Breeding Success Of Four Male Life History Types In Spring Chinook Salmon Spawning Under Quasi-Natural Conditions

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Spring Chinook Spawning Communities Are Generally Thought Of As Assemblages Of Large Anadromous Fish

However, A Variety Of Alternative Male Life History Types Occur On Spawning Grounds

And Their Abundance May Increase Due To Artificial Culture

At The Cle Elum Supplementation Research Facility:

•37 – 49% Of All Males Matured At Age 2 (Larsen et al. 2004) (1999 – 2007 = 125,000/yr; Pearsons et al. 2009)

• Males Maturing At Age 3 increased From 8.5% To 22.9% After One Generation Of Culture (Knudsen et al. 2006)

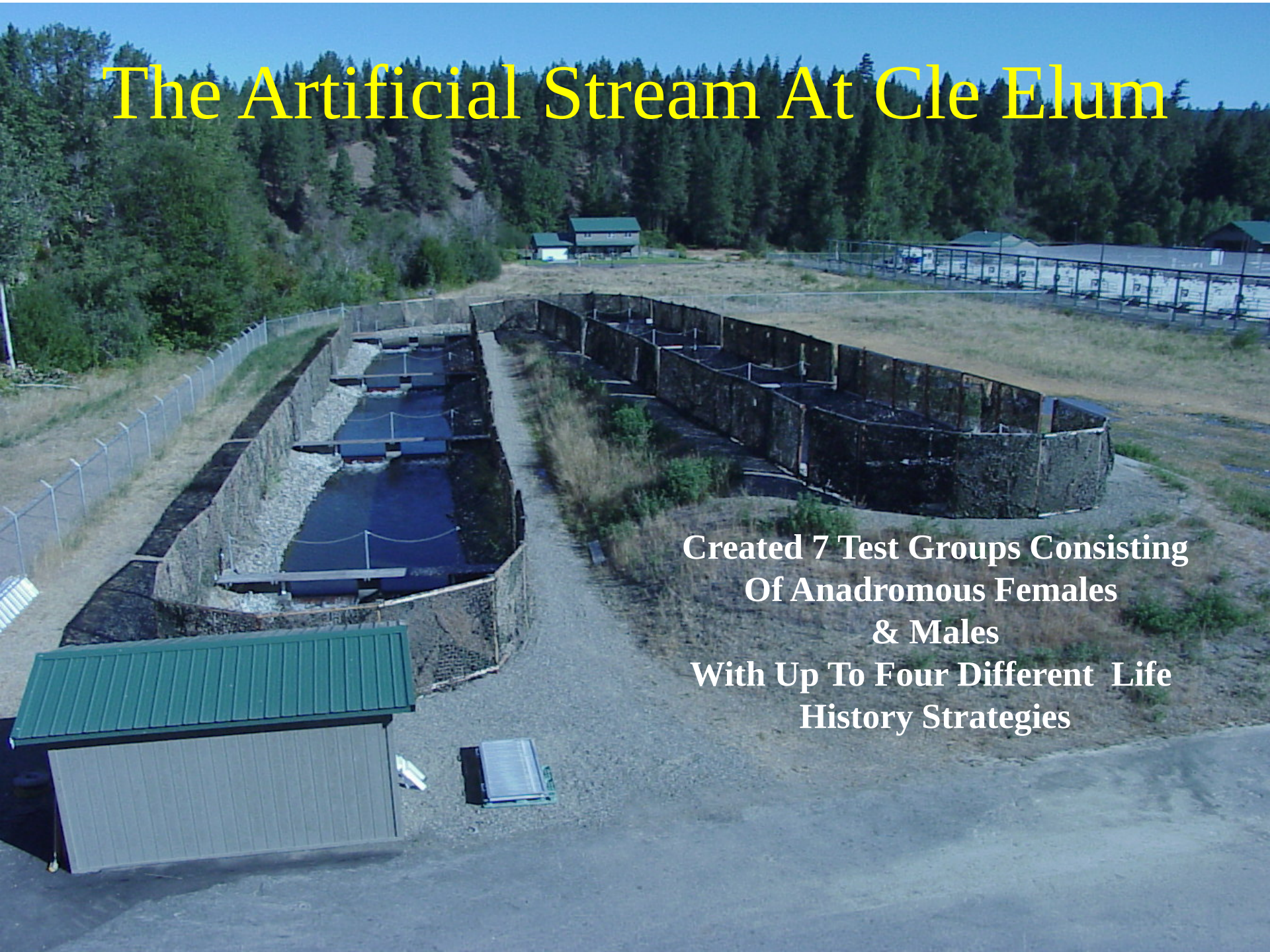
• Similar Decreases in Male Age At Maturity Have Been Observed In Other Hatcheries (e.g. Gebhards 1960; Mullan et al. 1992)

What Genetic Effects Might Enhanced Numbers Of Early Maturing Males Have On Wild Spring Chinook Populations?

1) Must Know Their Abundance On The Spawning Grounds, and

2) **Their Relative Breeding Success Under Natural Conditions**

The Artificial Stream At Cle Elum



Created 7 Test Groups Consisting Of Anadromous Females & Males With Up To Four Different Life History Strategies

Types Of Fish In The Test Groups

Anadromous 4 & 5 yr –old males & Females:
("Large Anadromous Fish")

Anadromous 3-yr-old males:
("Jacks")

Types Of Fish In The Test Groups

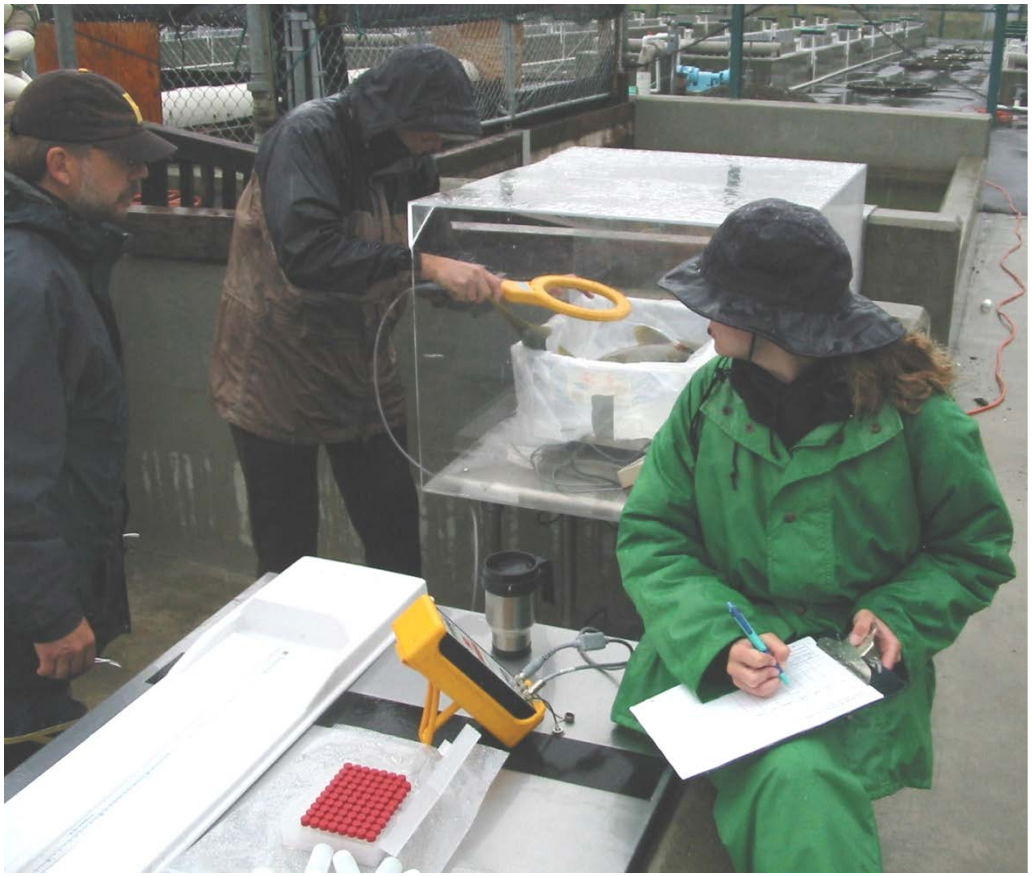
Hatchery Origin “Yearling Precocious Male”

Wild Origin “Yearling Precocious Males”

Types Of Fish In The Test Groups

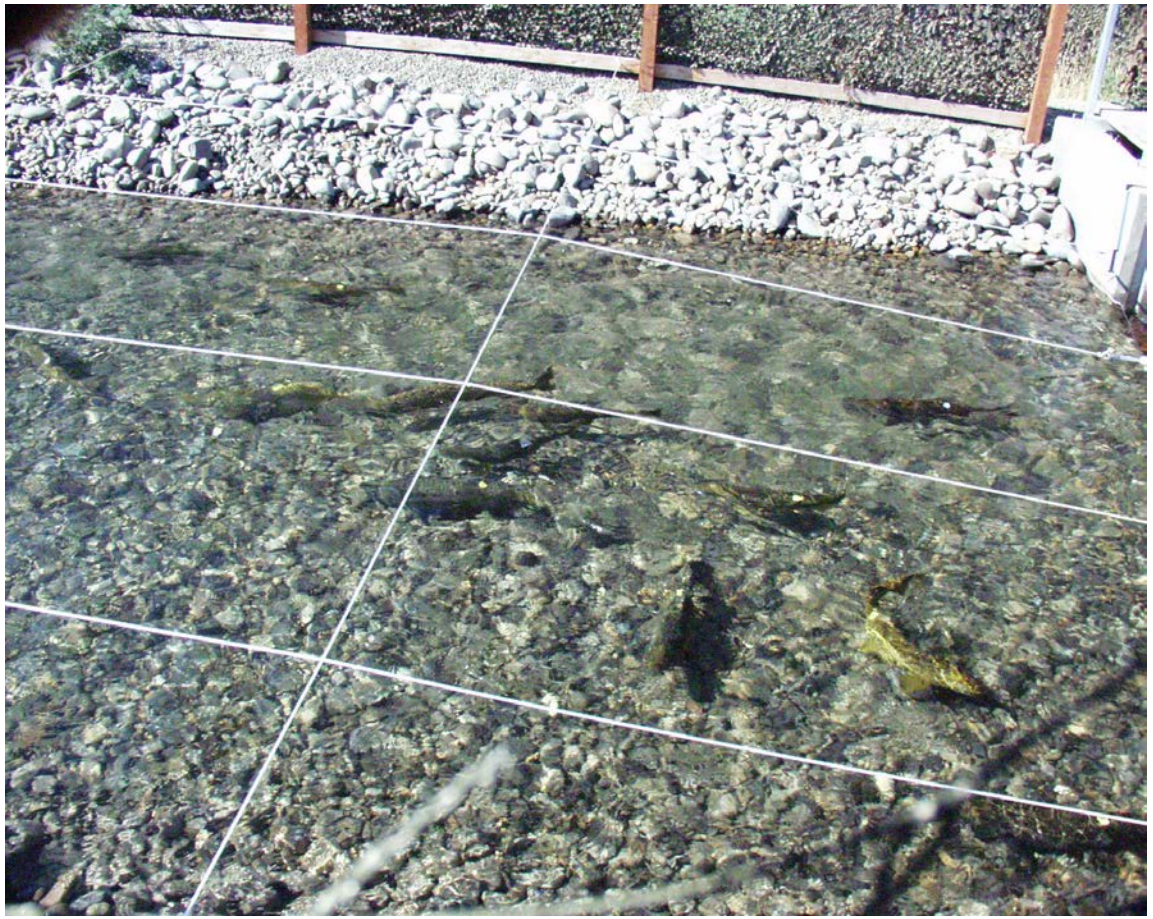
Wild “Sub Yearling Precocious Male”

Prior To Placement In The Artificial Stream Each Fish Was:

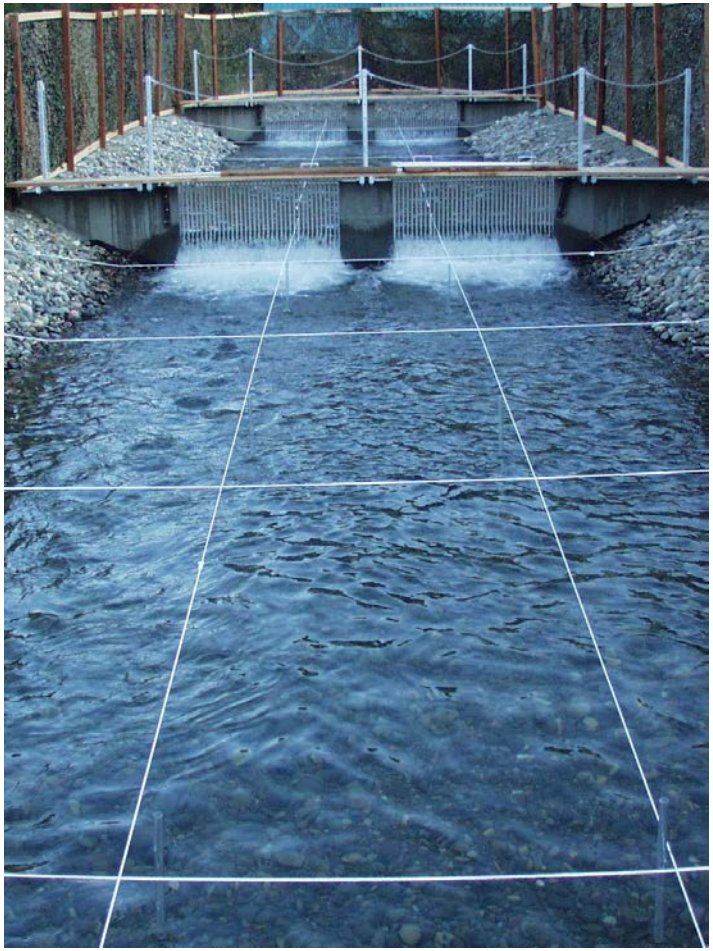


And, A Small Bit Of Fin Material Was Removed For Later DNA Extraction

The Fish Were Released Into The Artificial Stream & Spawned Under Quasi-Natural Conditions



Fish No.s & Types Placed Into The Artificial Stream



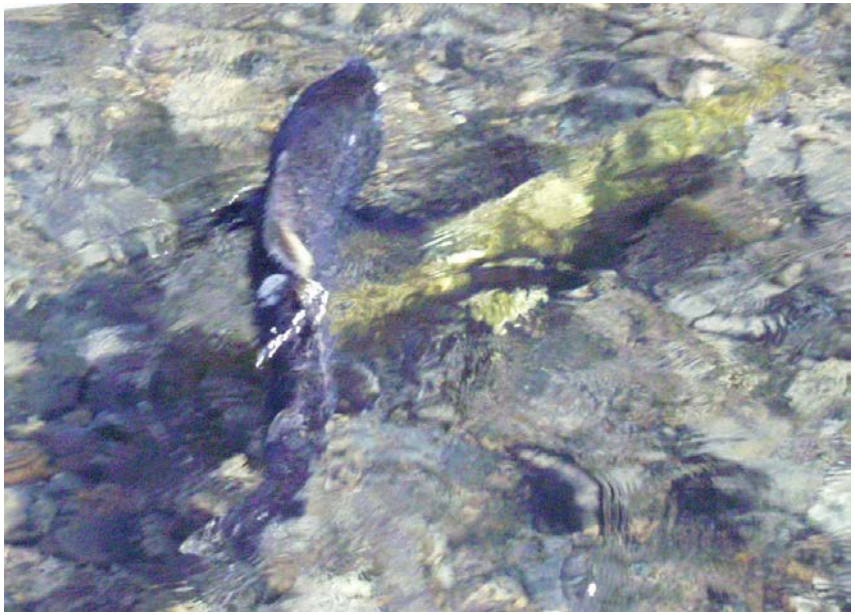
Test Group	No. Of Females	No. Of Lg Anadromous Males	No. Of Jacks	No. Of Yr Precocious Males	No. Of Sub Yearling Precocious
2001 A	16	21	3	-	-
2001 B	17	18	2	5	5
2002 A	22	22	2	6	-
2002 B	17	16	2	6	-
2003	24	24	6	13	7
2004	20	29	4	12	-
2005	23	25	4	8	8
Totals	139	155	23	50	20

All Fry Produced From The Artificial Stream Were Trapped & Counted

10% Of The Fry Were Sub-sampled & a Pedigree Analysis Using Micro-satellite DNA Was Performed To Assign Parentage

Fry Production

Test Group	Fry Produced	No. Of Fry Assigned To Parents	% Of Population Assigned
2001 A	**18,960**	**991**	**5.2%**
2001 B	**42,263**	**780**	**1.8%**
2002 A	**45,889**	**1.566**	**3.4%**
2002 B	**37,141**	**1,264**	**3.4%**
2003	**64,494**	**2,750**	**4.3%**
2004	**47,140**	**2,892**	**6.1%**
2005	**49,552**	**2,973**	**6.0%**
TOTALS	**305,439**	**13,216**	**4.3%**



Calculating Male Breeding Success

$$\text{IBrS or Individual Breeding Success} = \frac{\text{Progeny In The 10\% Fry Sample}}{\text{No. Of Fry In 10\% Sample}}$$

And the mean breeding success for a male type in each test group =

$$\text{Mean BrS}_{\text{MALE TYPE A}} = (\sum \text{IBrS}_1 + \text{IBrS}_2 + \ldots \text{IBrS}_n)/(n_A),$$

Where n_A = Number of Males Of Type A in a test group

Results Were Examined In Two Ways

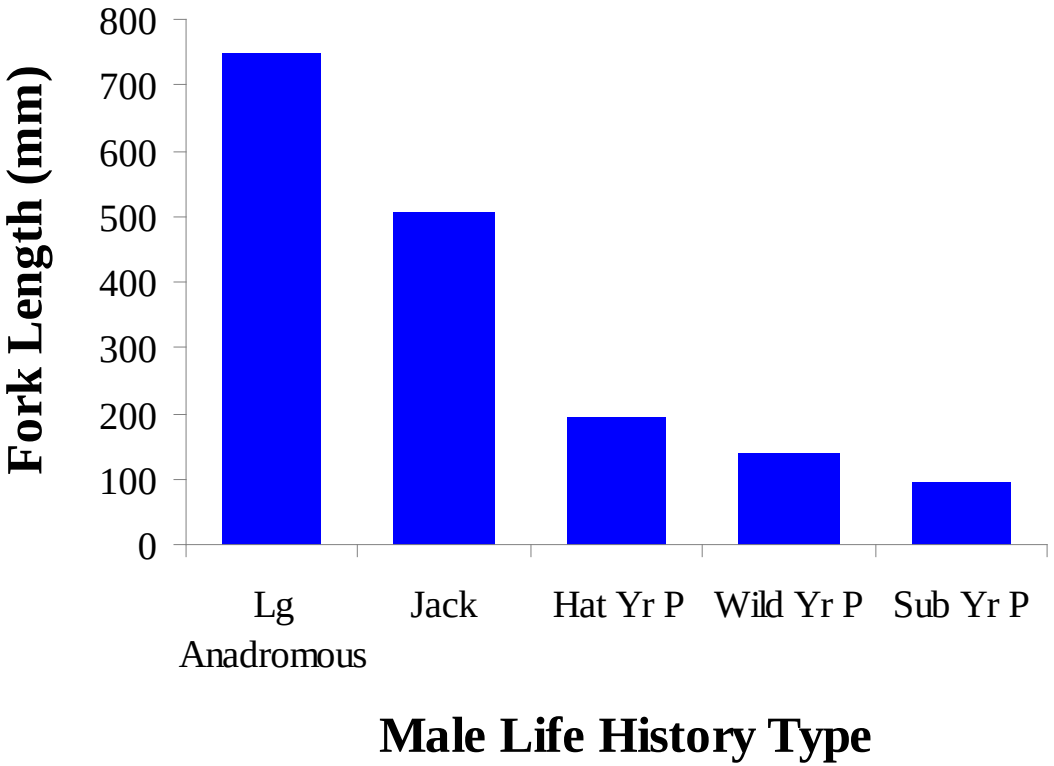
Individual Effects

1) Size
2) Tertiary Sex Ratios
3) Mate Numbers

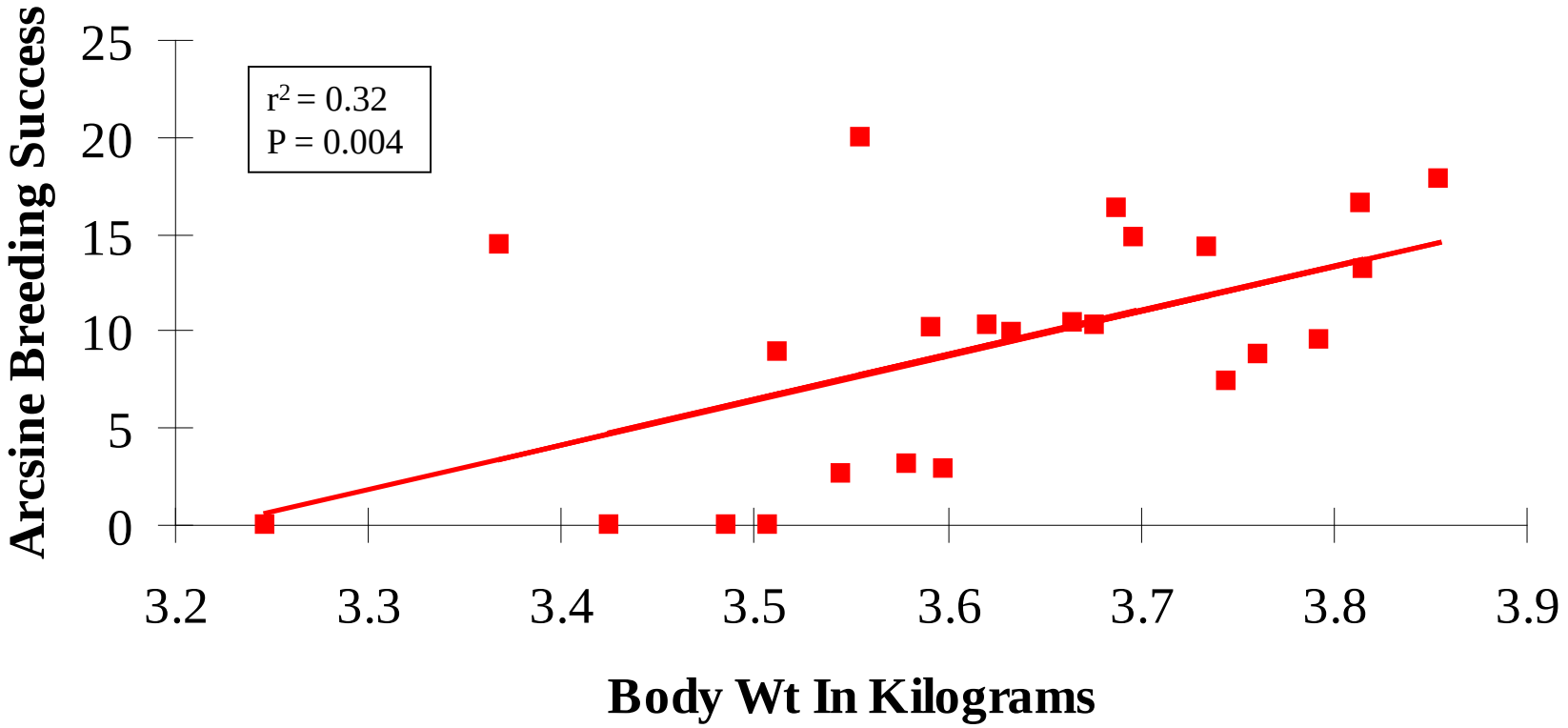
Population Effects

1) Tertiary Sex Ratios
2) Prevalence Of The Male Life History Types

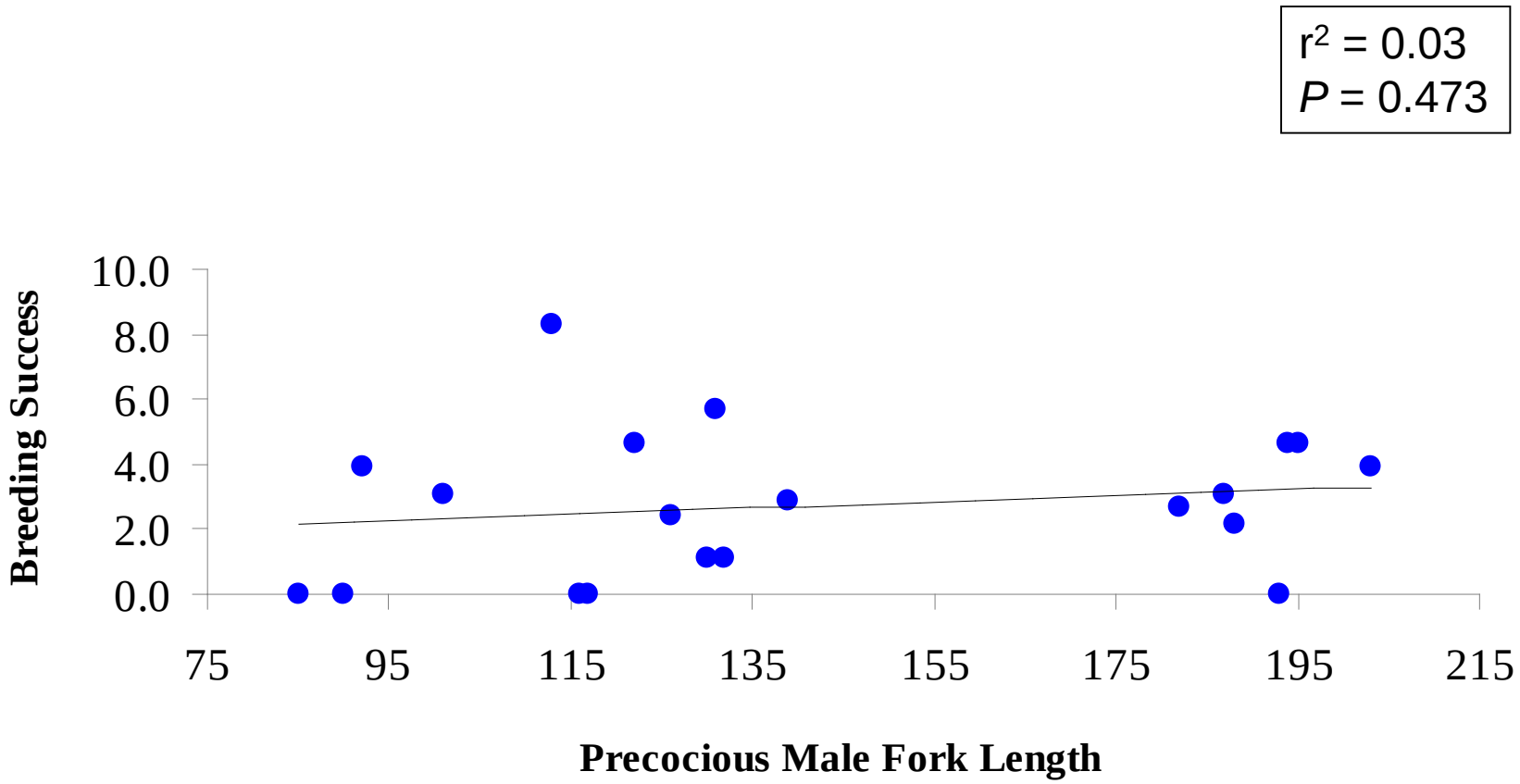
Mean Fork Lengths Of The Male Life History Types



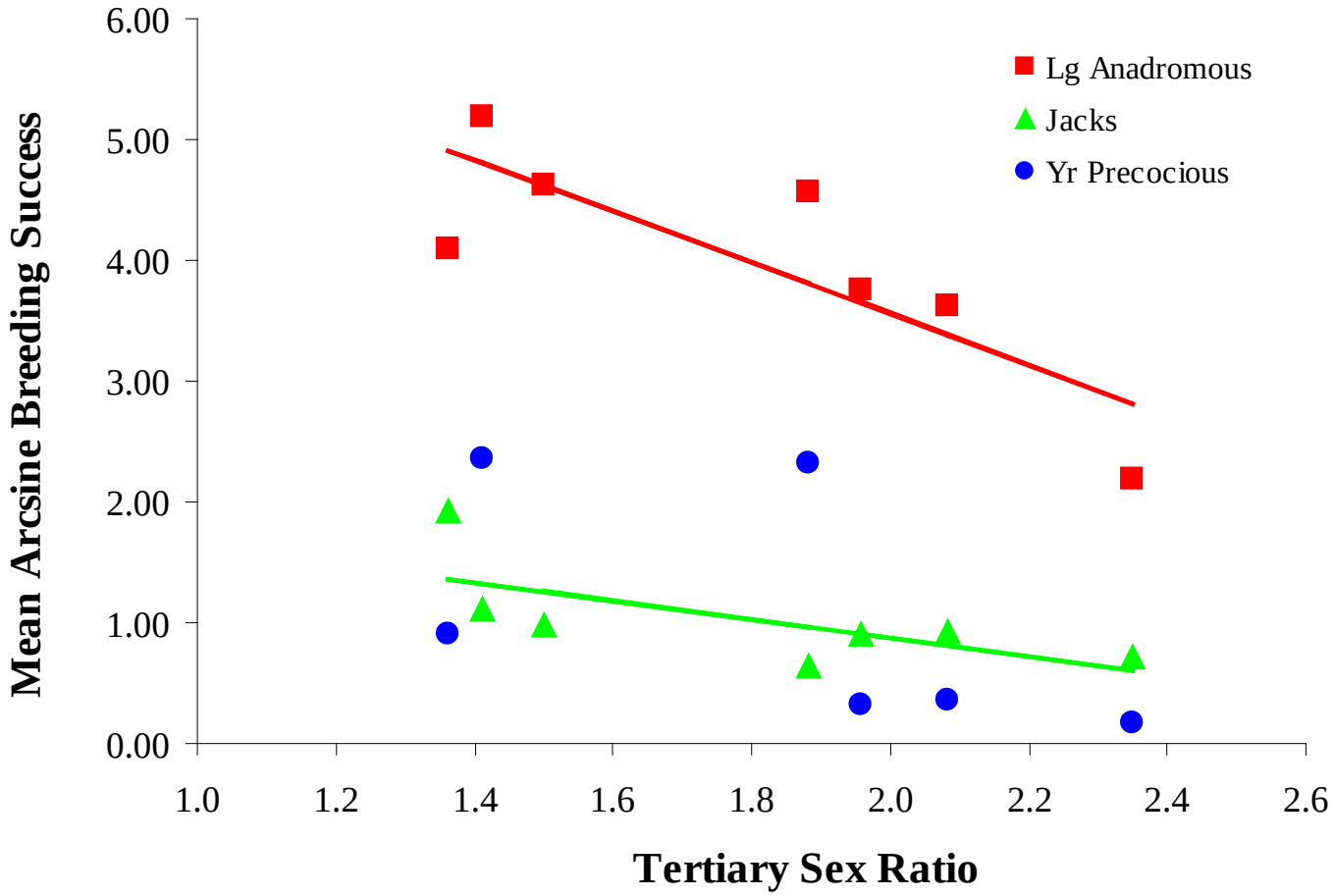
Body Wt vs. Breeding Success In Large Anadromous Males



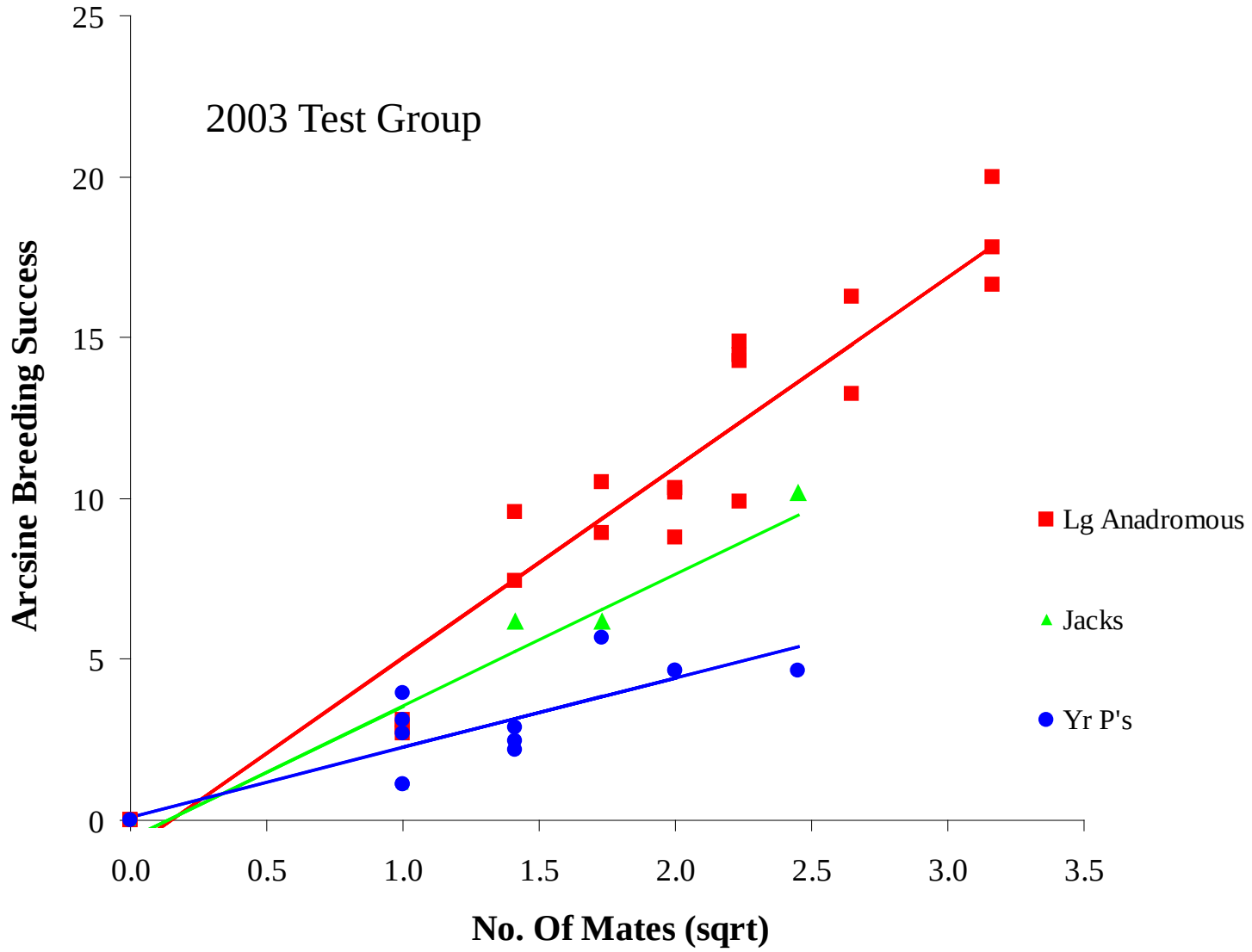
Breeding Success Vs. Fork Length In Precocious Males



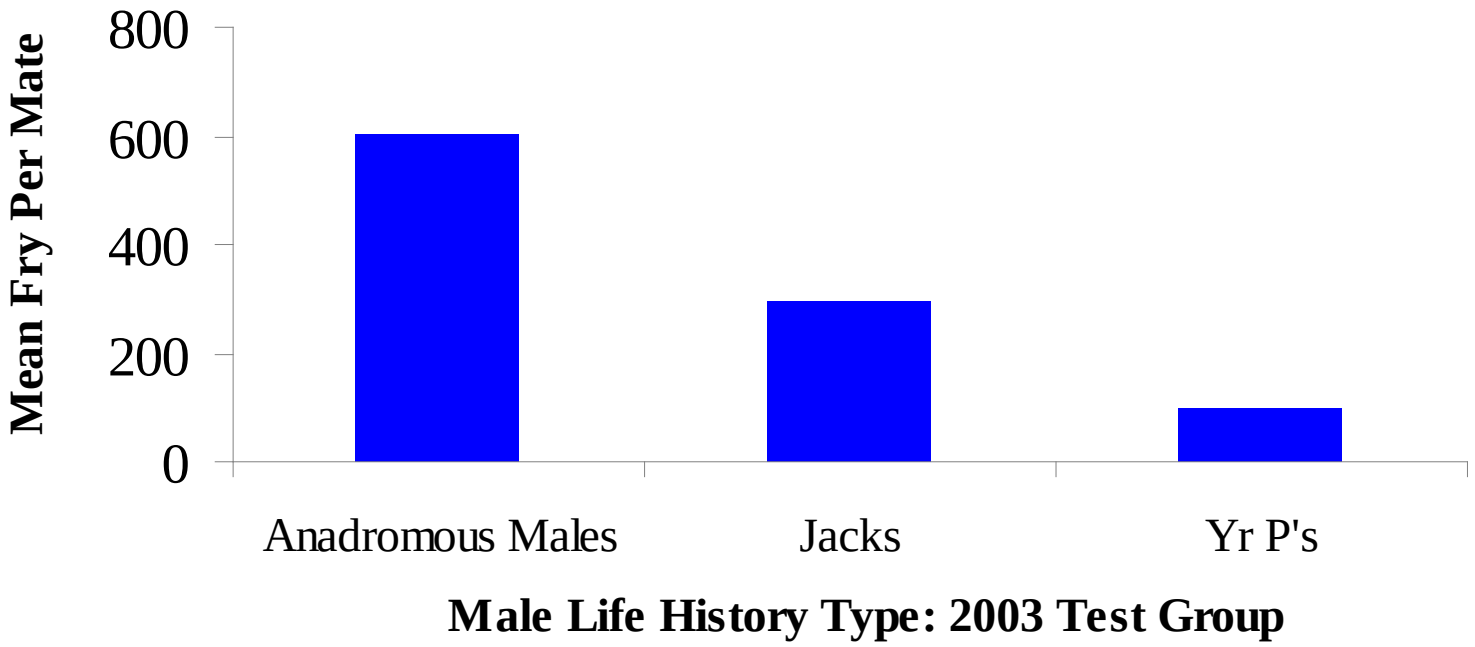
Effect Of Tertiary Sex Ratio On Individual Male Breeding Success



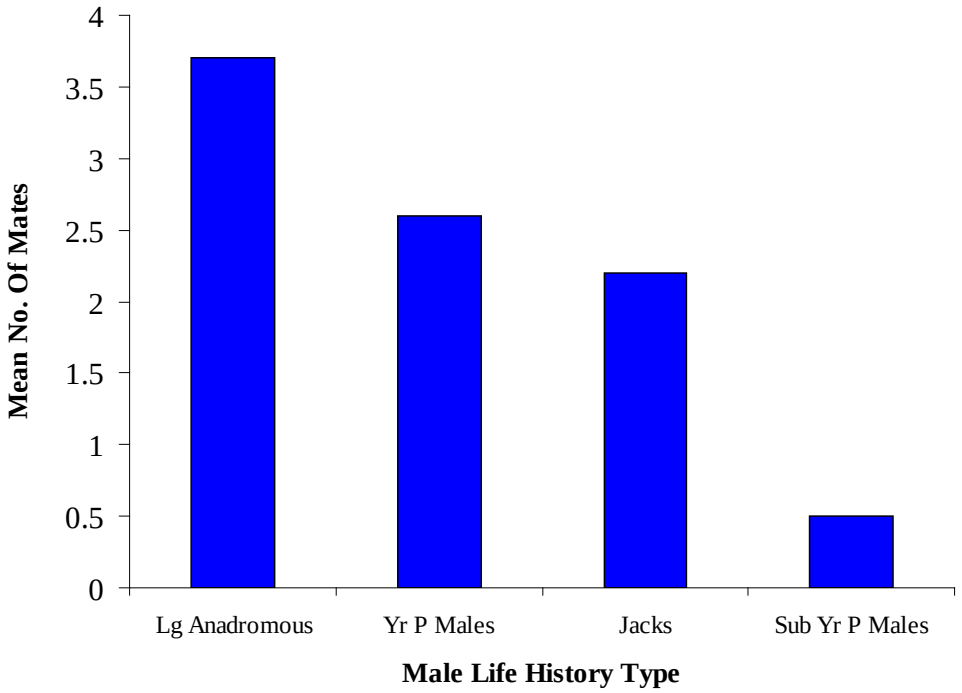
Mate Number & Breeding Success By Male Life History Type



Fry Per Mate By Male Life History Type

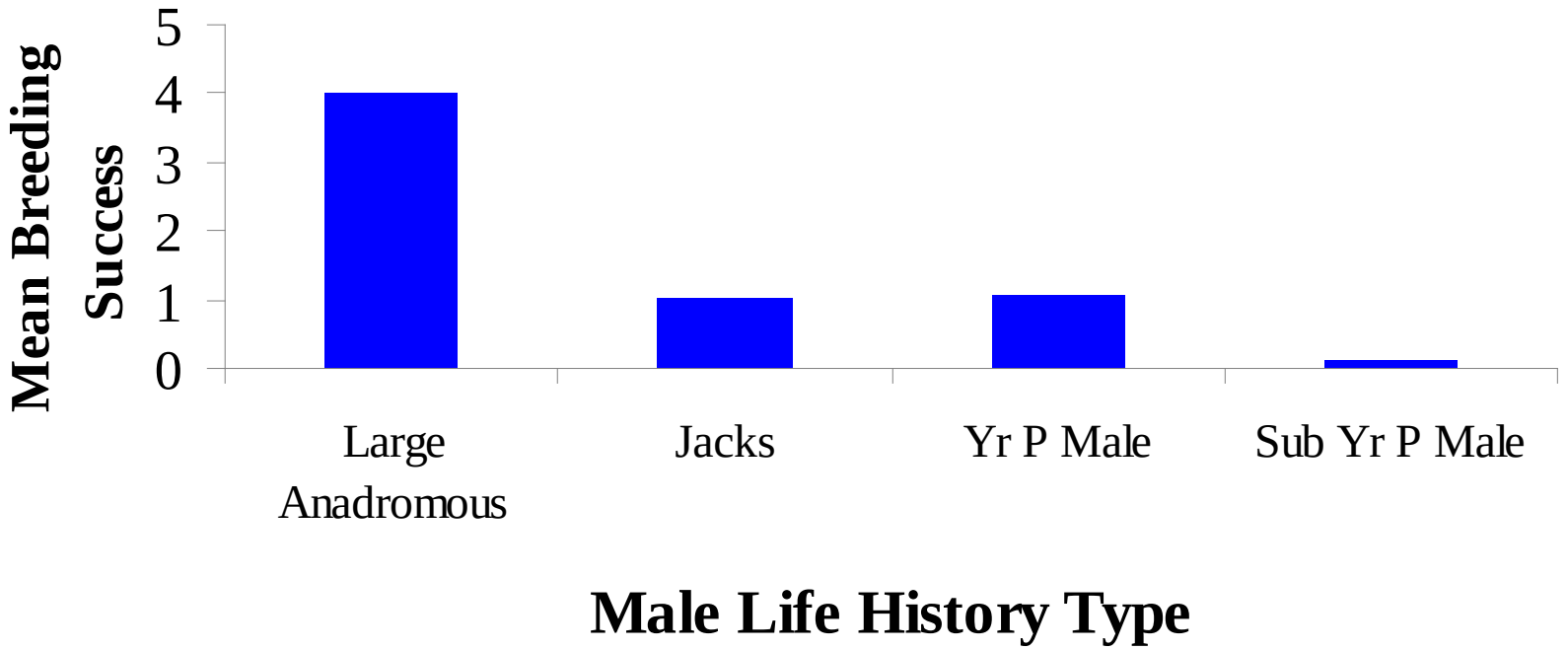


Mean Mate Number By Life History Type

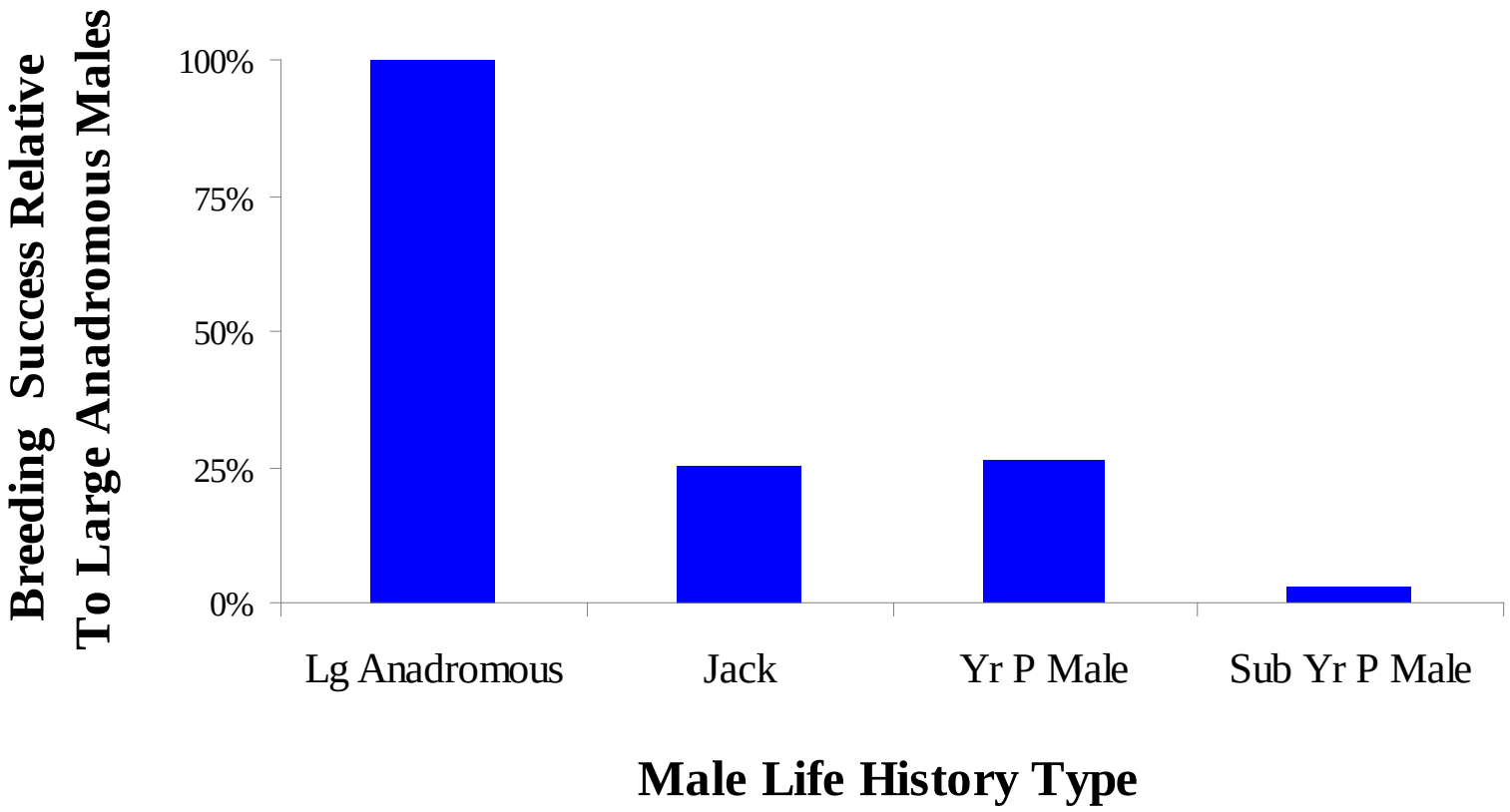


Comparisons Among Male Life History Types	
Male Life History Type	**Comparison**
Lg Anadromous	**= Yr P Males, > Jacks, > Sub Yr P Males**
Jacks	**= Yr P Males, > Sub Yr P Males**
Yr P Males	**> Sub Yr P Males**

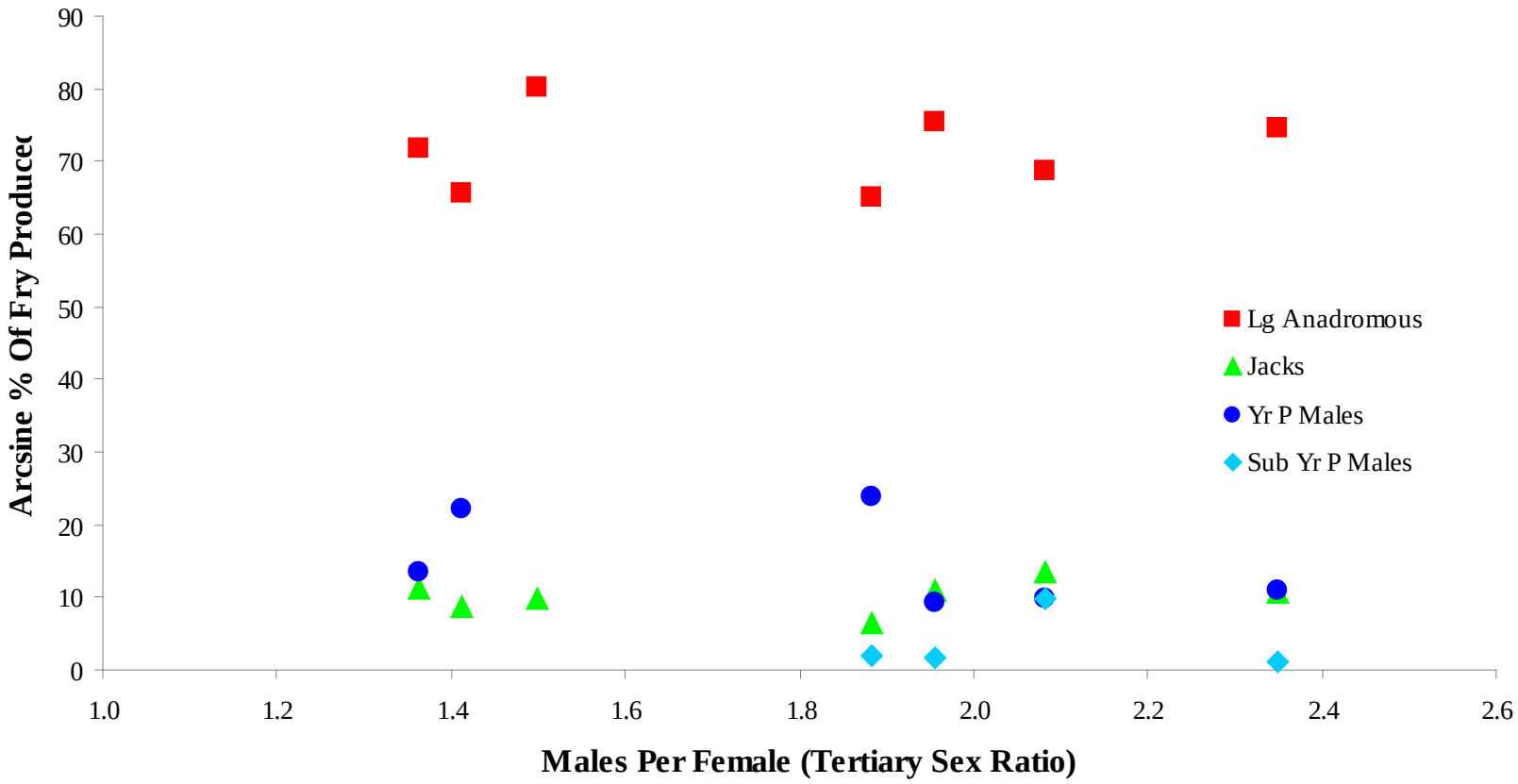
Mean Individual Breeding Success By Male Life History Type



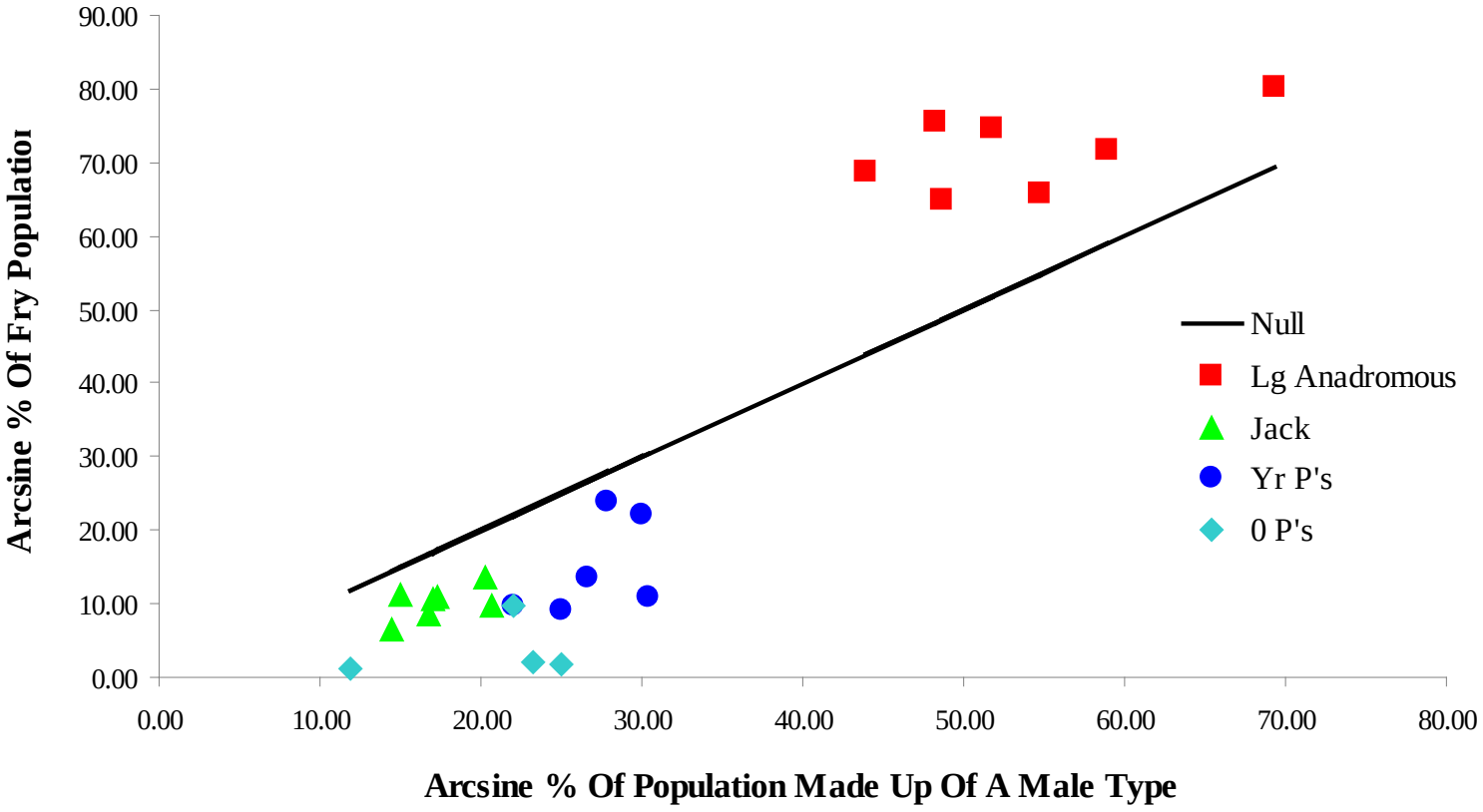
Relative Breeding Success Of The Life History Types



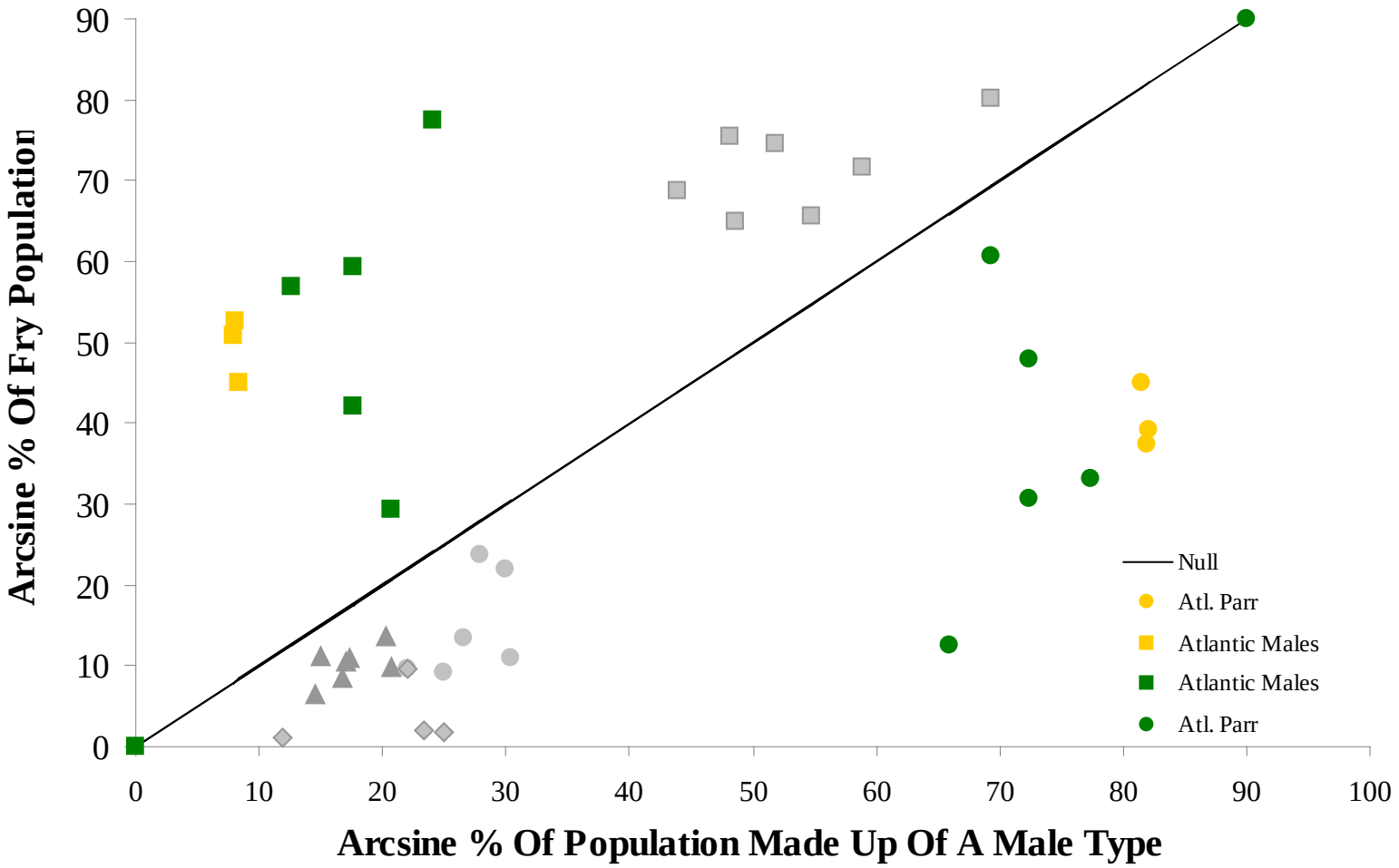
Tertiary Sex Ratios Vs. Progeny Paternity



% Male Life History Type Vs. Progeny Paternity



% Male Life History Type Vs. Progeny Paternity



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