

# **A Comparison Of Reproductive Success In Naturally Spawning Wild- & Hatchery-Origin Spring Chinook**

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# Defining Reproductive Success

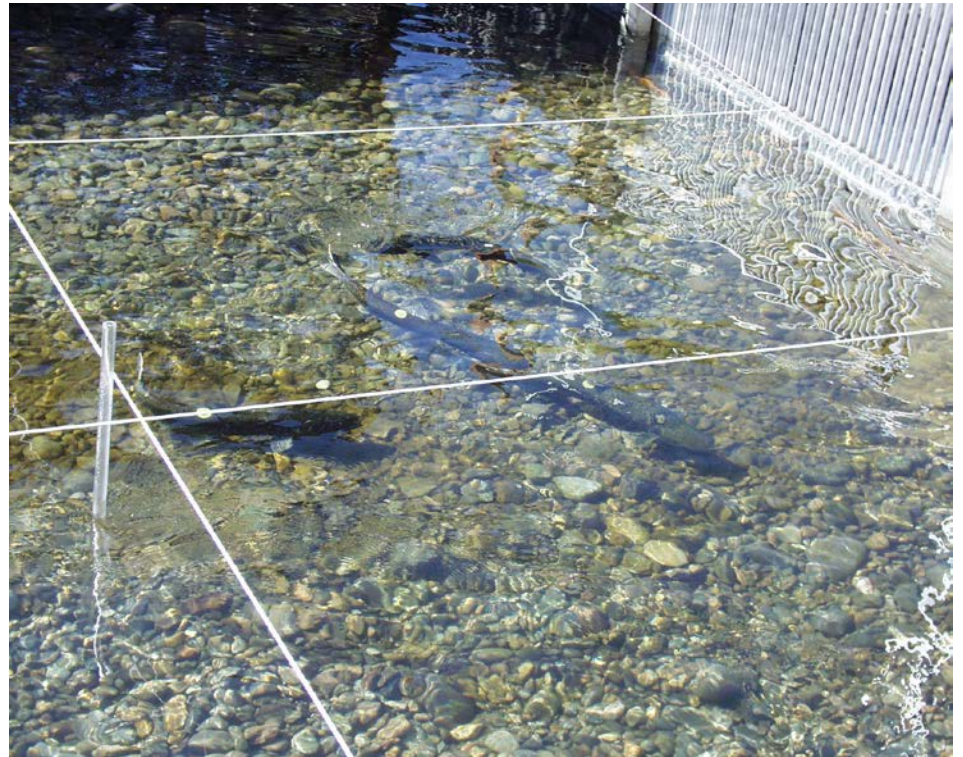
**Male RS In This Study Equals The Ability  
To Produce Unfed Fry**



# Experimental Approach Used To Compare RS In Hatchery & Wild Males

- **Heterogeneous Pops:**

**Fish Origin Is Mixed  
Competition Is Across  
Types**



# Observation Stream



# All Fry Produced From The Observation Stream Were Trapped & Counted

10% Of The Fry Were  
Sub-sampled

Parental Assignments  
Based On Microsatellite  
DNA Were Made On The  
Sampled Fry



# Estimating Male Reproductive Success

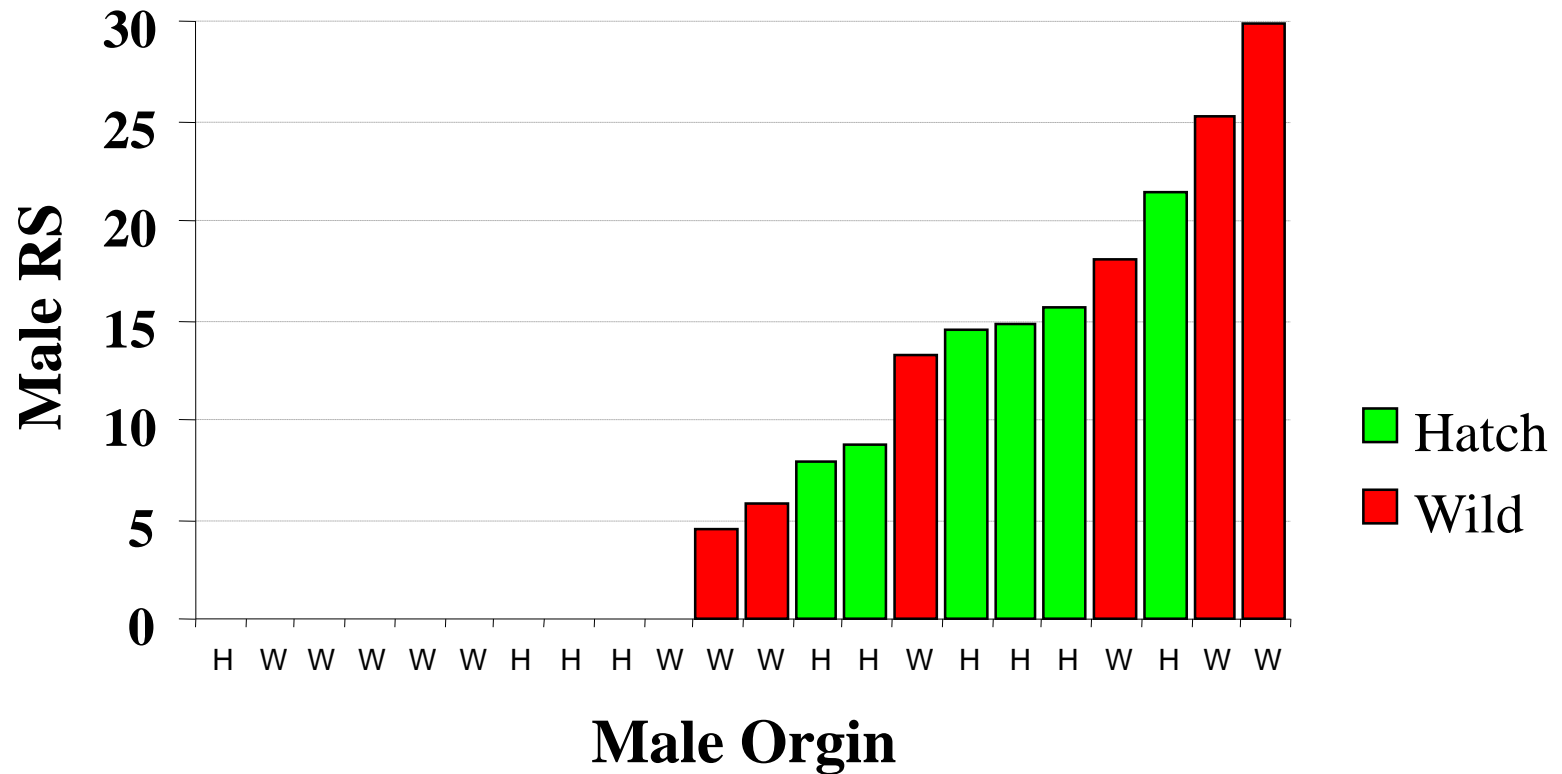
Population	No Of Fry In Pedigree Eval
1	991
2	780
3	2,892



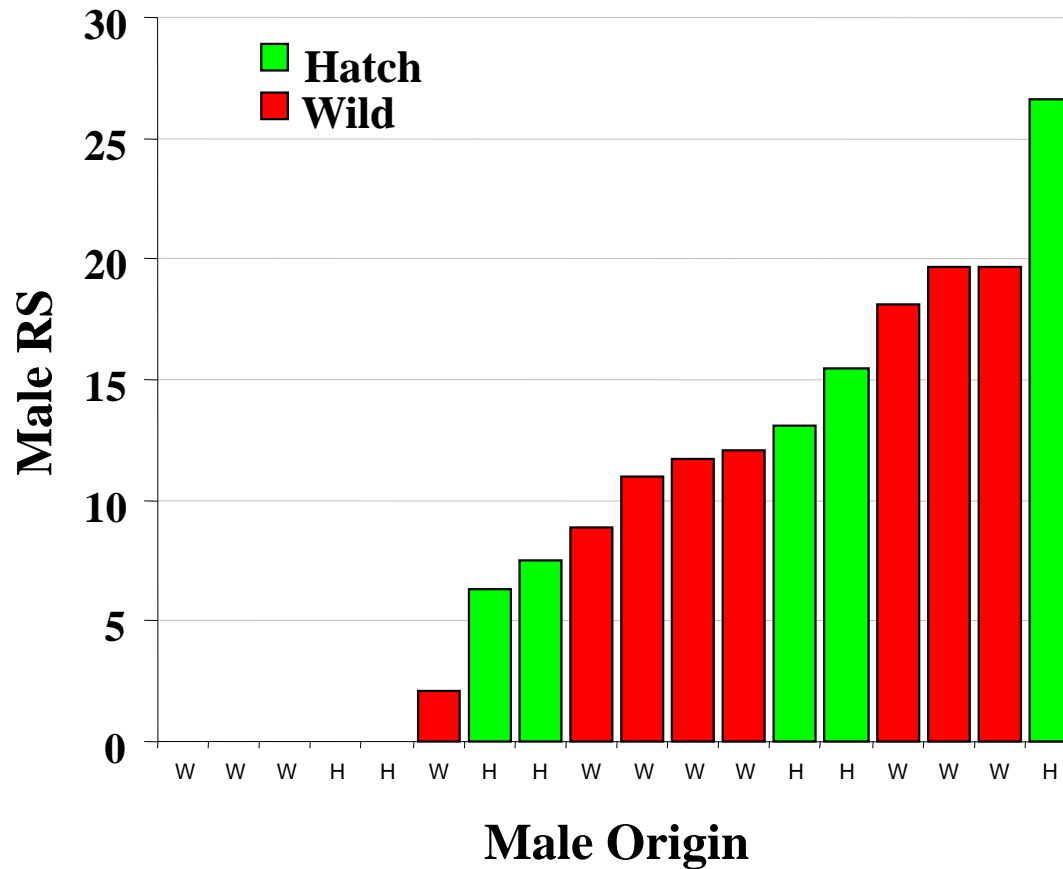
$$\text{Estimate Of Male RS} = \frac{\text{No. Of Fry Sired In Sample}}{\text{No. Of Fry Sampled}} = \%*$$

\* Normalized by using the arc sin sqrt transformation

# Reproductive Success Of Hatchery & Wild Males

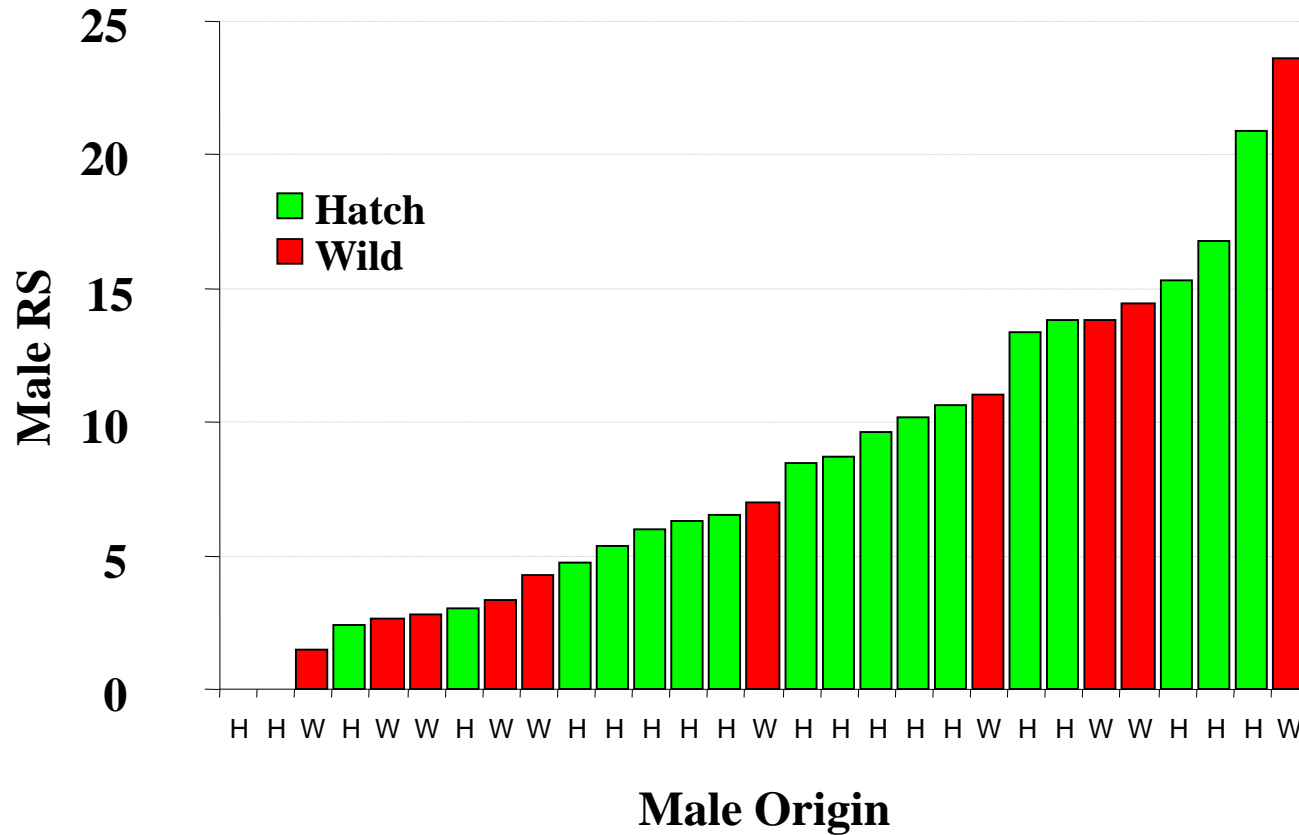


# Reproductive Success Of Hatchery & Wild Males





# Reproductive Success Of Wild & Hatchery Males

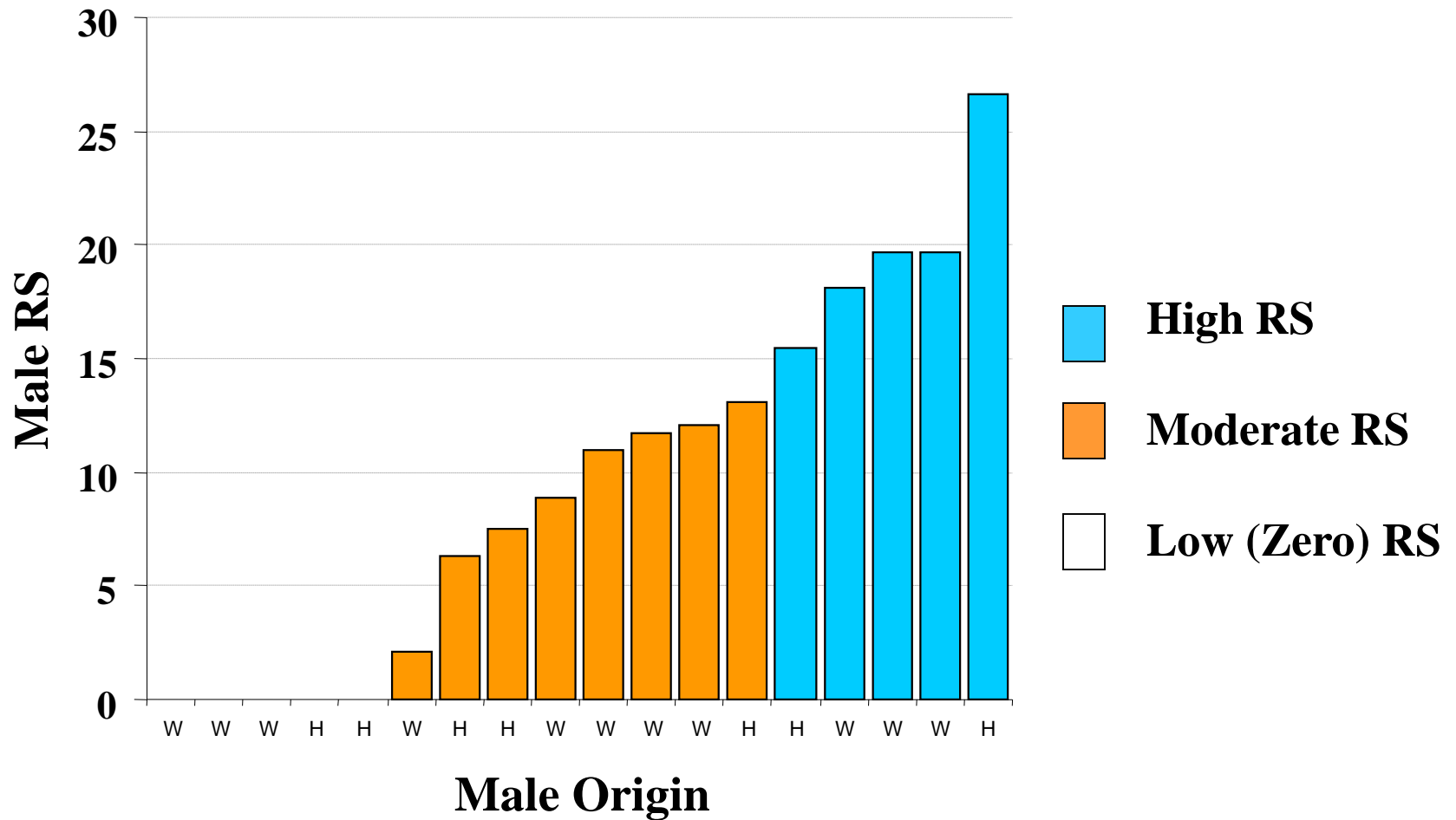


# Results Of Two-Way ANOVAs That Compared Male RS By Type & Population

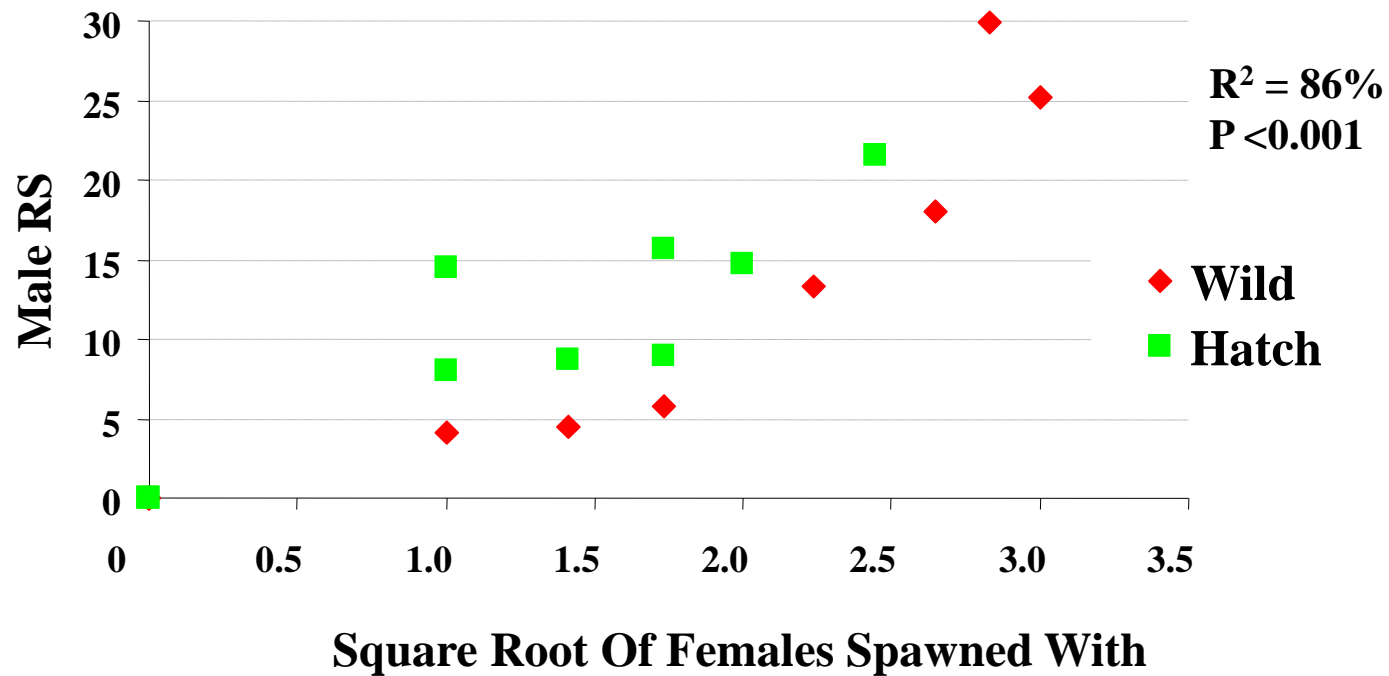
Null Hypotheses	F value	p Value
1) No Difference In Hatchery & Wild Male RS	0.018	0.895
2) No Difference in Male RS Among The Populations	0.164	0.849
3) No Interaction Between Male RS & Population	0.003	0.997

N =  
36 hatchery males  
33 wild males

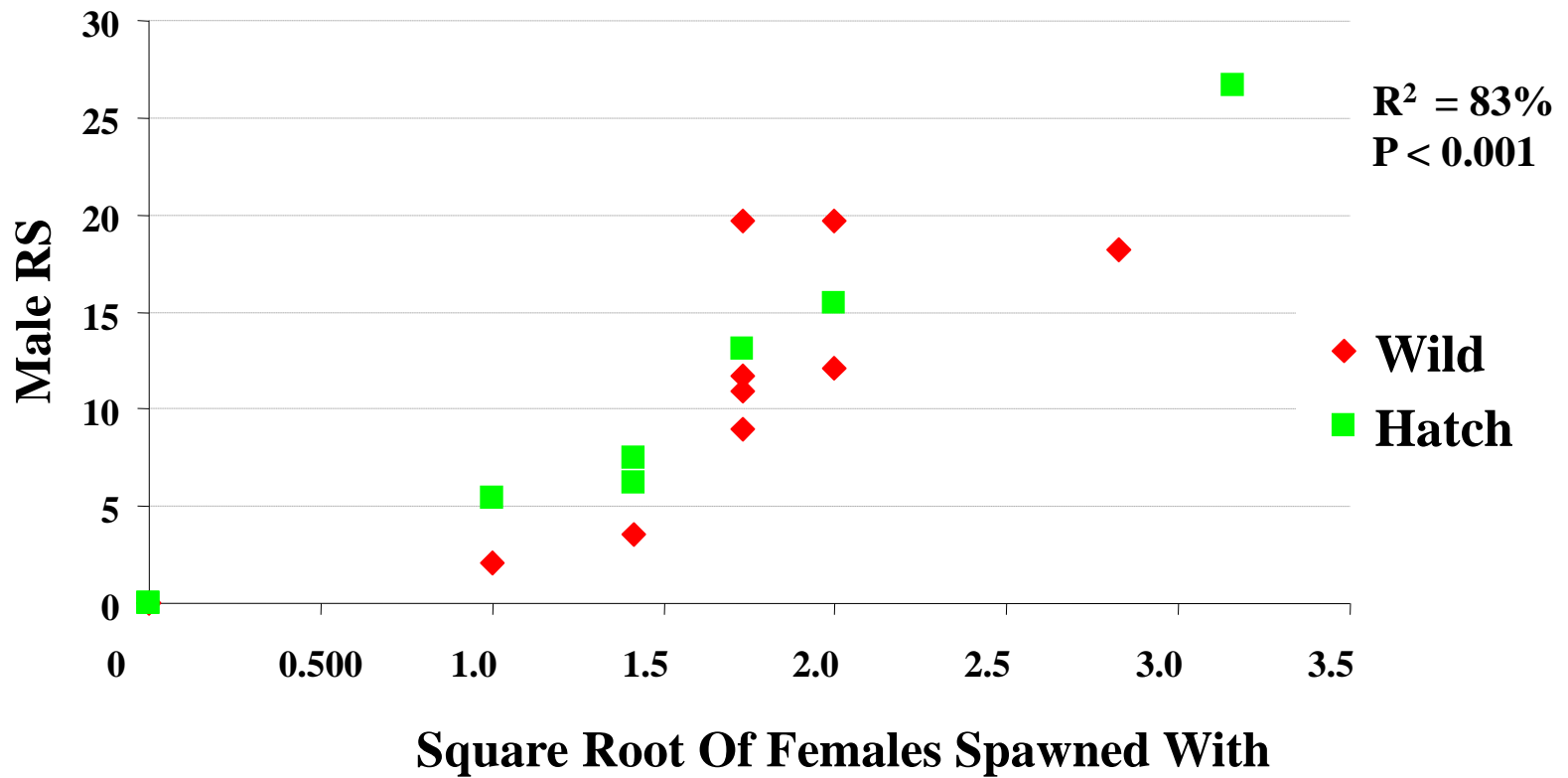
# What Makes A Male Successful?



# Relationship Between Number of Females A Male Spawned With & Reproductive Success



# Relationship Between Number Of Females A Male Spawned With & Reproductive Success

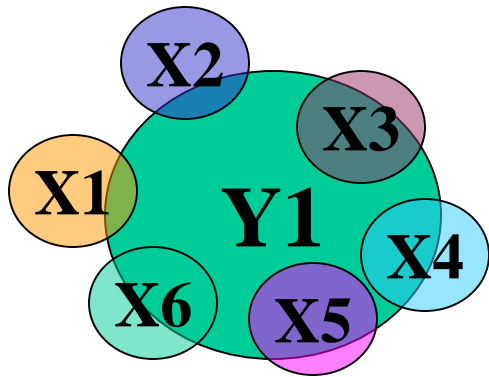


# Behavioral Attributes & Traits Examined

<b>Trait Category</b>	<b>No Of Traits In Category</b>	<b>Examples of Traits Measured</b>
<b>Agonistic</b>	<b>9</b>	<b>Mean No. Of Attacks Per Min % Of Attacks Instigated By Obs Male</b>
<b>Social Status (Agonistic)</b>	<b>5</b>	<b>% Of Males Dominated % Of Time In Black Color Pattern</b>
<b>Social Status (Courting)</b>	<b>4</b>	<b>Frequency Of Courting Behavior % Of Time In Alpha Status</b>
<b>Size</b>	<b>2</b>	<b>Weight and Relative Size</b>
<b>Movement</b>	<b>1</b>	<b>Tendency To Move</b>

# Analytical Approach Taken

## Backward Stepwise Multiple Regression



### Independent Variables

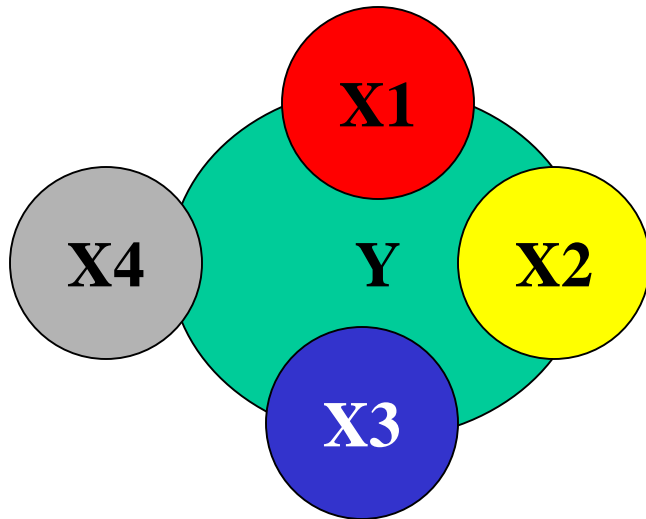
<b>X1</b>	<b>Movement</b>
<b>X2</b>	<b>Size</b>
<b>X3</b>	<b>Agonistic Behavior</b>
<b>X4</b>	<b>Courting Behavior</b>

### Dependent Variable

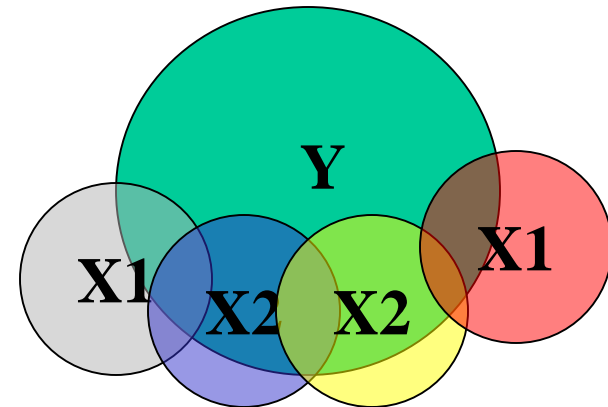
<b>Y1</b>	<b>Male RS</b>
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# Regression Models With and Without Collinearity

**Without Collinearity**



**With Collinearity**



Y = Dependent Variable (Male RS)

X1, X2, X3, etc. = Independent Variables



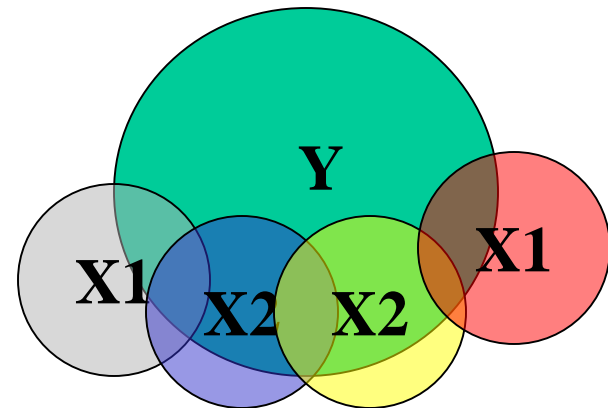
# Effects Of Collinearity

A) Regression Coefficients May Be Far From True

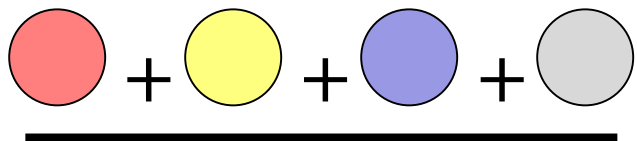
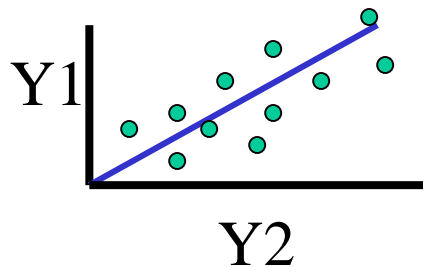
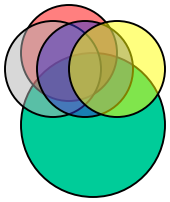
B) Beta Coefficients (Slope) May Take On Wrong Sign

C) Failure to Reject  $H_0$  When It Is False (Type II Error)

D) May Exclude True Predictors



# Reducing The Effects Of Collinearity



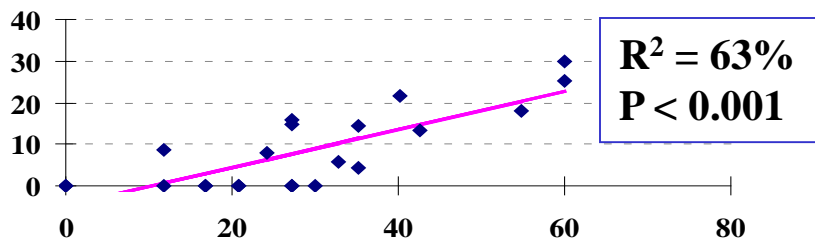
# of Y variables summed

- A) Pick One Out Of The Many Tightly Correlated X or Independent variables
- B) Regress Two Tightly Correlated X variables Use Residual Values For The Least Important One
- C) Create Summated Scale Data

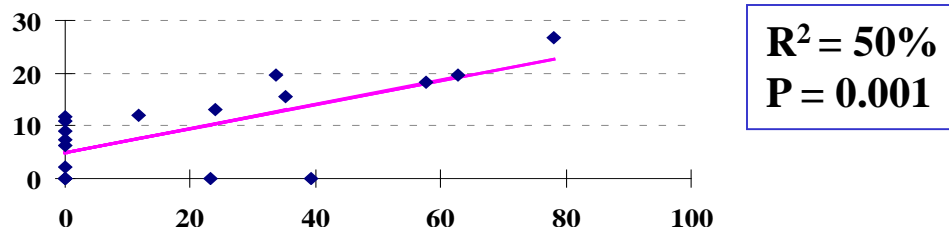
# Stepwise Regression Model For Population Number One

<b>Independent Variables</b>	<b>Used</b>	<b>% Variance In Male RS Explained</b>	<b>p Value</b>
<b>Status</b>	<b>Yes</b>	<b>66.20%</b>	<b>&lt; 0.001</b>
<b>Ago Sum</b>	<b>No</b>		
<b>Male Movement</b>	<b>No</b>		
<b>Male Size</b>	<b>No</b>	<b>Complete Model = 68.2%</b>	

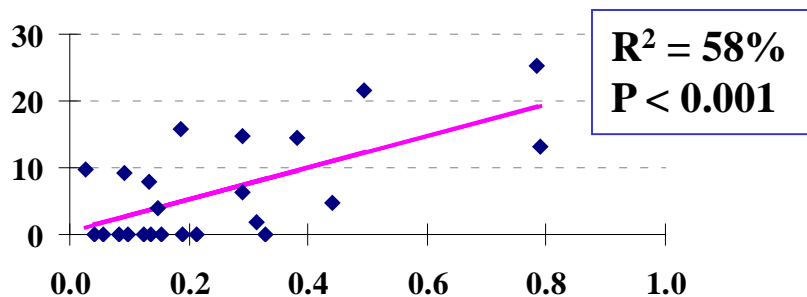
# Social Status Variables Vs. Male RS



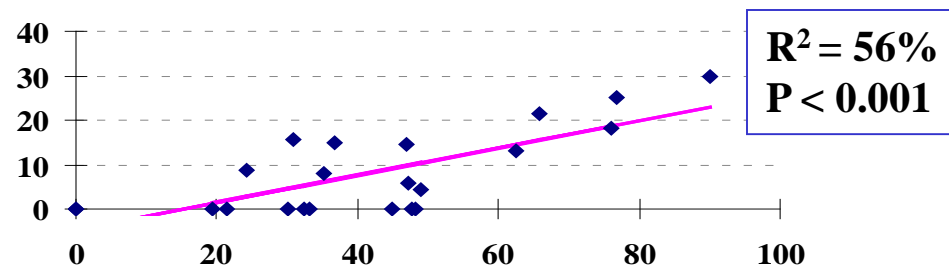
**% Of Potential Rivals Dominated**



**% Of Time In Black Color Pattern**



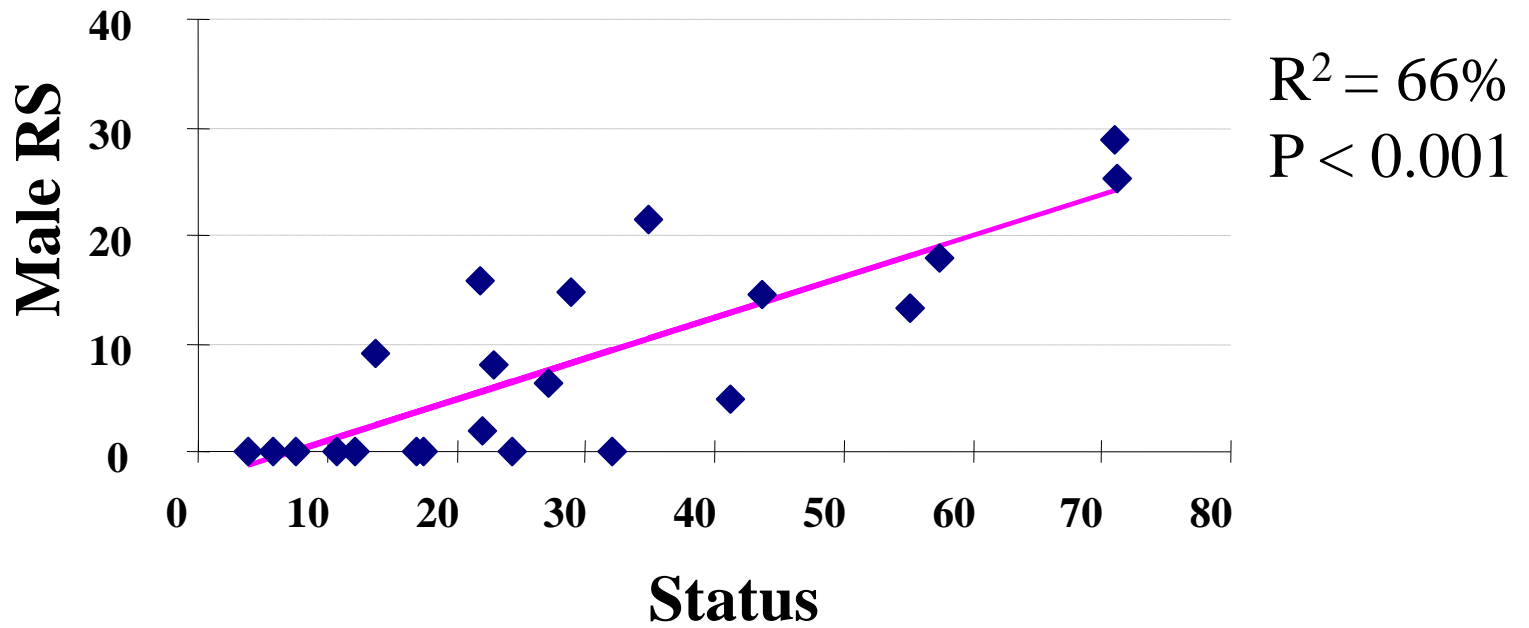
**% Of Time In Alpha/Sat Status**



**% Of Actual Rivals Dominated**

**Traits Were Used To Create The Status Variable**

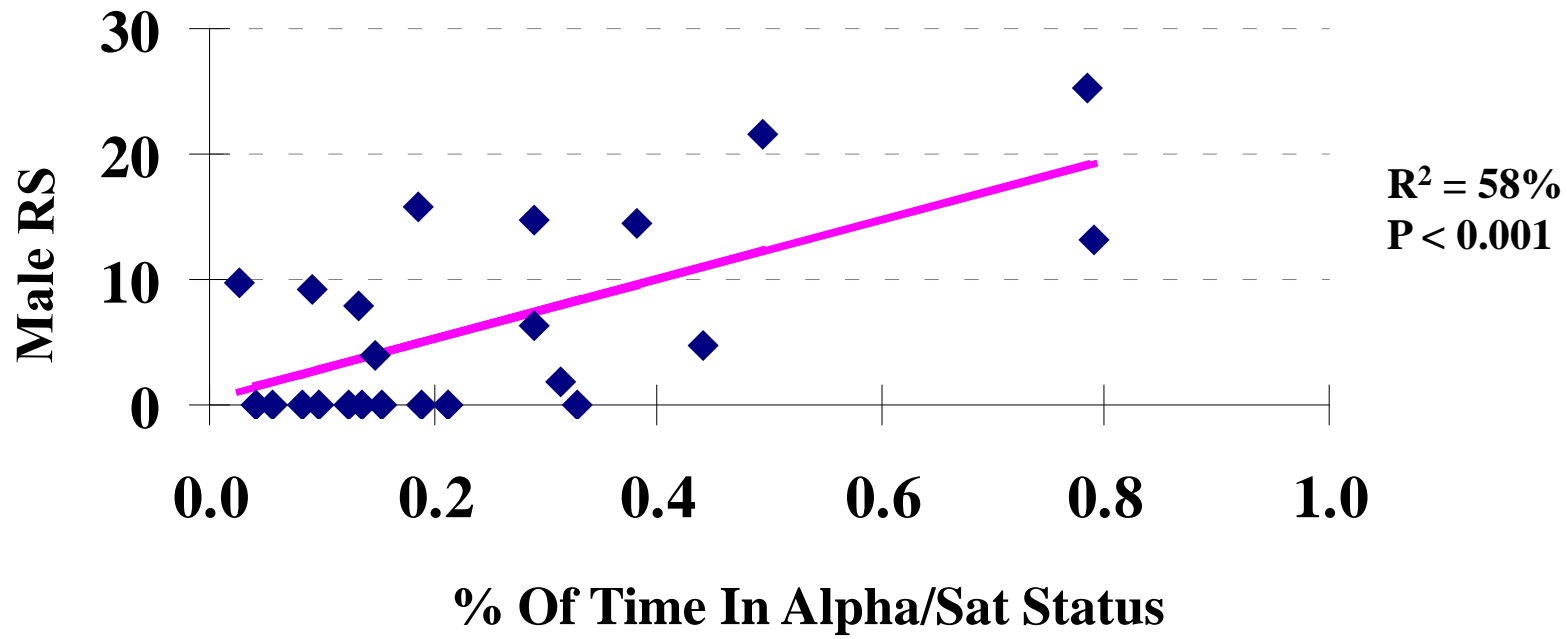
# Male Status Vs. RS



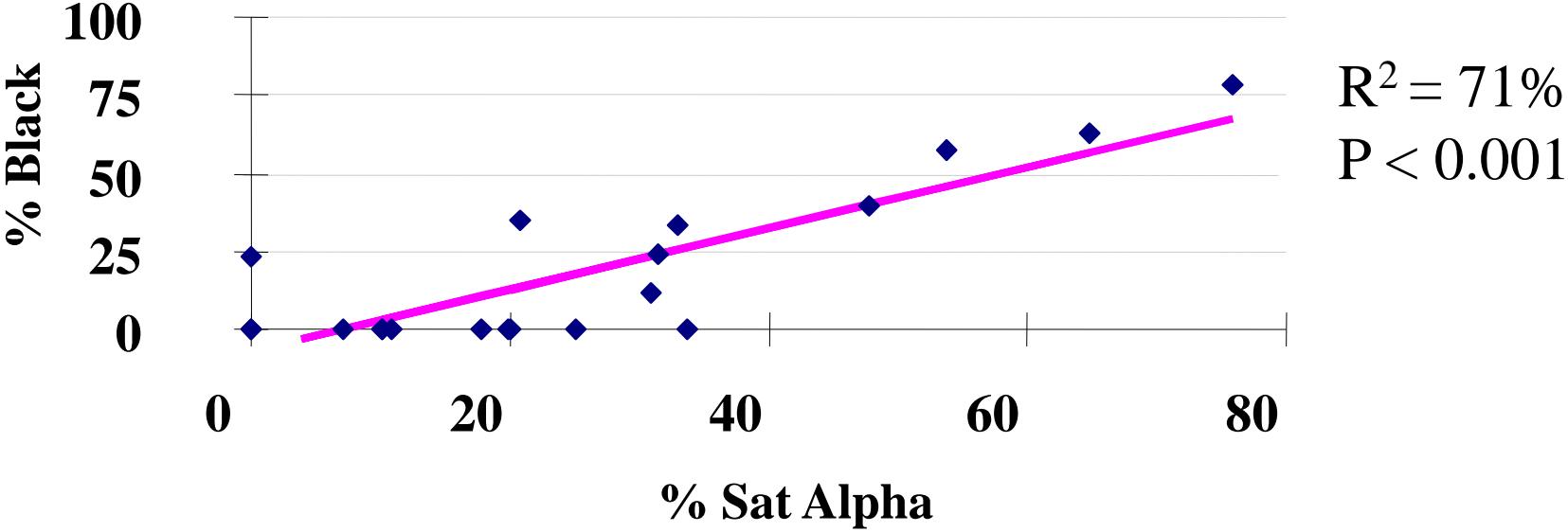
# Stepwise Regression Model For Population Number Two

Independent Variables	Used	% Variance In Male RS Explained	p Value
Sat + Alpha Occurrence	Yes	94%  Complete Model = 96.8%	< 0.001
Black Color Residual	Yes		
Male Movement	Yes		
Male Size	No		

# Alpha & Satellite Occurrence Vs. Male RS



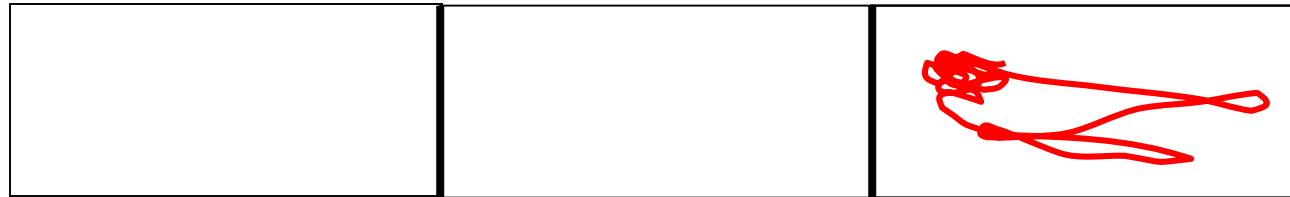
# Relationship Between Two Social Status Variables: Black & SatAlpha





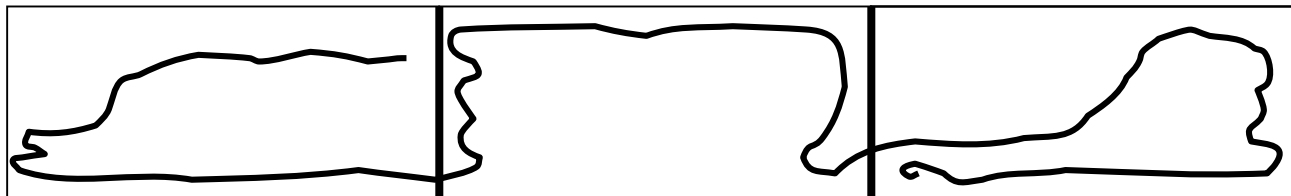
# Quantifying Male Movement

(Converting Movement Information Into Binomial Data)



 Male Movement

**30 Min Movement Score = 0**

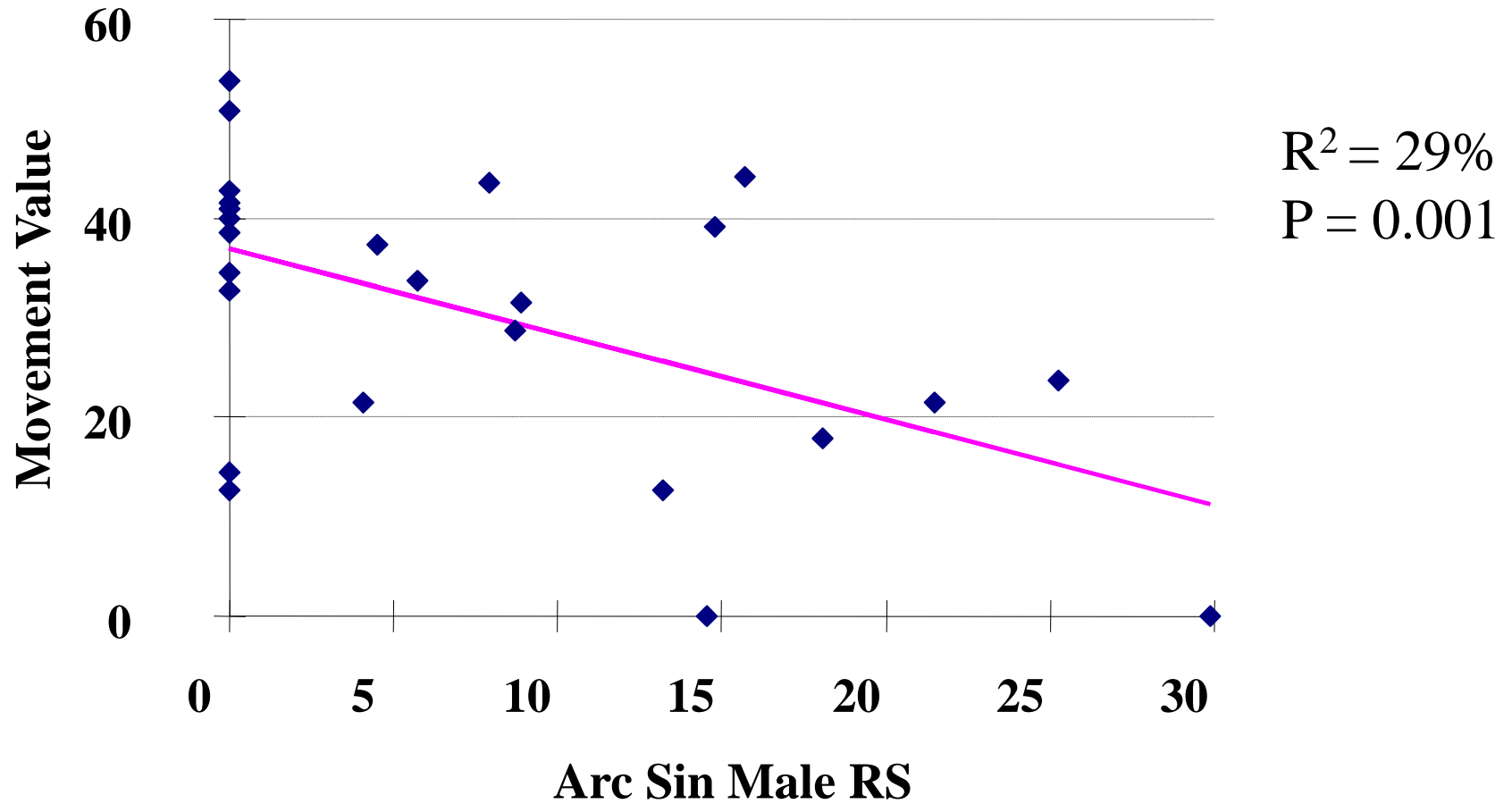


 Male Movement

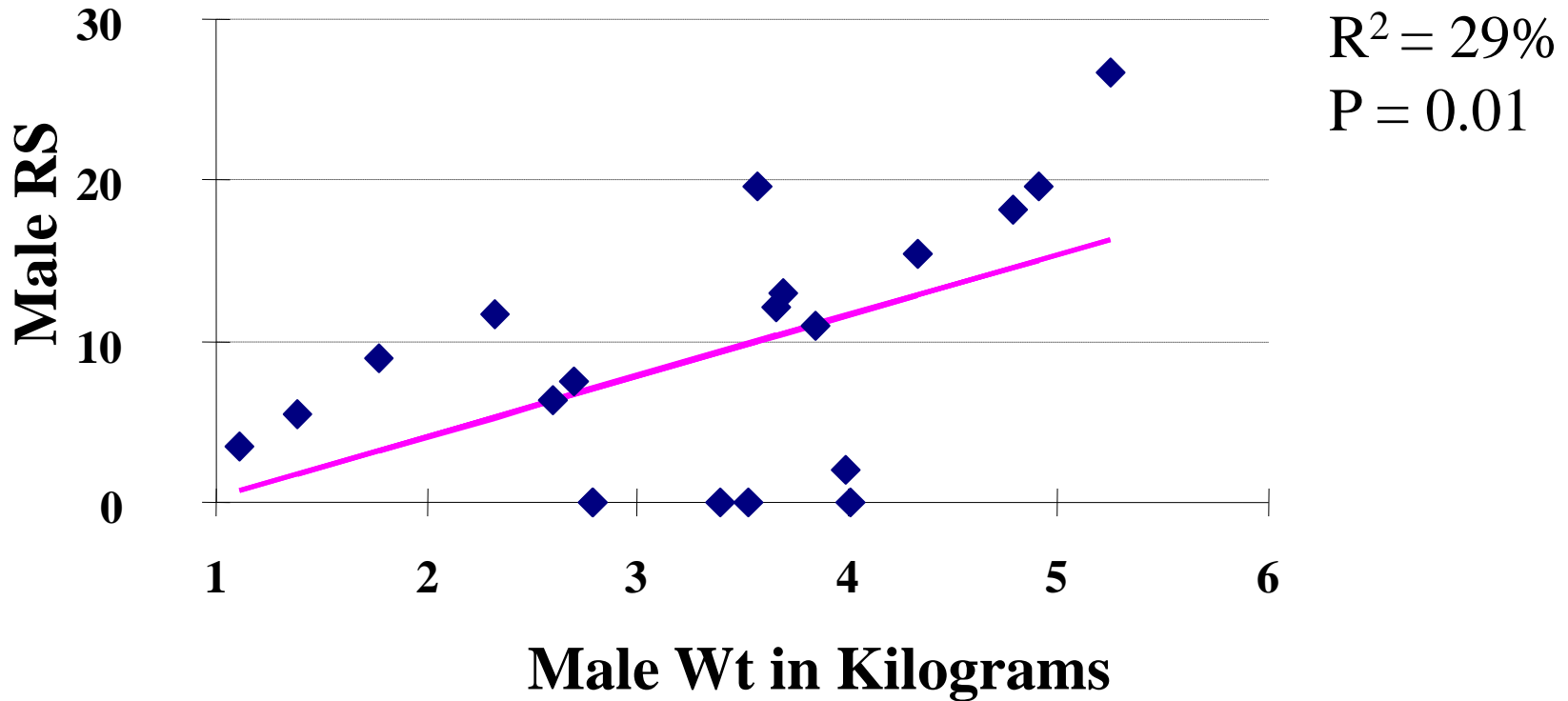
**30 Min Movement Score = 1**

**Sum Of The Movement Scores** = **Movement Score**  
**No. Of Periods Observed**

# Male Movement & RS

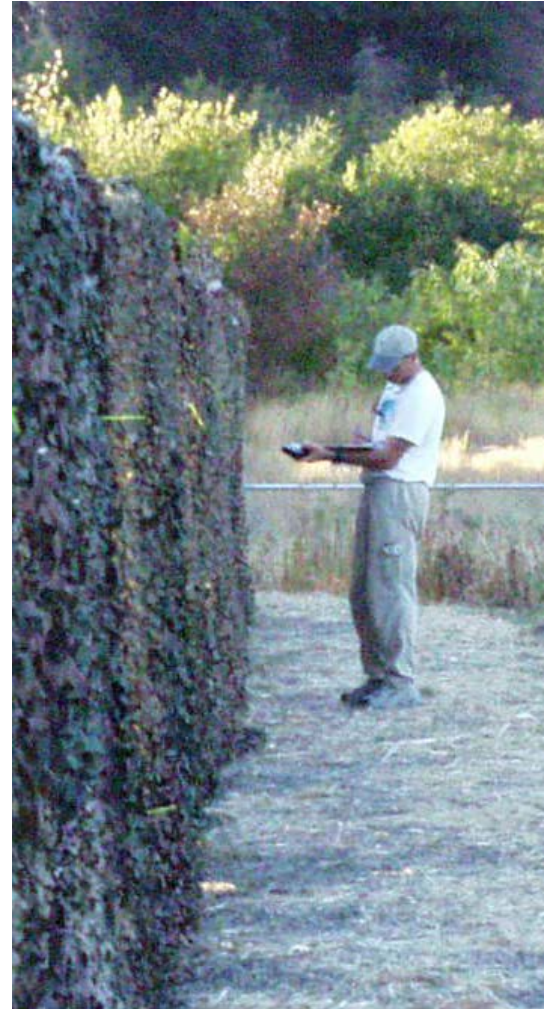


# Male Body Weight vs. RS



# Conclusions

- 1) **High Variation Exists in Male RS  
(CVs 70 to 116%)**
- 2) **No Detectable Difference in RS Of  
Wild & Hatchery Males**



# Conclusions

## 3) Males With High RS Values Were:

- a) Socially Dominant
- b) Aggressive, &
- c) Tended To Stay In  
Localized Areas



# Conclusions

**4) Male Size Was Less Important Than Behavior In Determining RS**

**5) Access To Females & The Capacity To Defend Them Was Largely Responsible For Variation In Male RS**

