Effects of the 2008 High Flow Experiment on Abundance, Growth, and Survival Rates of Early Life Stages of Rainbow Trout in the Lees Ferry Reach of the Colorado River

Josh Korman (Ecometric), Matthew Kaplinski (NAU), Ted Melis (GCMRC)

with contributions from

Ted Kennedy (GCMRC) and Andy Makinster (AGF)

Korman, J., Kaplinski, M., and T. Melis. 2010. USGS Open File Report 2010-1034, and Trans. Am. Fish. Soc. (submitted)

Central Questions

1. Did the March 2008 HFE influence survival rates of early life stages of rainbow trout:

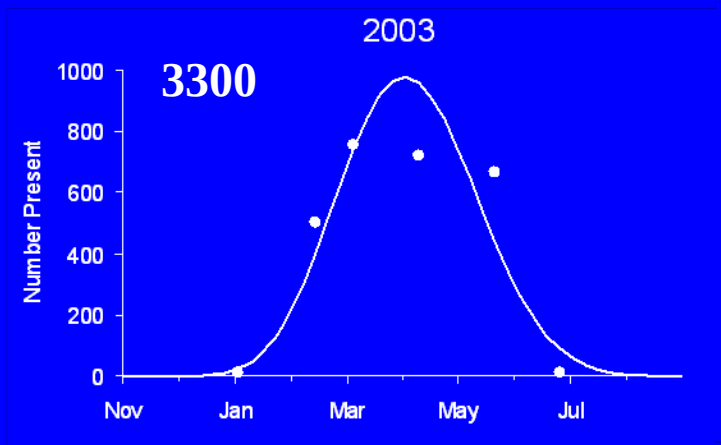
2. Did the March 2008 HFE influence growth of age-0 trout?

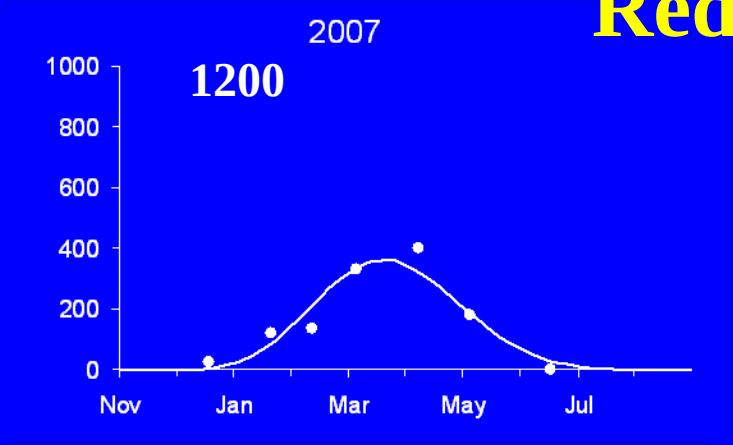
3. Did these changes increase age-0 abundance (juvenile recruitment to adult population)?

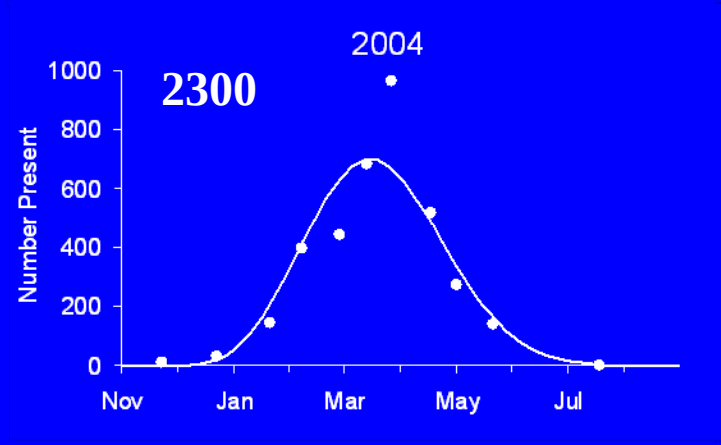
4. Did these fish move downstream, potentially causing harm to native fish?

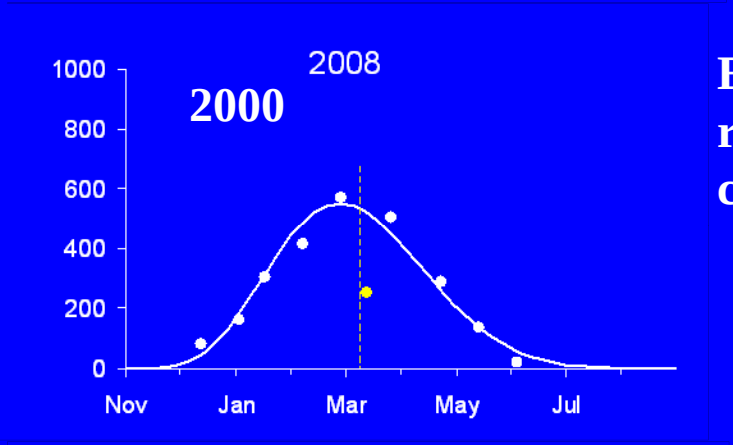
5. What mechanisms caused the observed responses?

Redd Counts





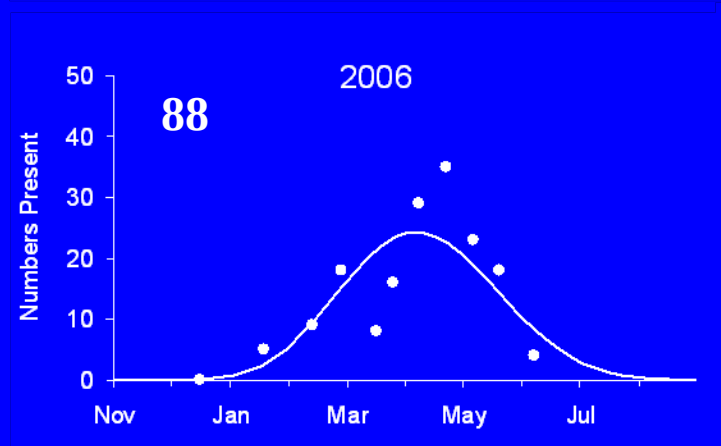


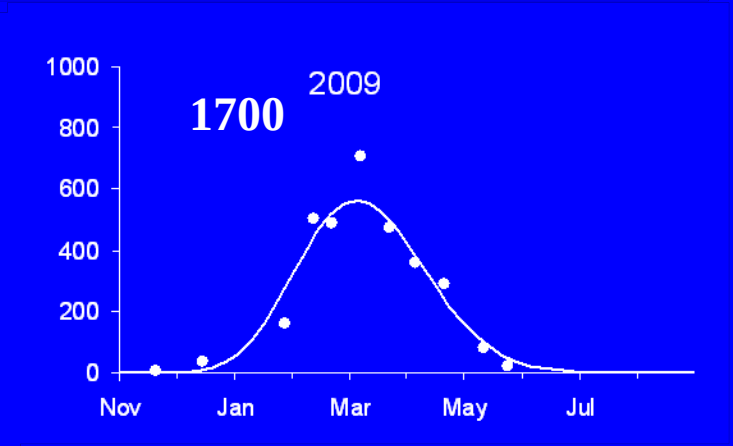


Estimate of total redds (egg nests) created each year

↓

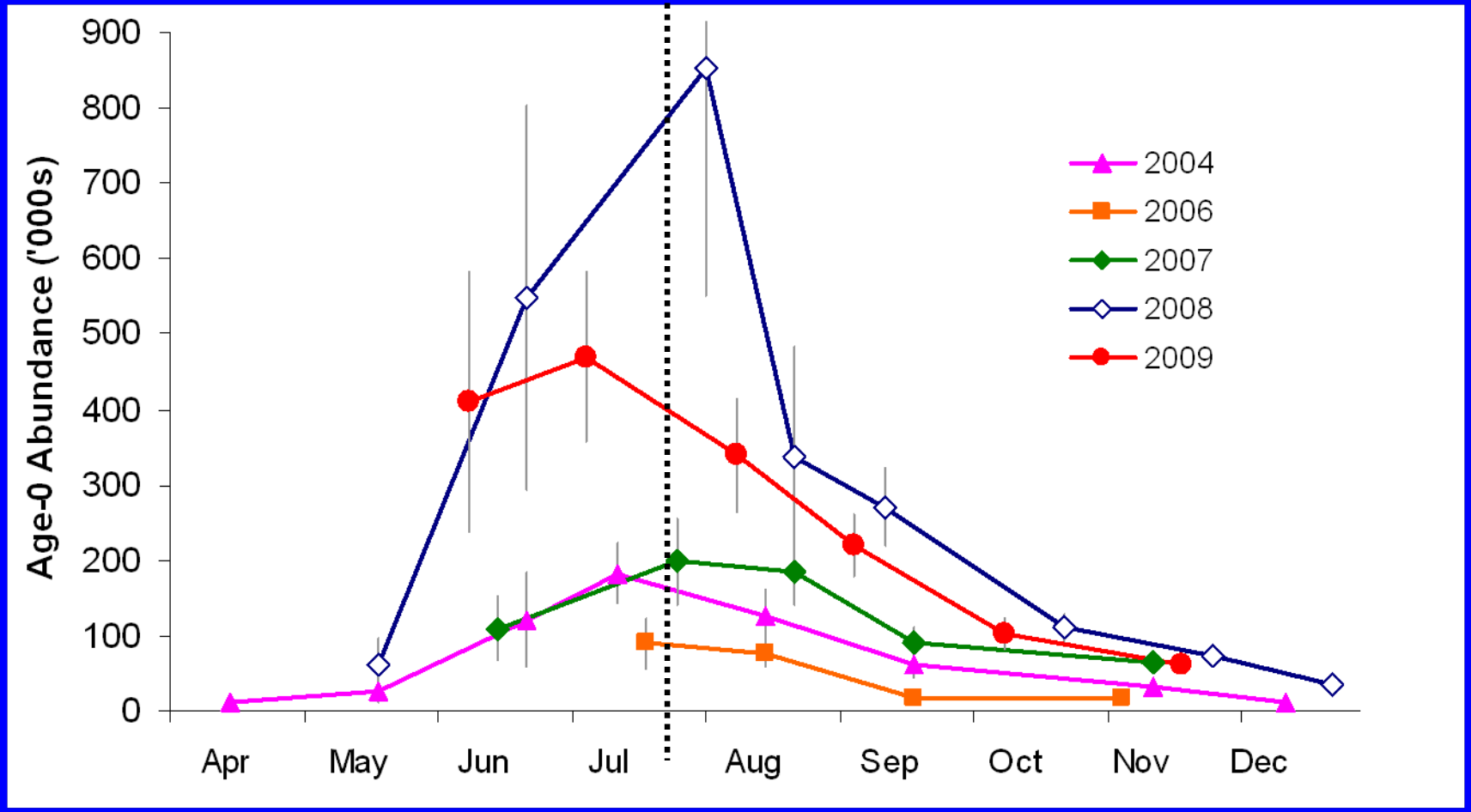
Egg Deposition



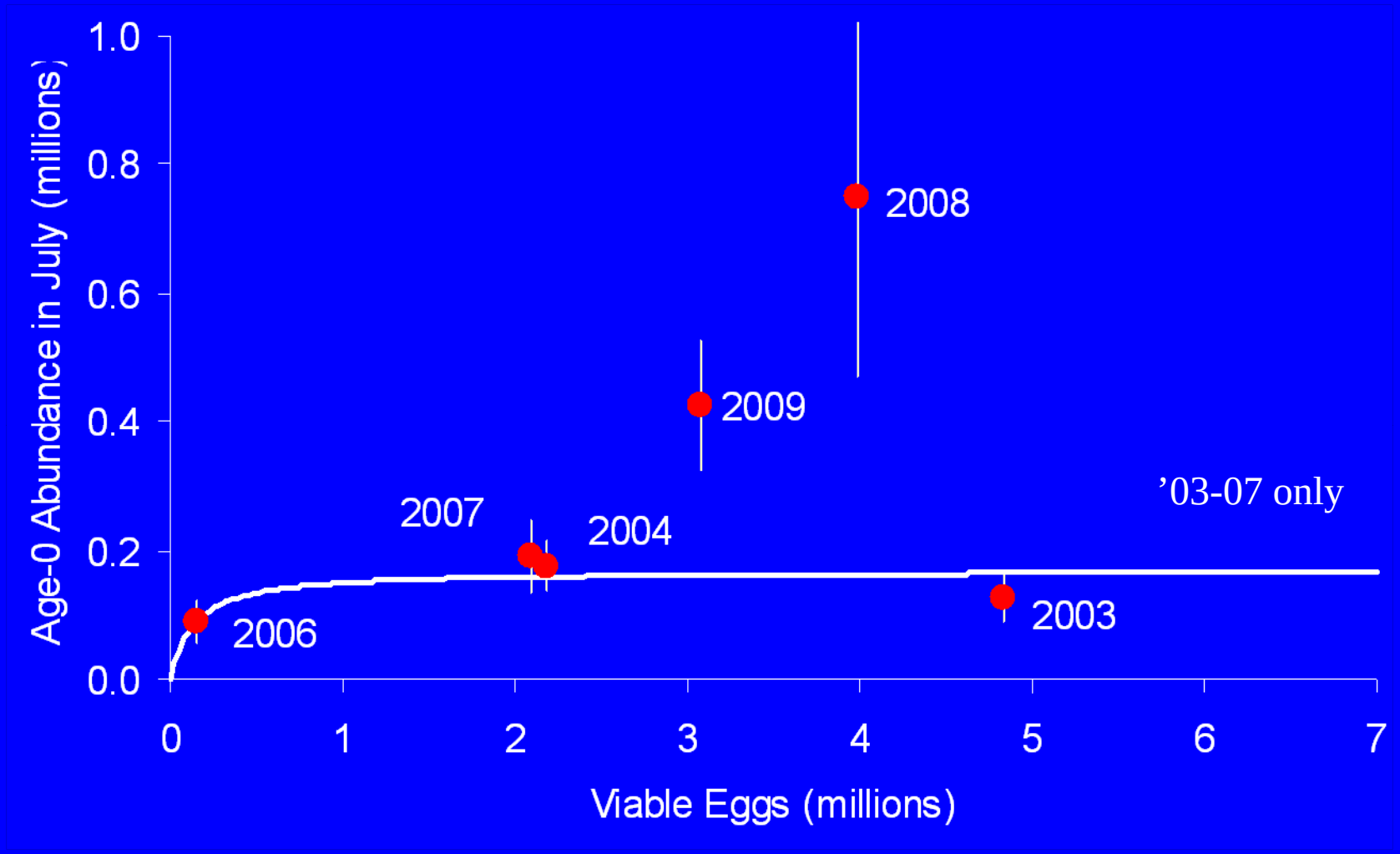


Trends in Age-0 Abundance by Brood Year

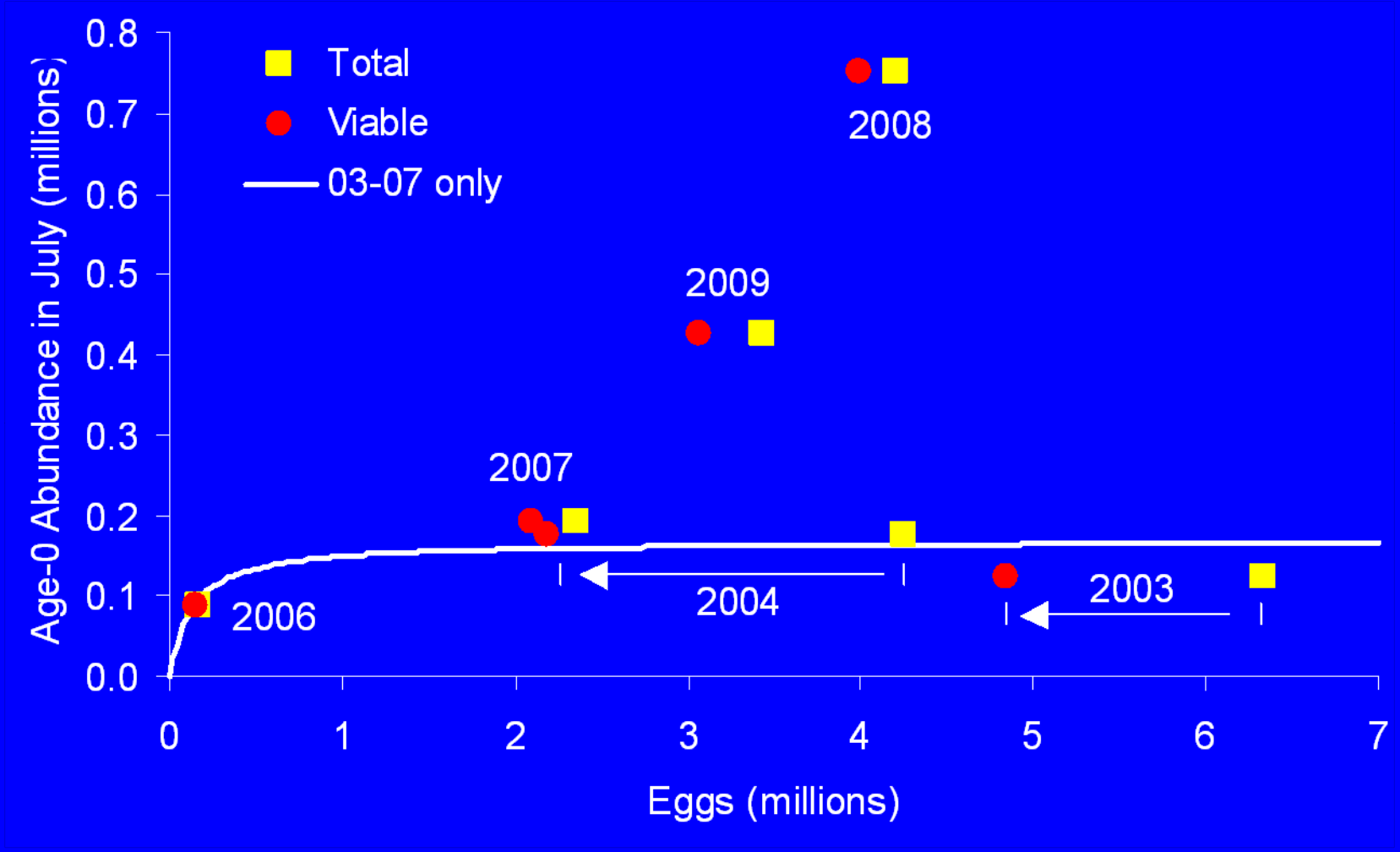
Age-0 abundance ~ 2 months from peak emergence



Stock-recruit analysis

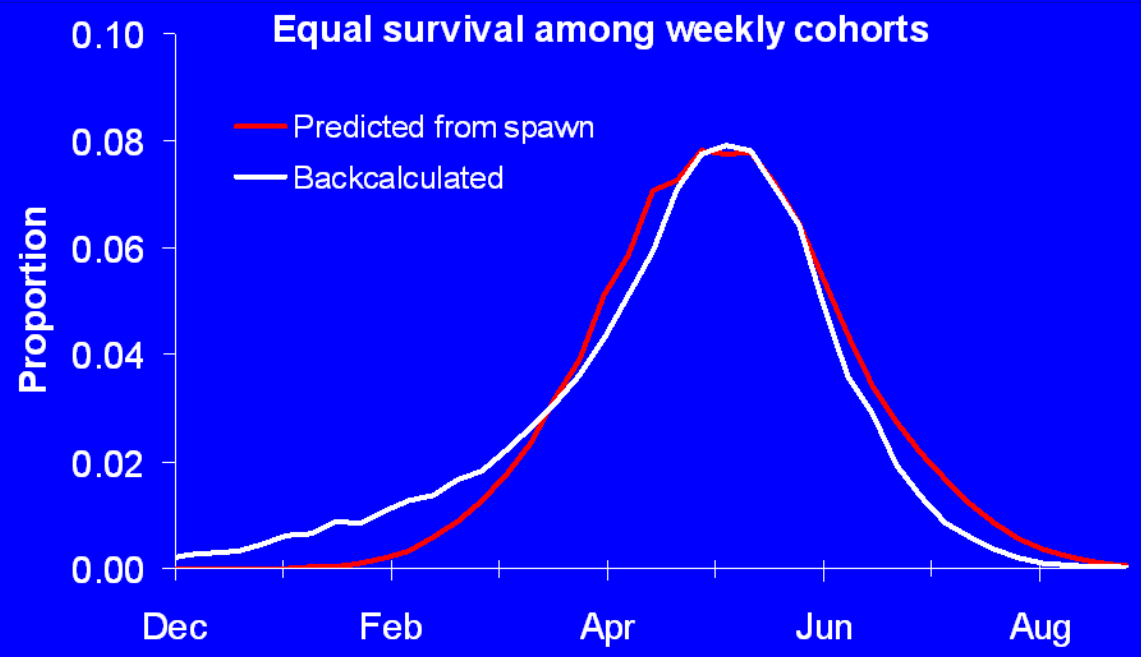


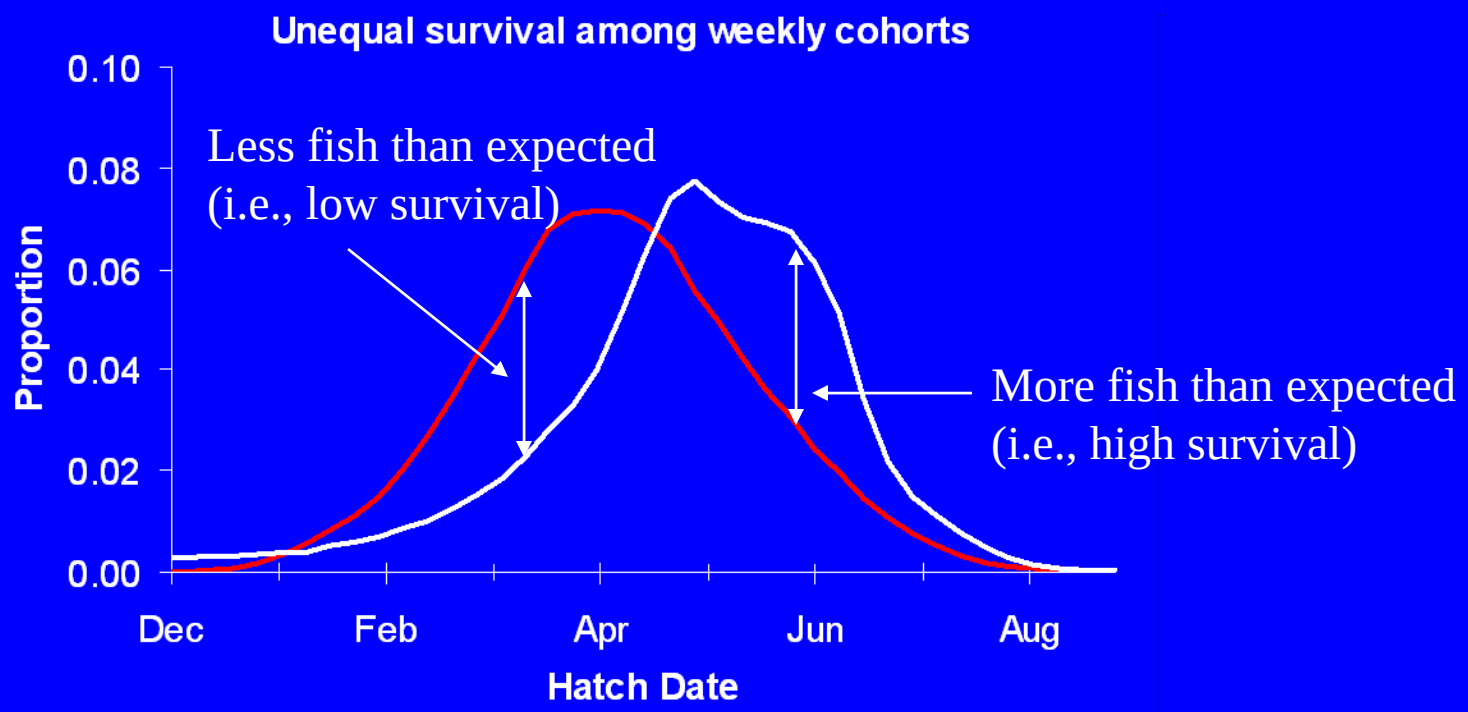
Effect of 2003-2005 Nonnative Fish Suppression Flows



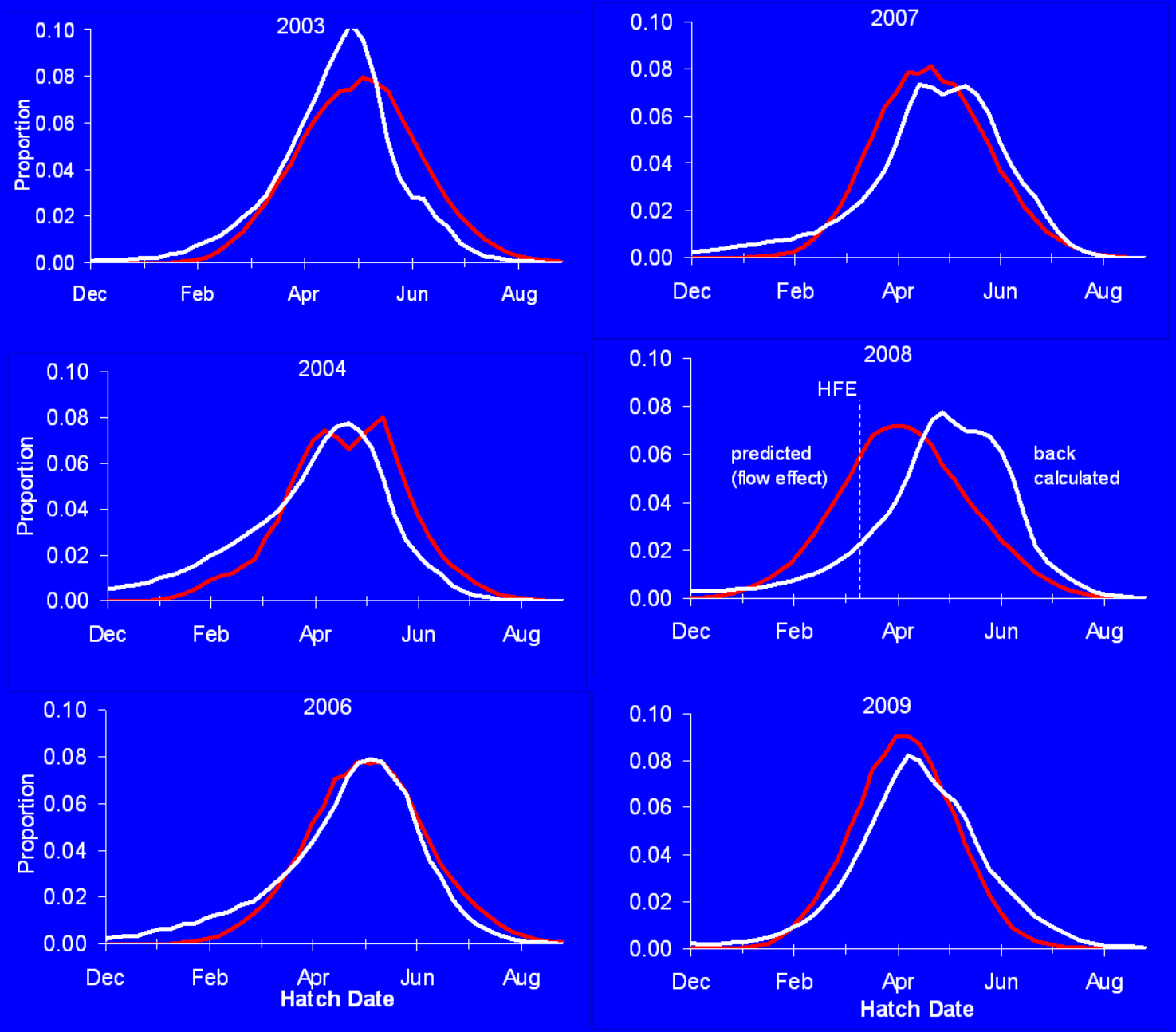
Hatch Date Analysis

- **Objective is to relate variation in early survival rates among weekly cohorts to changes in flow**





Effect of 2008 High Flow Experiment



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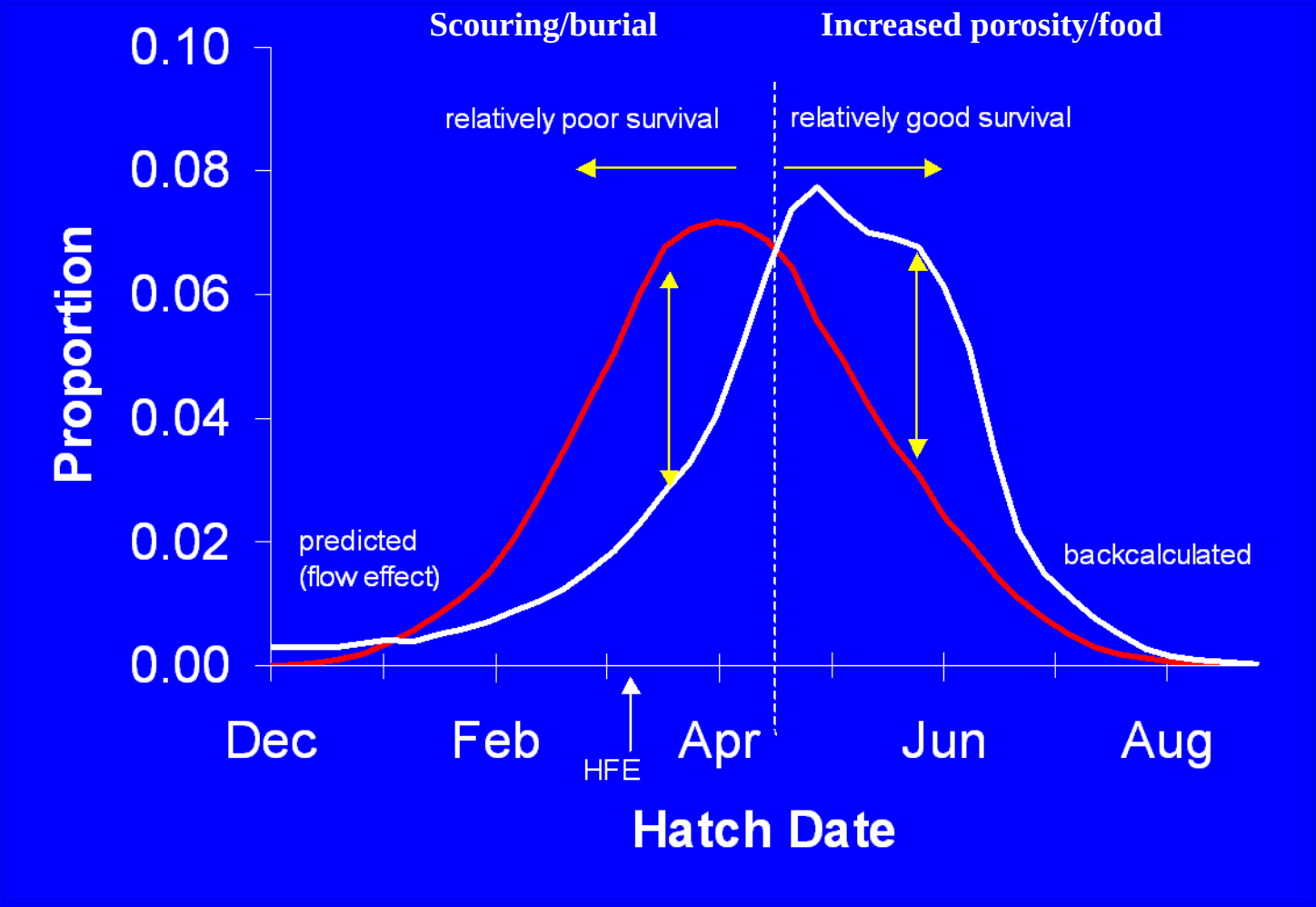
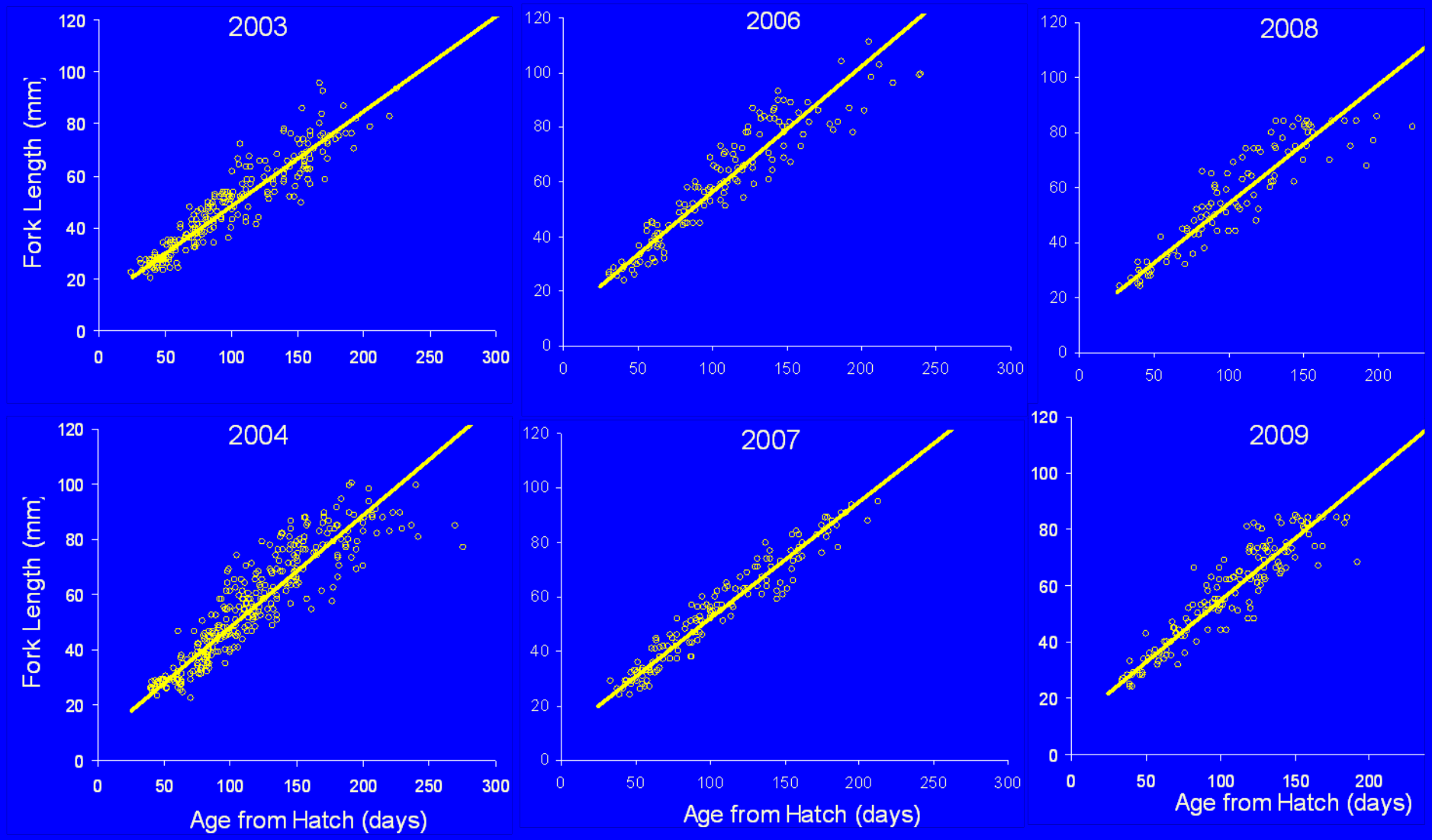
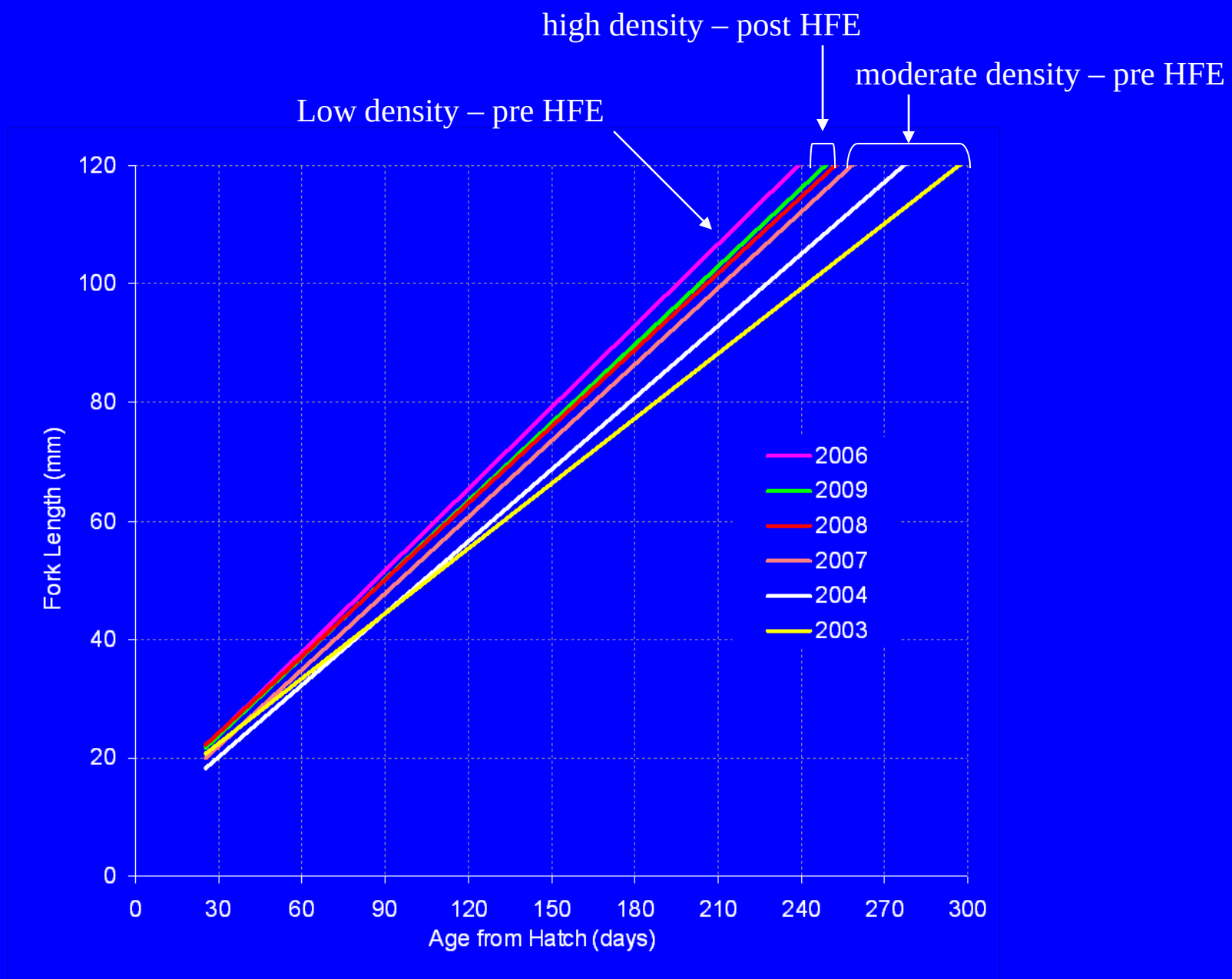


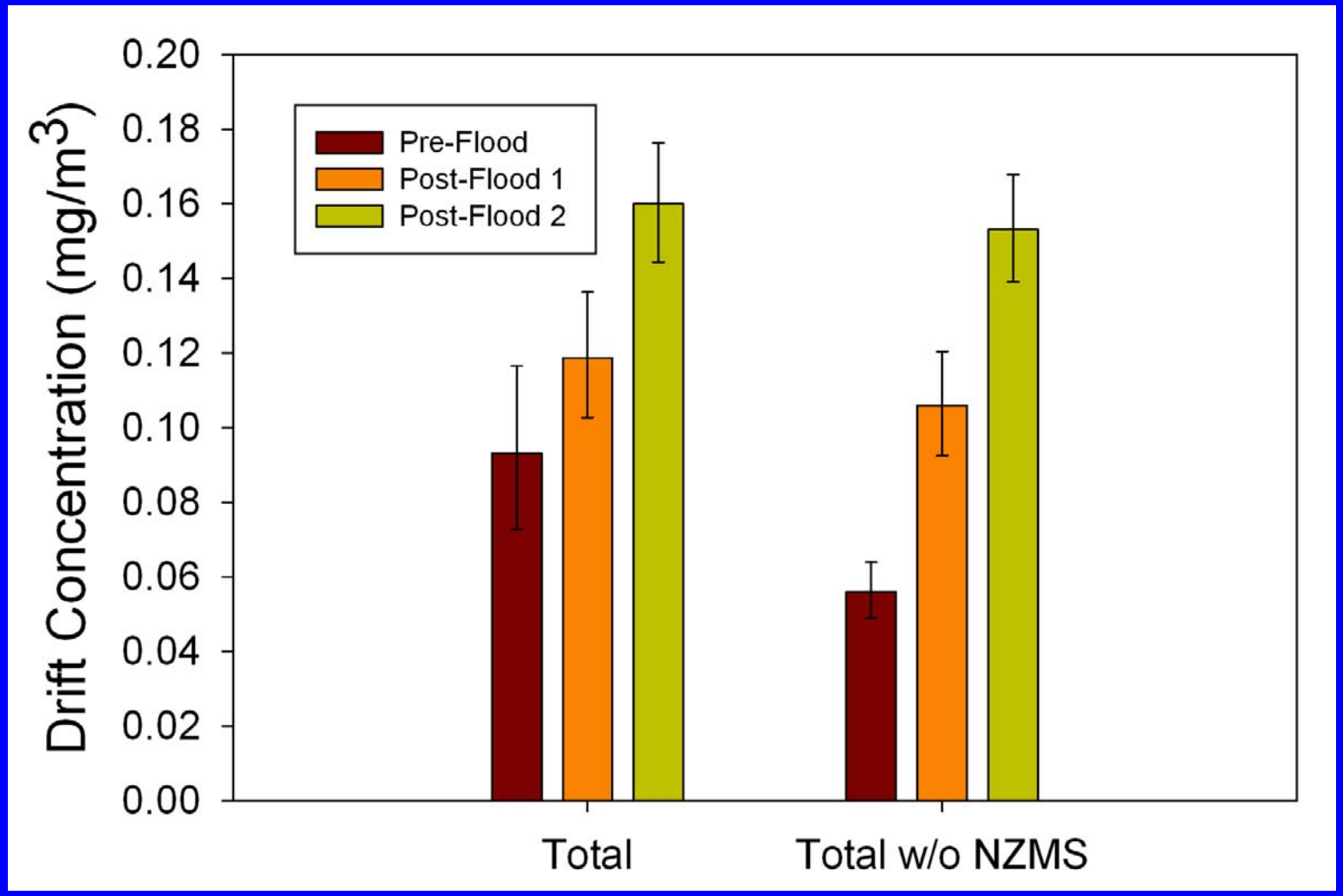
Age-0 growth from otoliths



Age-0 growth – year effects

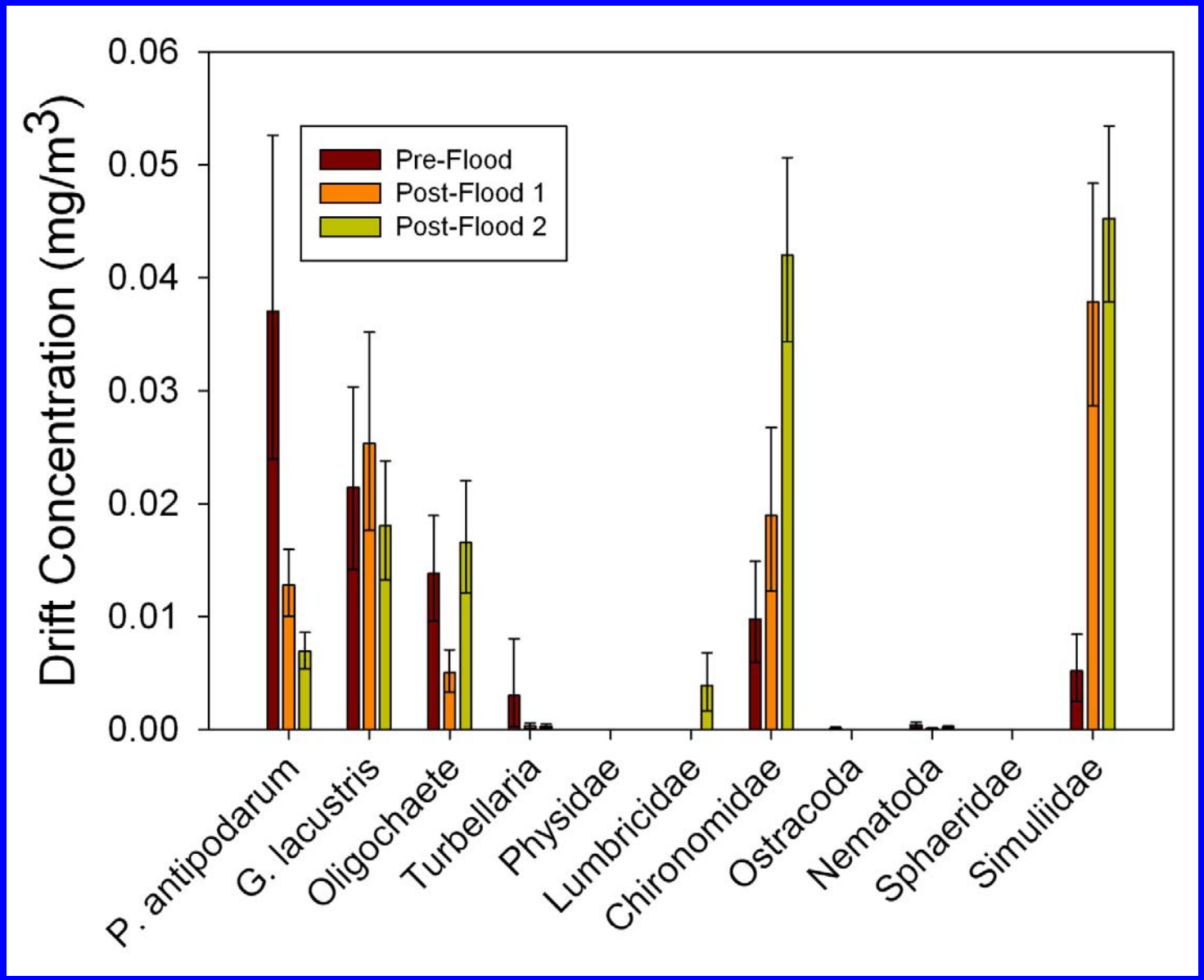


Effects of HFE on Age-0 Food Base

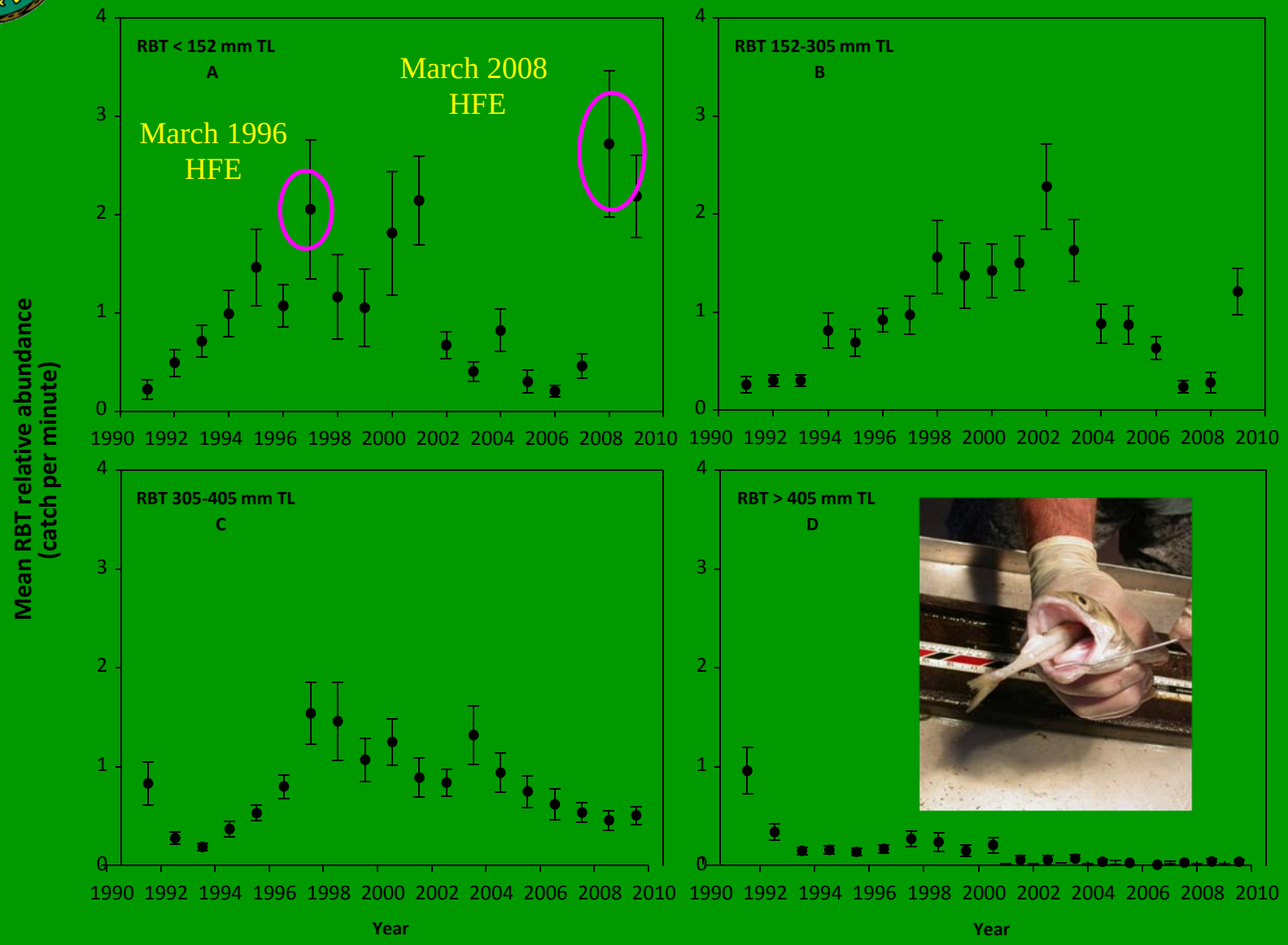


Kennedy et al. 2010. THE USE OF INVERTEBRATE DRIFT IN COMBINATION WITH FLOW FOOD WEBS TO EVALUATE THE EFFECTS OF A CONTROLLED FLOOD ON A TAILWATER TROUT POPULATION. (NABS)

Effects of HFE on Age-0 Food Base (con't)



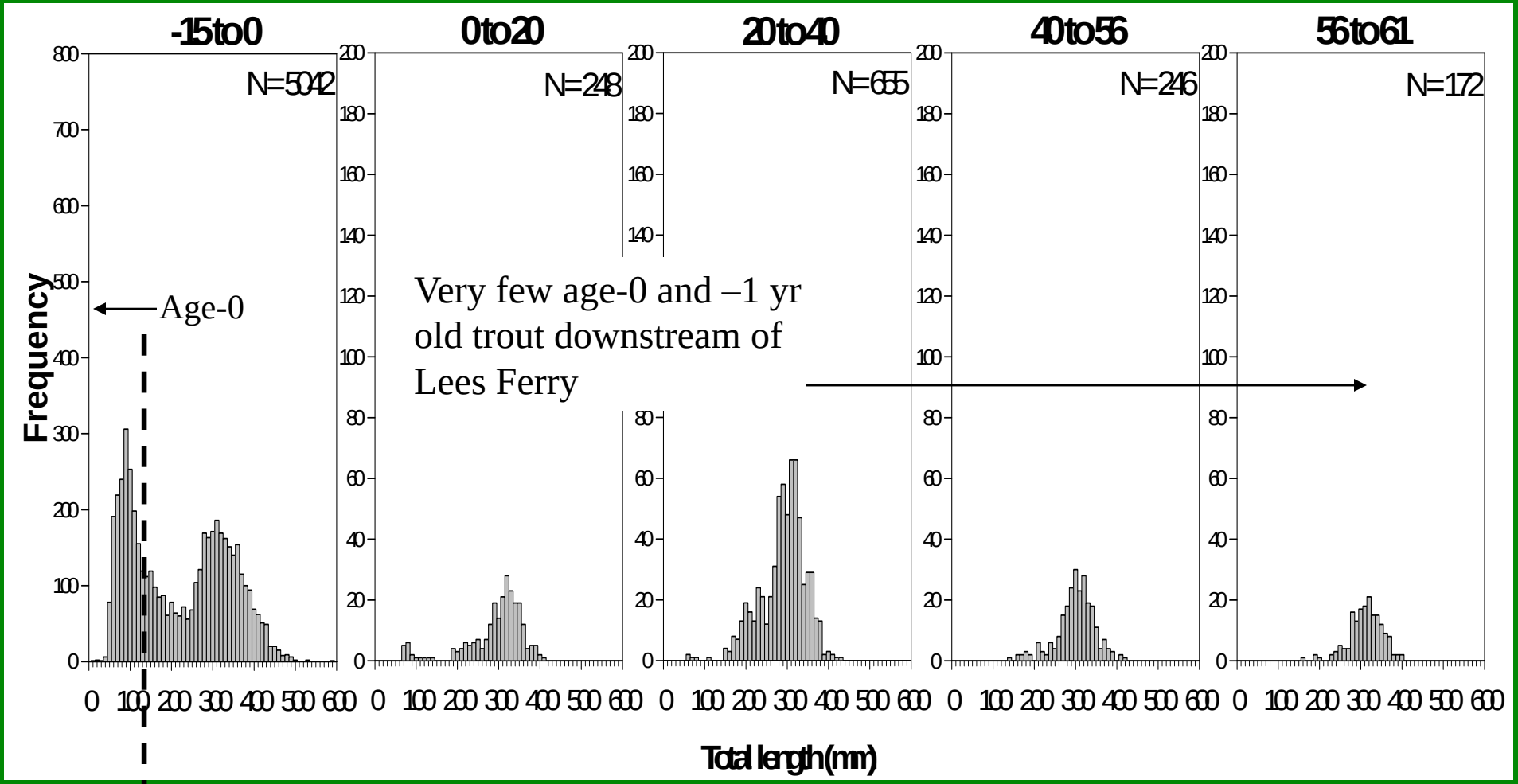
Evidence for HFE Effect in 1996



PROVISIONAL DATA SUBJECT TO REVIEW AND REVISION

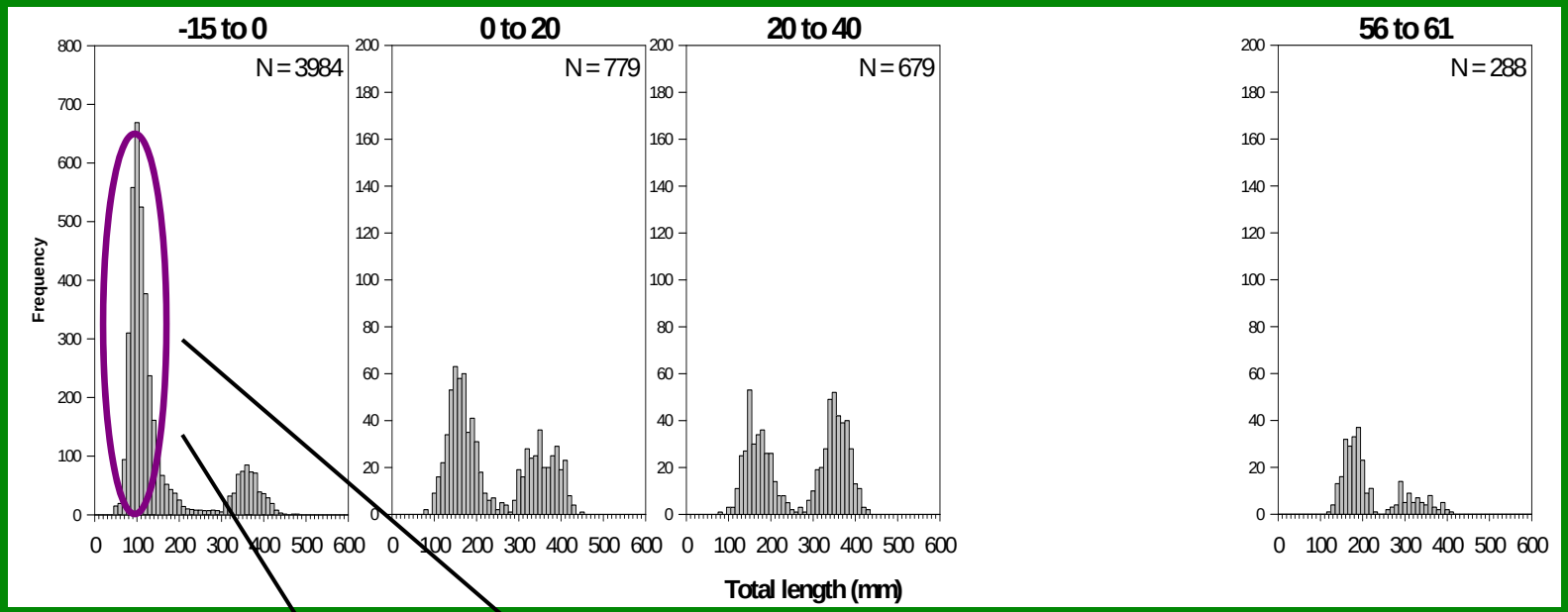
Data provided by A. Makinster, Arizona Game & Fish Department

Implications of Age-0 Abundance in Lees Ferry Reach on Trout Abundance Downstream

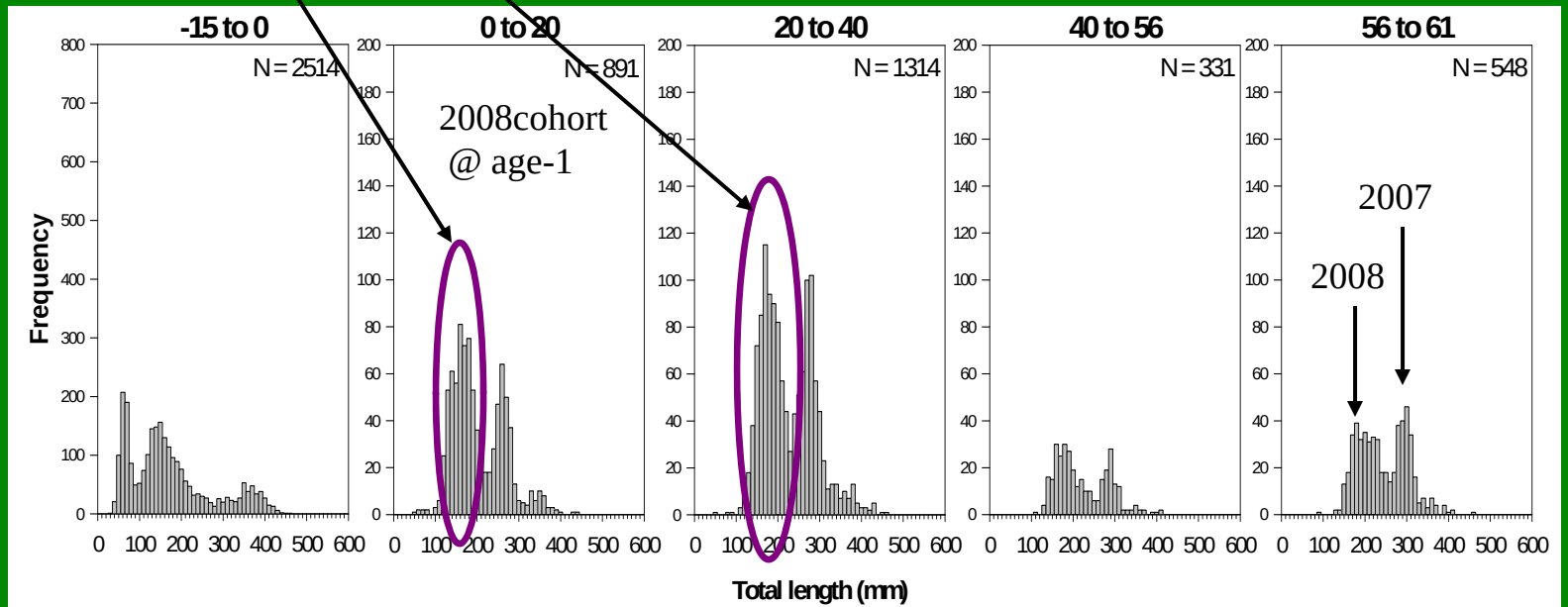


2000

Trout Produced from 2008 HFE Moved Downstream in 2009

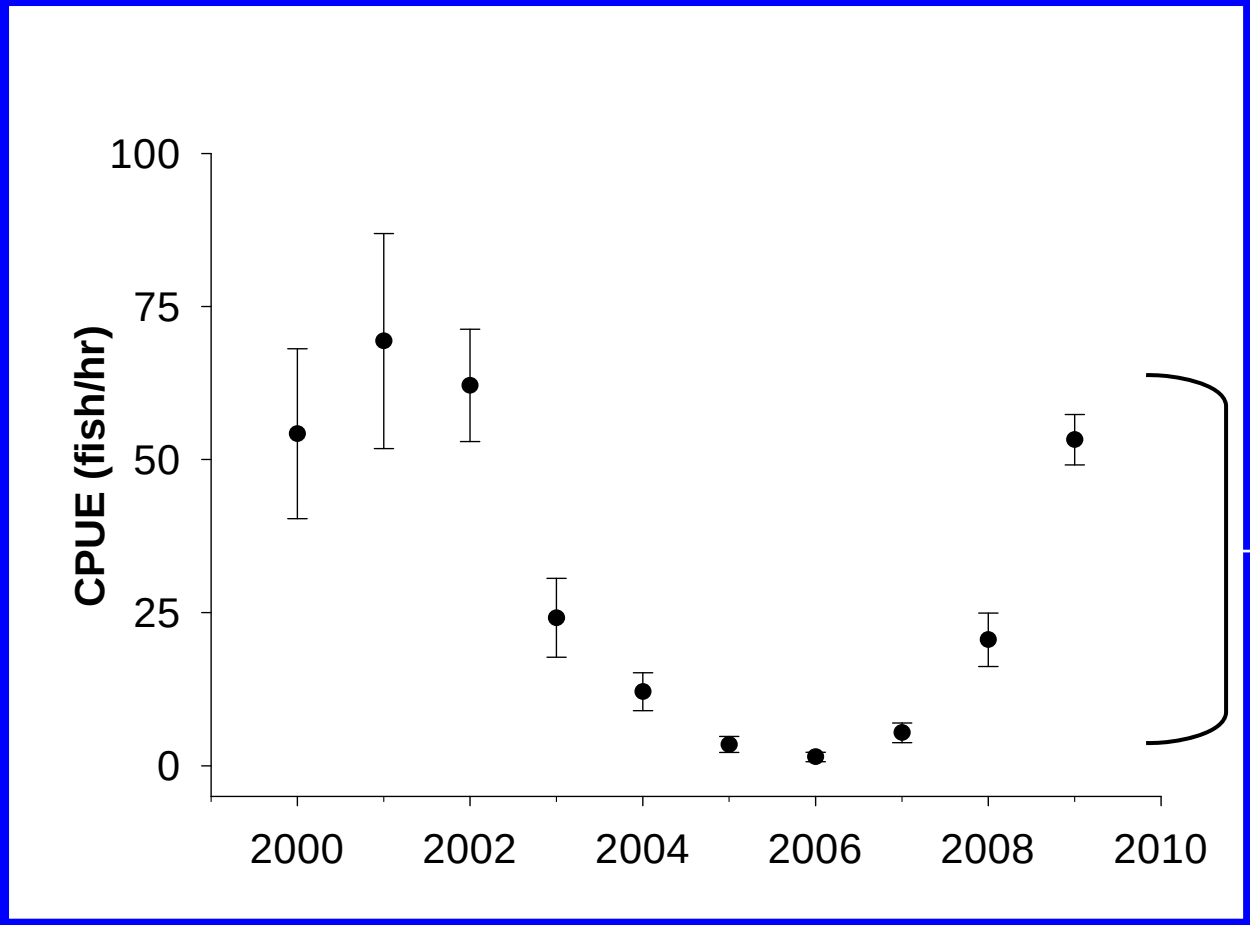


2008



2009

Total Rainbow Trout Abundance in Removal Reach



Increase is not solely due to HFE. Was increasing by 2008

Summary of Main Findings

1. Stock-recruit analysis indicated that 2008 HFE increased survival rates of recently emerged trout by four-fold and effect persisted into 2009.

2. Hatch date analysis indicated much higher survival for fish which hatched about 1.5 months or more after 2008 HFE (~ May 1st or later).

3. Otolith analysis indicated that growth of age-0 trout has been relatively good since 2008 HFE in spite of much higher density.

4. Early survival and growth responses to 2008 HFE likely caused by increase in food availability (+25-70% increase in drift), and possibly increase in interstitial space.

5. Age-1 abundance in Marble Canyon increased in 2009, perhaps due to increased age-0 abundance in Lees Ferry in 2008 (density-dependent dispersal).

Key Uncertainties

1. Will an HFE conducted in the fall have the same effect on age-0 trout survival as it does in spring?

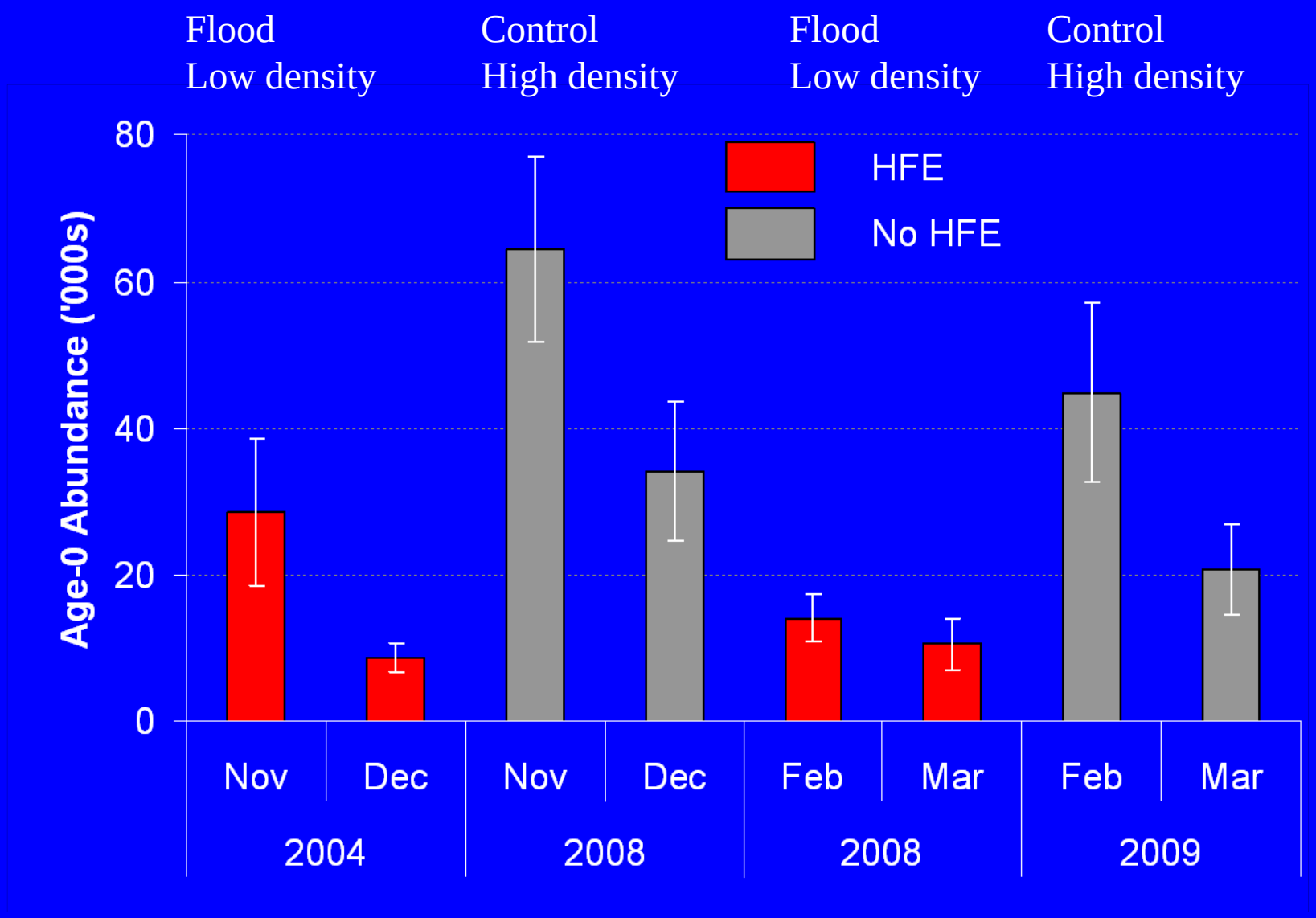
2. Does a fall HFE reduce adult trout condition, potentially influencing fishery, maturation/fecundity, and downstream dispersal?

3. Does the magnitude of the age-0 trout survival response to HFEs decrease with frequency of HFEs? How persistent is effect?

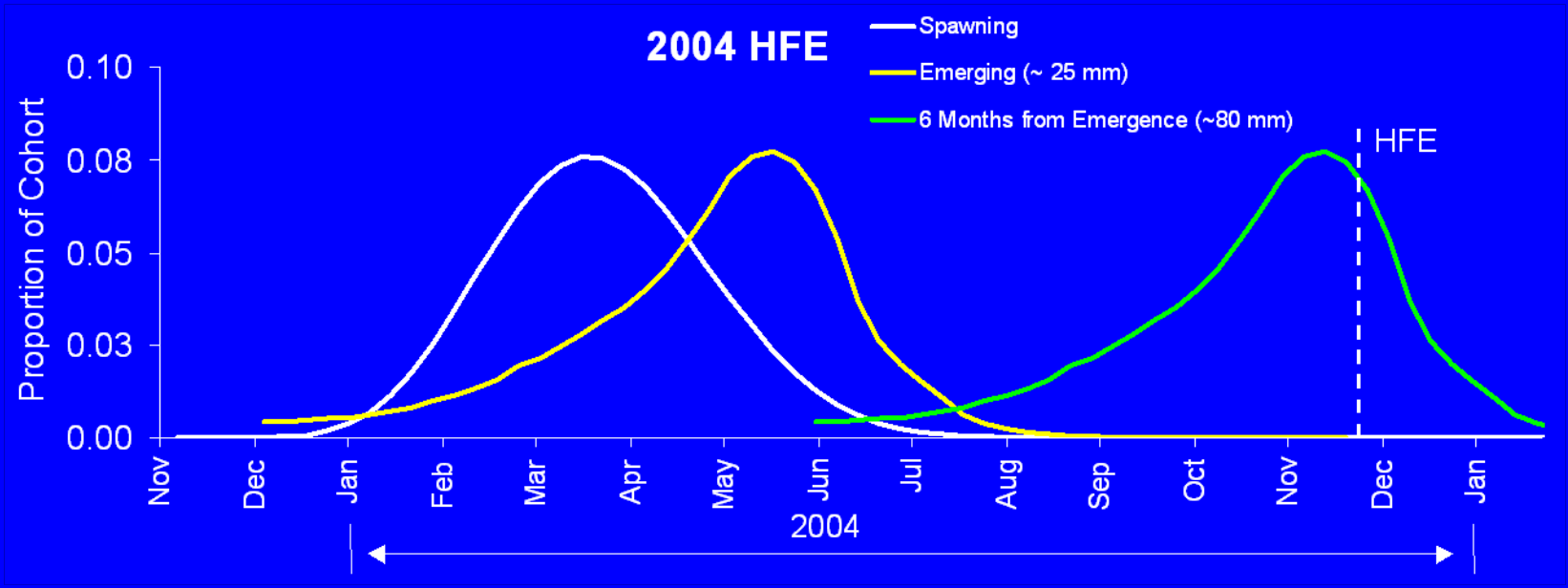
4. Do trout from Lees Ferry move downstream, and if so, what factors control dispersal rate (density, food availability)?

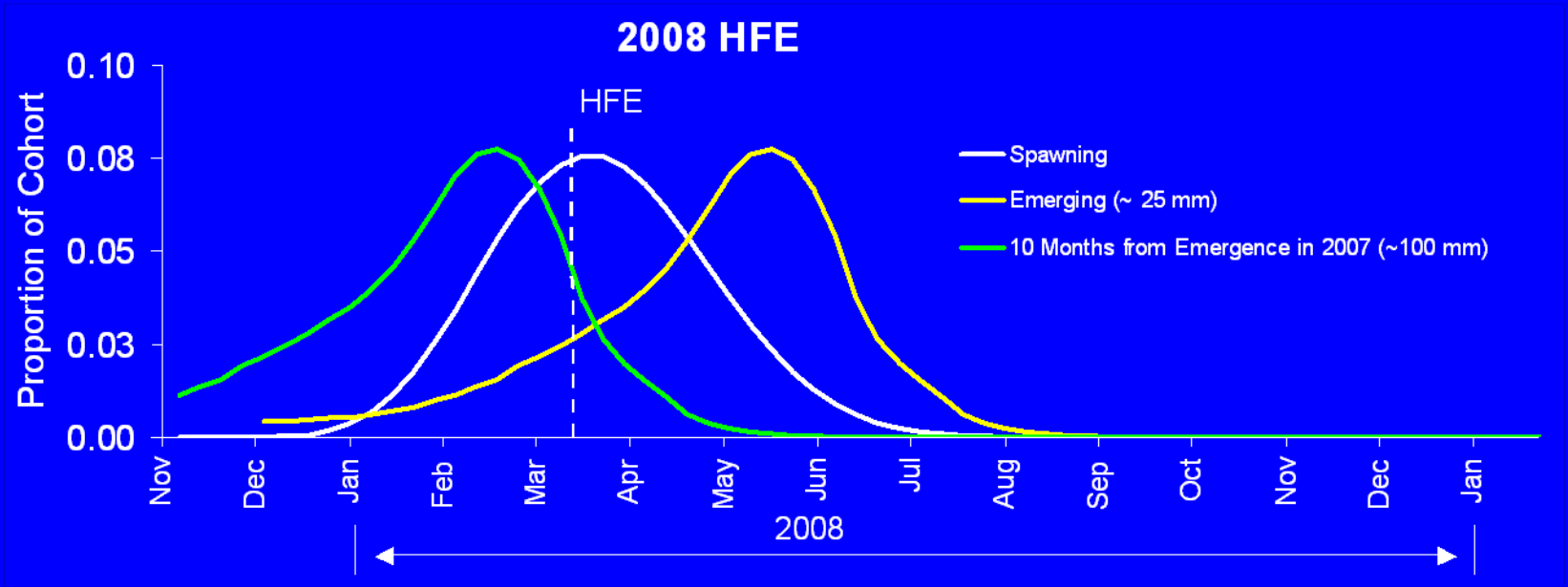
5. Can nonnative fish suppression flows or mechanical removal limit trout abundance in Marble Canyon or LCR reach when juvenile recruitment is high?

Effect of HFE on Age-0 Survival Rates

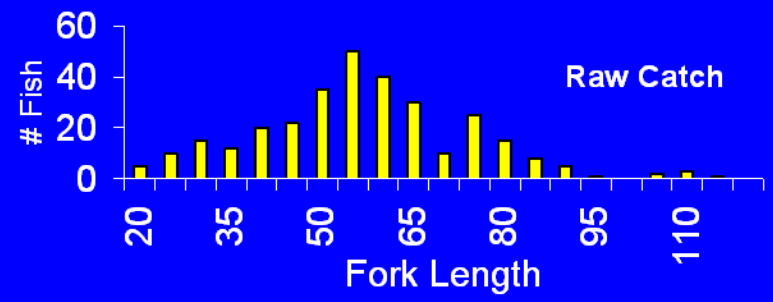


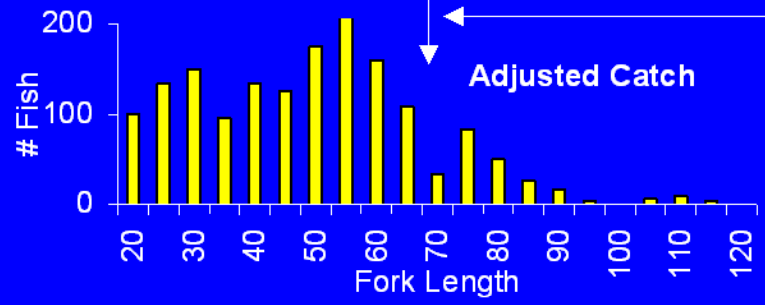
Life History in Relation to HFE Timing

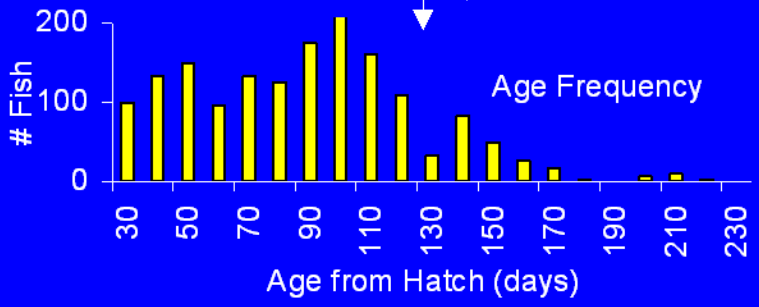


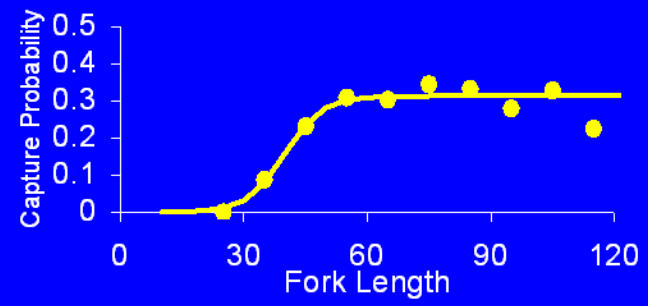


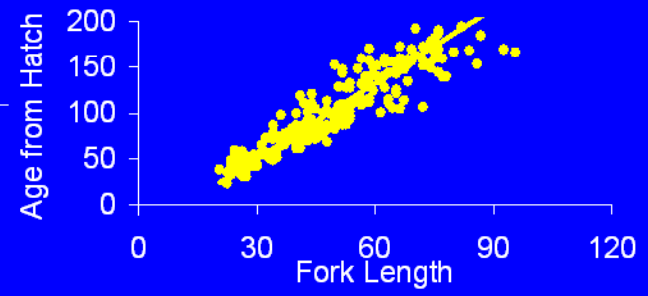
Backcalculation of Hatch Date Distribution

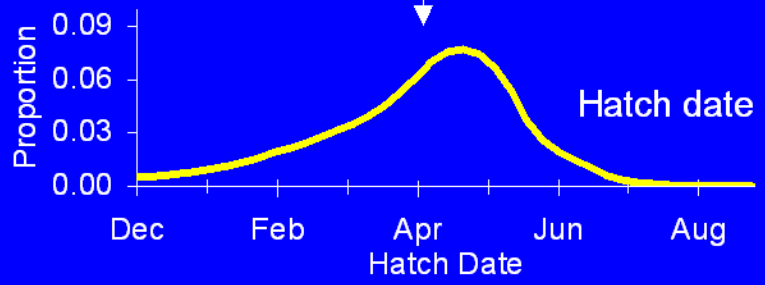










Loop over habitats and trips

Date of capture
Mortality adjustment