A Comparison of Life-History Traits in First-Generation Hatchery- and Wild-origin Upper Yakima River Spring Chinook Salmon

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

- operate as an integrated hatchery program

Integrated hatchery programs allow, "…the natural environment to drive the adaptation and fitness of a composite population of fish that spawns both in a hatchery and in the wild." (HSRG *et al.* 2004).

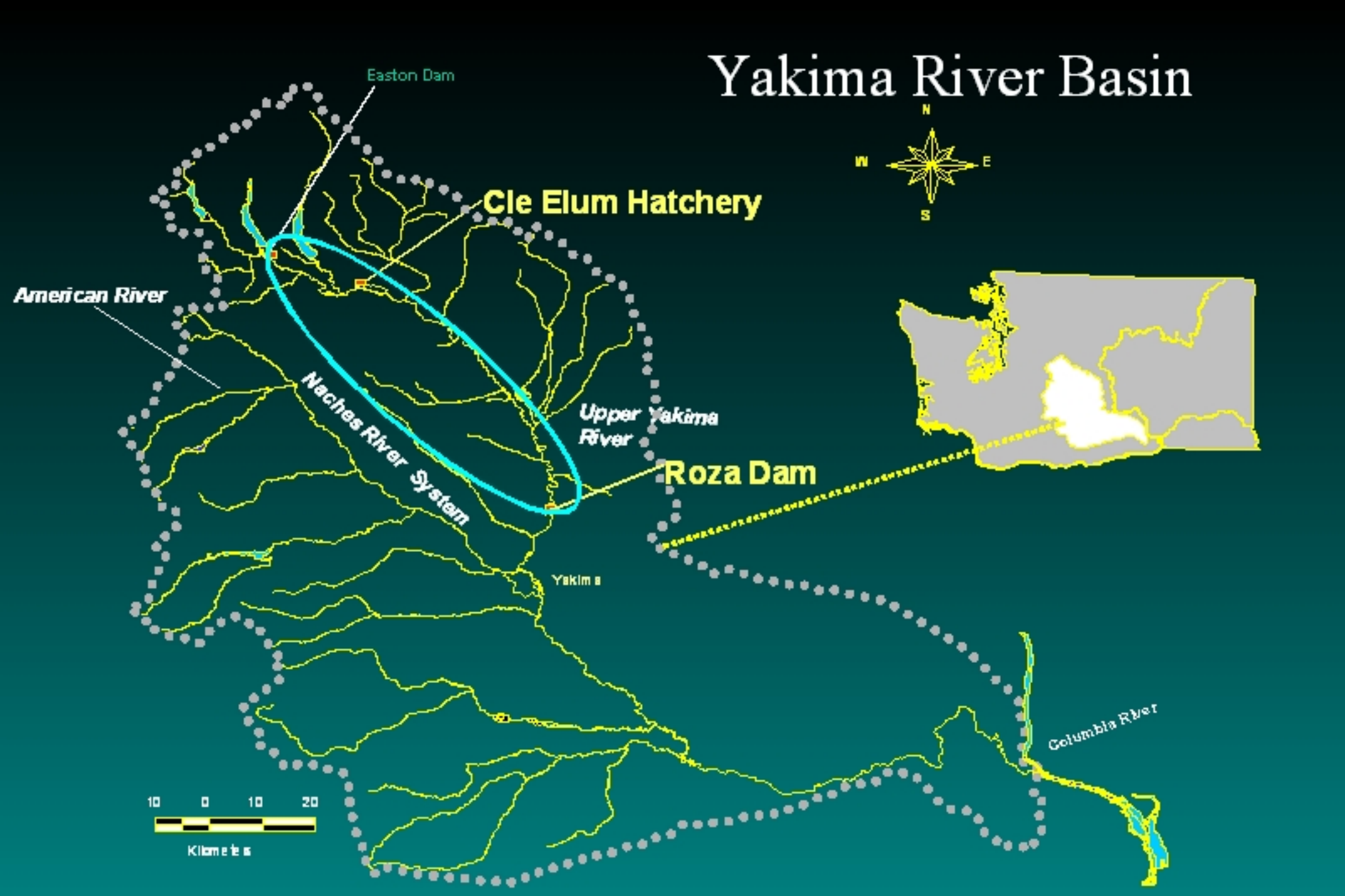
The YKFP spring chinook hatchery program was designed to minimize domestication effects.

- operate as an integrated hatchery program
- use only representative wild-origin broodstock
- limit the relative size of the program so as not to overwhelm the naturally spawning population
- 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 low rearing densities (see Hagar and Costello 1999)
- volitionally release juveniles at sizes comparable to wild-origin smolts

OBJECTIVE: Compare first generation hatchery and wild origin fish returning between 2000 and 2004. Do trait distributions of hatchery fish diverge from the integrated local wild population's?

- age composition
- size-at-age
- sex ratio
- passage timing at RAMF
- spawning timing (at CESRF and from in-river carcass recoveries)

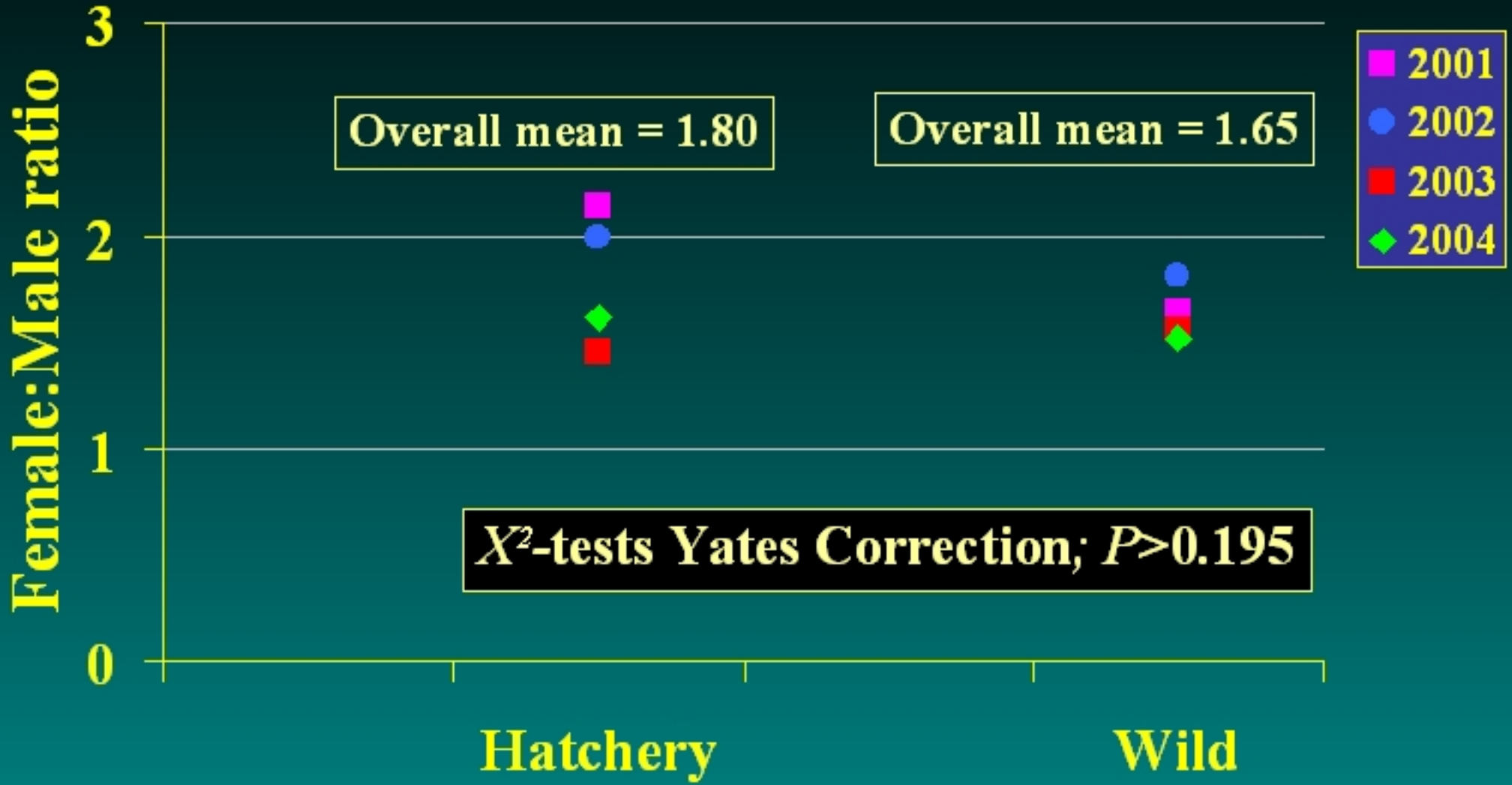
Yakima River Basin



Sex Ratios

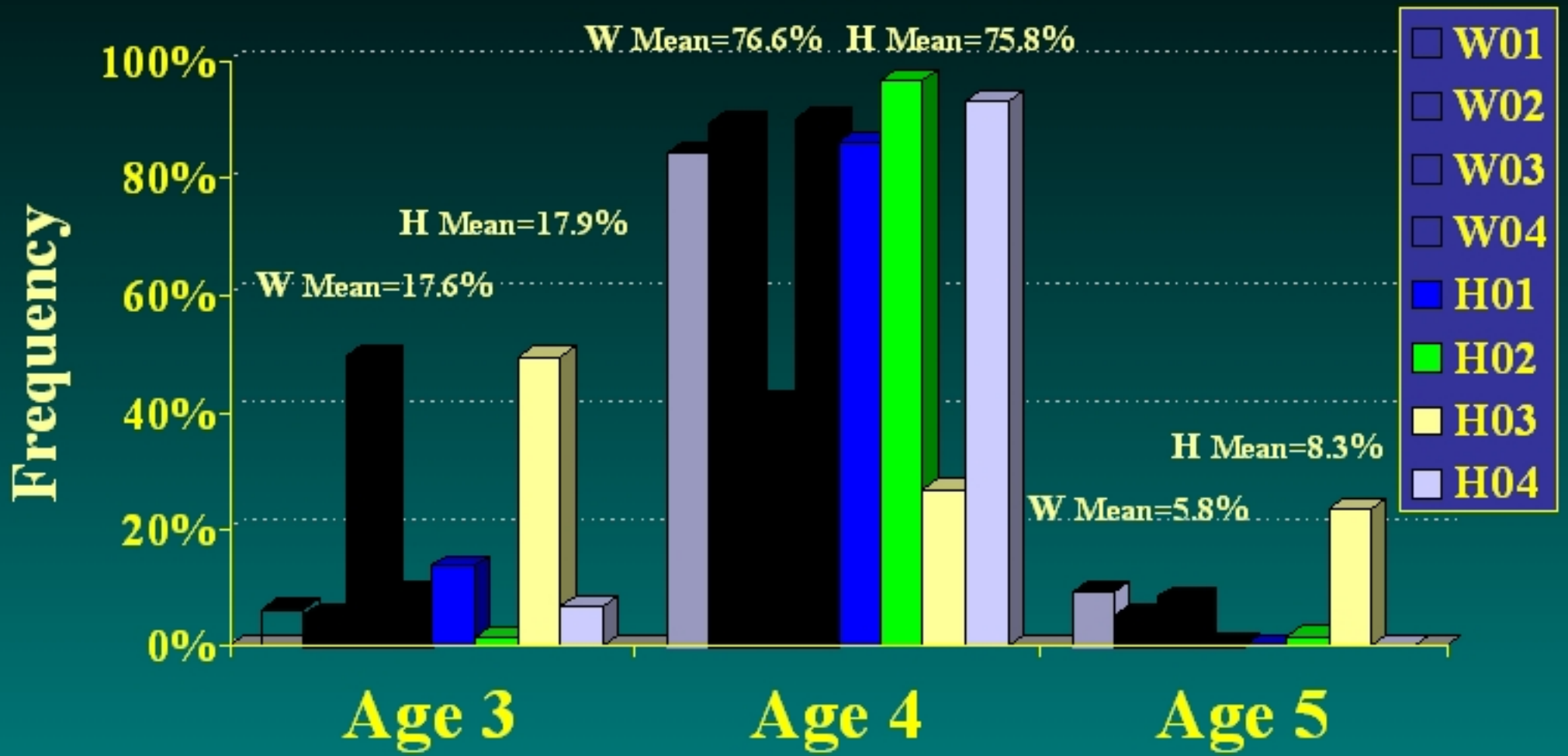
Sex Ratio Upper Yakima Age 4's

(*post mortem* samples)



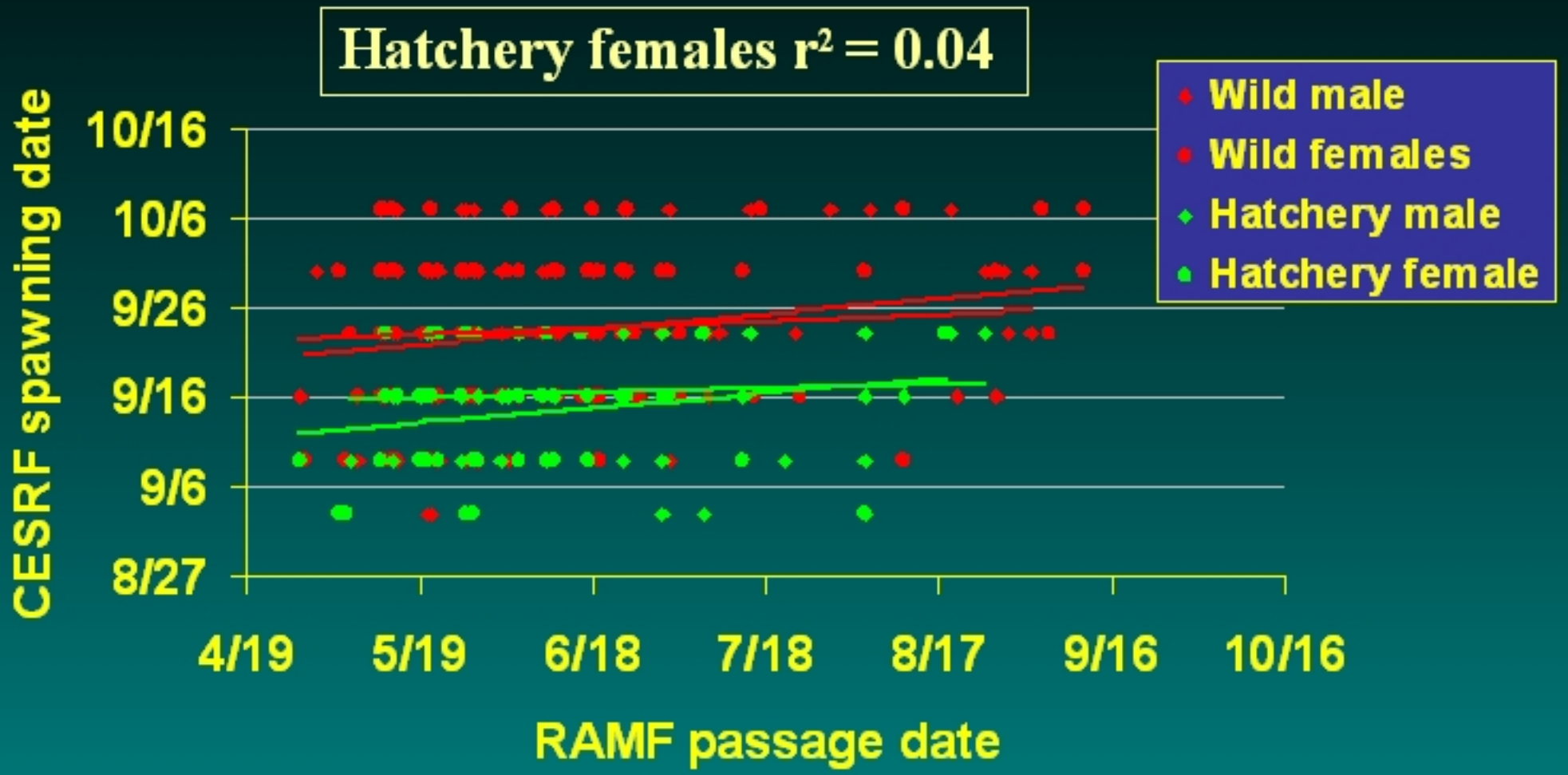
Age Composition

Upper Yakima Age Composition by Return Year

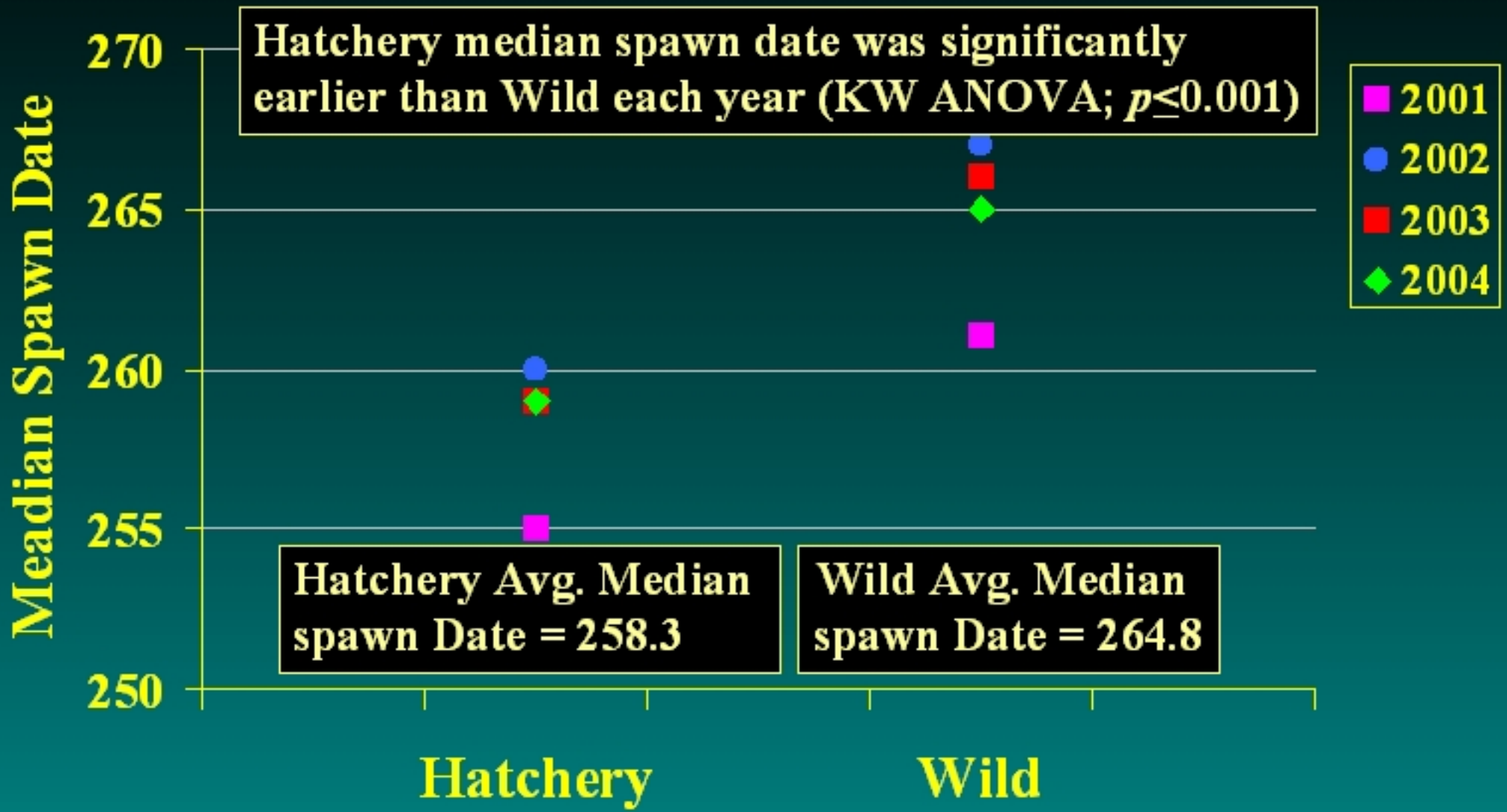


Migration and Spawn Timing

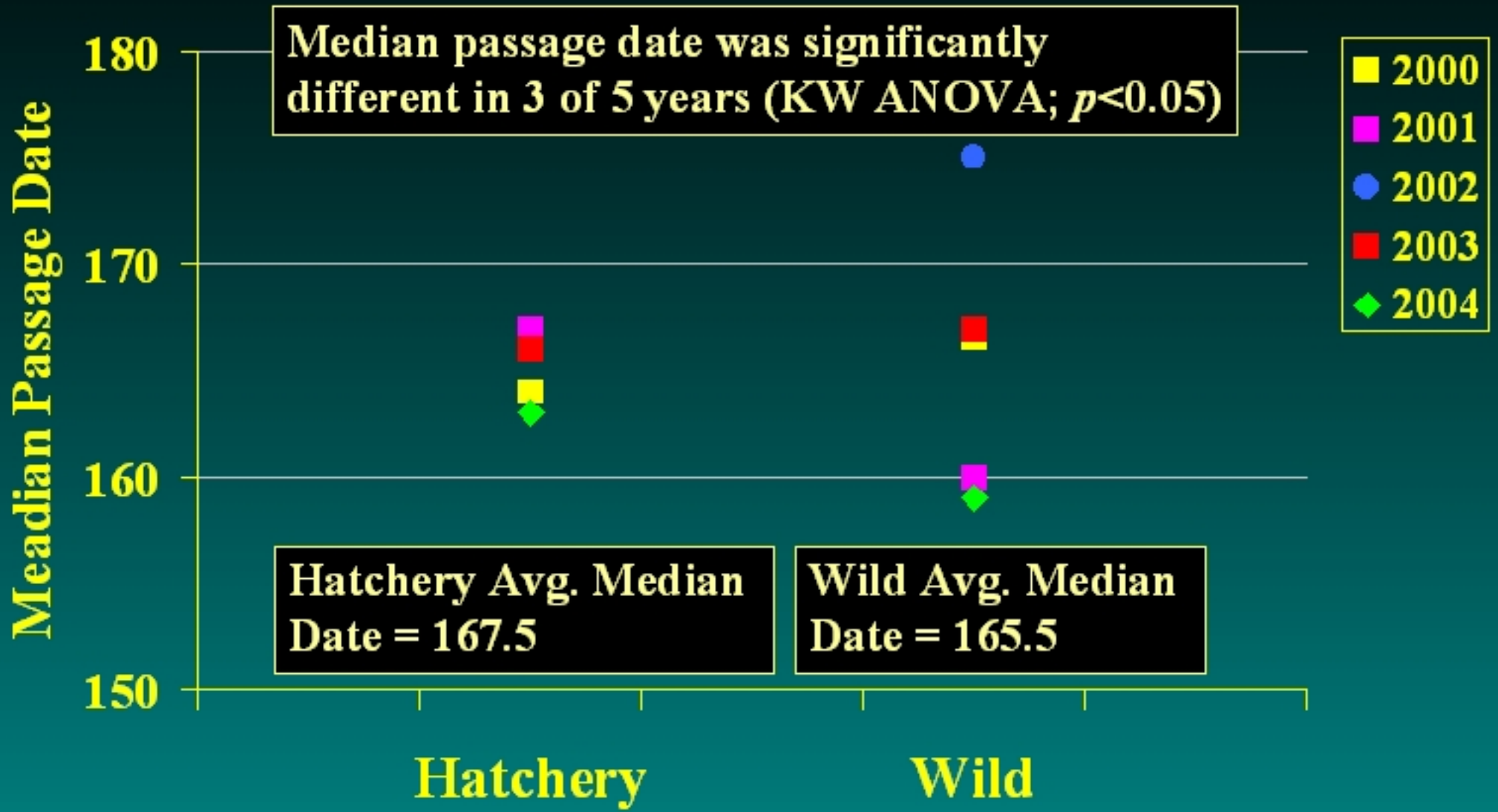
2003 Spawn Timing vs RAMF Passage



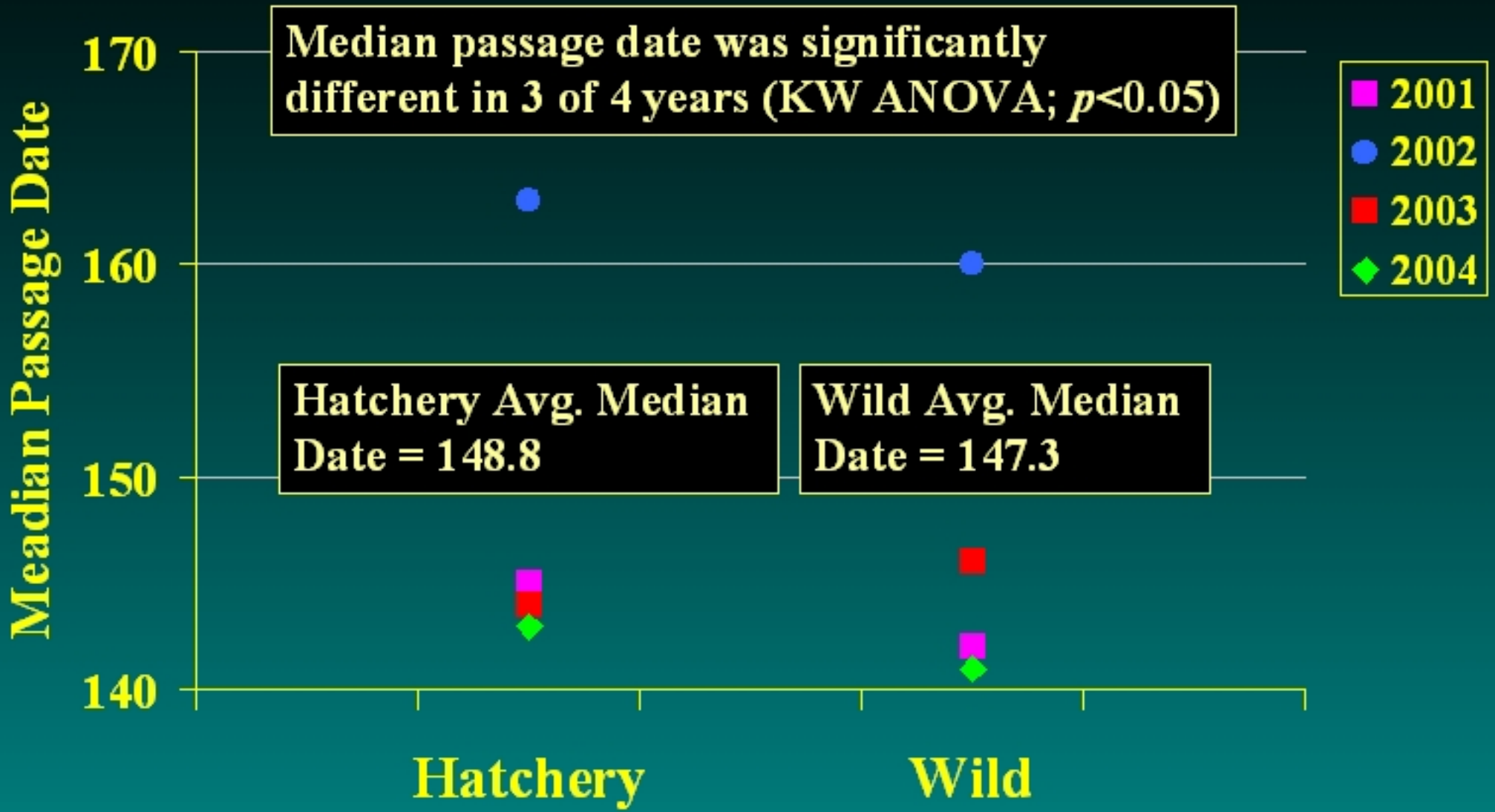
Spawn Timing At CESRF



Jack Median Passage Date At RAMF



Adult Median Passage Date At RAMF



Hatchery and wild median in-river carcass recovery timing (Julian days). No YN carcass recovery surveys occurred in 2003.

	2001		2002		2004	
	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild
Median	269	268	269	273	271	270
SD	6.9	6.5	7.6	7.5	4.1	6.8
N	145	181	184	79	177	78

Size-at-Age
(reflecting growth rates)

Age 3 Length


45
40
35
Mean POHP (cm)
2000
2001
2002
2003
2004
Mean difference = 2.7 cm
Wild
Hatchery

Age 3 Body Weight

Age 3: 2-Way ANOVA

POHP Length

Source	SSq	df	MS	F-ratio	*P*
Origin	1000.41	1	1000.41	71.28	0.000
Year	792.85	4	198.21	14.12	0.000
Origin*Year	62.05	4	15.51	1.11	0.352
Error	25012.03	1782	14.04		

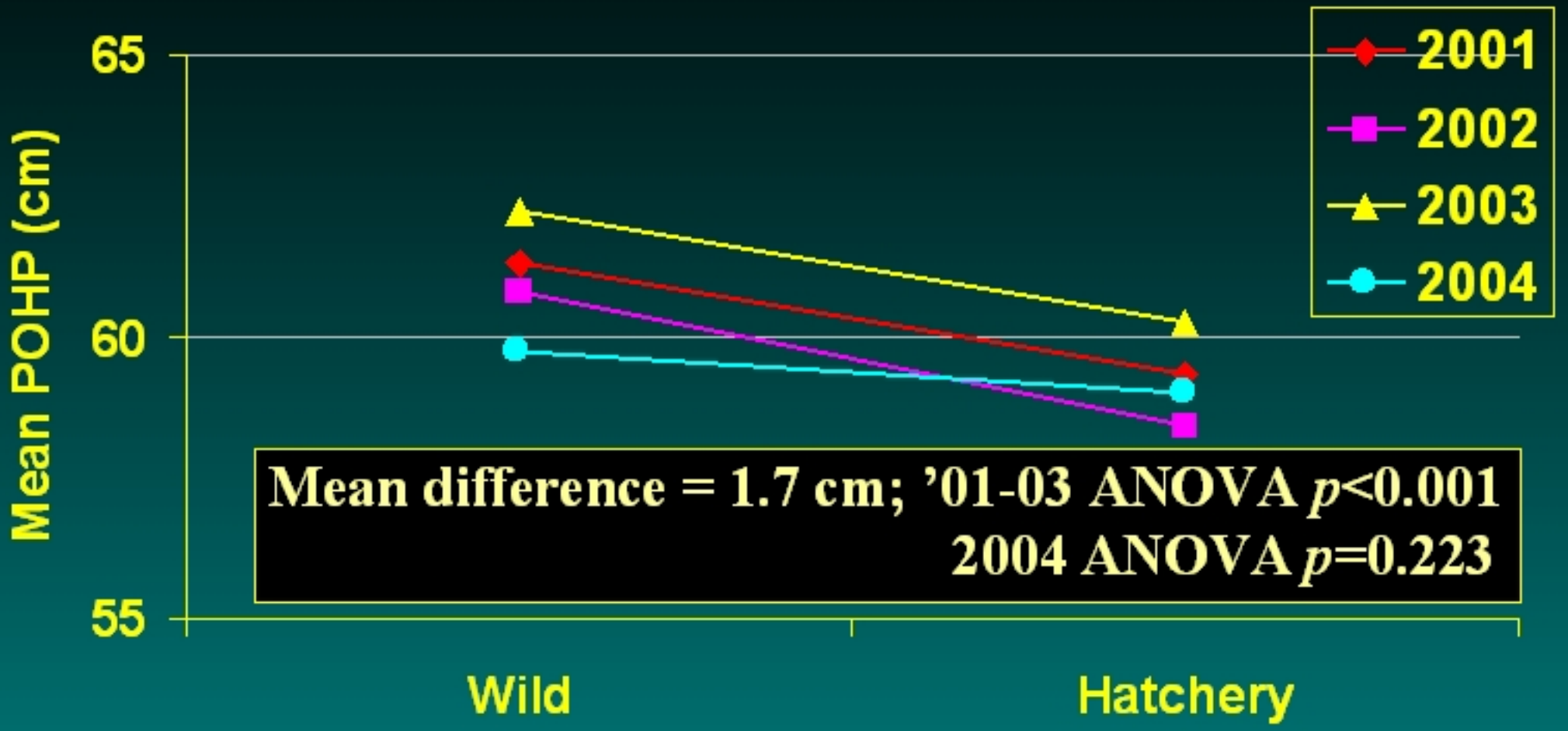
Body Weight

Source	SSq	df	MS	F-ratio	*P*
Origin	8.89	1	1000.41	55.10	0.000
Year	6.73	4	1.68	10.43	0.000
Origin*Year	1.44	4	0.36	2.23	0.063
Error	287.45	1782	0.16		

Age 4 Body Weight 2-Way ANOVA

Source	Sum-of-Squares	df	Mean-Square	F-ratio	*P*
Origin	55.333	1	55.333	80.930	0.000
Year	104.664	3	34.888	51.026	0.000
Origin*Year	21.906	3	7.302	10.680	0.000
Error	4389.497	6420	0.684		

Age 4 Length


65
60
55
Mean POHP (cm)
2001
2002
2003
2004
Mean difference = 1.7 cm; '01-03 ANOVA p<0.001
2004 ANOVA p=0.223
Wild
Hatchery

Age 4 Body Weight

Mean difference = 0.3 kg; '01-03 ANOVA $p<0.001$
2004 ANOVA $p=0.963$

Age 5 Length

Mean difference = 2.7 cm; '02-03 ANOVA $p<0.001$

Age 5 Body Weight

Mean difference = 0.8 kg; '02-03 ANOVA $p<0.001$

Body Size Trends

- Wild fish were larger at age (grew faster) in all years differing by as much a 1 SD
- The differences in body size were significant in all comparisons accept 2004 age 4's
- Differences observed in age-3 fish had to occur over the ~16 months after release
- The differences do not appear to be the result of selective fisheries

Conclusions: Hatchery vs. Wild Quantitative and Life History Traits

- Age Composition and Sex Ratios of hatchery and wild fish were similar or showed no trends.
- Hatchery and wild passage at RAMF was significantly different in some years, but the differences were relatively small with no trend.
- Spawn timing of Hatchery fish at CESRF was consistently earlier by 7 days in all years, but not in in-river carcass recoveries.
- Hatchery fish were significantly smaller then wild fish due to reduced growth rate.