

*Comparison of Life-History Traits  
Between 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.**

- **operated as an integrated hatchery program**
- **use only 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 from broodyears 1997 to 2000.**

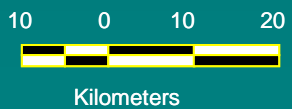
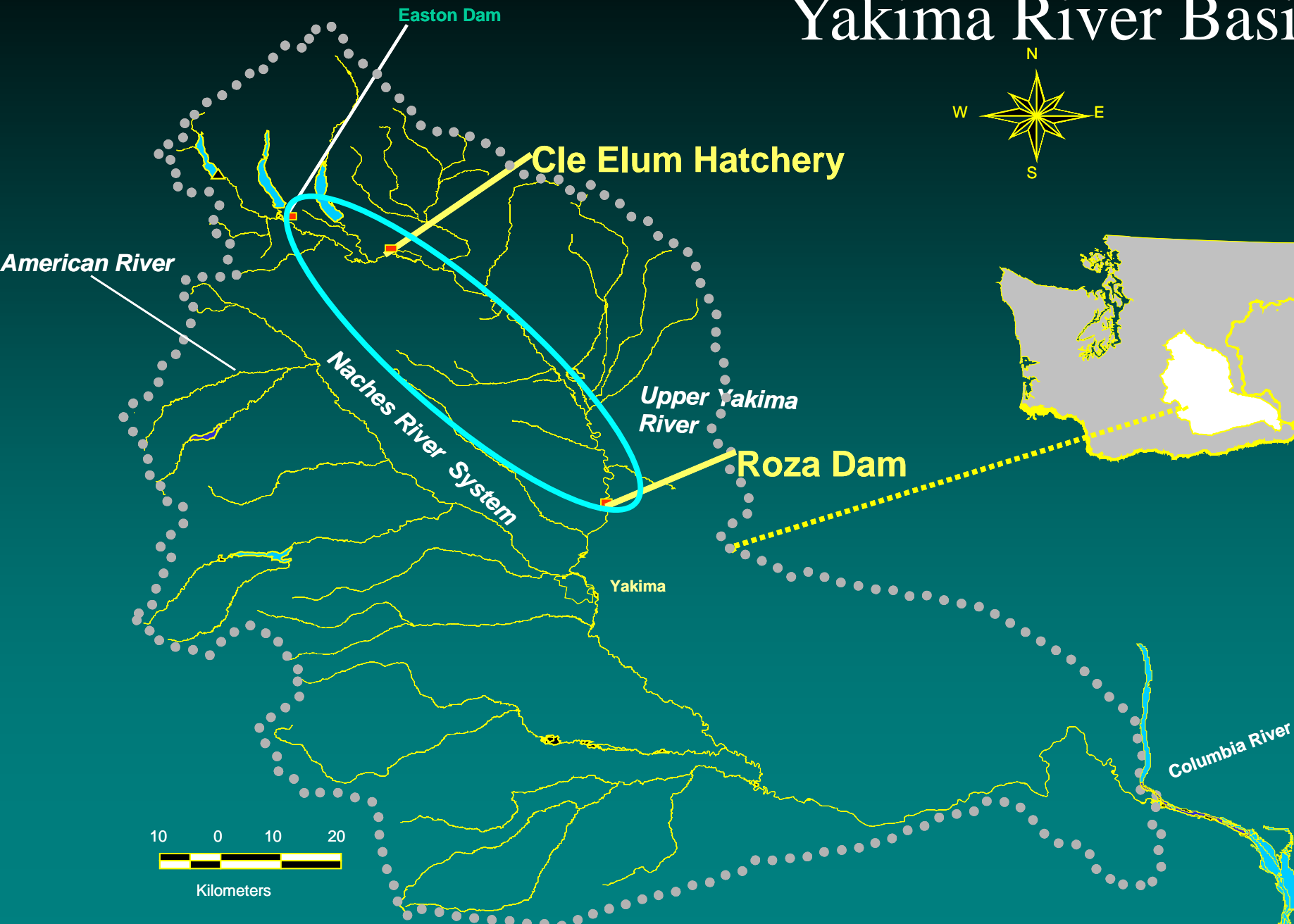
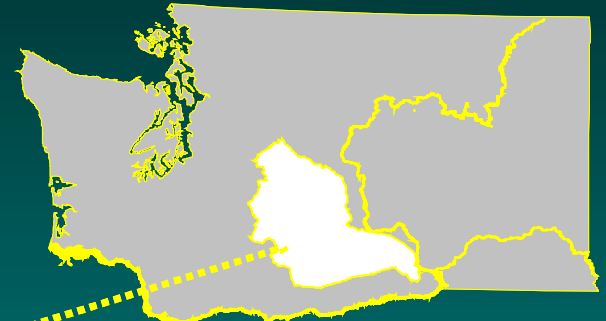
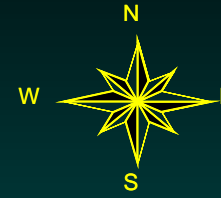
		First Generation				Second Generation							
		Hatchery fish begin returning to spawn				First NORs from naturally spawning hatchery fish							
Brood Year→		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Time ↓	2000	3											
	2001	4	3										
	2002	5	4	3									
	2003		5	4	3								
	2004			5	4	3							
	2005				5	4	3						
	2006					5	4	3					
	2007						5	4	3				
	2008							5	4	3			

**OBJECTIVE: Compare first generation hatchery and wild origin fish returning from broodyears 1997 to 2000.**

**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**

# Yakima River Basin

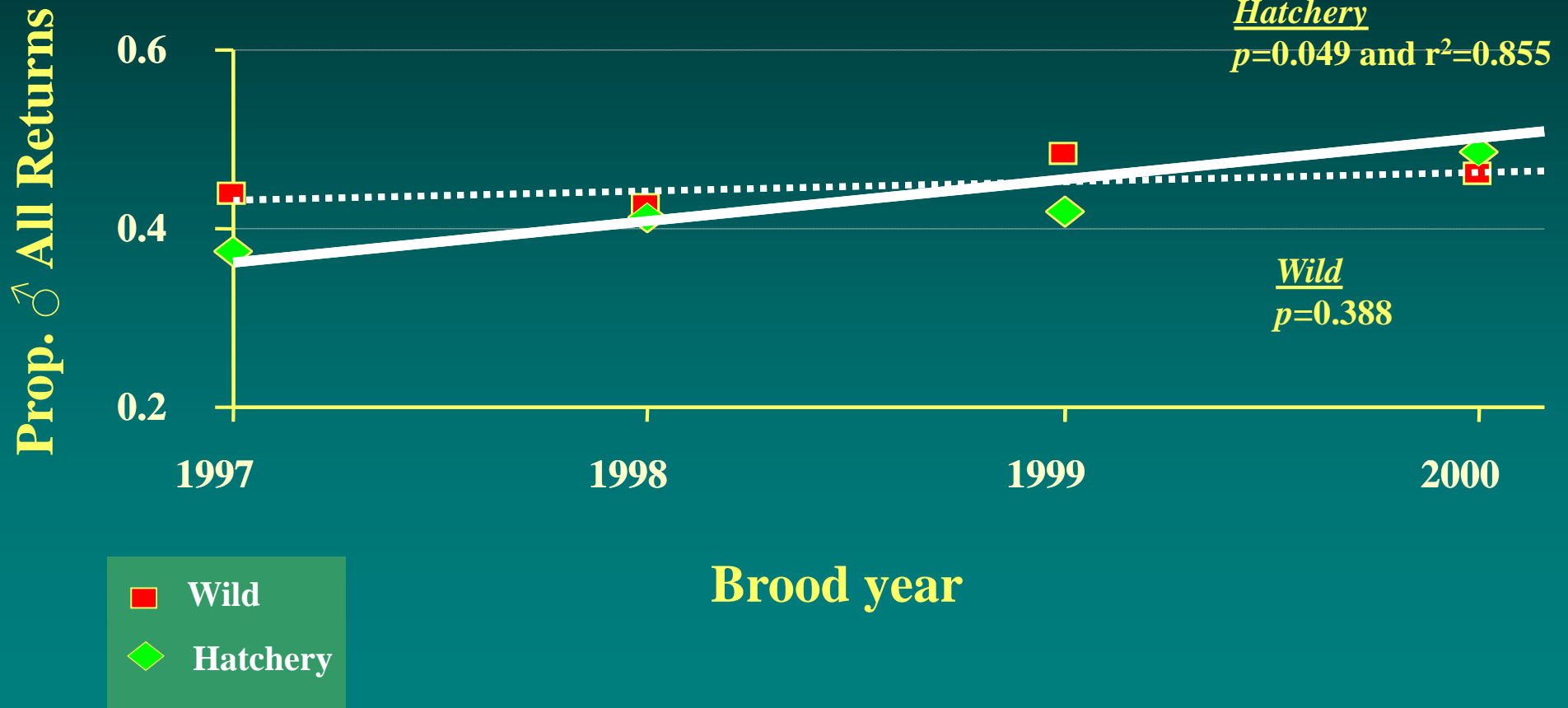


# Sex Composition

A photograph showing a dissected fish specimen, likely a salmon, laid out on a dark surface. A yellow ruler is placed below the specimen for scale, with markings in centimeters and millimeters. A hand is visible at the top, holding the specimen. The text "Sex Composition" is overlaid in white, bold, serif font in the center of the image. The fish's internal organs, including the reddish-pink gonads, are clearly visible.



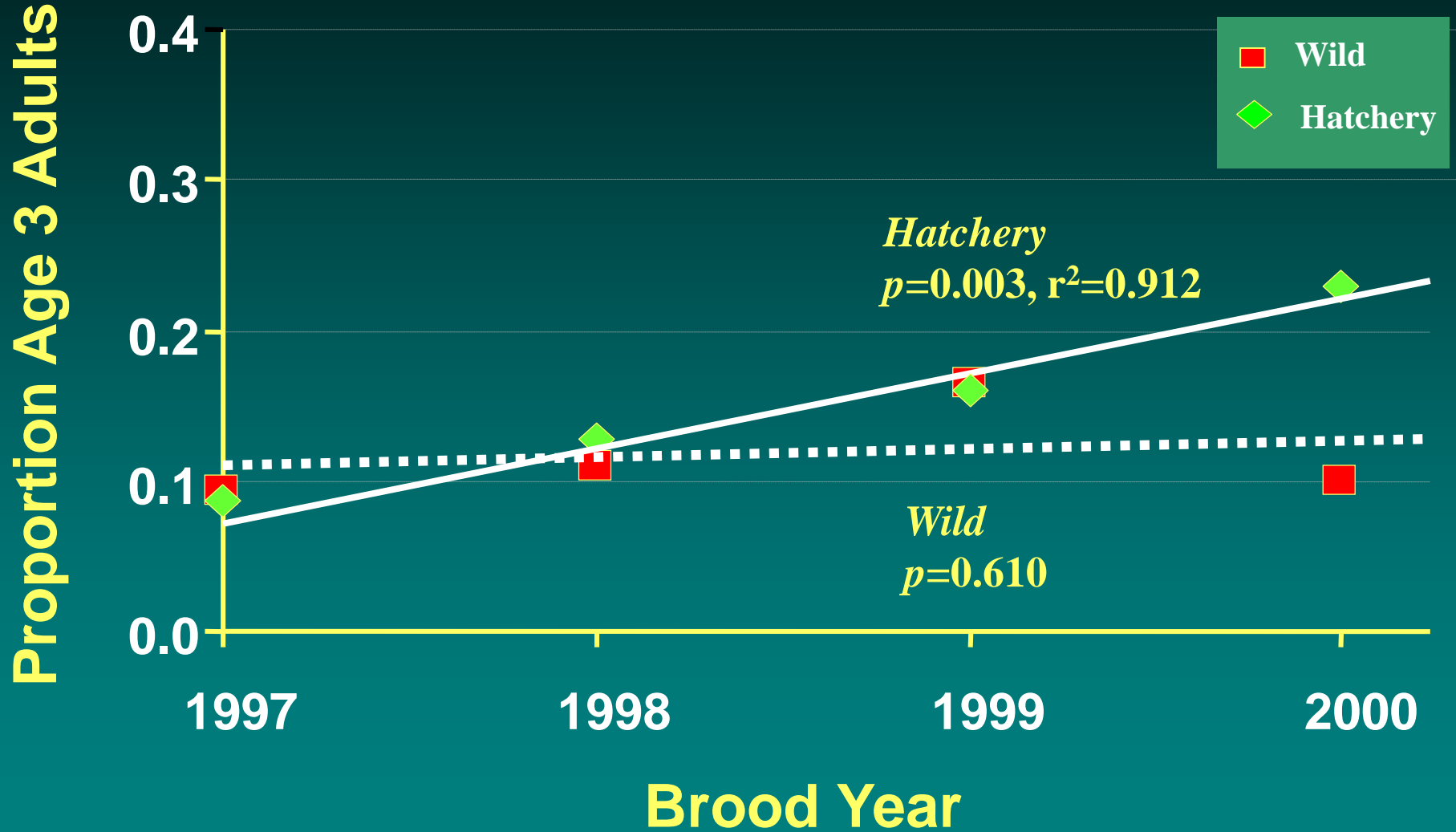
# Proportion ♂ Upper Yakima: All ages (*post mortem* CESRF samples)



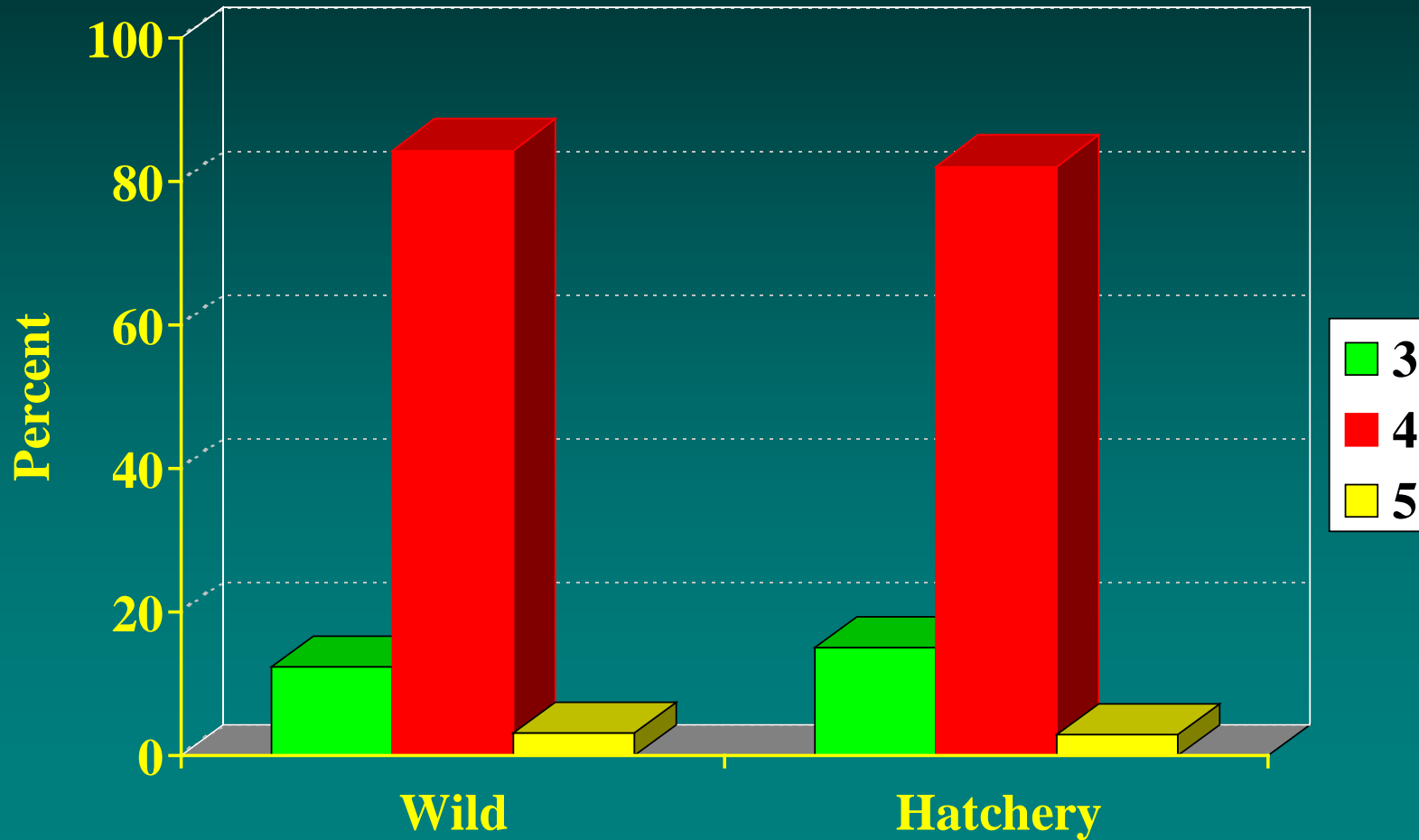


# Age Composition

# Proportion Age 3 Adults



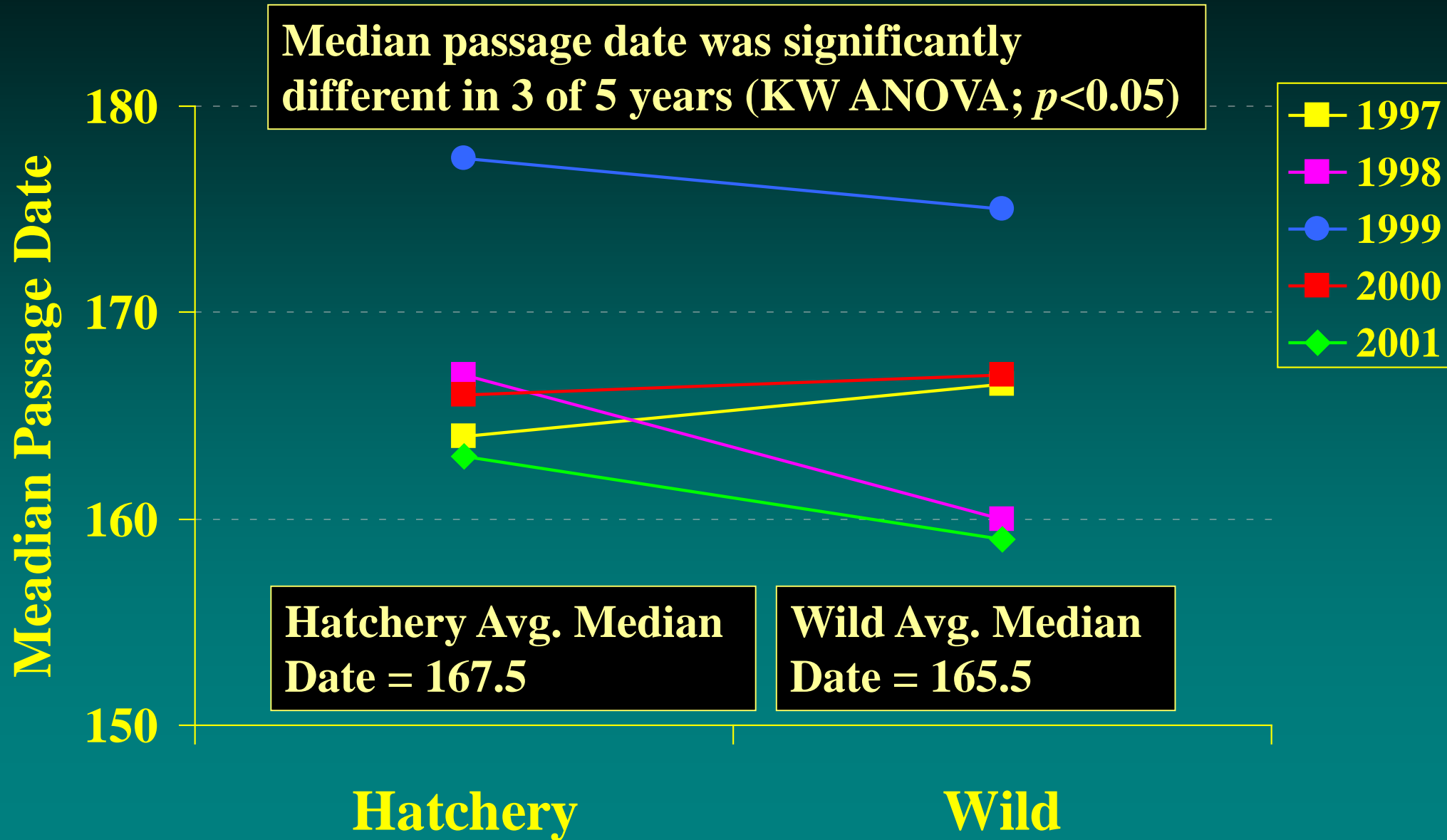
# Mean Age Composition: BY 1997-2000



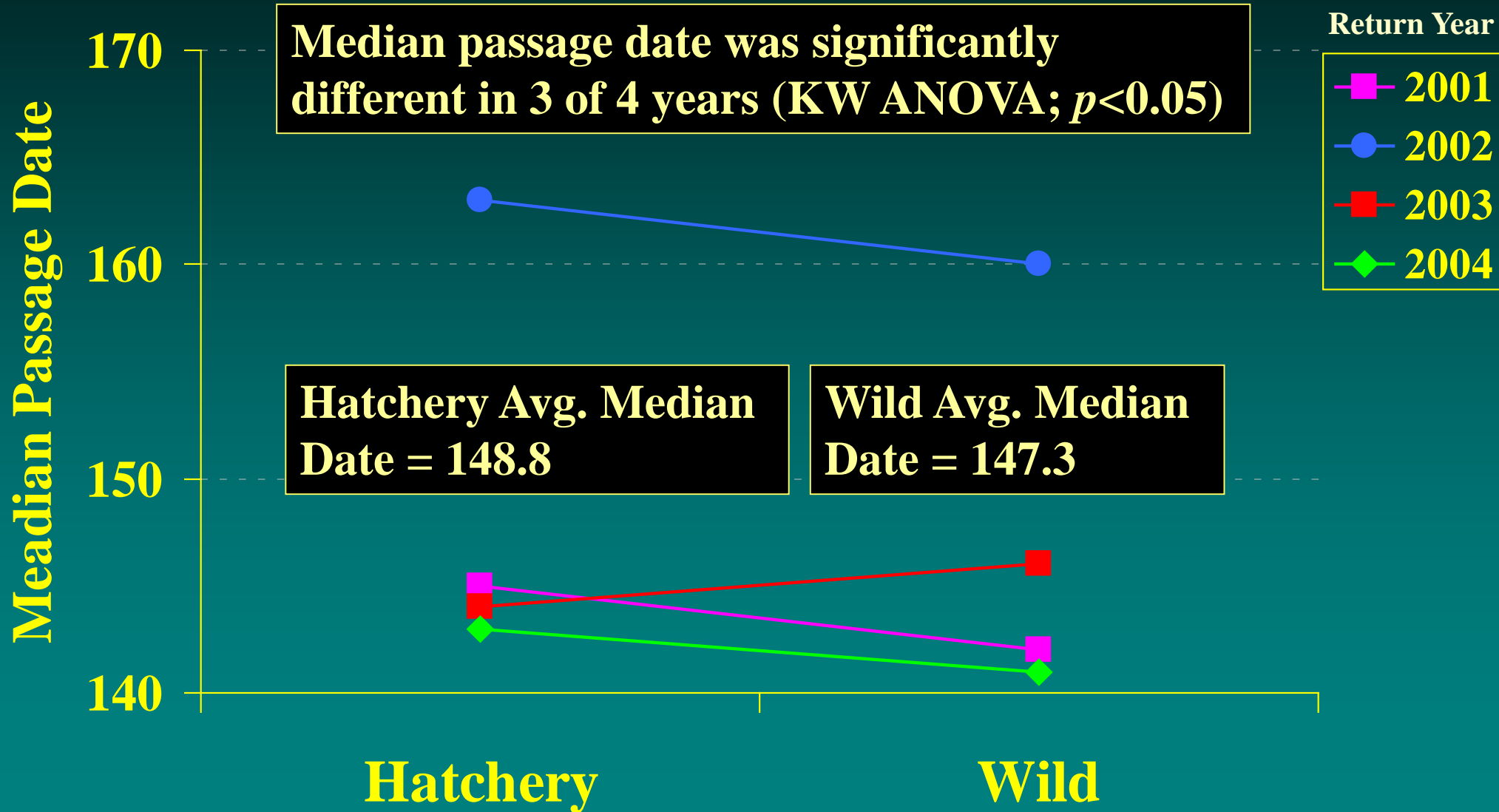
# Migration and Spawn Timing

An aerial photograph of a rugged, rocky coastline. The water is dark blue, and the rocks are a mix of grey, brown, and green. A large, dark, irregularly shaped opening, possibly a cave or a deep crevice, is visible in the center of the image. The overall scene is natural and somewhat desolate.

# Age 3 Median Passage Date At RAMF

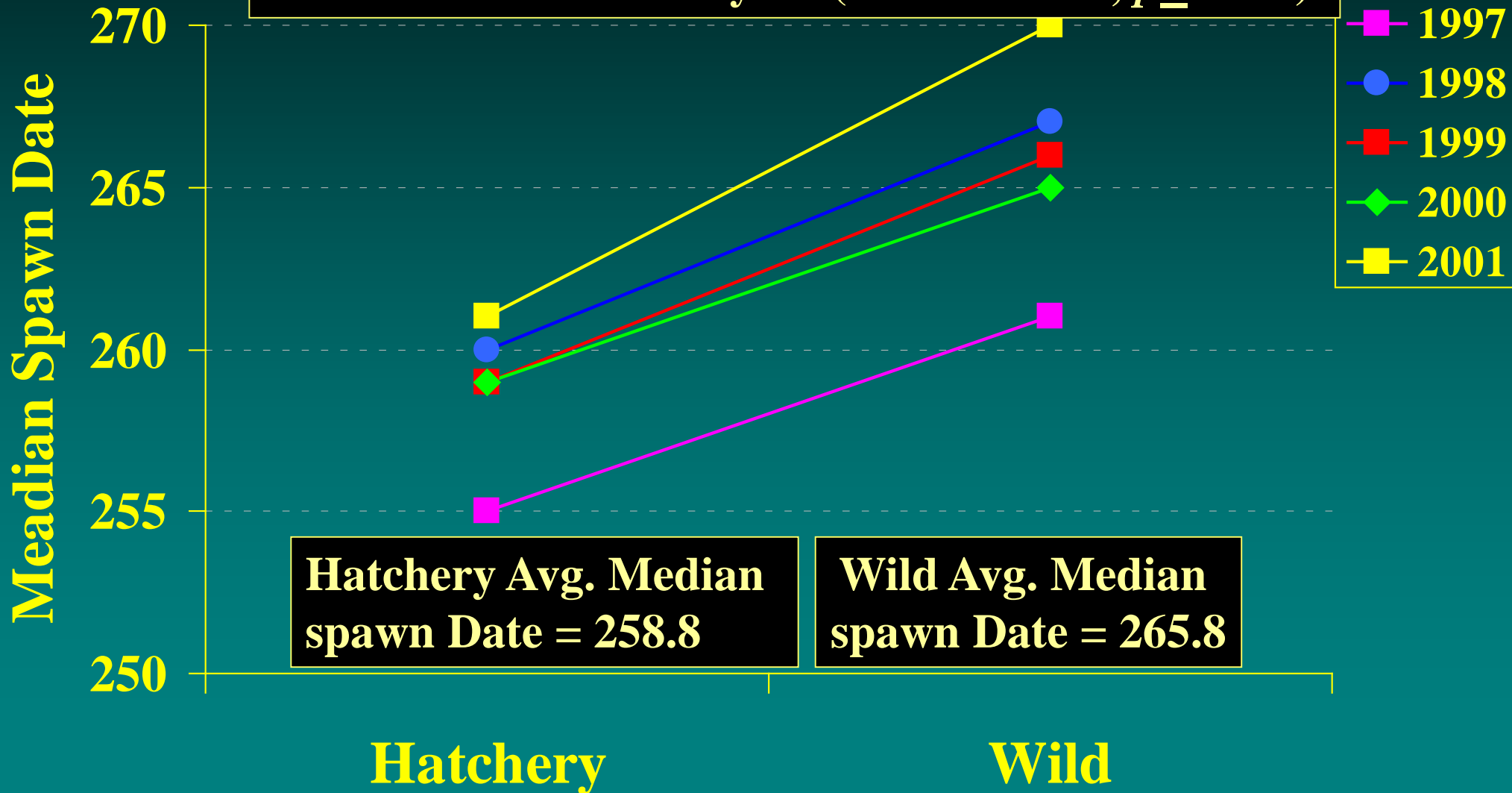


# Age 4 and 5 Median Passage Date At RAMF



# Spawn Timing At CESRF

Hatchery median spawn date was significantly earlier than Wild each year (KW ANOVA;  $p \leq 0.001$ )

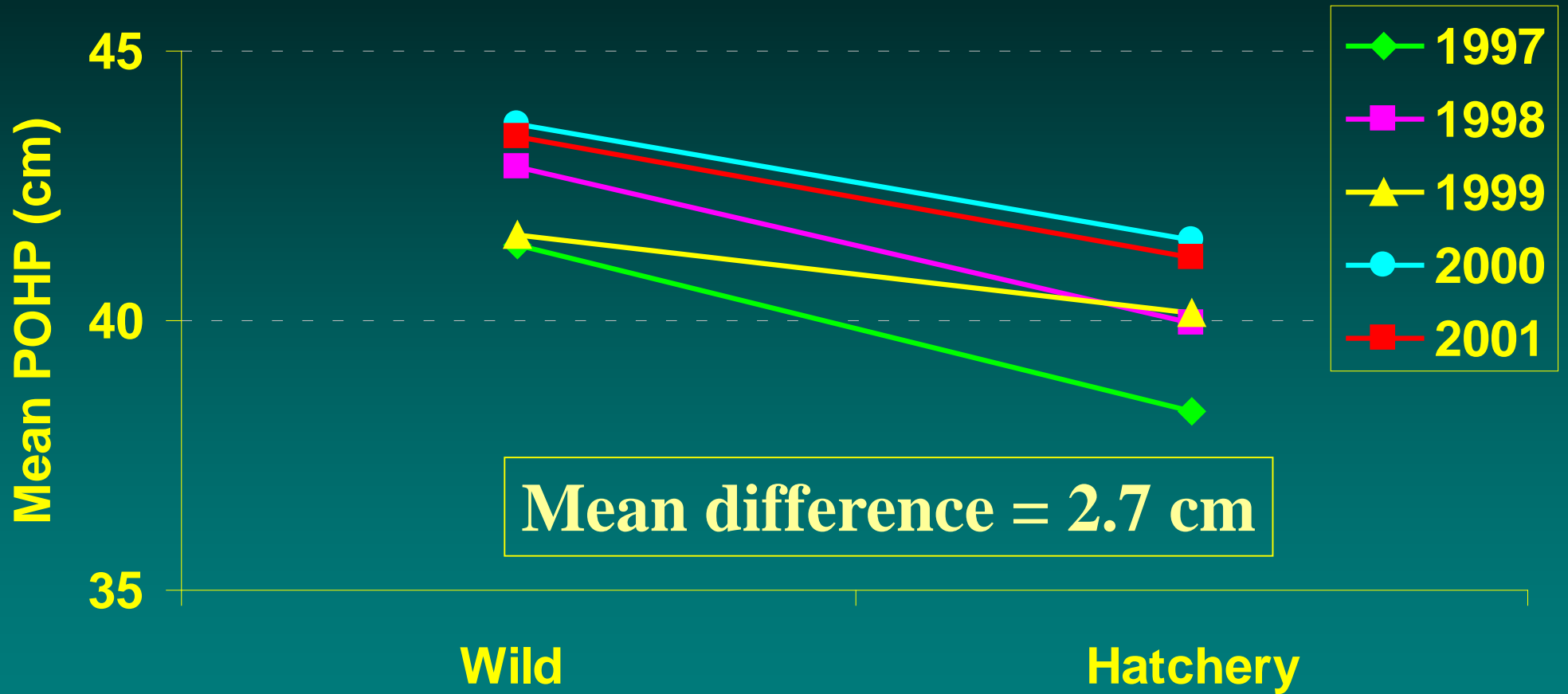




# Size-at-Age (reflecting growth rates)



# Age 3 Length



# Age 3 Body Weight



### Age 3: 2-Way ANOVA

#### POHP Length

Source	SSq	df	MS	F-ratio	<i>P</i>
<b>Origin</b>	<b>1000.41</b>	<b>1</b>	<b>1000.41</b>	<b>71.28</b>	<b>&lt;0.001</b>
<b>Year</b>	<b>792.85</b>	<b>4</b>	<b>198.21</b>	<b>14.12</b>	<b>&lt;0.001</b>
<b>Origin*Year</b>	<b>62.05</b>	<b>4</b>	<b>15.51</b>	<b>1.11</b>	<b>0.352</b>
<b>Error</b>	<b>25012.03</b>	<b>1782</b>	<b>14.04</b>		

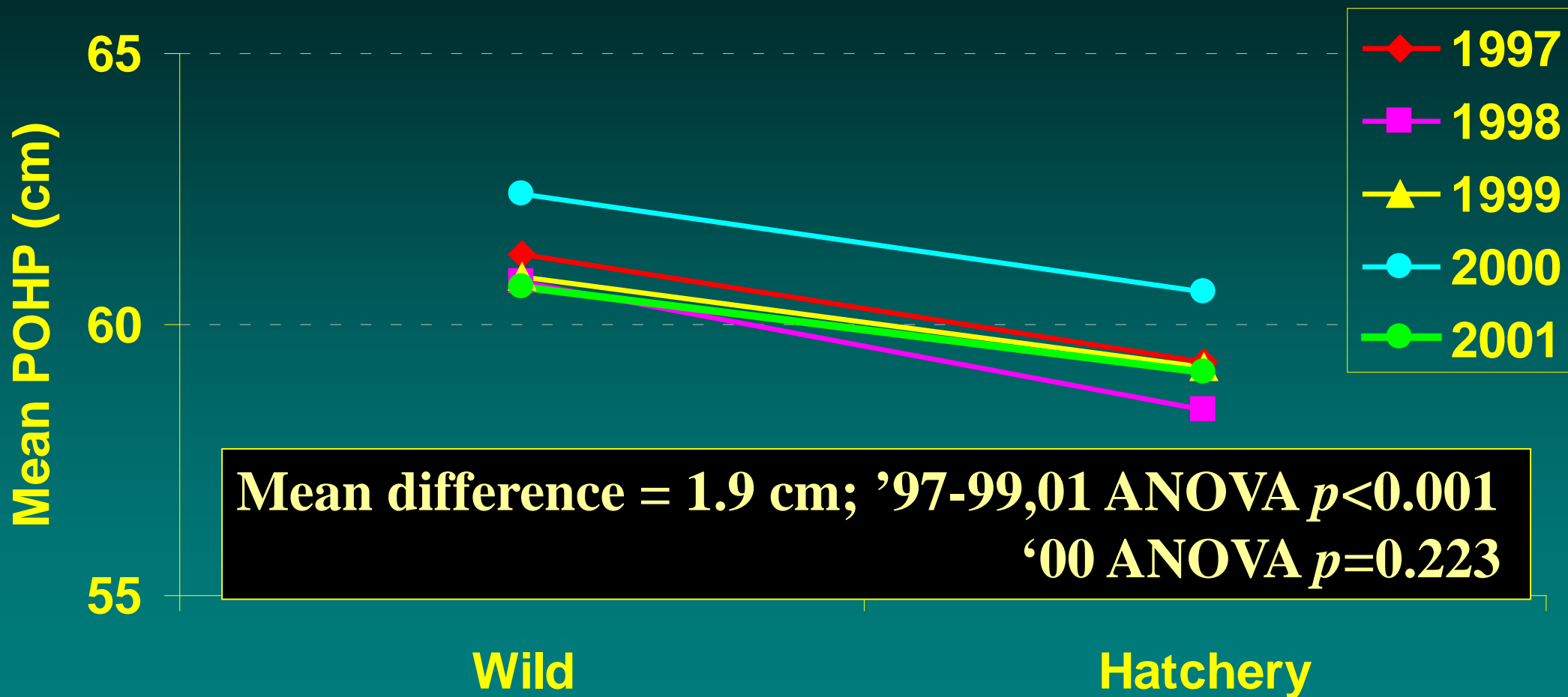
#### Body Weight

Source	SSq	df	MS	F-ratio	<i>P</i>
<b>Origin</b>	<b>8.89</b>	<b>1</b>	<b>8.89</b>	<b>55.10</b>	<b>&lt;0.001</b>
<b>Year</b>	<b>6.73</b>	<b>4</b>	<b>1.68</b>	<b>10.43</b>	<b>&lt;0.001</b>
<b>Origin*Year</b>	<b>1.44</b>	<b>4</b>	<b>0.36</b>	<b>2.23</b>	<b>0.063</b>
<b>Error</b>	<b>287.45</b>	<b>1782</b>	<b>0.16</b>		

## Age 4 Body Weight 2-Way ANOVA

Source	Sum-of-Squares	df	Mean-Square	F-ratio	<i>P</i>
Origin	55.333	1	55.333	80.930	<0.001
Year	104.664	3	34.888	51.026	<0.001
Origin*Year	21.906	3	7.302	10.680	<0.001
Error	4389.497	6420	0.684		

# Age 4 Length

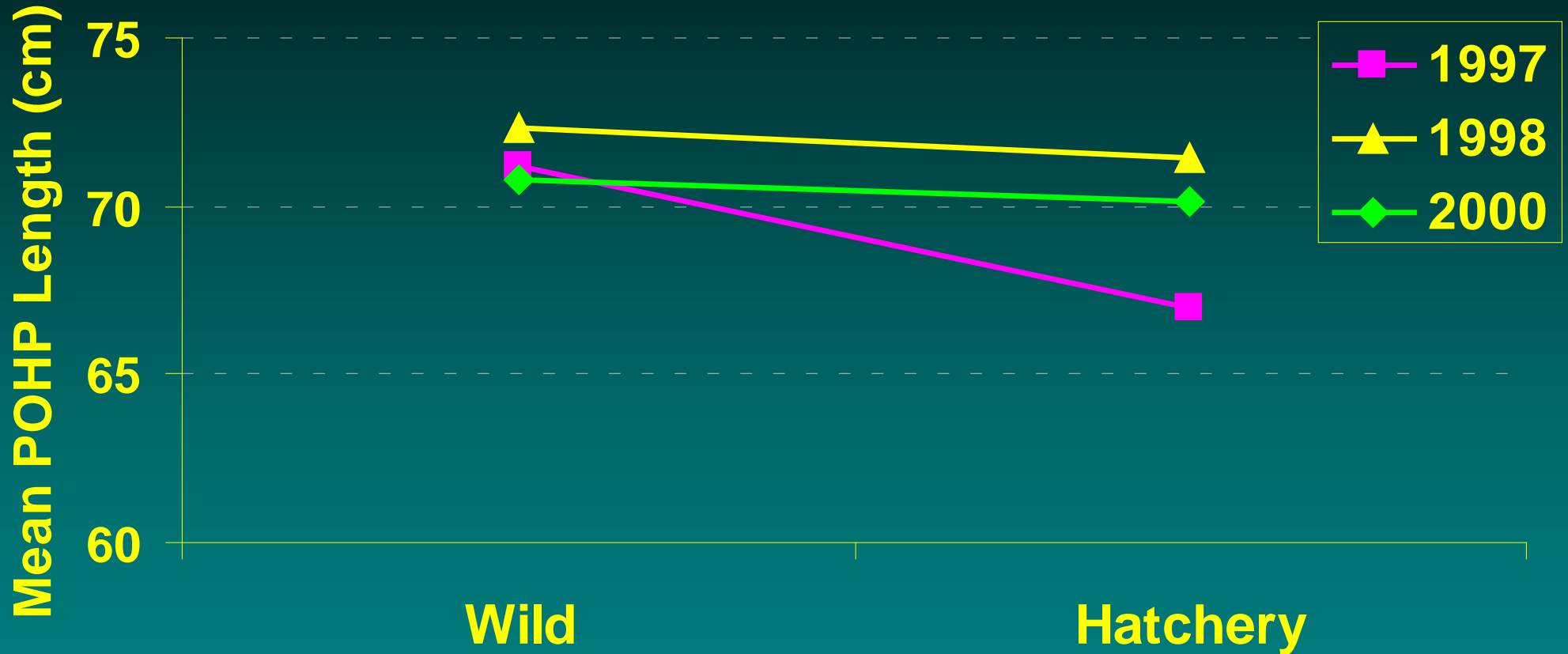


# Age 4 Body Weight



Mean difference = 0.3 kg; '97-99, 01 ANOVA  $p < 0.001$   
'00 ANOVA  $p = 0.963$

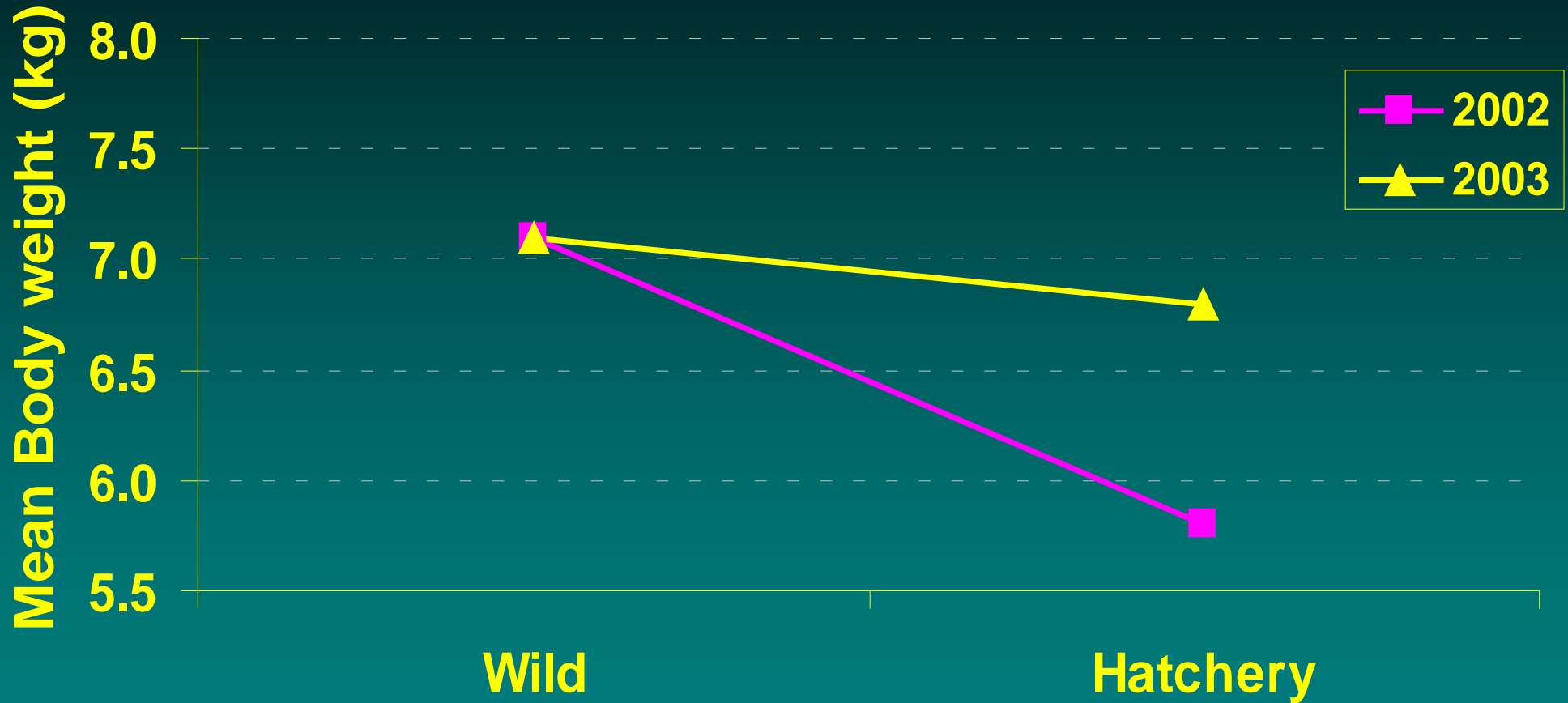
# Age 5 Length



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

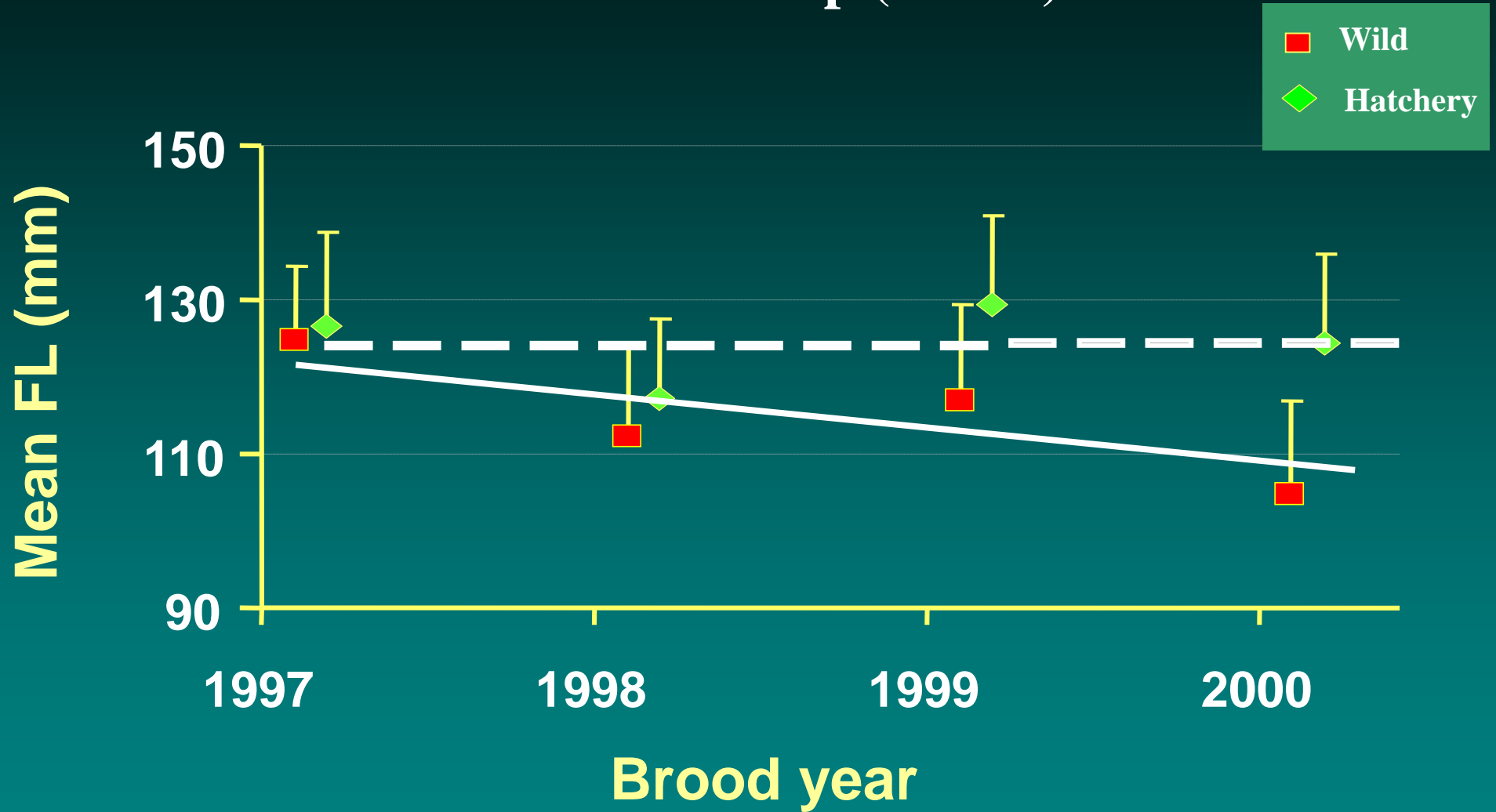


# Age 5 Body Weight



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

# Fork length of hatchery and wild smolts at Roza Trap (+1 SD)



# Conclusions: 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 except BY2000 age 4's**
- **Differences observed in age-3 fish had to occur sometime over the ~16 months after release**
- **The differences do not appear to be the result of smolt size differences or selective fisheries**

# Conclusions: Hatchery vs. Wild Life History Traits

- **Age Composition** – increasing proportion of hatchery age 3 returns.
- **Sex Ratios** – increasing proportion of hatchery male returns.
- **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.

# Acknowledgements

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





# Prop. ♂ Up Yakima R: Ages 4 and 5

