

**Morphometric Differences between  
Natural- and Hatchery-Origin  
Adult Spring Chinook after One  
Generation of Hatchery Culture**

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# **Morphological Change in Adults due to Domestication: Predictions**

**Fish will become more fusiform**

**Secondary sexual characteristics will  
become less pronounced**

# Methods

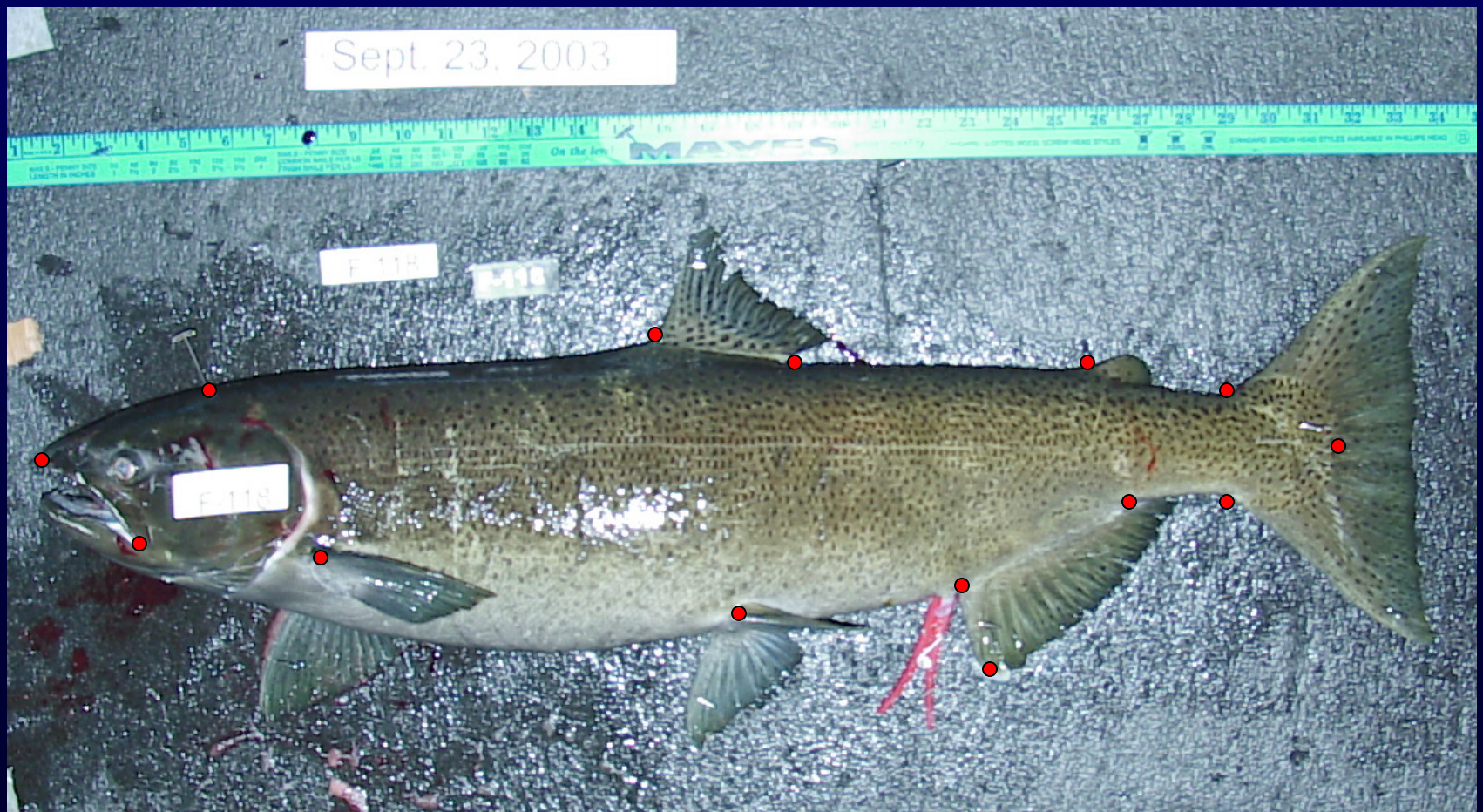
- 1) Photograph fish at spawning (CESRF)**
- 2) Digitize landmarks (TPSUTIL, TPSDIG)**
- 3) Use Thin-Plate Spline analysis to develop consensus shapes and partial warp scores (TPSRELW and TPSREGR)**
- 4) Use partial warp scores for multivariate regression, MANOVA/MANCOVA, and canonical discriminant functions (SYSTAT)**

**Table 1. Aged 4-year old spring chinook used in morphometric analysis**

		2002	2003	2004	Total
Males	Hatchery Origin	20	8	8	36
	Natural Origin	88	24	99	211
	Total	108	32	107	247
Females	Hatchery Origin	55	30	41	126
	Natural Origin	199	148	215	562
	Total	254	178	256	688

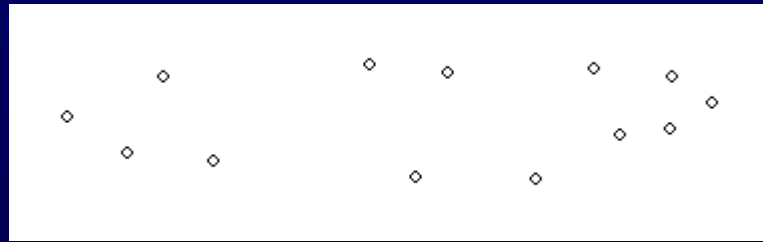
# Morphological Landmarks Used (13)

(based on Hard et al. 2000)

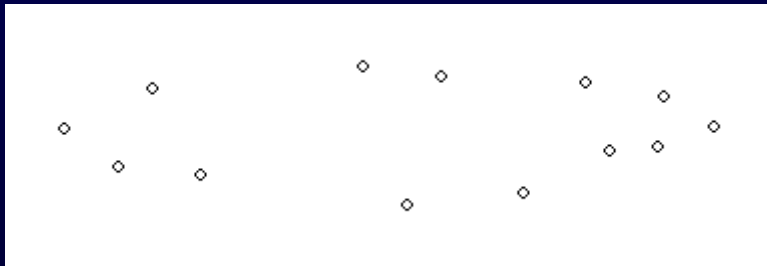


# Simple Explanation of Thin-Plate Spline Analysis

Consensus shape



Fish 1 shape



Fish 1 shape



Fish 1 partial warp scores



Fish 2 partial warp scores

# MANCOVA Results

- 1) Males differ significantly from females**
- 2) Natural-origin fish of both sexes differ significantly from hatchery-origin fish**
- 3) Shape varies significantly with size**
- 4) Shape varies significantly over years**

# Shape Differences between Males and Females

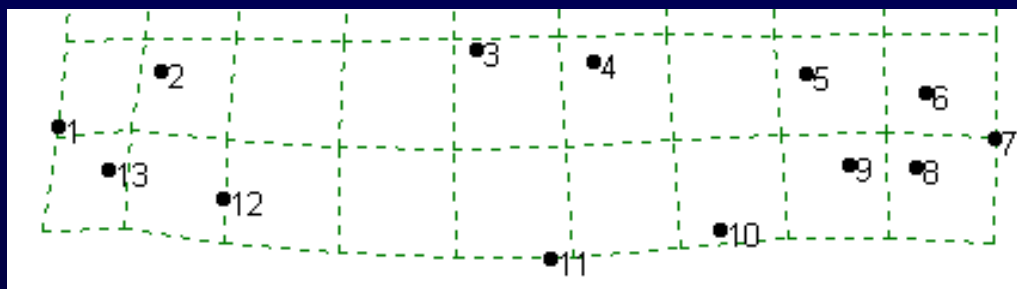
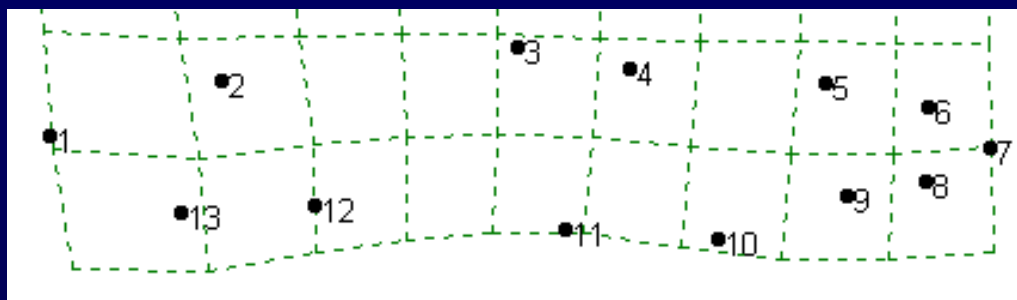
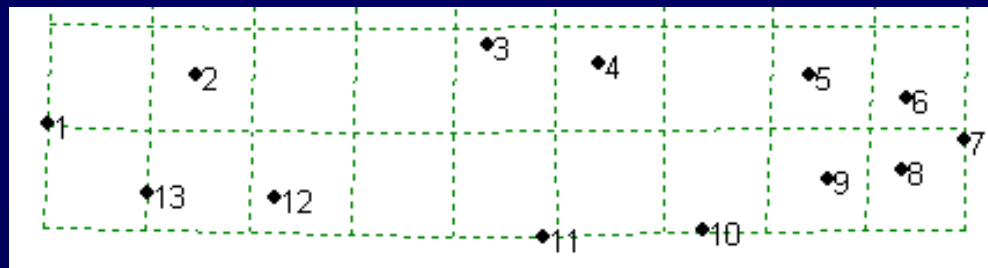


Table 2. Jackknifed classification to sex of age-4 adult spring chinook (irrespective of origin) by canonical discriminant analysis. Values in parentheses indicate range over within-year analyses.

Sex	Classification		
	Male	Female	% Correct
Male	246	1	100(98-100)
Female	0	688	100
Total	246	689	100 (99-100)



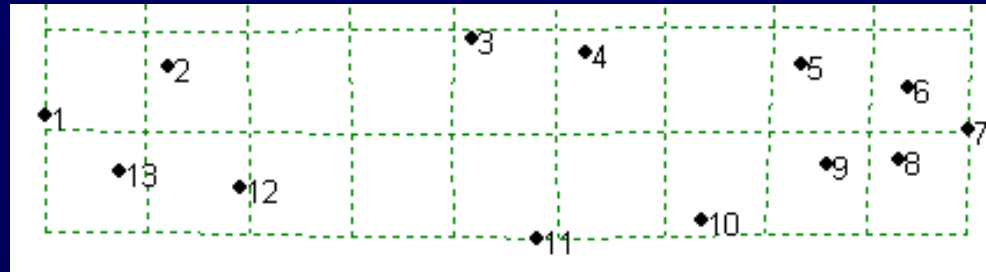
# Shape Differences between Natural- and Hatchery-origin Males



**Table 3. Jackknifed classification to origin of age-4 male spring chinook by canonical discriminant analysis. Values in parentheses indicate range over within-year analyses.**

Origin	Classification		
	Hatchery	Natural	% Correct
Hatchery	28	8	78 (60-88)
Natural	29	182	86 (76-95)
Total	57	190	85 (73-94)

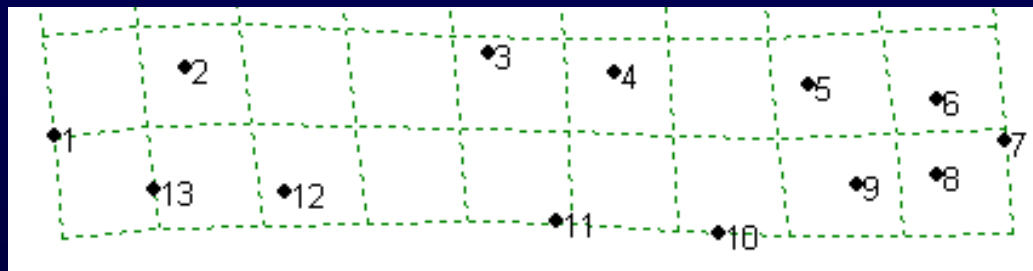
# Shape Differences between Natural- and Hatchery-origin Females



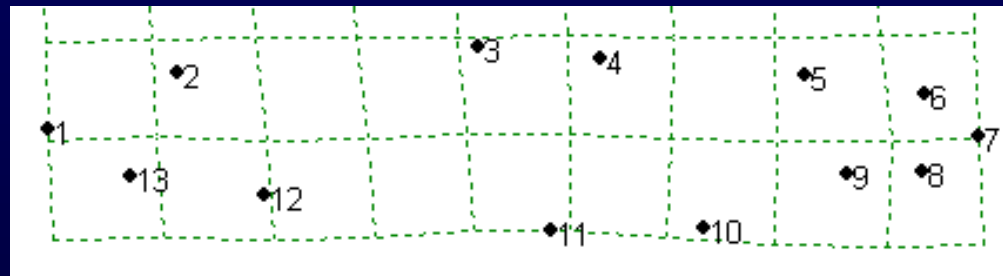
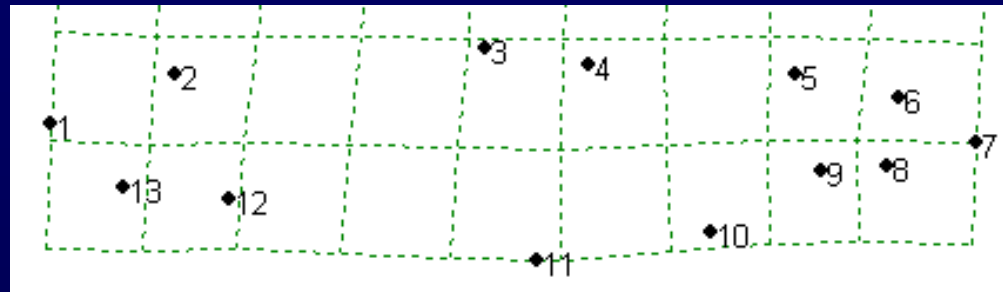
**Table 4. Jackknifed classification to origin of age-4 female spring chinook by canonical discriminant function. Values in parentheses indicate range over within-year analyses.**

Origin	Classification		
	Hatchery	Natural	% Correct
Hatchery	106	20	84 (76-85)
Natural	75	487	87 (84-89)
Total	181	507	86 (83-89)

# Shape Variation due to Size in Males



# Shape Variation due to Size in Females



# Shape and Size in Classification to Origin

**Table 5. Mean post-orbital hypural lengths (cm) of 4-year old spring chinook used in morphometric analysis**

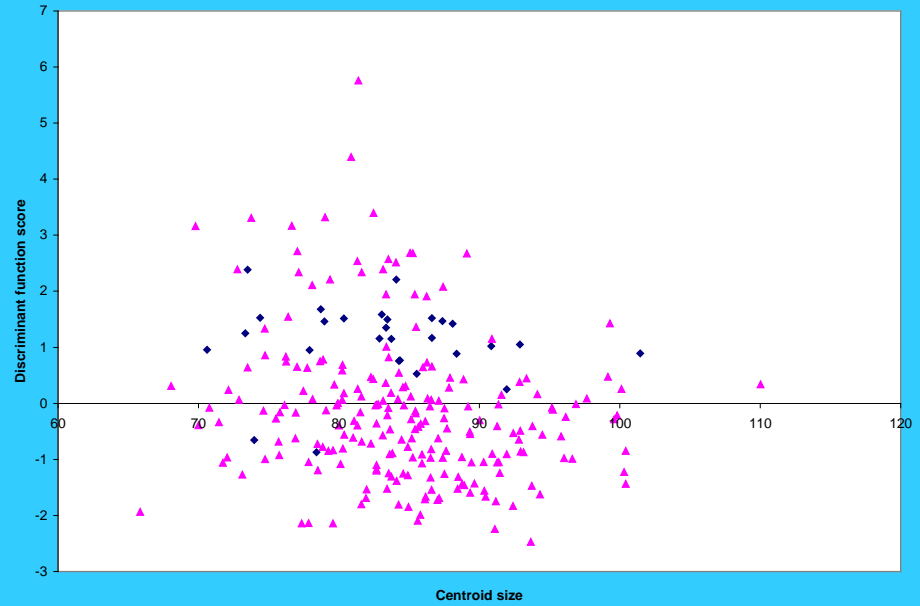
		2002	2003	2004	Overall
Males	Hatchery Origin	58.7	58.0	57.0	58.2
	Natural Origin	60.1	64.8	59.0	60.1
Females	Hatchery Origin	59.3	60.2	59.3	59.5
	Natural Origin	60.9	62.7	58.3	60.4

**Table 6. Percentage of correct classification to origin of male and female chinook, based on three different discriminant function schemes.**

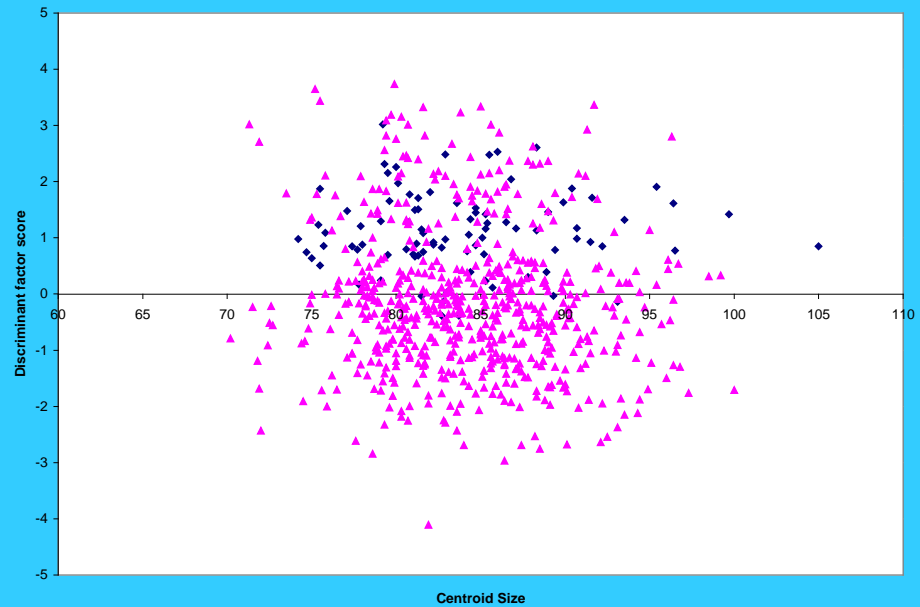
	Males			Females		
	Partial warps only	Centroid only	Warps + Centroid	Partial warps only	Centroid only	Warps + Centroid
Hatchery-origin	78	58	75	84	60	86
Natural-origin	86	59	86	87	58	87
Overall	85	59	85	86	58	86

# Size and Accuracy of Classification to Origin

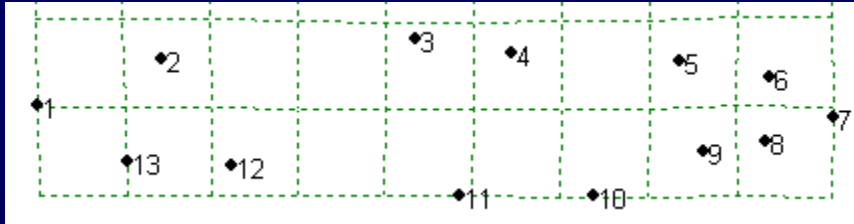
a)



b)



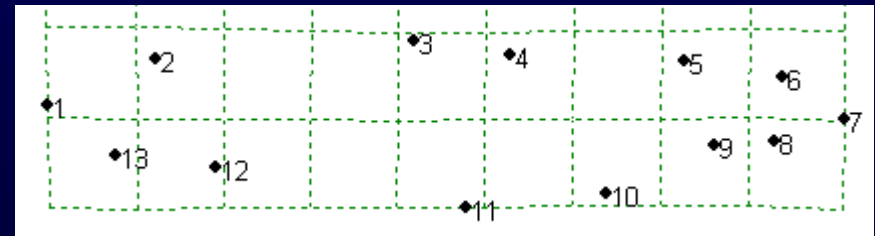
# Shape Variation due to Year



Males



Females



# Shape Variation due to Year

**Table 7. Jackknifed classification to year of age-4 male spring chinook, irrespective of origin, by canonical discriminant analysis. Parenthetical values indicate range of correct classification in within-origin analyses.**

<b>Males</b>				
Year	Classification			
	2002	2003	2004	% Correct
2002	69	19	20	64 (60-66)
2003	9	21	2	66 (71-75)
2004	15	4	88	82 (75-83)
Total	93	44	110	72 (67-74)

<b>Females</b>				
Year	Classification			
	2002	2003	2004	% Correct
2002	142	57	55	56 (60-61)
2003	23	151	4	85 (75-84)
2004	44	6	206	80 (75-81)
Total	209	214	265	73 (67-75)



# Conclusions

**Adult shape varies significantly by sex, origin, and over time.**

**Little if any evidence evidence at this point of systematic shape change due to domestication in directions expected.**

# **Future Work**

**Finer-scaled detailing of differences due to sex in natural-origin fish**

**Finer-scaled detailing of differences between U. Yakima and Naches populations**

**Juvenile morphology**

# Acknowledgments

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