

Comparison of Age and Size at Maturity
and Sex Ratios Between
Hatchery and Naturally Produced
Chinook Salmon *Oncorhynchus tshawytscha*
in the Imnaha River

Timothy L. Hoffnagle, Richard W. Carmichael and Patrick Keniry

Oregon Department of Fish and Wildlife
La Grande, Oregon

Background

Hatchery management is moving towards supplementation and conservation practices, with increased emphasis on genetic conservation and diversity of endemic stocks.

Need to produce hatchery fish that perform well in the wild.

Assumption is that the hatchery fish that are genotypically and phenotypically most similar to wild fish will be best suited to wild conditions and will perform better.

Hatchery objective:

Operate hatchery programs so that the genetic and life history characteristics of hatchery fish mimic those of the wild fish. This should result in more and better fish to fulfill management objectives.

Innaha River Hatchery Program

The Innaha River hatchery program began in 1982 using broodstock from wild Innaha River adults.

Production strategy is to release yearling smolts.

Natural and Hatchery fish are collected for hatchery broodstock and returning Hatchery fish spawn naturally in the Innaha River.

- ❖ Naturally spawning fish that were of hatchery origin was 31-77% from 1990-2001.
- ❖ Hatchery broodstock from 1989-2001 was 14-71% naturally-spawned fish.

Imnaha River Basin



Objectives

Determine and compare age at return of Hatchery and Natural fish.

Compare size at age of return for Hatchery and Natural fish.

Assess differences in sex ratios of adult Hatchery and Natural fish.

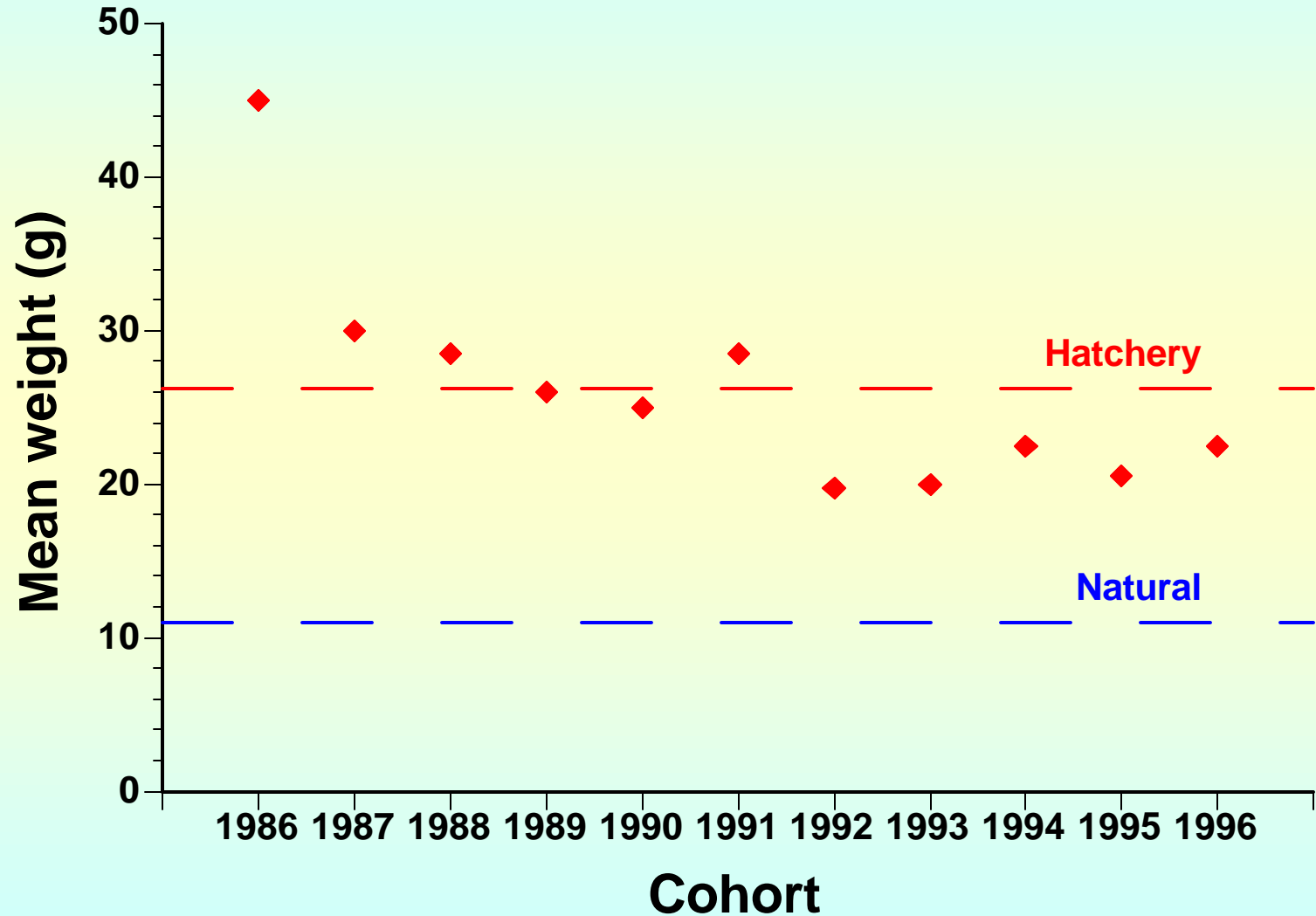
Assumption: Effectiveness of reproducing in the wild is related to the age and size of the fish: e.g., mate selection, fecundity and access to spawning sites.

Methods

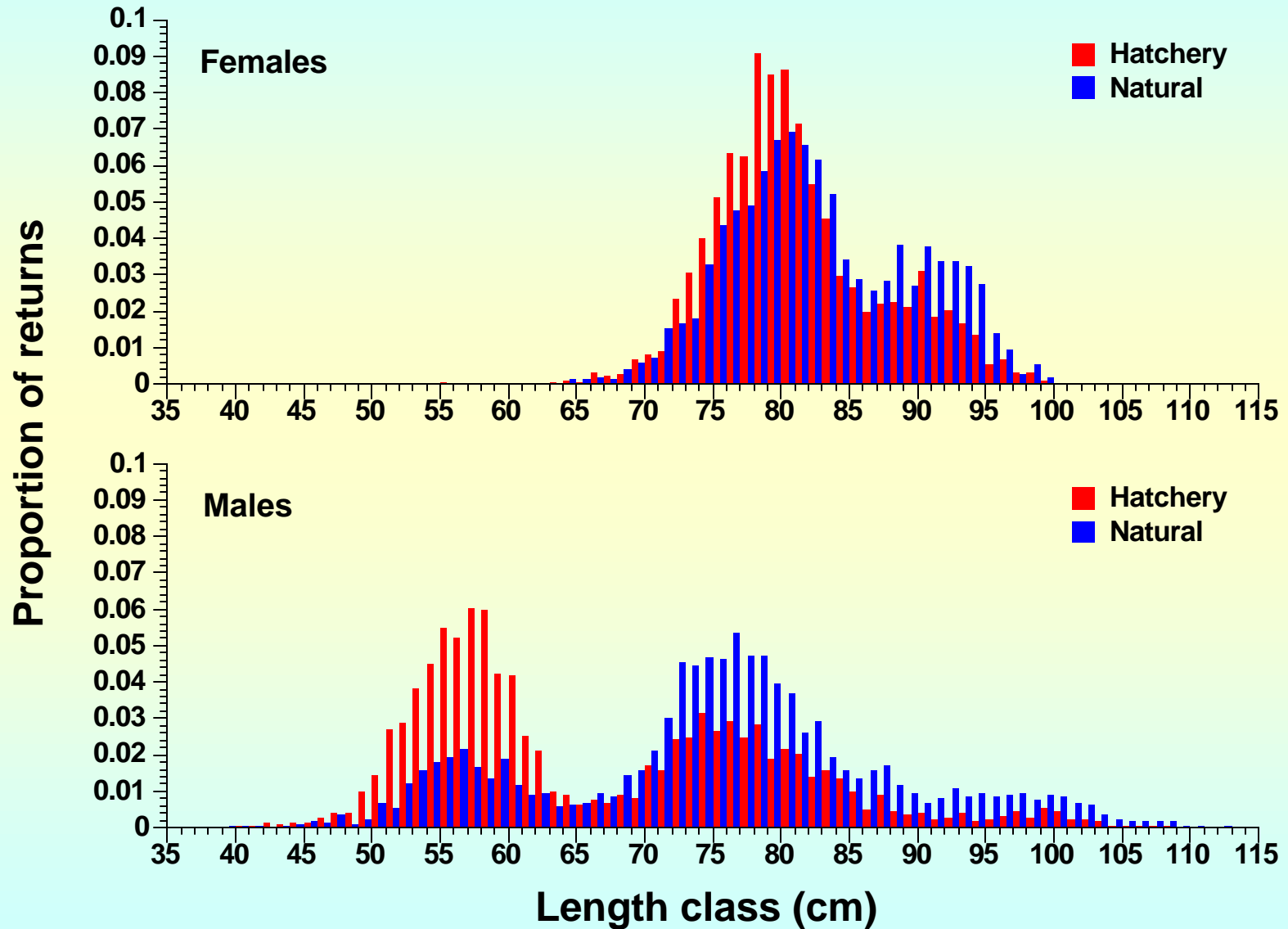
Analyses were conducted using number of fish returning to the river from 1986-1996.

Age and sex were determined from fish captured at the weir and from spawning ground surveys. Scales were used to age Natural fish and coded wire tags and scales for Hatchery fish.

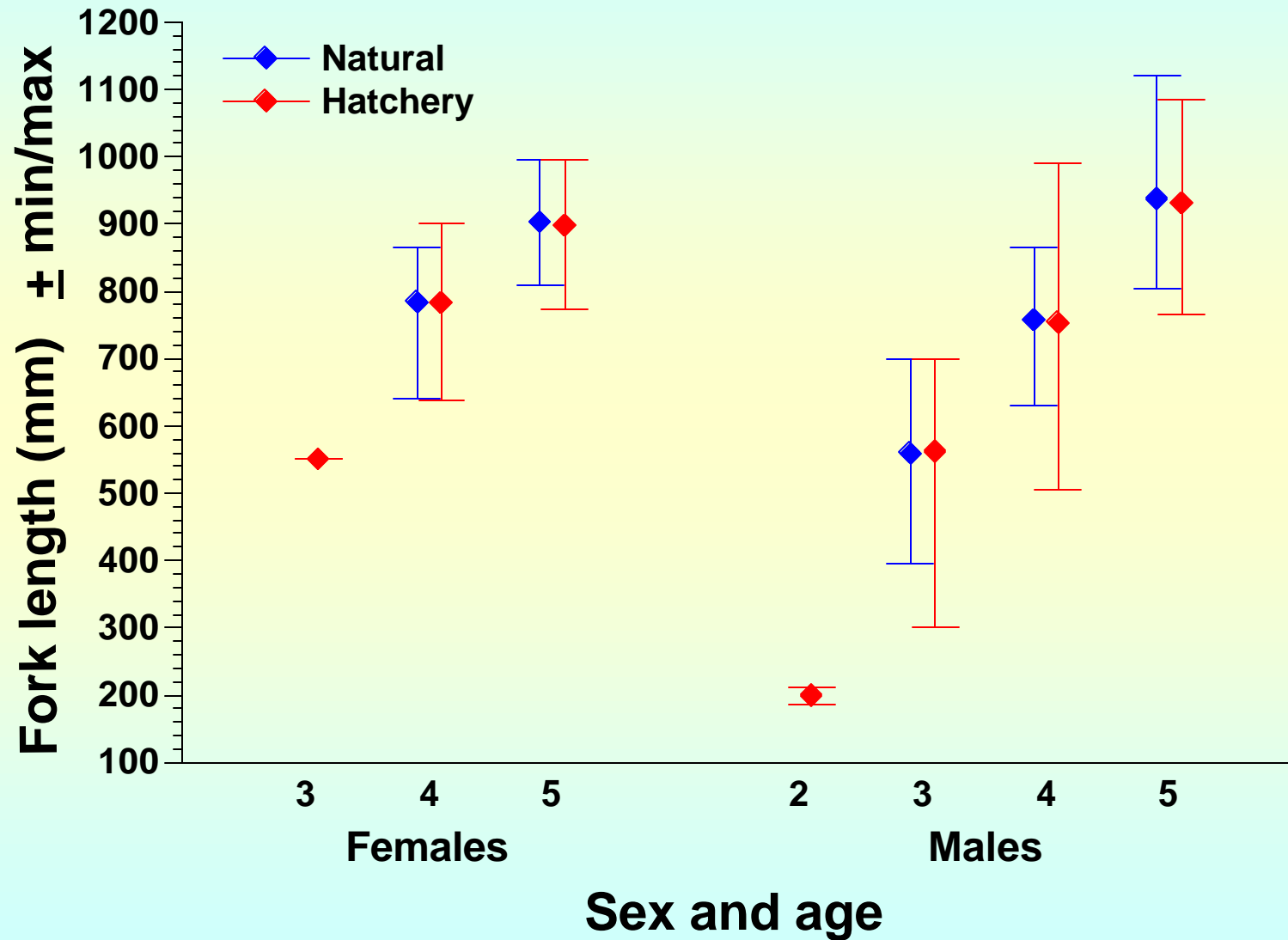
Weight of Hatchery Smolts



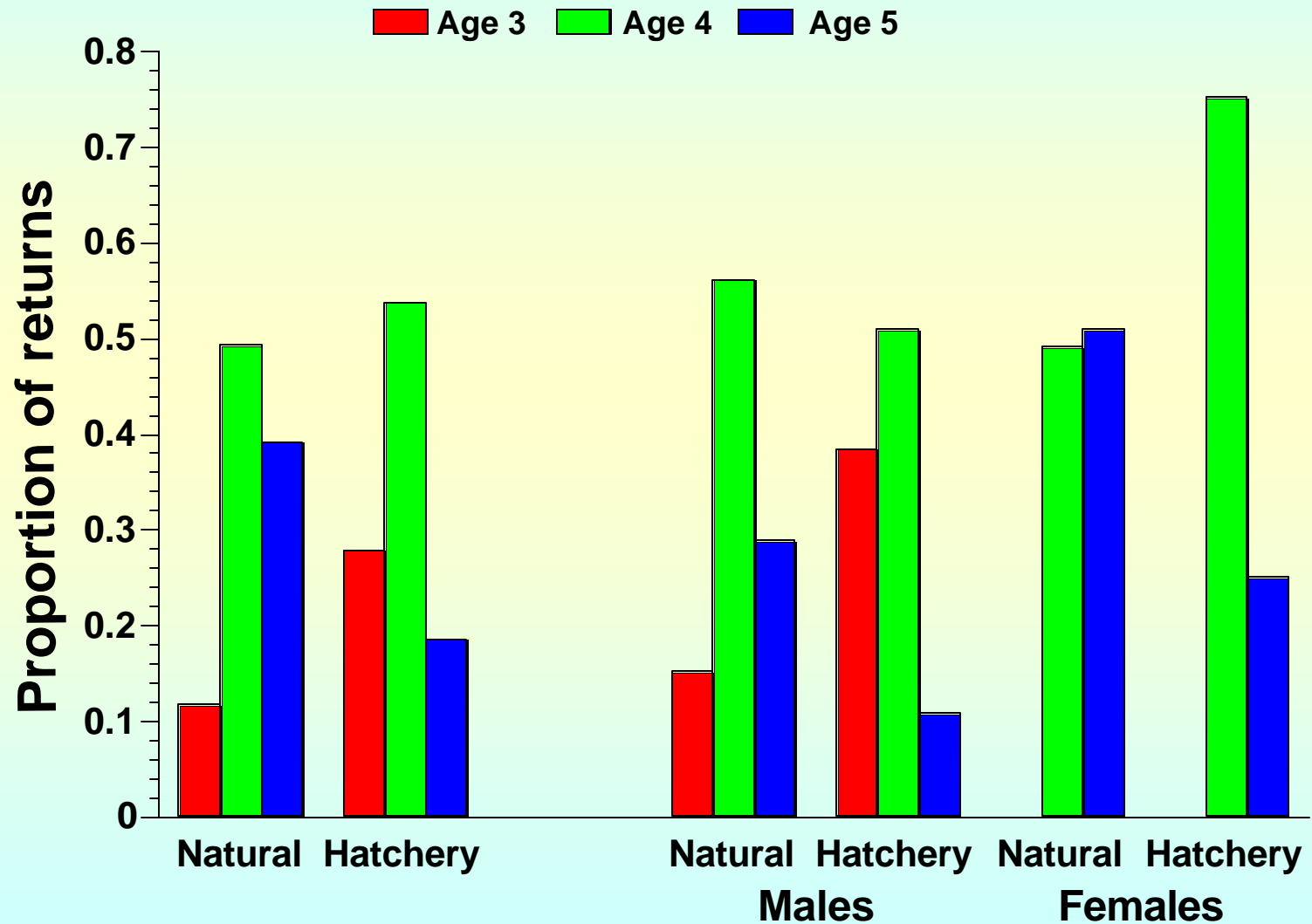
Length Frequency of Returns



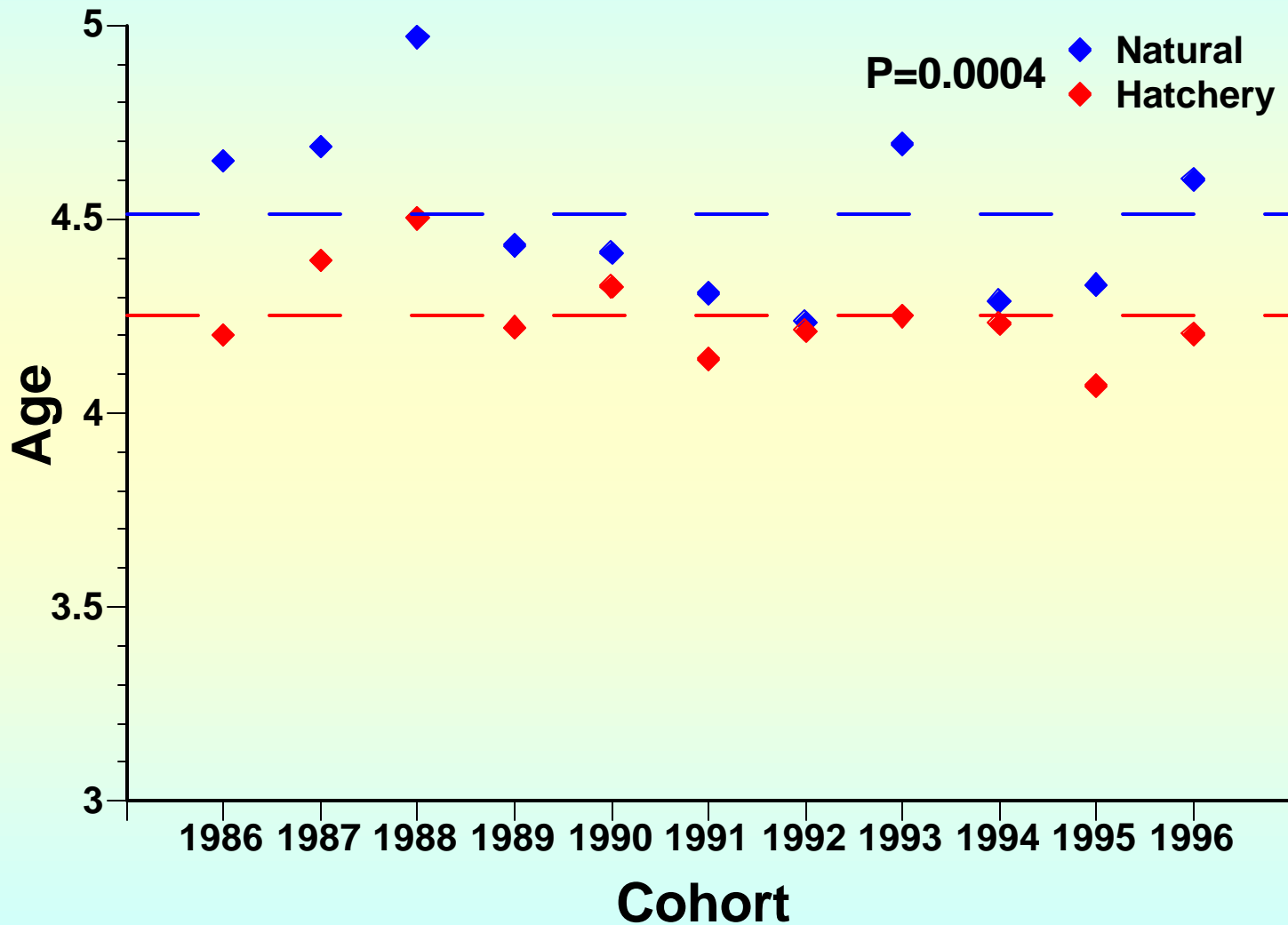
Length at Age of Return



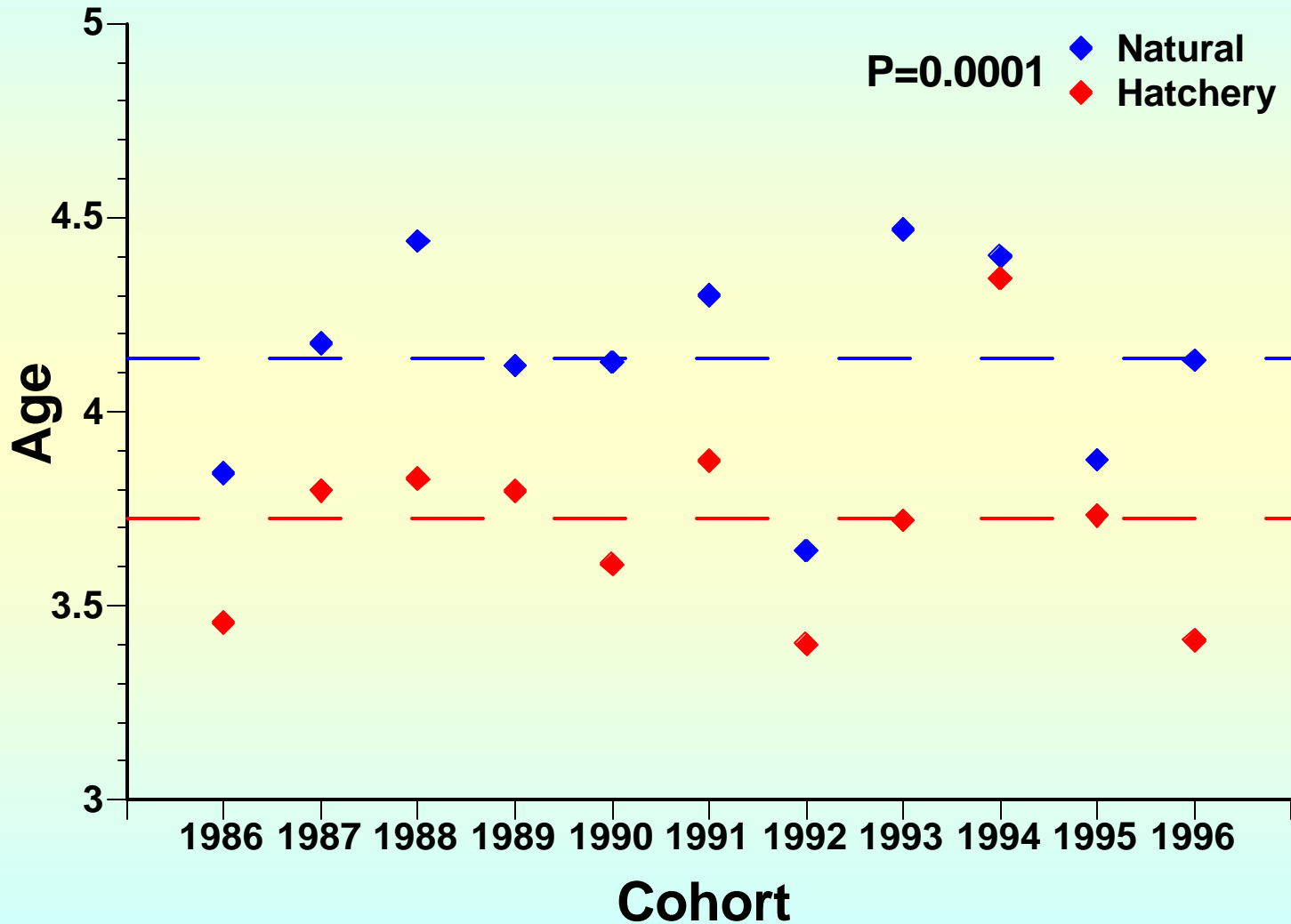
Proportion of Returns at Age



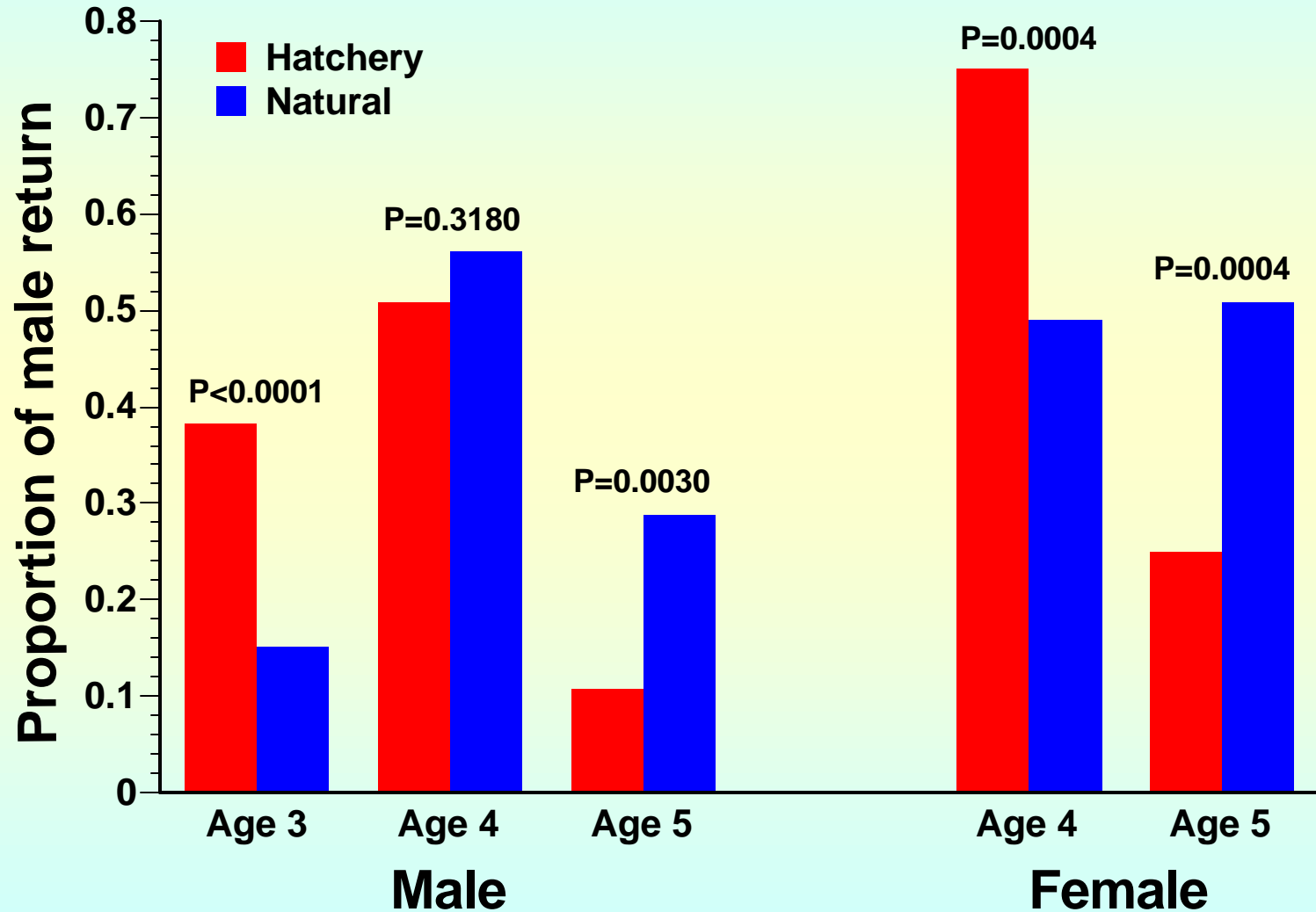
Age of Female Adults



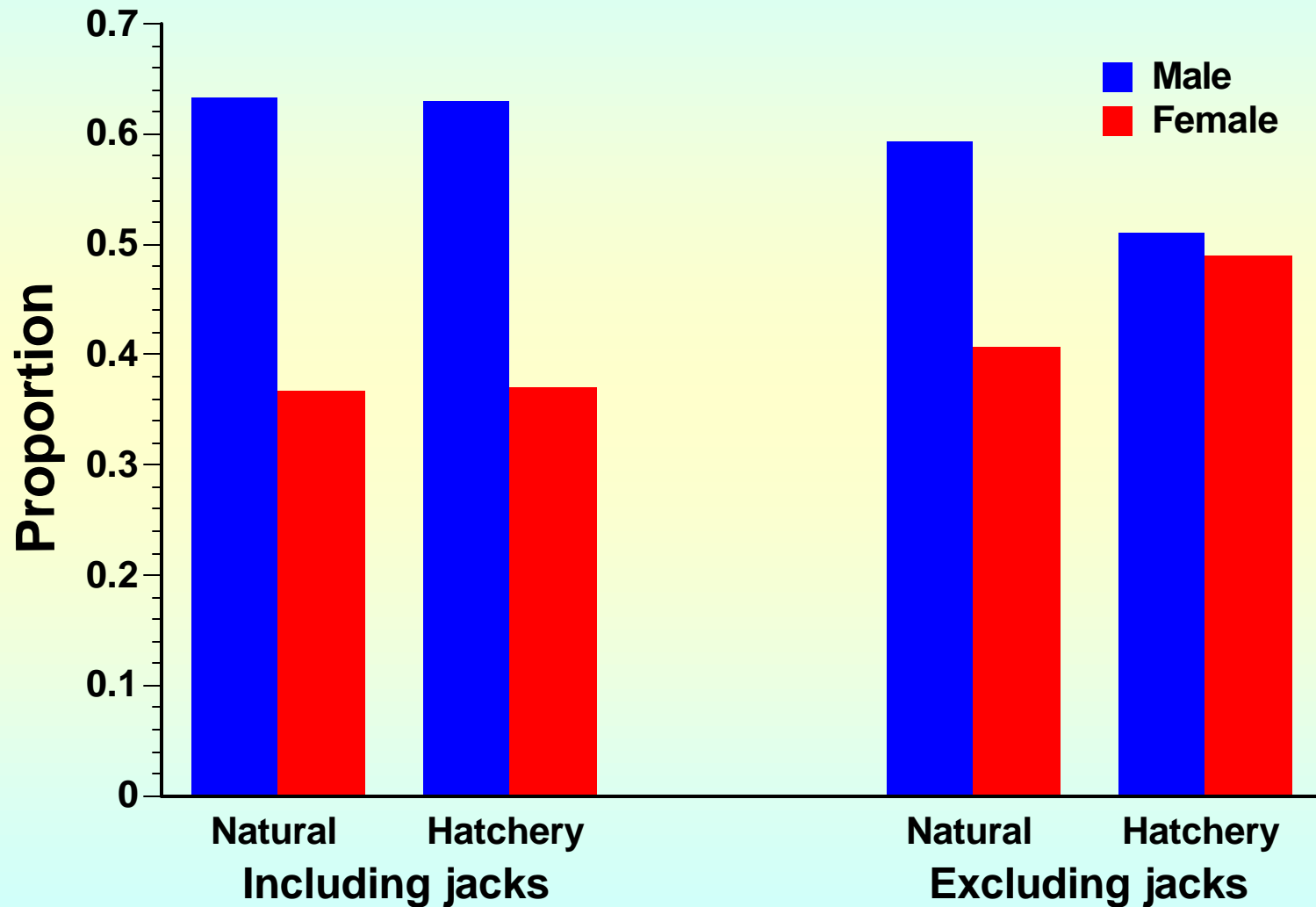
Age of Male Adults



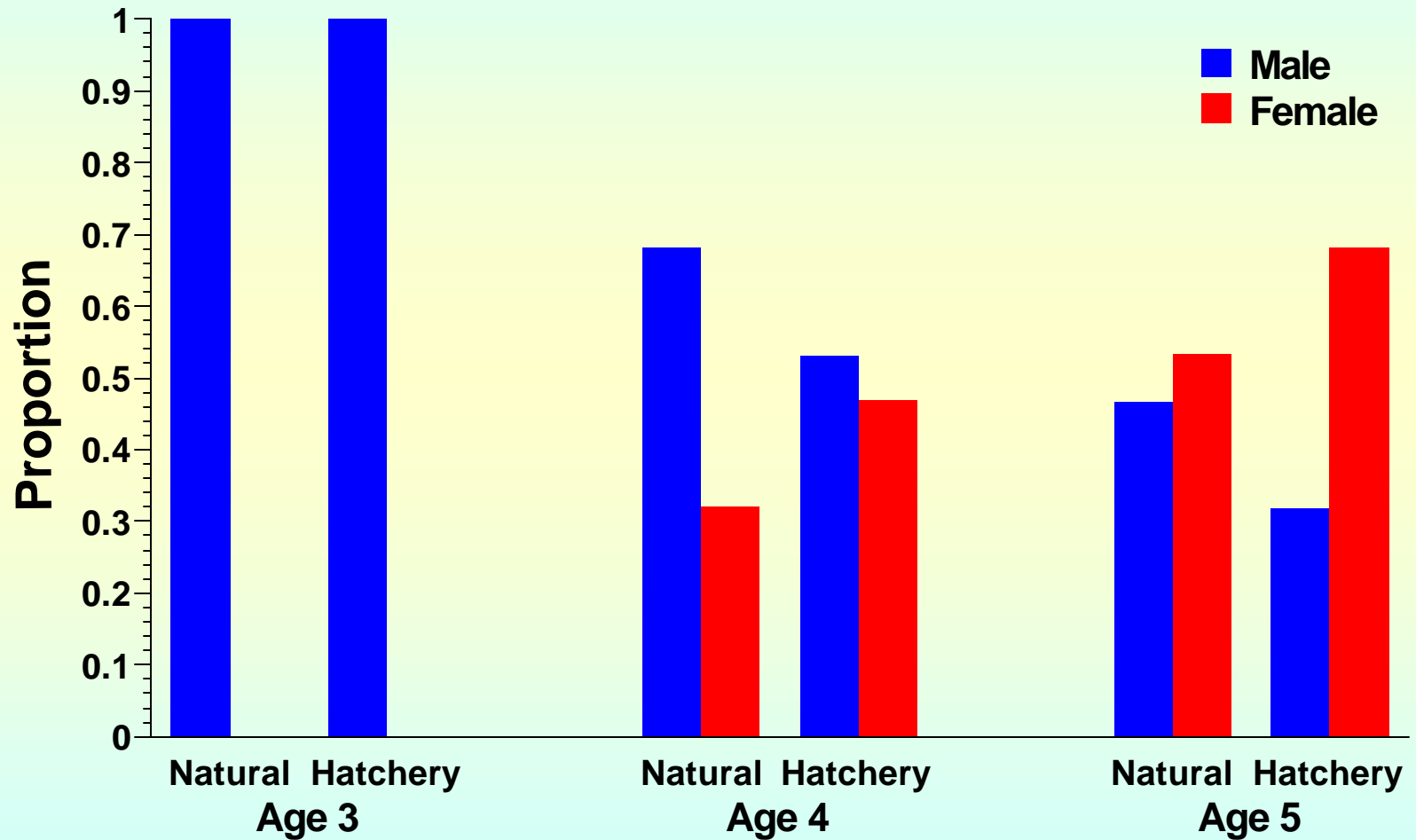
Proportion of Returns



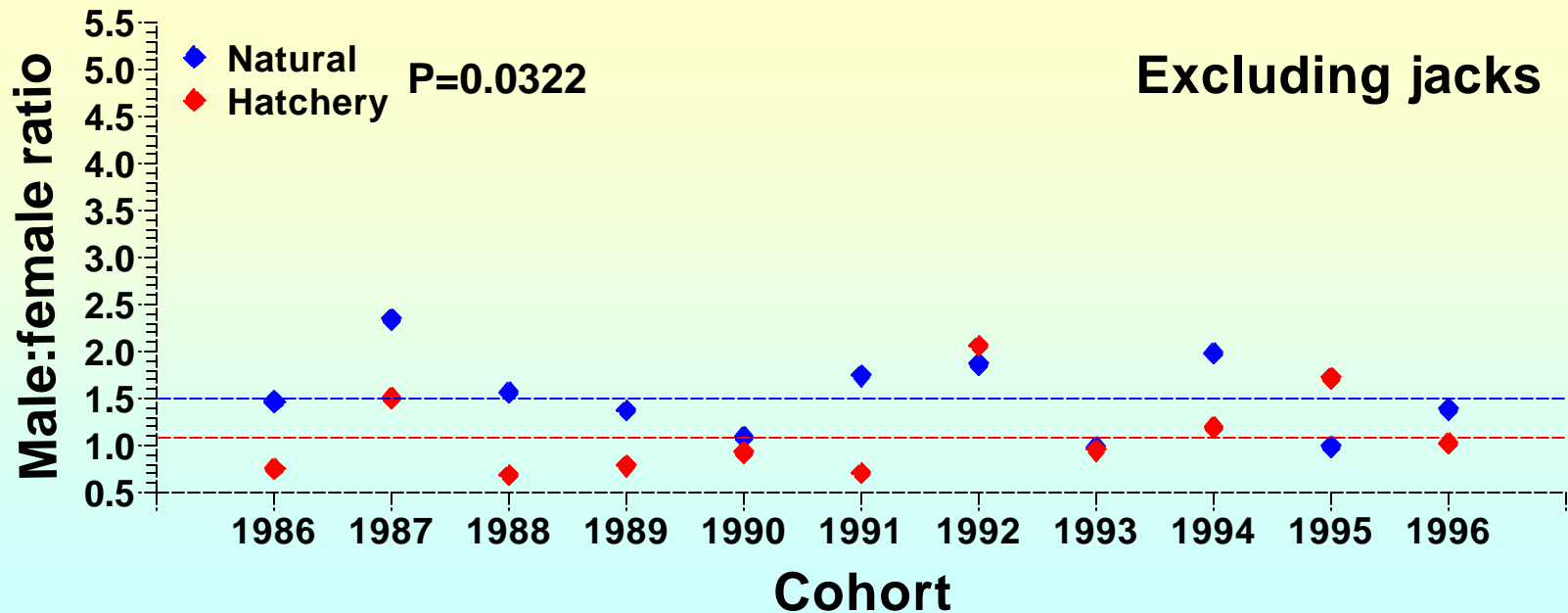
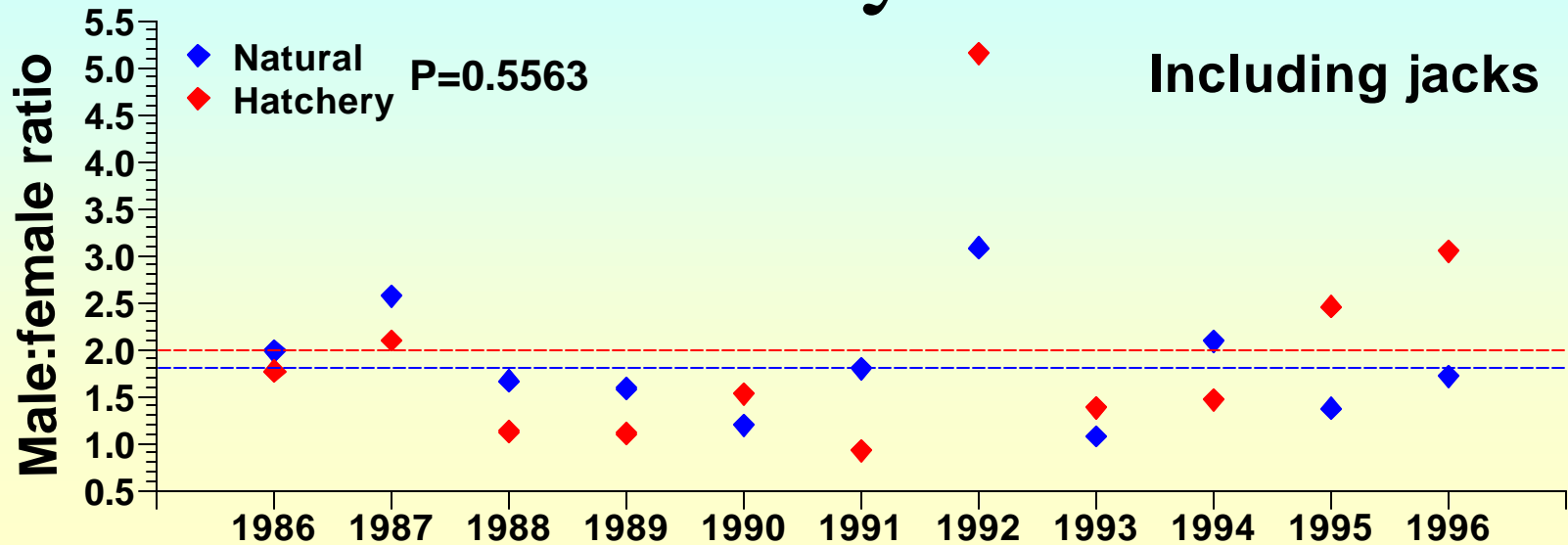
Sex Ratios



Sex Ratios by Age



Sex Ratio by cohort



Summary

Hatchery age structure is not similar to that of Natural fish.

- ❖ Hatchery fish matured at a younger age than Natural fish.
- ❖ Mean length at age of maturity was similar between Hatchery and Natural fish.
- ❖ Sex ratio was skewed towards males for both groups. Natural fish had a greater M:F ratio when jacks were excluded.
- ❖ Proportions of:
 - Age 3 males higher for Hatchery fish.
 - Age 4 males not different.
 - Age 5 males higher for Natural fish.
 - Age 4 females higher for Hatchery fish.
 - Age 5 females higher for Natural fish.

Conclusions

To deal with the large number of hatchery jacks, we:

- ❖ Limit release of hatchery-reared age 3 males into nature to levels similar to those occurring naturally (no more than 10% of all males).
- ❖ Use spawning matrices to incorporate jacks in hatchery spawning.
- ❖ Outplant hatchery jacks for nutrient enrichment of streams.

To reduce the number of hatchery jacks produced, we are developing growth and release strategies to attempt to produce age structures of returning hatchery adults that mimic natural age structures while maintaining high survival of hatchery fish to attain management objectives.