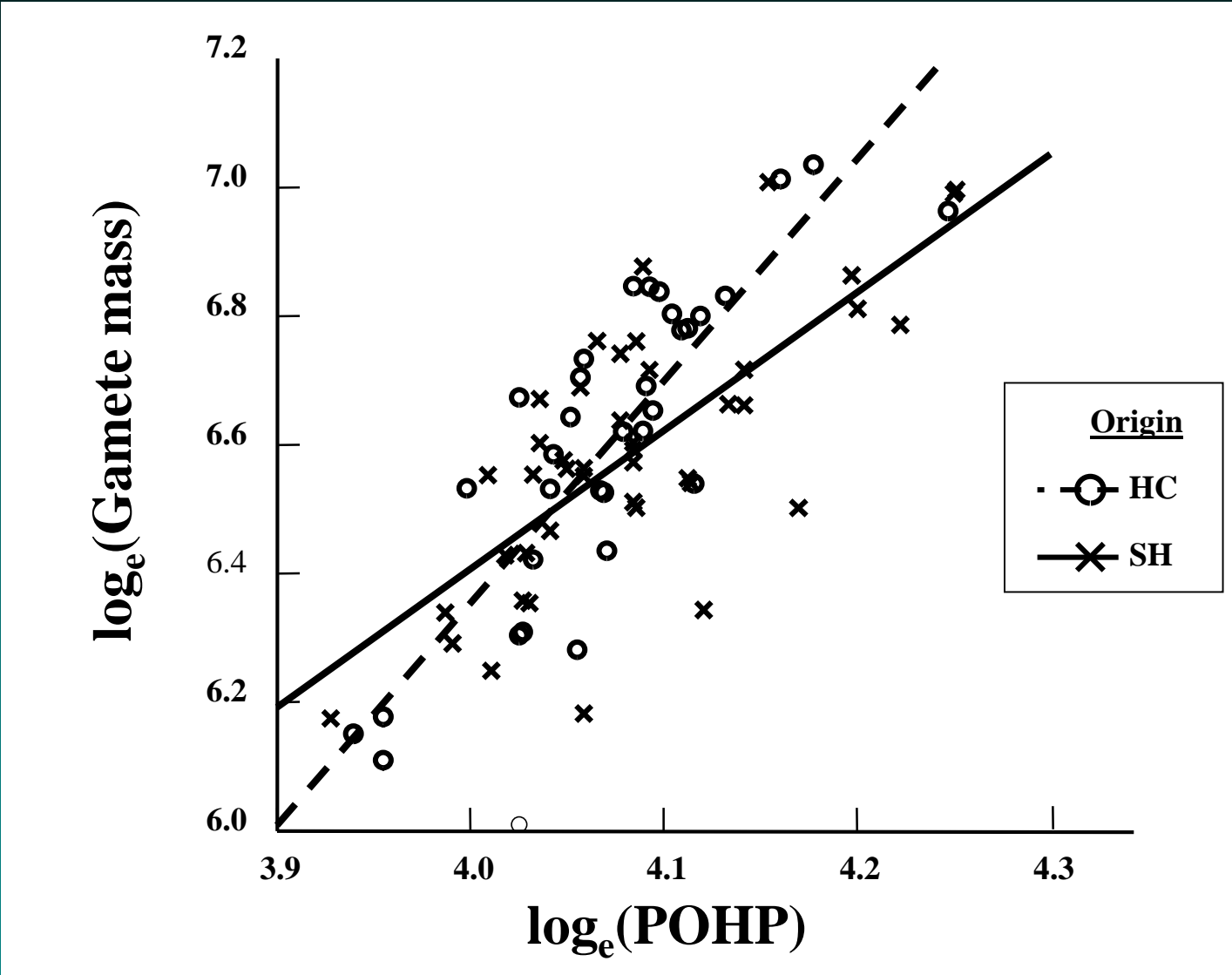


# Total Female Gamete Mass

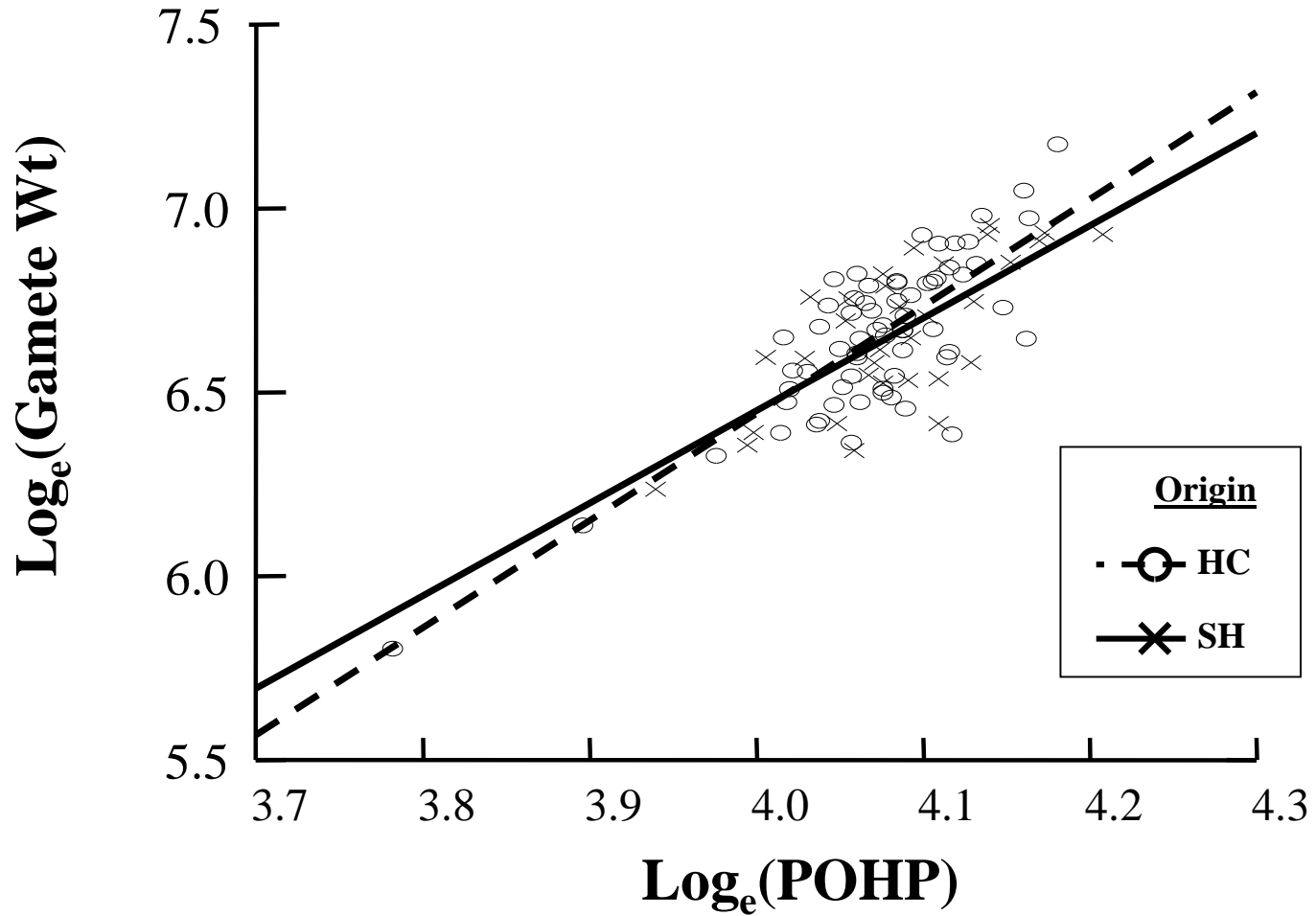




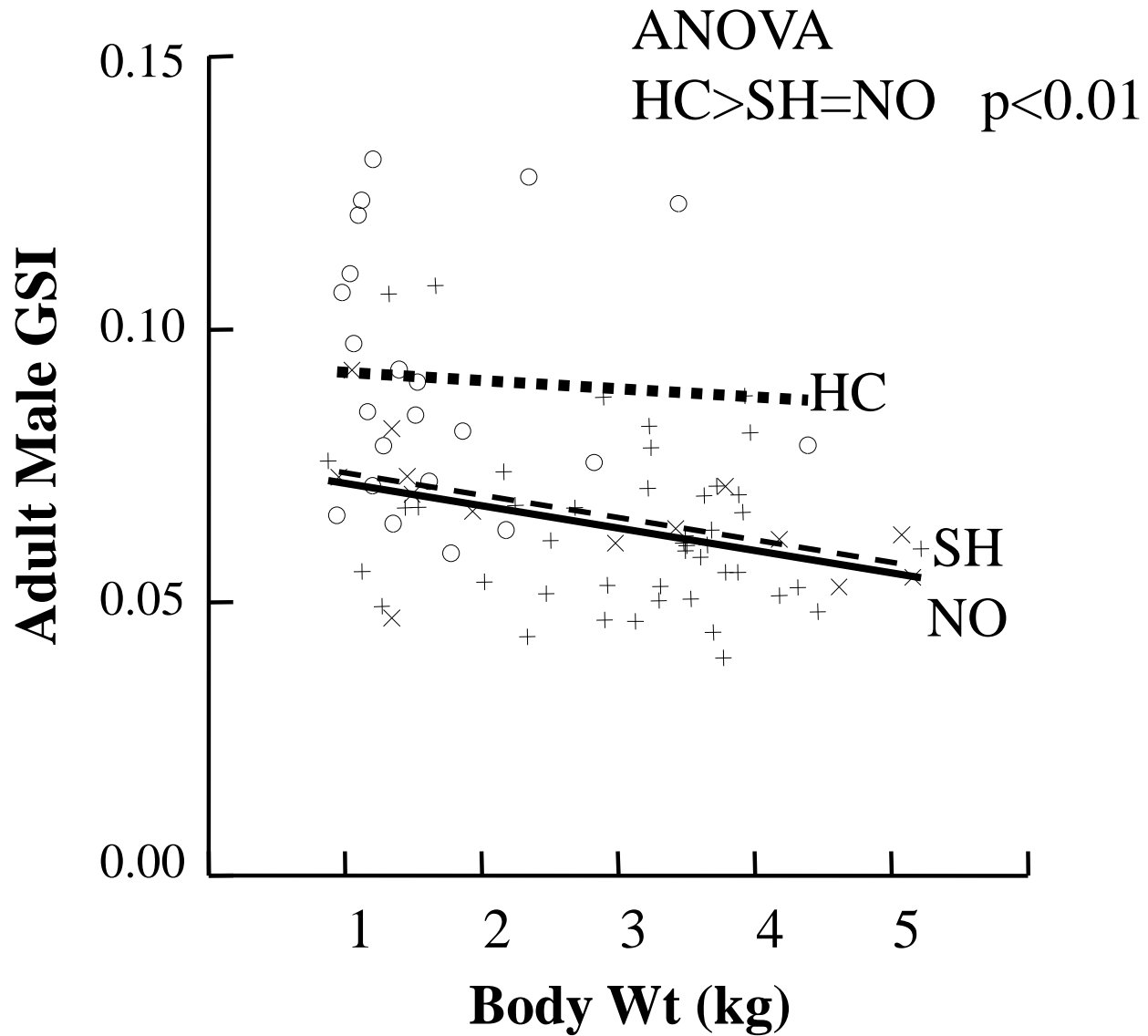
# 2007 ANCOVA: Equal slopes p=0.014



# 2008 ANCOVA: Equal slopes $p=0.442$

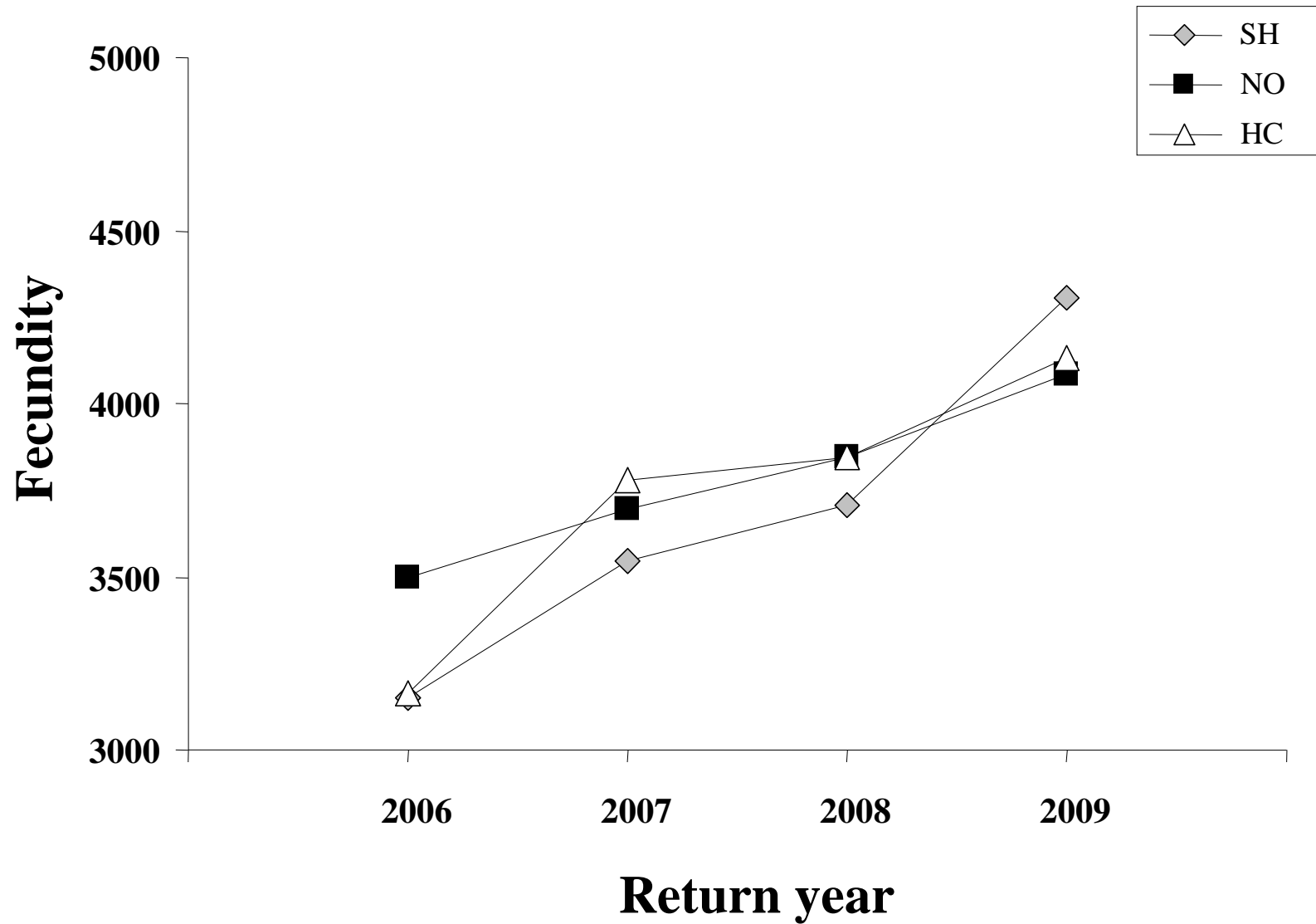


# 2009 Adult Male Gonadosomatic Index

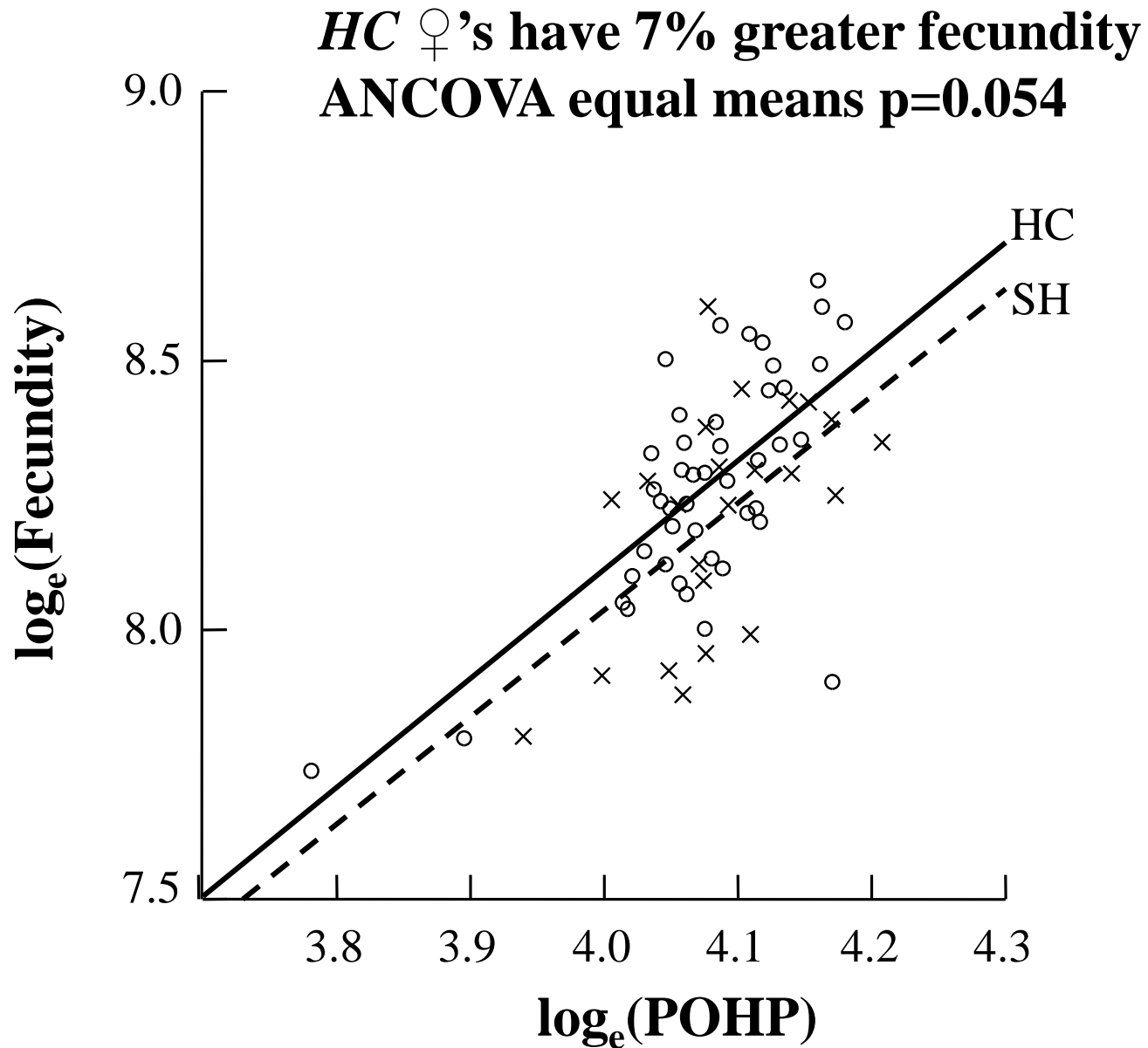




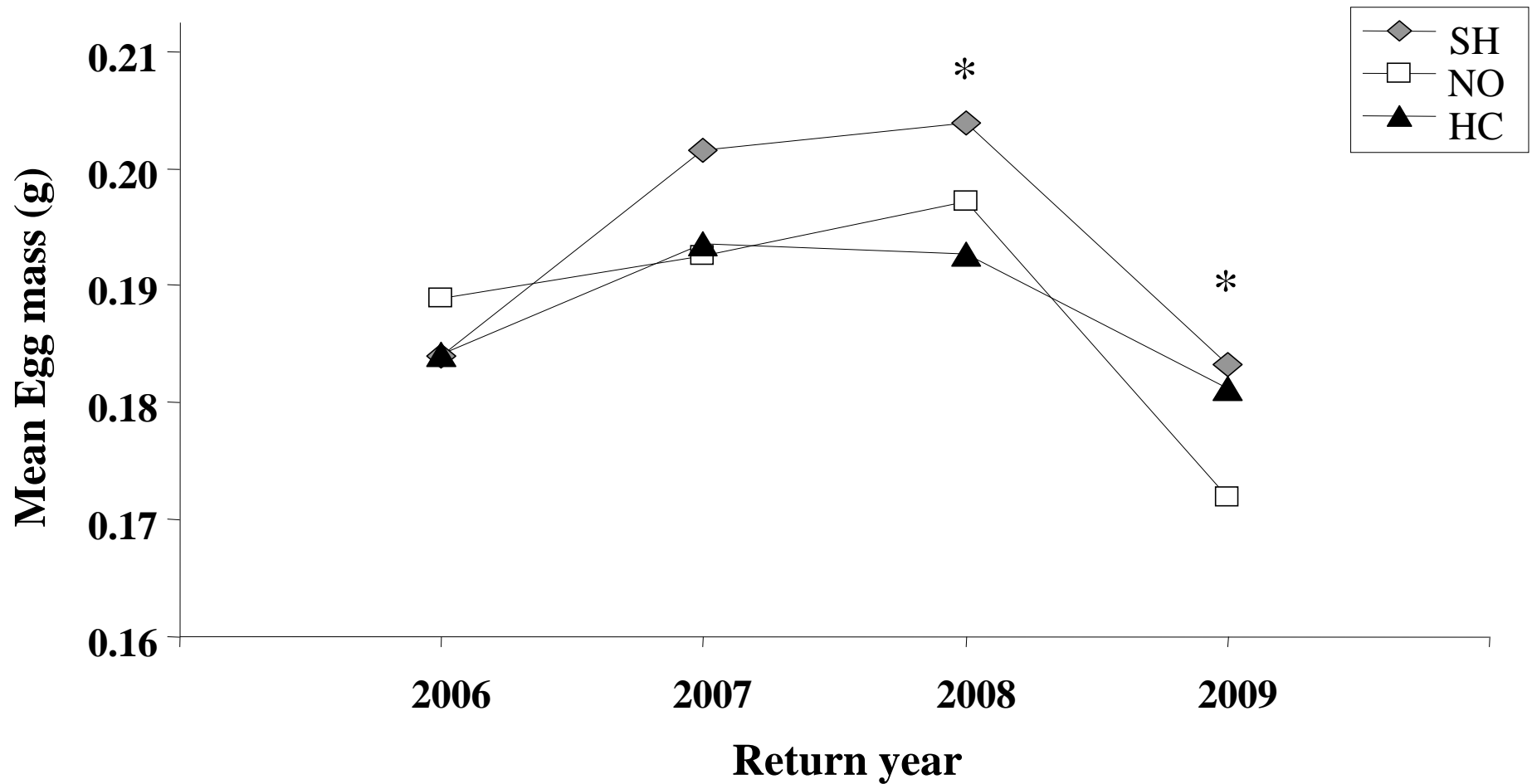
# Fecundity



# Fecundity vs POHP length 2008



# Mean Egg Mass

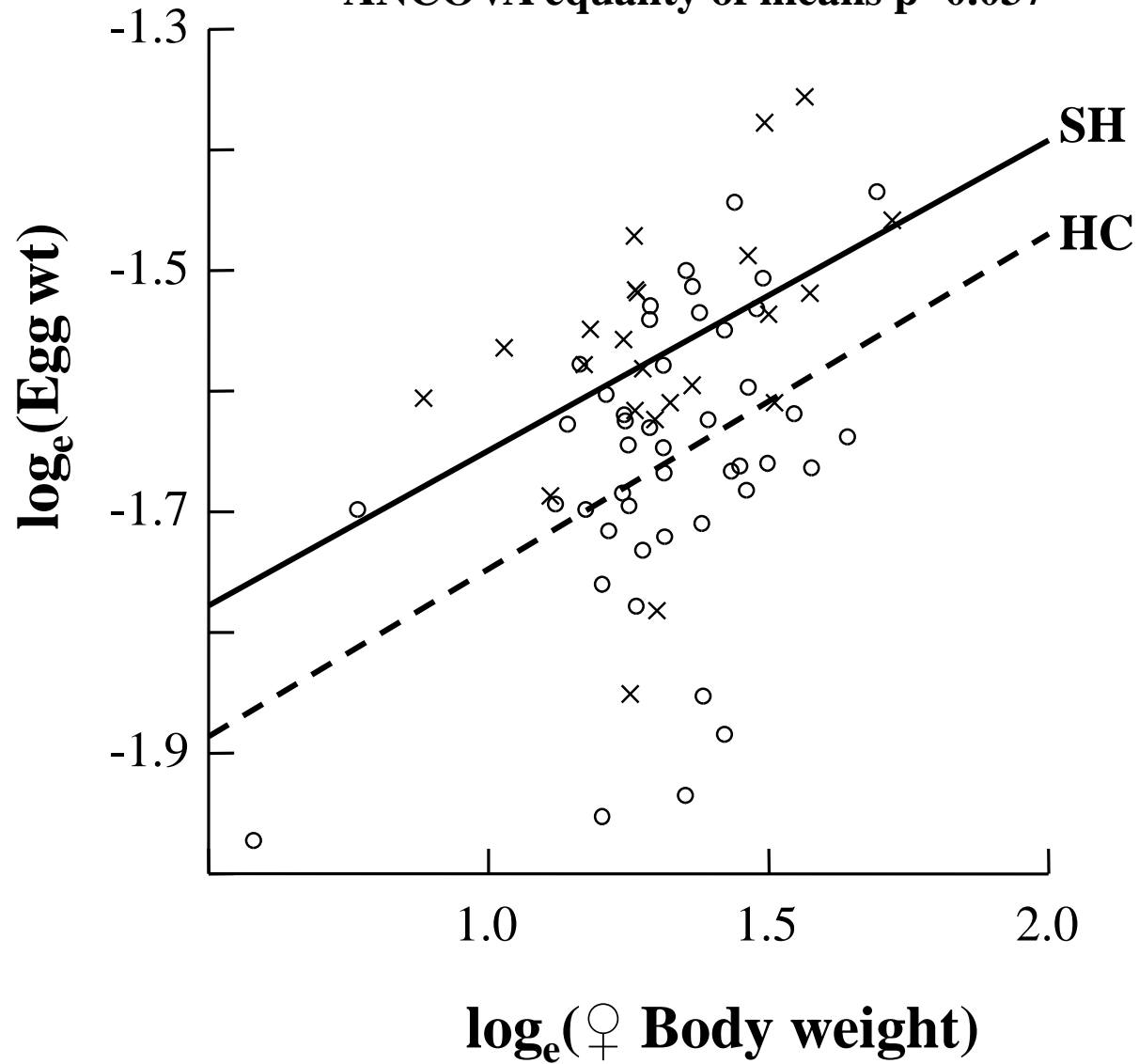




**2008 Results:**

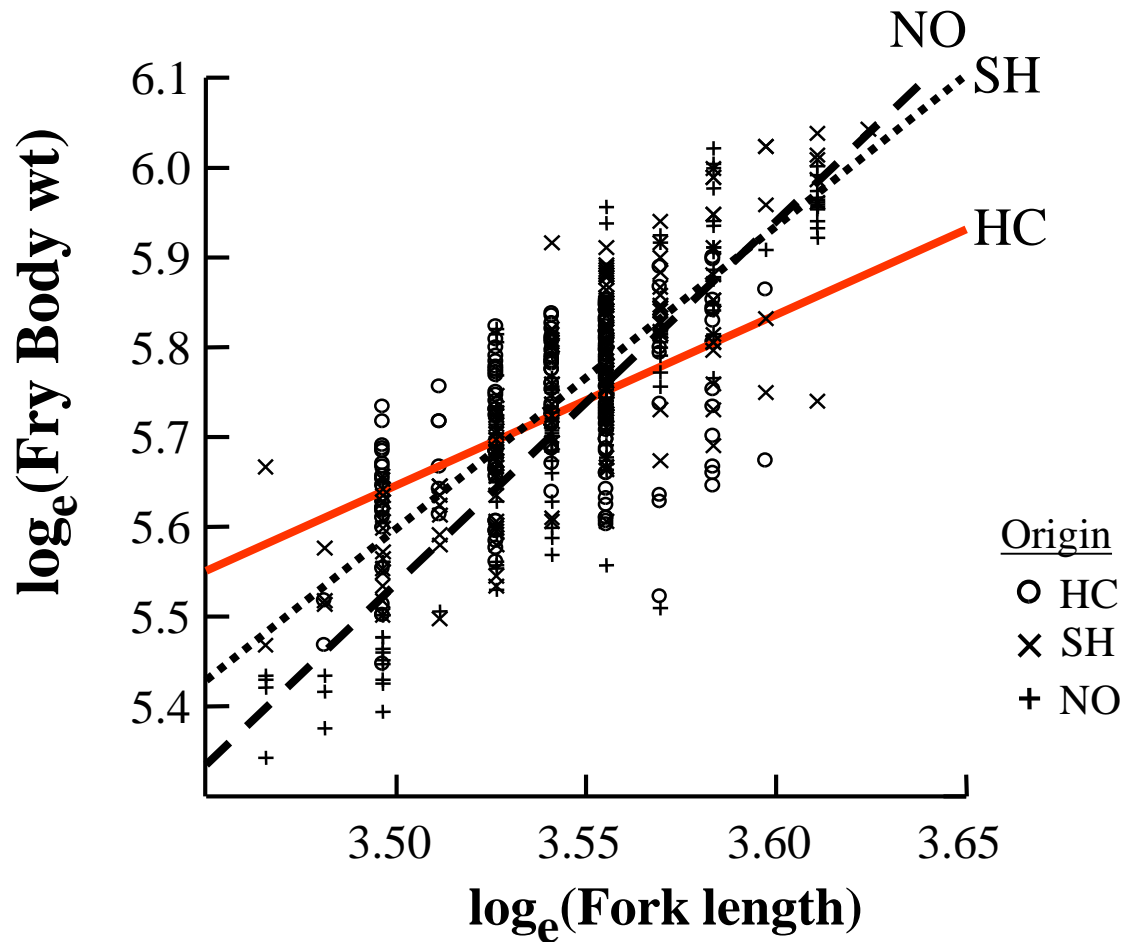
***SH* eggs are 9% larger than *HC* eggs**

**ANCOVA equality of means  $p=0.037$**

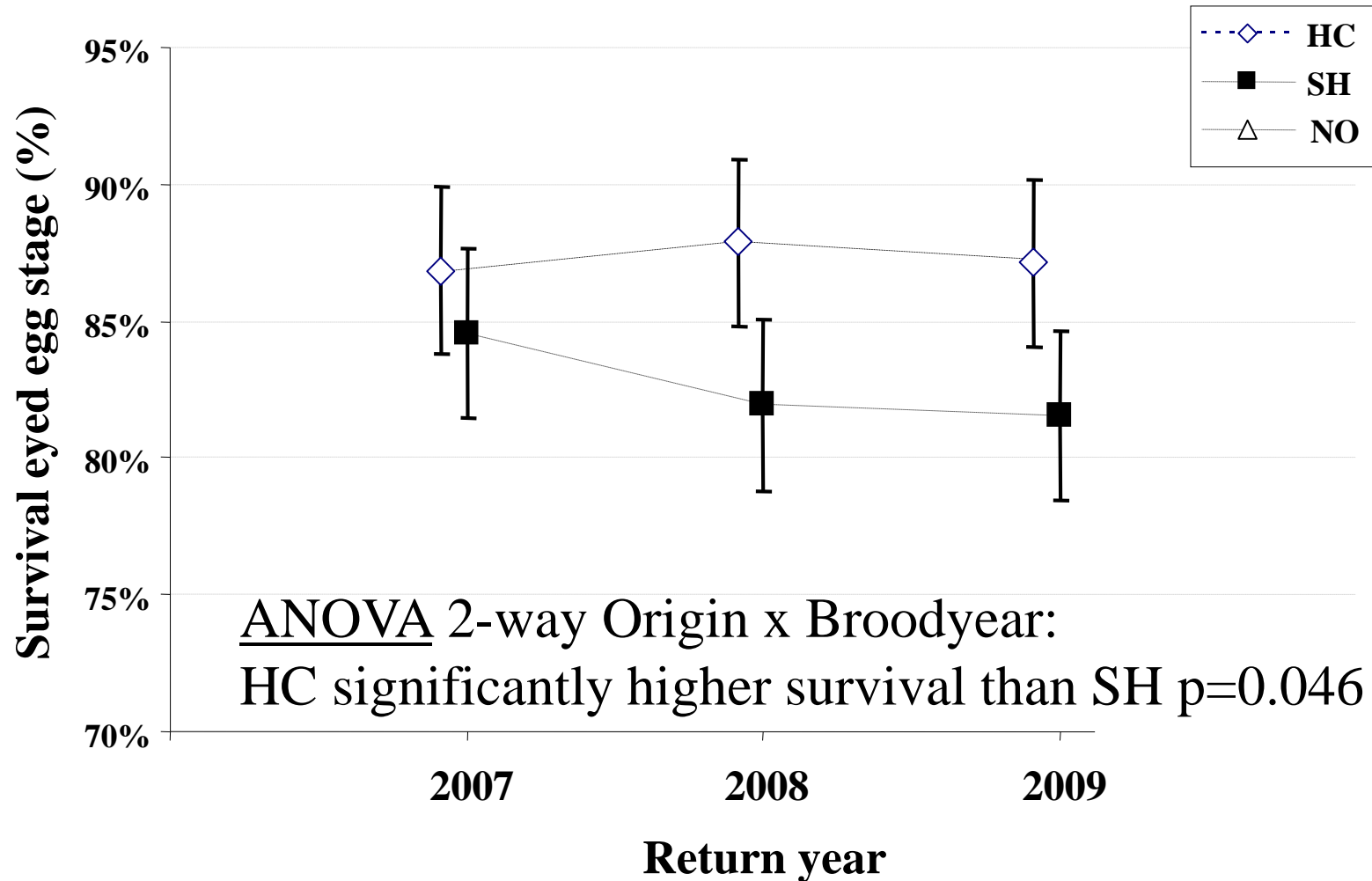


# Fry Length at ponding BY08

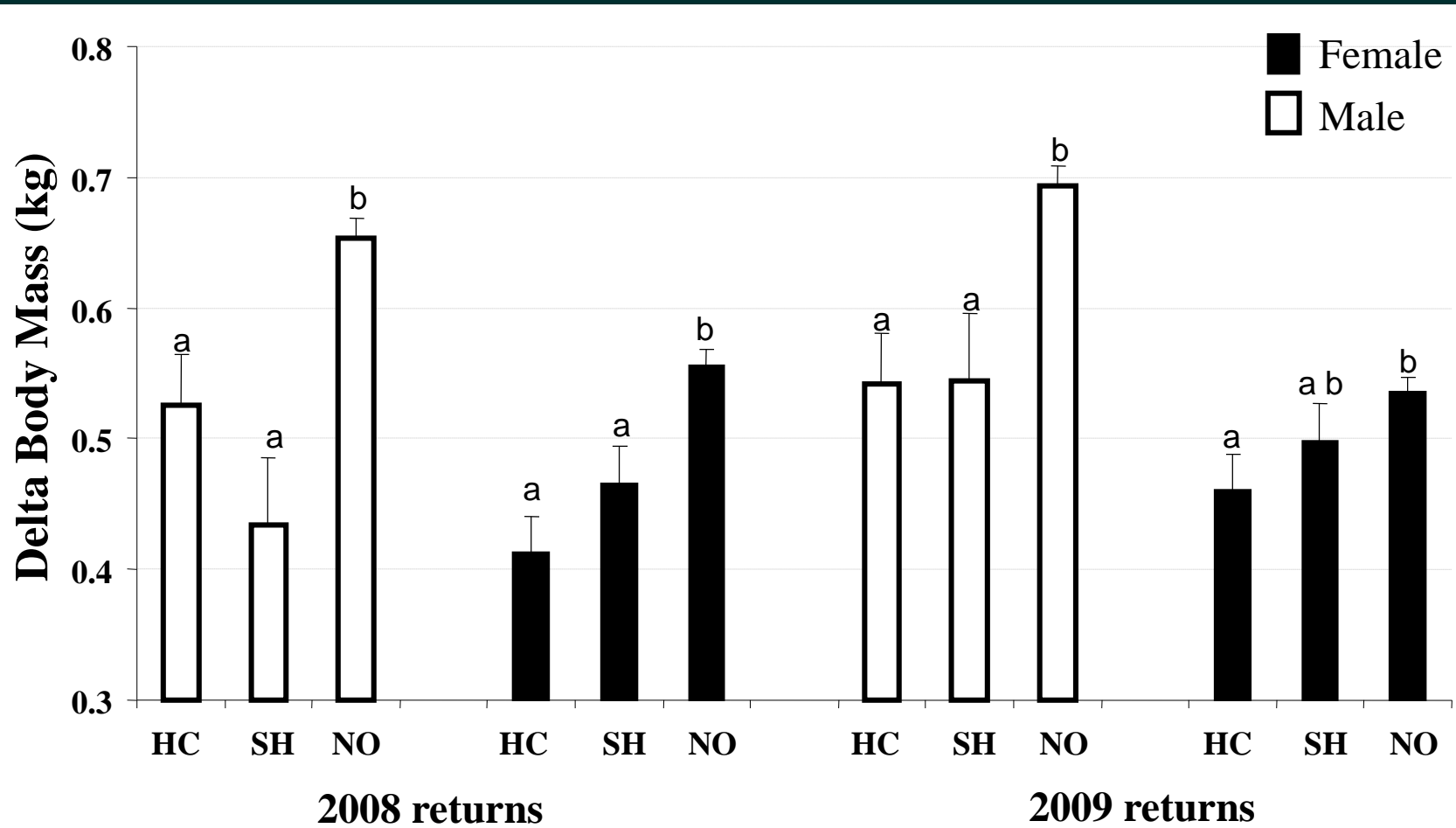
ANCOVA equal slopes  $p < 0.001$



# Mean Survival to Eyed-egg Stage ( $\pm 1$ se)



# Change in Body Wt At CESRF Adjusted for Holding Time and Initial Body Weight



# Mini-jack/Precocious Male Production

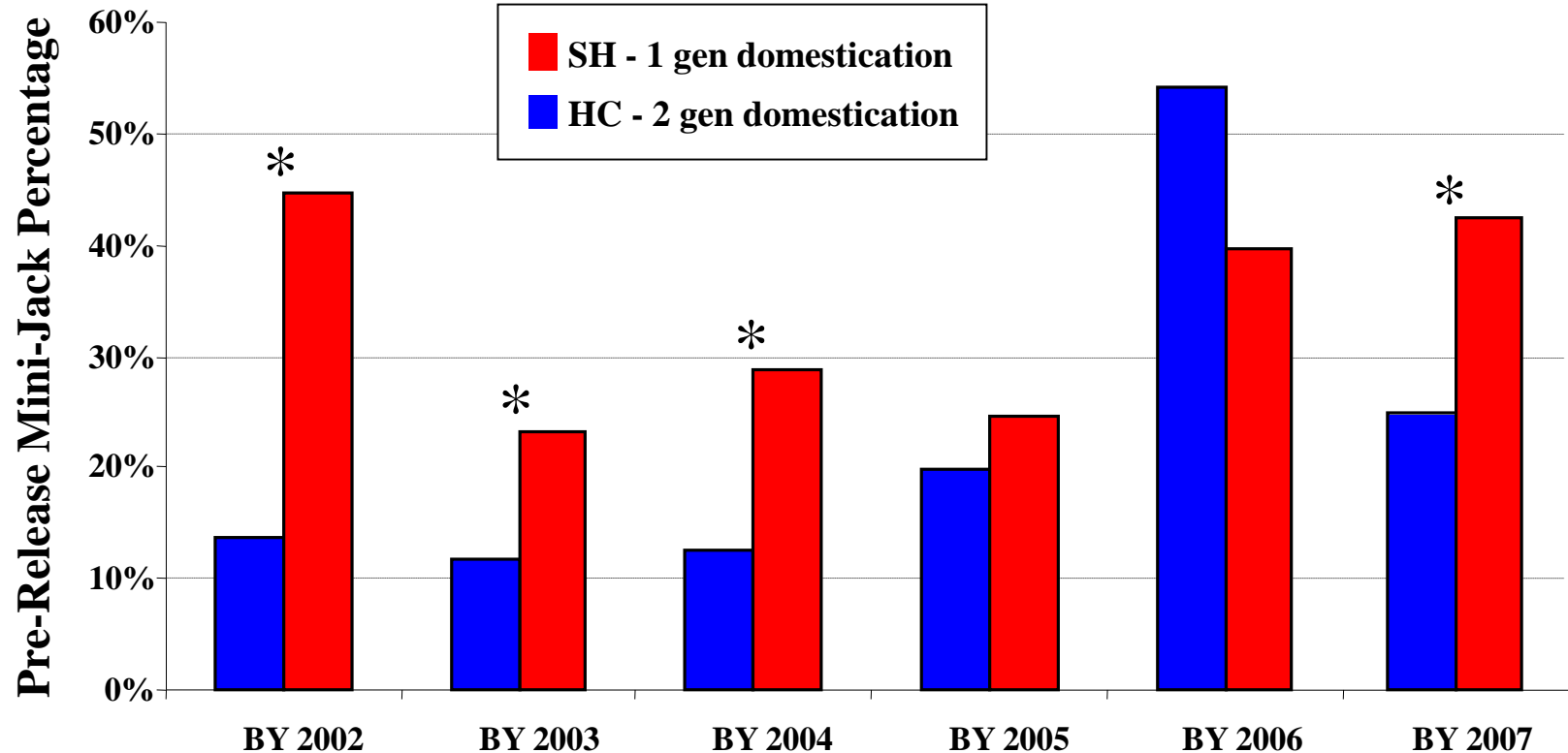


Figure modified from Neeley, D. 2009. HxH vs NxN Comparison Draft Summary for Juvenile Traits.



# Observations Phase 2

- **Age 4 SH and HC fish have increased their growth rates more rapidly over time than NO fish and in 2009 were approximately equal in size to NO fish.**
- **Spawn timing of SH fish at CESRF was significantly earlier than NO fish, HC earlier than NO but too few data points at this time**
- **The more generations of domestication the less body mass lost during holding at CESRF**

# Observations – cont'd

- **In a few return years gametic trait means were significantly affected by an additional generation of domestication**
- **Within certain years gametic traits exhibited significant differences such as:**
  - **The rate of gamete biomass production (kg eggs per cm change in body length)**
  - **The rate of egg production (# eggs per kg body growth)**
  - **Milt production (GSI)**

# Observations – cont'd

- **Survival to the eyed egg stage within the hatchery is greater for HC than SH fish**
- **The proportion of males maturing as precocious males was significantly reduced by an additional generation of domestication selecting against that life history type**
- **The proportion of males maturing as age 3 jacks was not different between HC and SH, but was greater than NO fish**

# Acknowledgements

- **Yakama Nation Roza Adult Monitoring Facility Crew**
- **Cle Elum Supplementation Research Facility Crew**
- **WDFW Ecological Interactions Crew**
- **Bonneville Power Administration for providing funding**



A scenic landscape photograph showing a river flowing through a valley. The river is surrounded by dense green forests, including tall evergreen trees. In the background, there are hills with sparse vegetation. The word "Questions?" is overlaid in large, bold, yellow text across the center of the image.

**Questions?**





# Domestication

- *Domestication* - Any genetic changes that result directly or indirectly from human efforts to control the environment experienced by a population.
- *Domestication selection* - “any change in the selection regime of a cultured population relative to that experienced by the natural population”
  - Broodstock selection and holding
  - Mating practices
  - Incubation
  - Juvenile Rearing
  - Release