



**Factors Affecting The  
Reproductive Success of Hatchery-  
& Wild Male Spring Chinook**

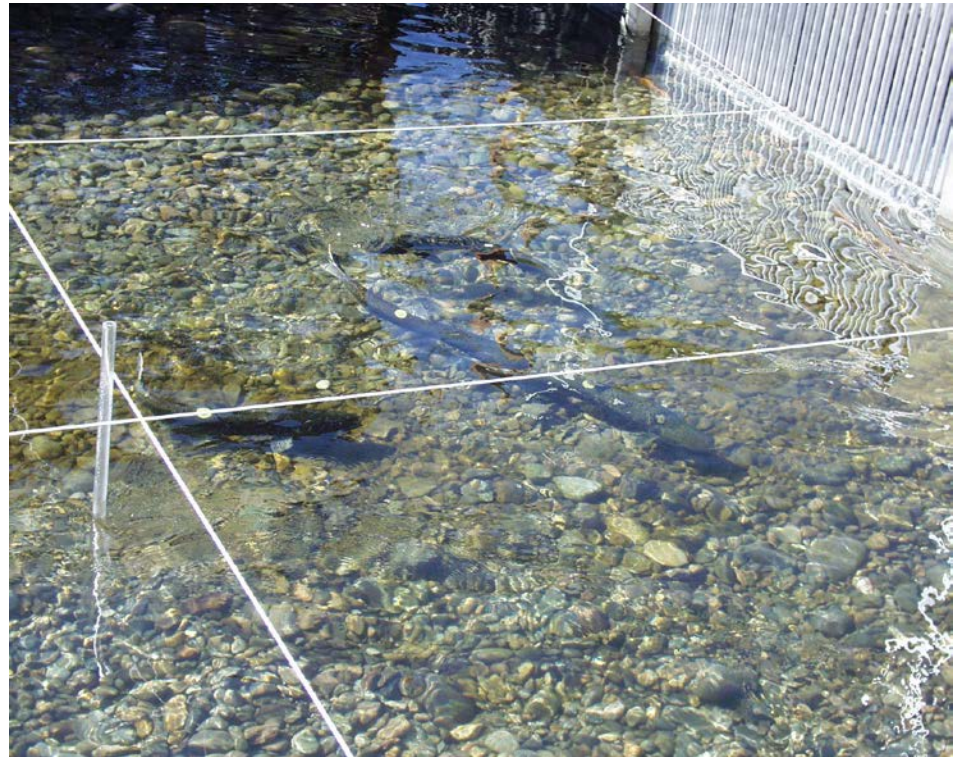
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& T. Kassler**

# Cle Elum Observation Stream



# Experimental Approaches To Evaluating RS

- **Homogenous Pops:**  
Fish Origin Is Same,  
Competition Is Within  
Type
- **Heterogeneous Pops:**  
Fish Origin Is Mixed  
Competition Is Across  
Types

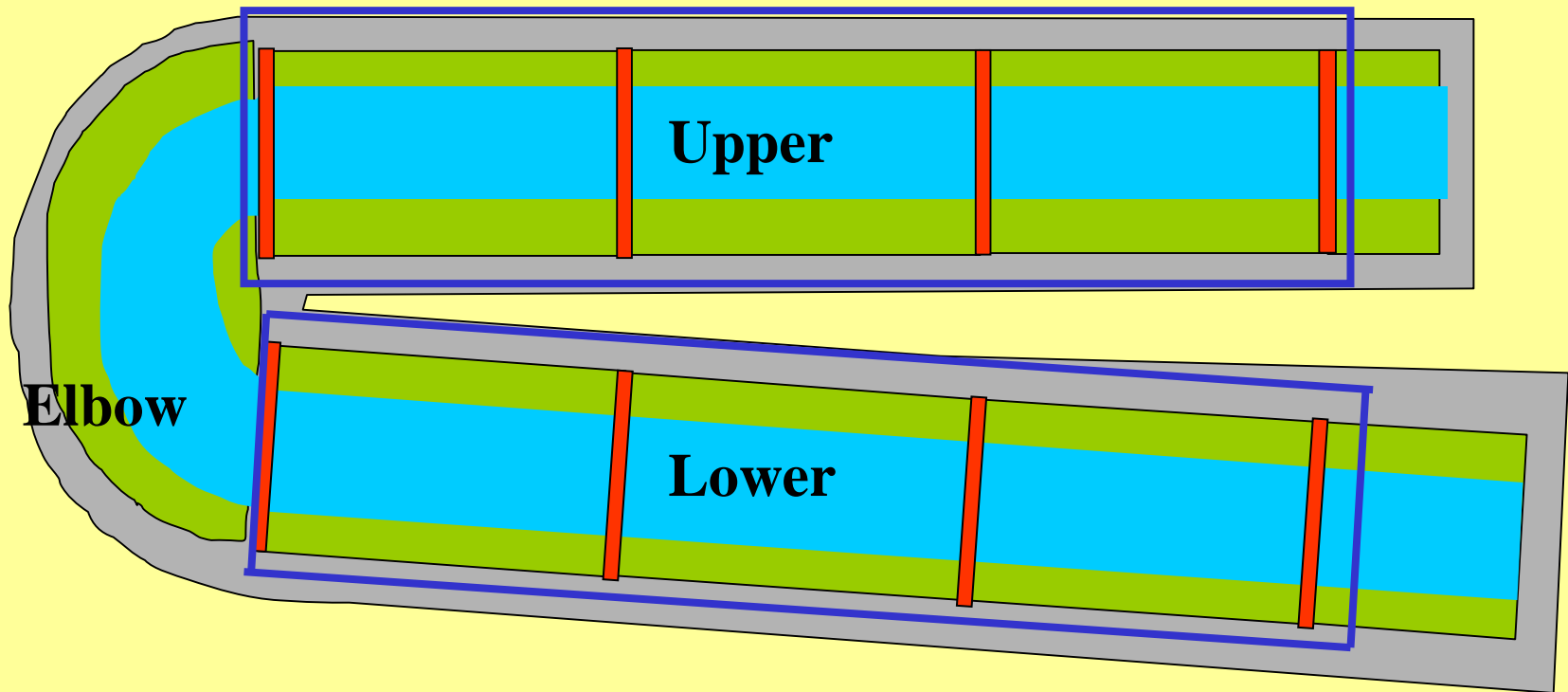


# Allotting Space For The Populations

- Wild Spring Chinook Females Occasionally Leave Their Redds For 30 Mins or More
- Space Was Needed To Allow The Expression Of Reproductive Behavior & Increase Statistical Power

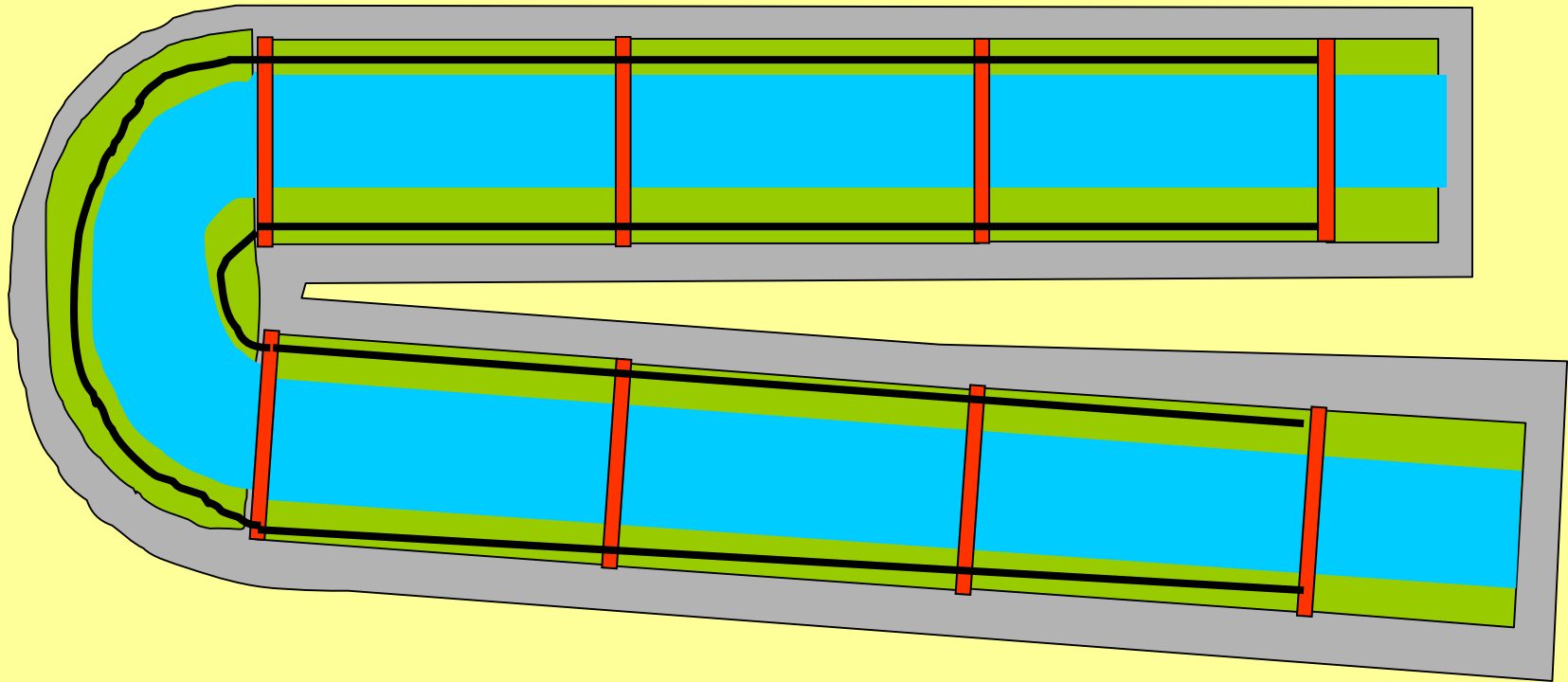


# Sections Of The Observation Stream Used In 01 & 02



**Upper & Lower Sections Were  
4.6 m wide by 45.7 m long**

# Area In Observation Stream Used In 2003, 04, & 05

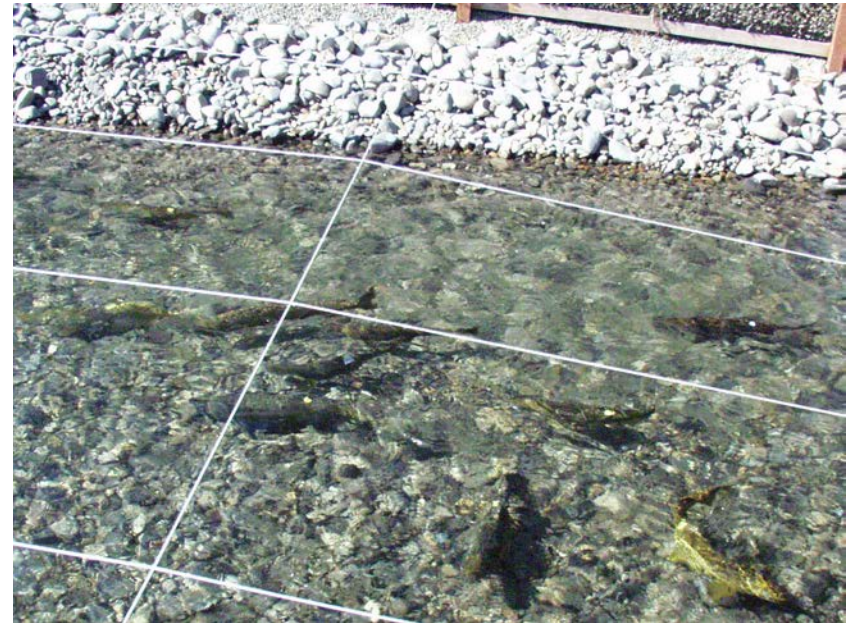


**Section Used In 2003 was 4.6 m x 127 m**

# Area Allotted Per Female

## 2001, 2002, & 2003 Populations

| Yr | Section | No. Of Females | M <sup>2</sup> Per Female |
|----|---------|----------------|---------------------------|
| 01 | Upper   | 19             | 12.5                      |
|    | Lower   | 18             | 13.2                      |
| 02 | Upper   | 22             | 10.8                      |
|    | Lower   | 19             | 12.5                      |
| 03 | Entire  | 26             | 21.5                      |



# Factors Affecting Male Reproductive Success

**Capacity To:**

**a) Find Females & Defend Them From Rivals**

**b) Fertilize Eggs**

**c) Produce Offspring**





# Null Hypothesis Tested: Males

- **Male Origin & Life History Strategy Does Not Influence RS**



# Types Of Males Used



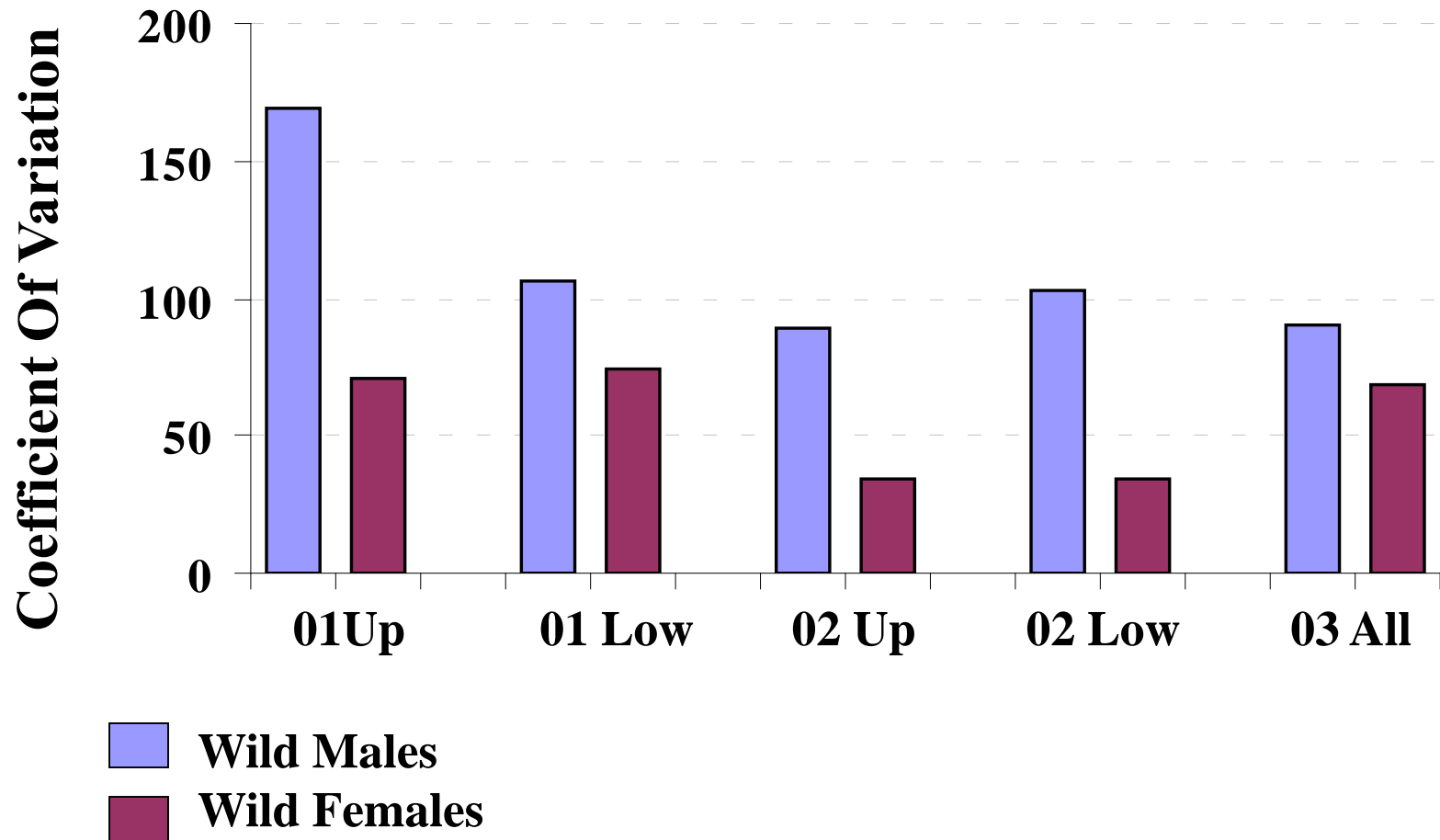
| Hatch & Wild<br>Type | Age   | POPULATION |           |           |           |           |
|----------------------|-------|------------|-----------|-----------|-----------|-----------|
|                      |       | 01 Up      | 01 Low    | 02 Up     | 02 Low    | 03        |
| Andromous            | 4 & 5 | X          | X         | X         | X         | X         |
| Jacks                | 3     | X          | X         | X         | X         | X         |
| Precocious           | 0 & 1 | -          | X         | X         | X         | X         |
| <b>Totals</b>        |       | <b>24</b>  | <b>32</b> | <b>36</b> | <b>28</b> | <b>51</b> |

# No Of Fry Used In Pedigree Evaluations

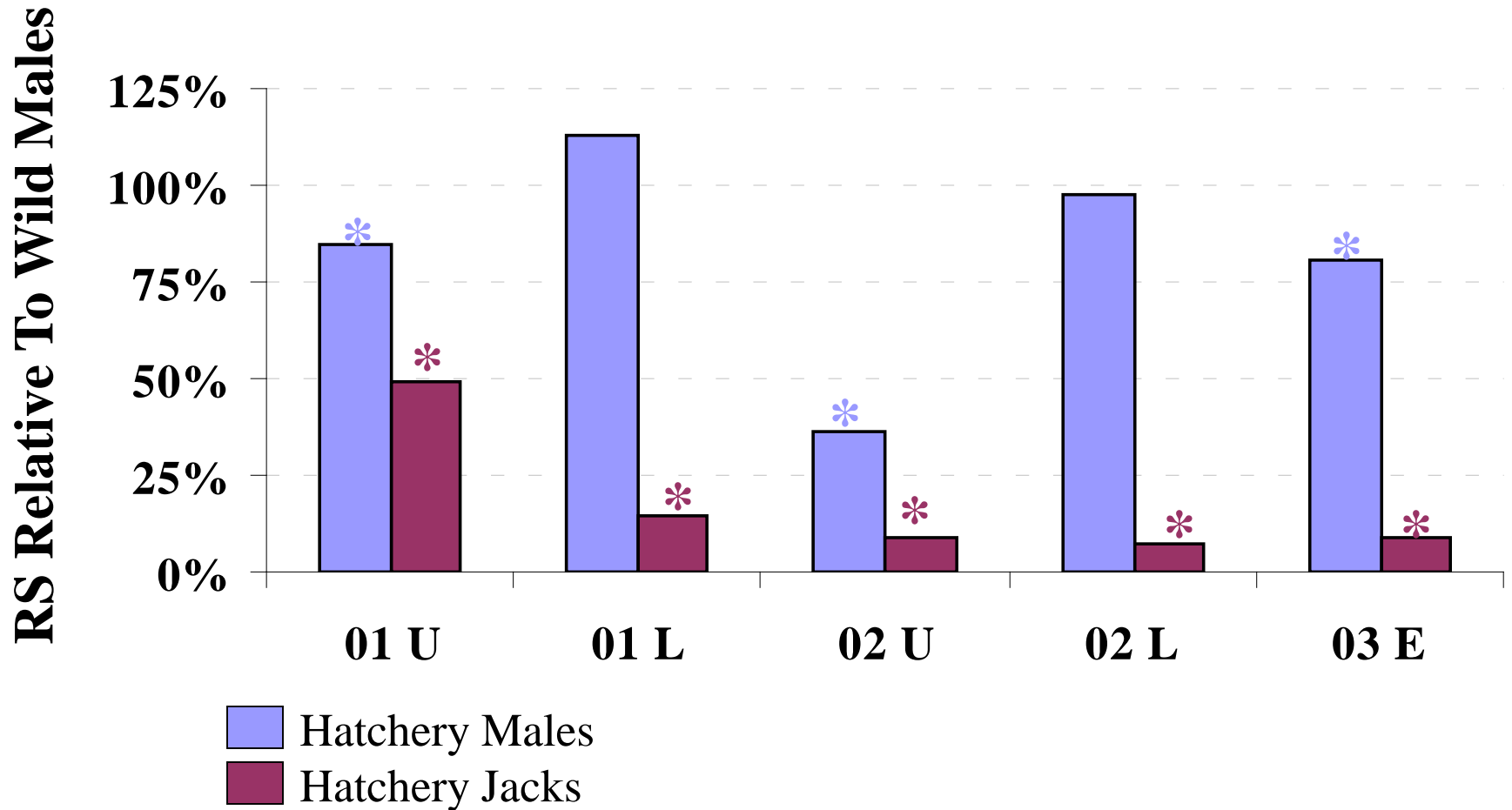
| Yr | Section | No. Of Fry In Pedigree Eval |
|----|---------|-----------------------------|
| 01 | Upper   | 989                         |
|    | Lower   | 778                         |
| 02 | Upper   | 1566                        |
|    | Lower   | 1261                        |
| 03 | Entire  | 2750                        |



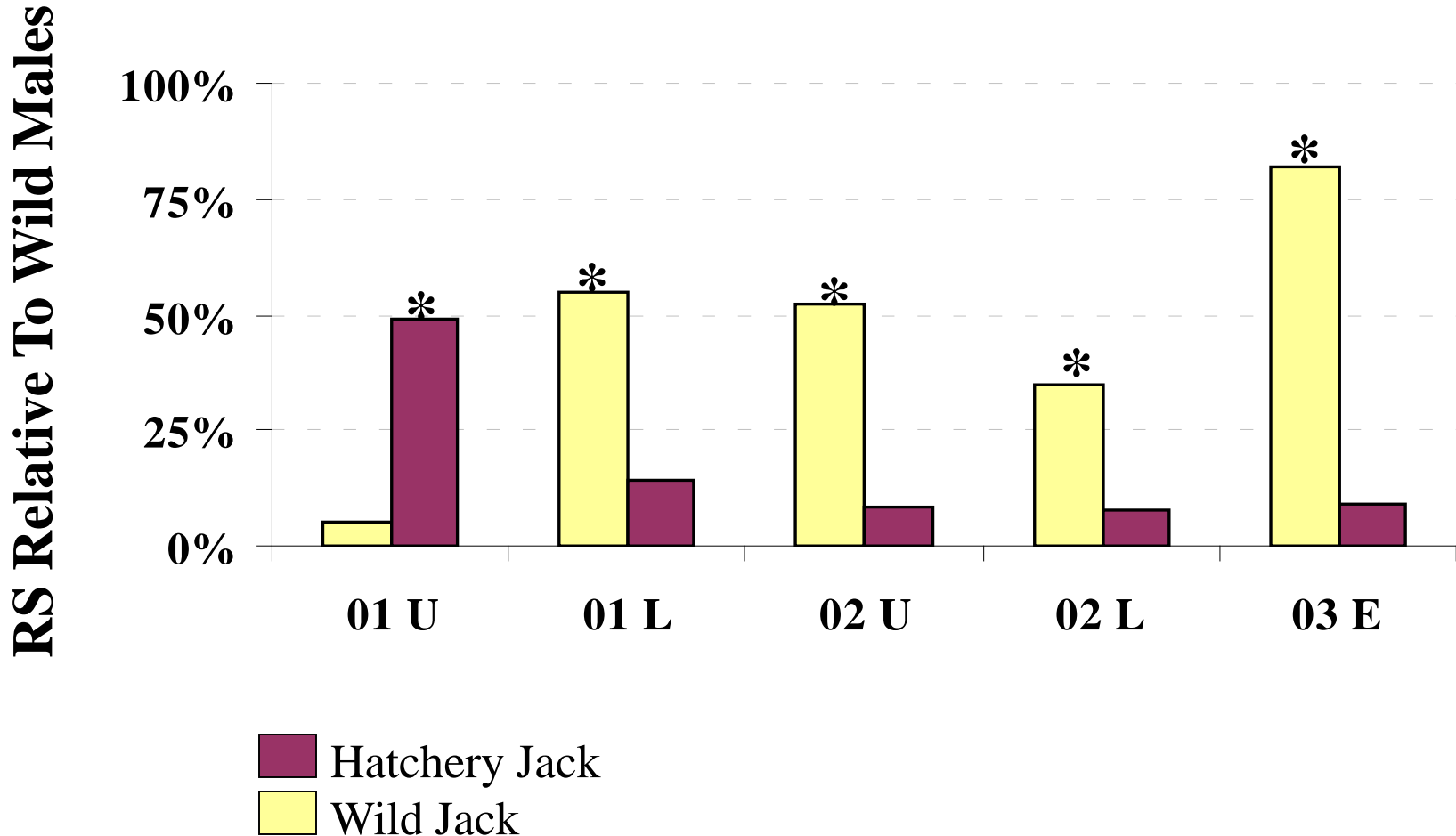
# Variation In RS By Sex



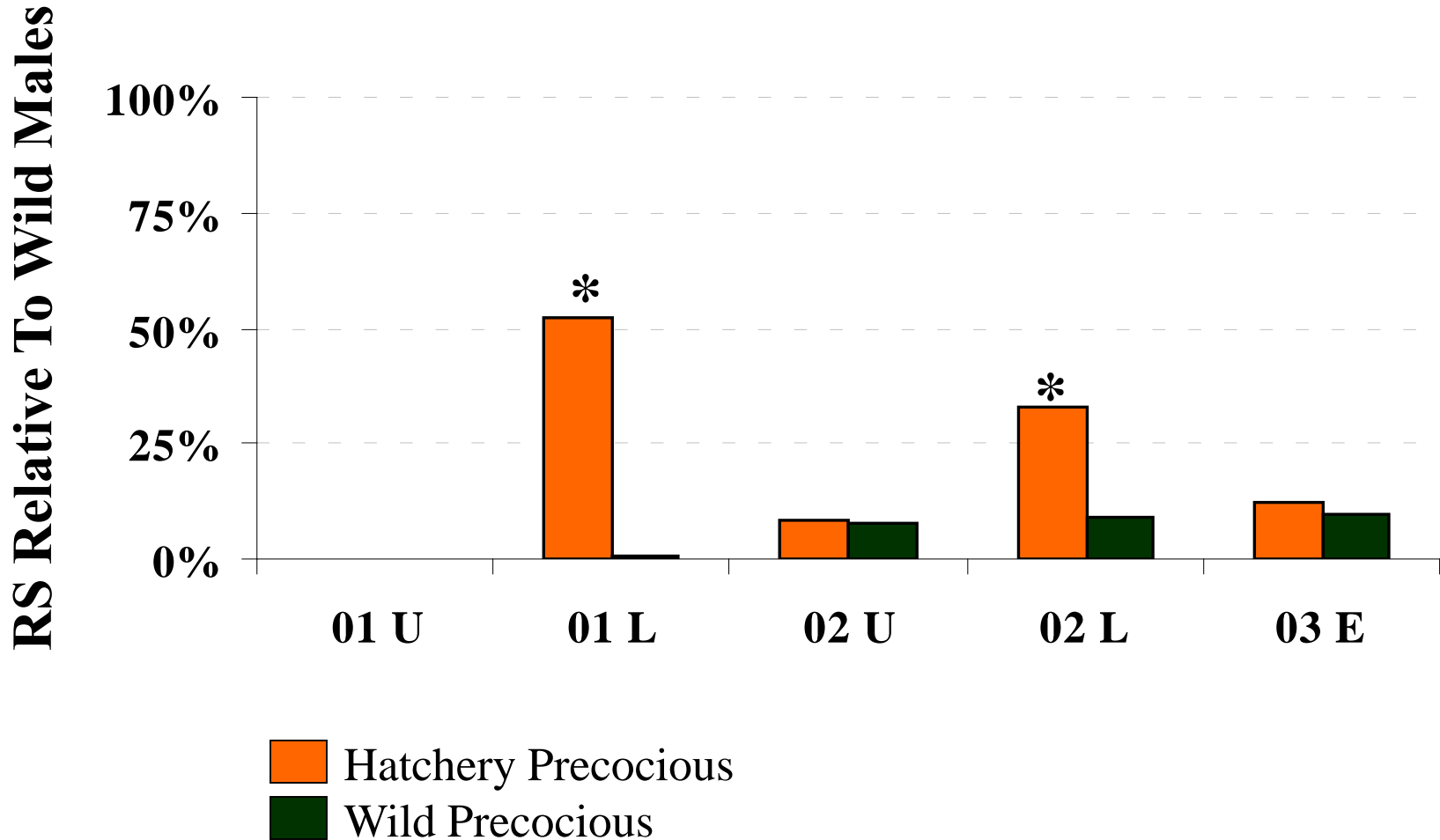
# RS Of Hatchery Males & Hatchery Jacks Relative To Wild Males



# RS Of Hatchery Jacks & Wild Jacks Relative To Wild Males & Each Other



# RS Of Hatchery & Wild Precocious Males Relative To Wild Males and Each Other



# Factors Affecting Female RS

- **The Ability To Dig Nests & Deposit Eggs**





# Factors Affecting Female RS

- **Ability To Guard Nests & Produce Fry**
- Fry Survival To The Adult Stage
- Capacity Of Adult Offspring To Reproduce



# Egg Deposition

“High Density Populations”

| "High Density Pops" |                 |      |        |
|---------------------|-----------------|------|--------|
| Yr &<br>Pop         | % Egg<br>Burial |      | Dif    |
|                     | Hat             | Wild |        |
| 01 Up               | 71.9            | 70.7 | +1.2   |
| 01 Low              | 87.2            | 91.1 | -3.9*  |
| 02 Up               | 75.5            | 93.9 | -18.4* |
| 02 Low              | 79.2            | 91.1 | -11.9* |



# Egg Deposition

“Low Density Population”

| "Low Density Pop" |                 |      |        |
|-------------------|-----------------|------|--------|
| Yr &<br>Pop       | % Egg<br>Burial |      | Dif    |
|                   | Hat             | Wild |        |
| 03                | 93.5            | 81   | +12.5* |



# Egg-To-Fry Survival

## “High Density Populations”

| <b>"High Density Pops"</b> |   |             |                   |
|----------------------------|---|-------------|-------------------|
| <b>Yr &amp; Pop</b>        | <b>% of Hatch-Origin Fry In Pedigree Sample</b> |             |                   |
|                            | <b>Exp</b>                                      | <b>Obs</b>  | <b>Difference</b> |
| <b>01 Up</b>               | <b>53.1</b>                                     | <b>41.5</b> | <b>-11.7*</b>     |
| <b>01 Low</b>              | <b>44.6</b>                                     | <b>36.9</b> | <b>-7.7*</b>      |
| <b>02 Up</b>               | <b>45.9</b>                                     | <b>43.9</b> | <b>-1.9</b>       |
| <b>02 Low</b>              | <b>54.2</b>                                     | <b>49.9</b> | <b>-4.3*</b>      |



| <b>Pooled Results</b> |              |
|-----------------------|--------------|
| <b>01 Populations</b> | <b>-9.9%</b> |
| <b>02 Populations</b> | <b>-3.0%</b> |

# Egg-To-Fry Survival

## “Low Density Population”

| "Low Density Pop" |  |      |            |
|-------------------|--|------|------------|
| Yr & Pop          | % of Hatch-Origin Fry In Pedigree Sample |      |            |
|                   | Exp                                      | Obs  | Difference |
| 03                | 55.3                                     | 58.7 | +3.4*      |

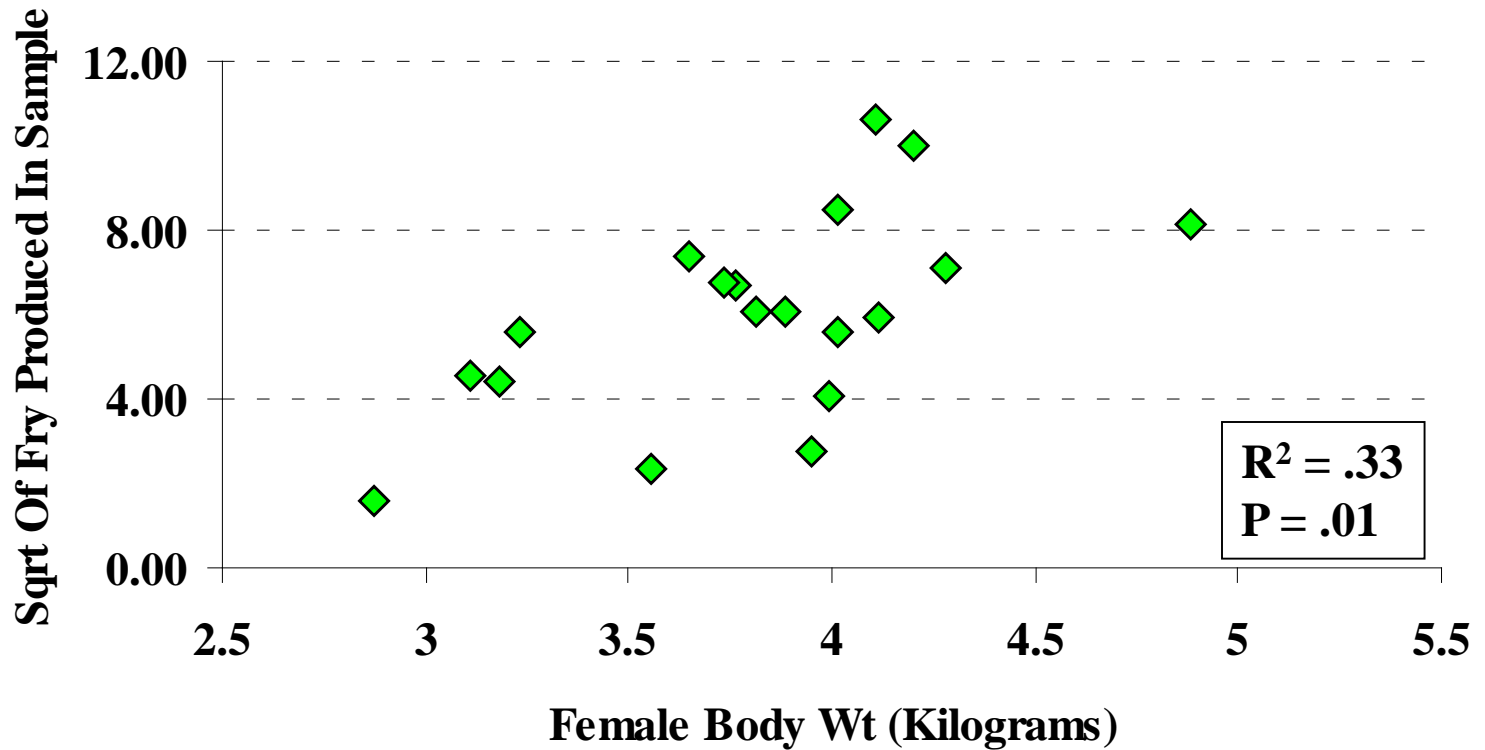


# Factors Examined That Could Potentially Affect Female RS: 2001 Lower Pop

| <b>Factors Examined</b>                  |  |
|--|--|
| <b>Physiological &amp; Morphological</b> | <b>Behavioral</b>  |
| <b>Body Size</b><br><b>Longevity*</b>    | <b>Redd Tenure*</b><br><b>Inst Density*</b><br><b>Redd Size*</b><br><b>Nearest Neighbors</b><br><b>Territory Estbl</b><br><b>Agonistic Interact*</b> |



# Female Body Wt. Vs. No. Of Fry In Pedigree Sample



# Adjusting For Differences In Fecundity & Egg Deposition

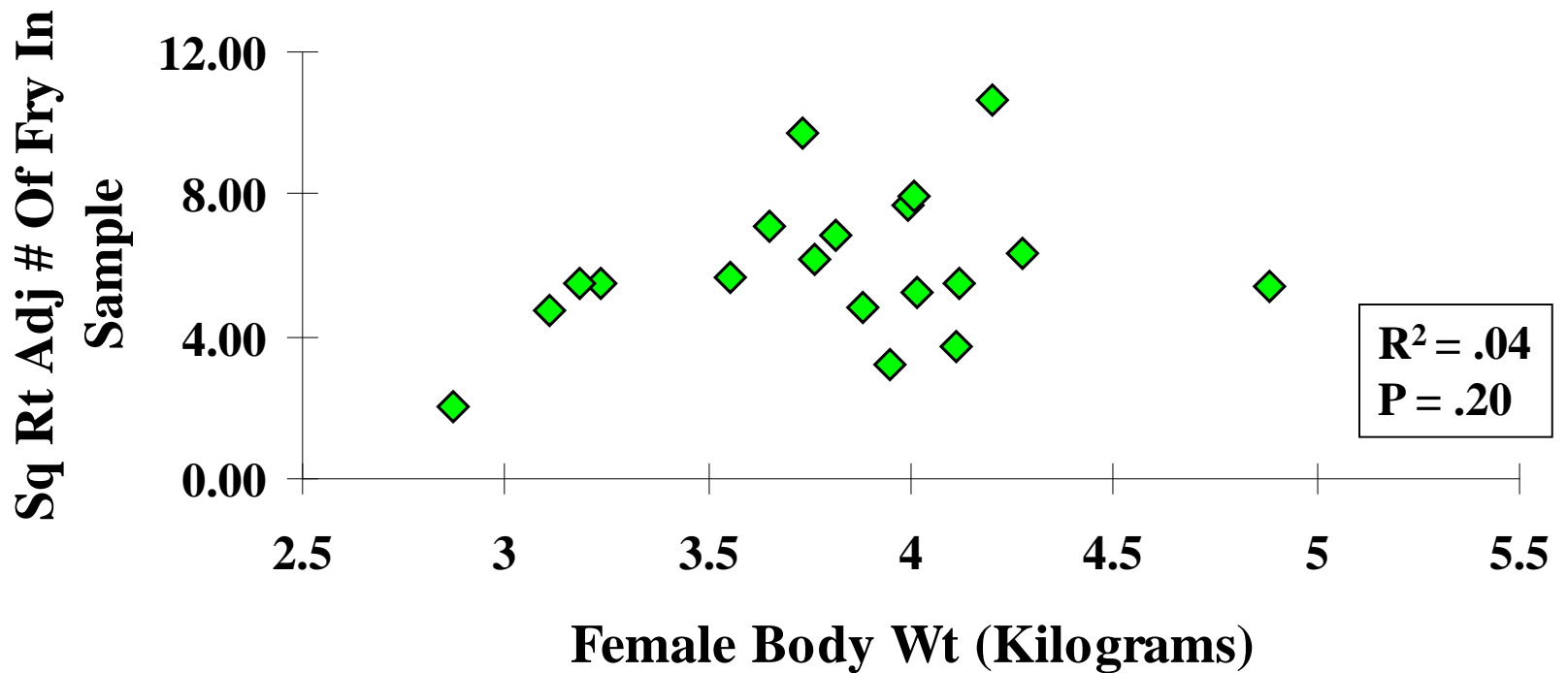
**Fry In Pedigree Sample = Traits + PED or AED**

| <b>Female</b> | <b>PED</b>  | <b>Fry In Sample</b> | <b>Mean PED</b> | <b>Adj No.</b> |
|---------------|-------------|----------------------|-----------------|----------------|
| <b>F1</b>     | <b>3000</b> | <b>50</b>            | <b>4000</b>     | <b>66.7</b>    |
| <b>F2</b>     | <b>5000</b> | <b>80</b>            | <b>4000</b>     | <b>64</b>      |

$$\text{Adj \#} = \frac{(\text{Obs \# Of Fry})(\text{Mean PED})}{(\text{Obs PED})}$$



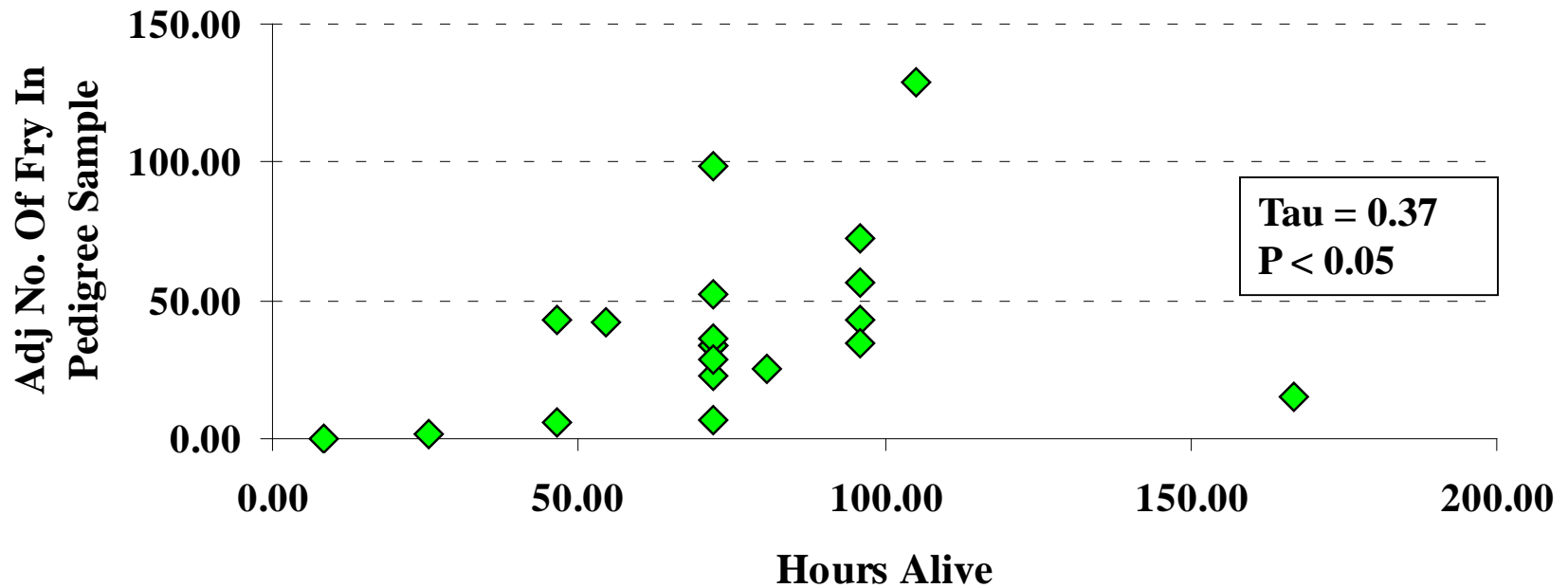
# Female Body Wt. Vs. No Of Adj Fry In Pedigree Sample



# The Effect of Longevity On Female RS

## 2001 Lower Population

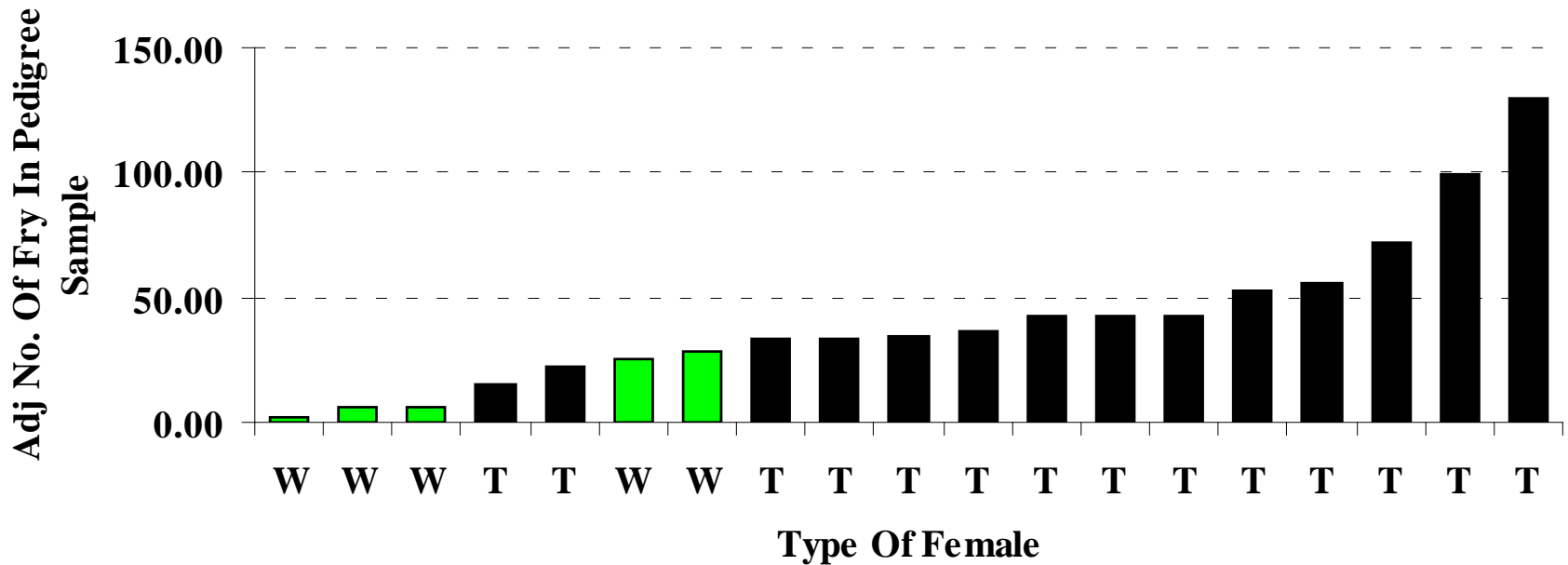
### Longevity & Fry Production From PED



# The Effect Of Redd Tenure

## 2001 Lower Population

### PED to Fry Production 2001

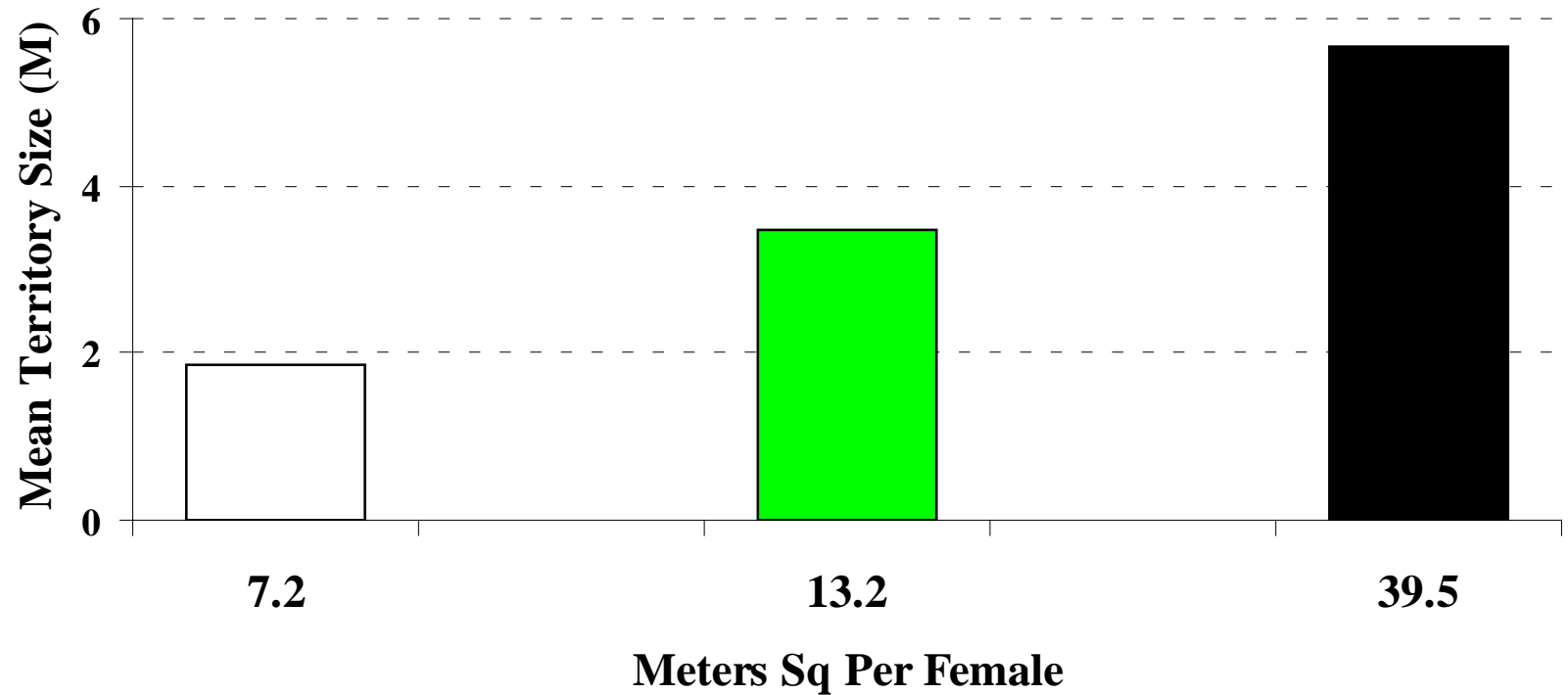


#### Mean Adjusted Fry Contributions

**Territorial** 50.9

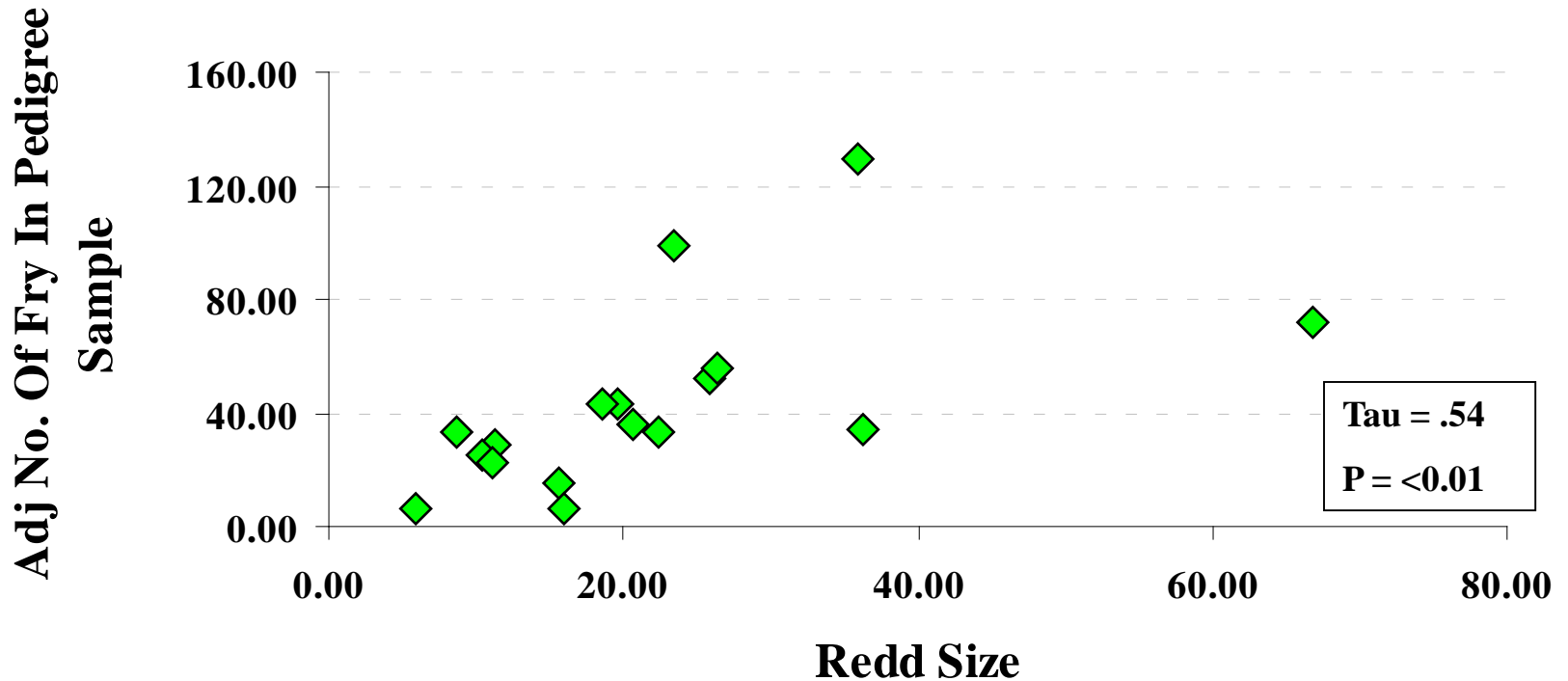
**Wandering** 13.7

# The Affect Of Instantaneous Density On Territory Size



# The Affect Of Redd Size On Female RS

2001 Lower Population: PED to Adj Fry No.



# Calculation Of Nearest Neighbor Distances

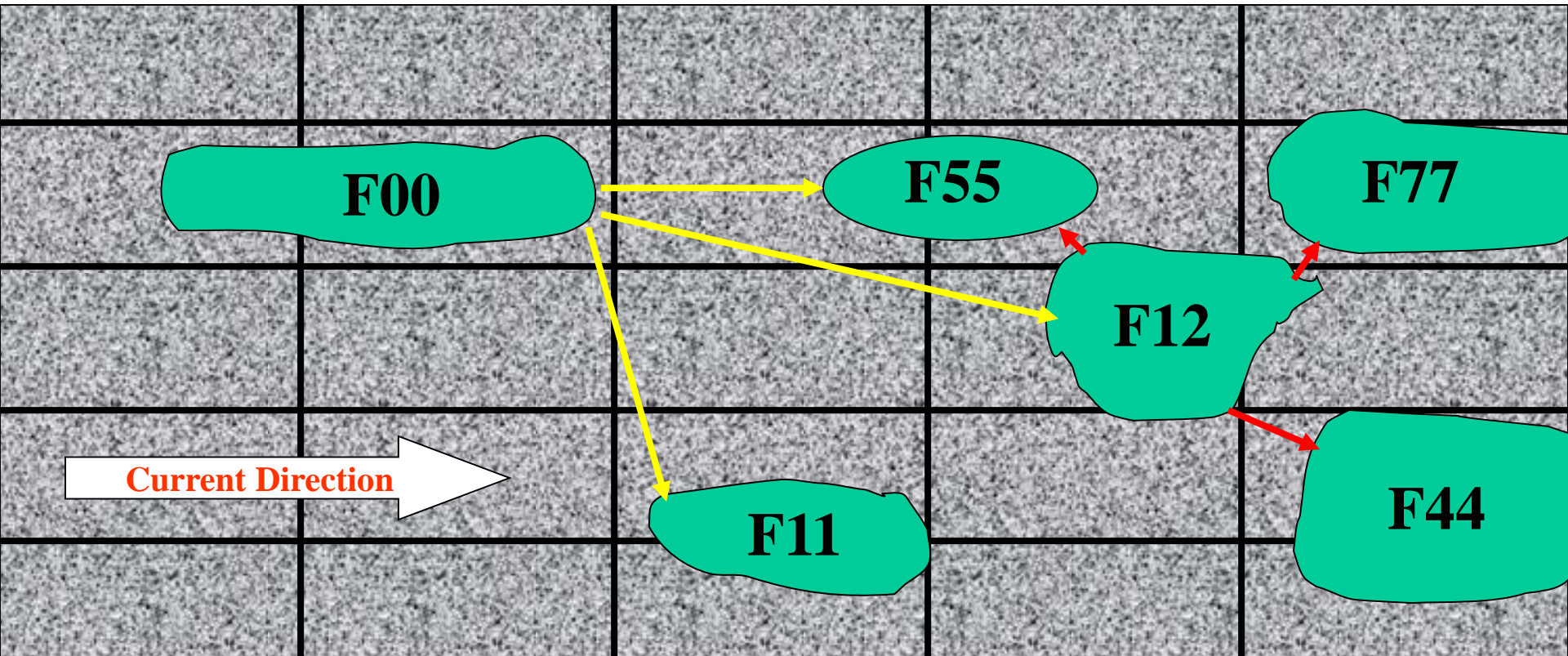
A

B

C

D

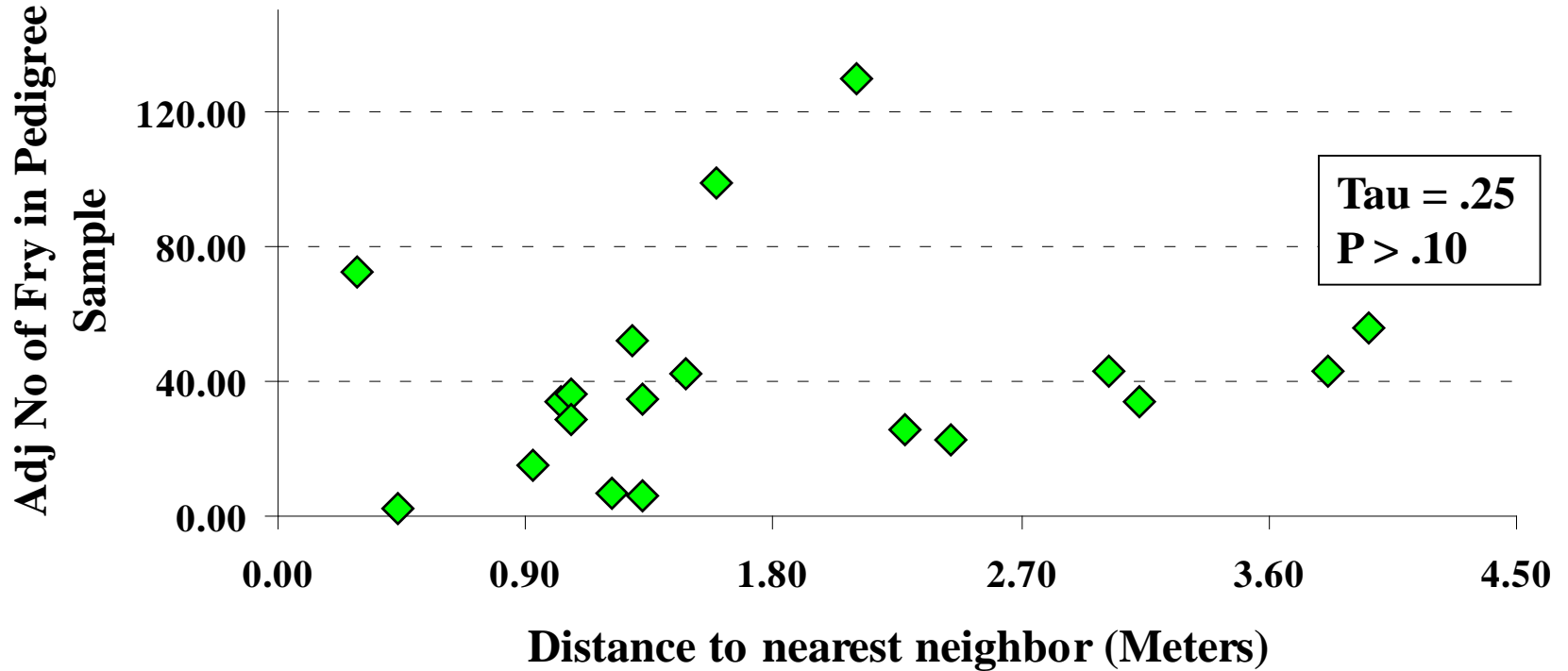
E



Mean distance in m from a female's three nearest neighbors

# Affect Of Instant. Density On Fry No.s/Female

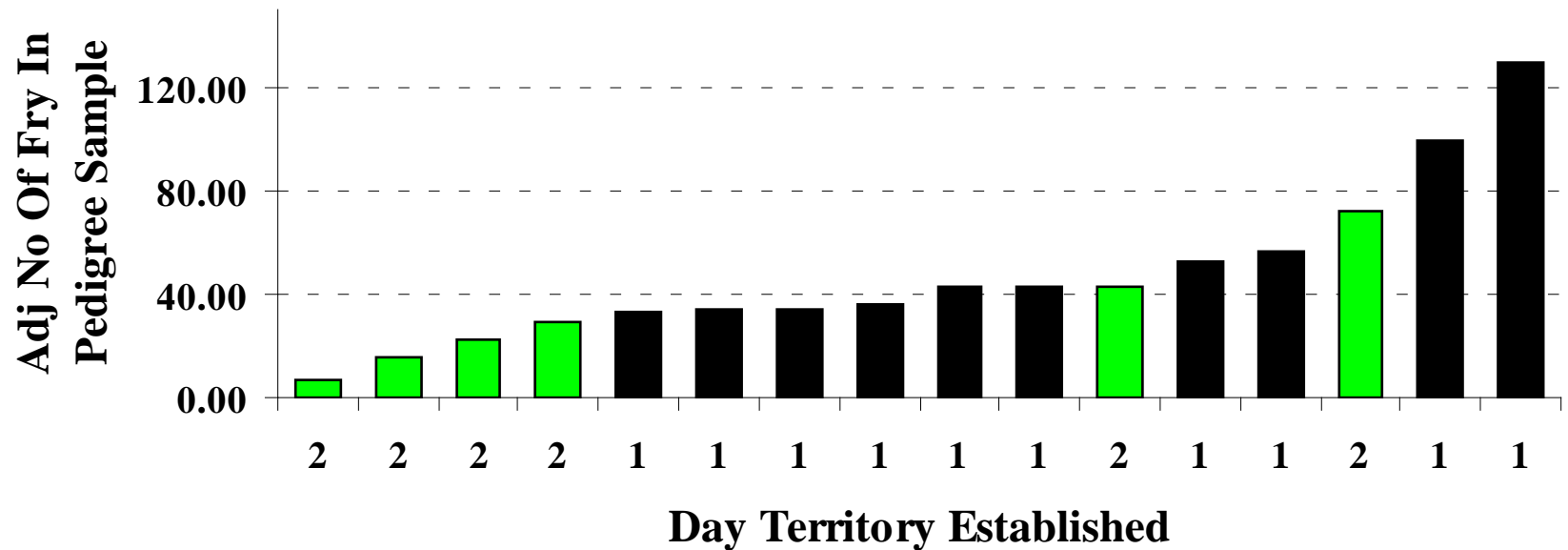
(2001 Low Population:Nearest Neighbors)



# Date Of Redd Establishment & Female RS

## 2001 Lower Population

### PED to Fry Production



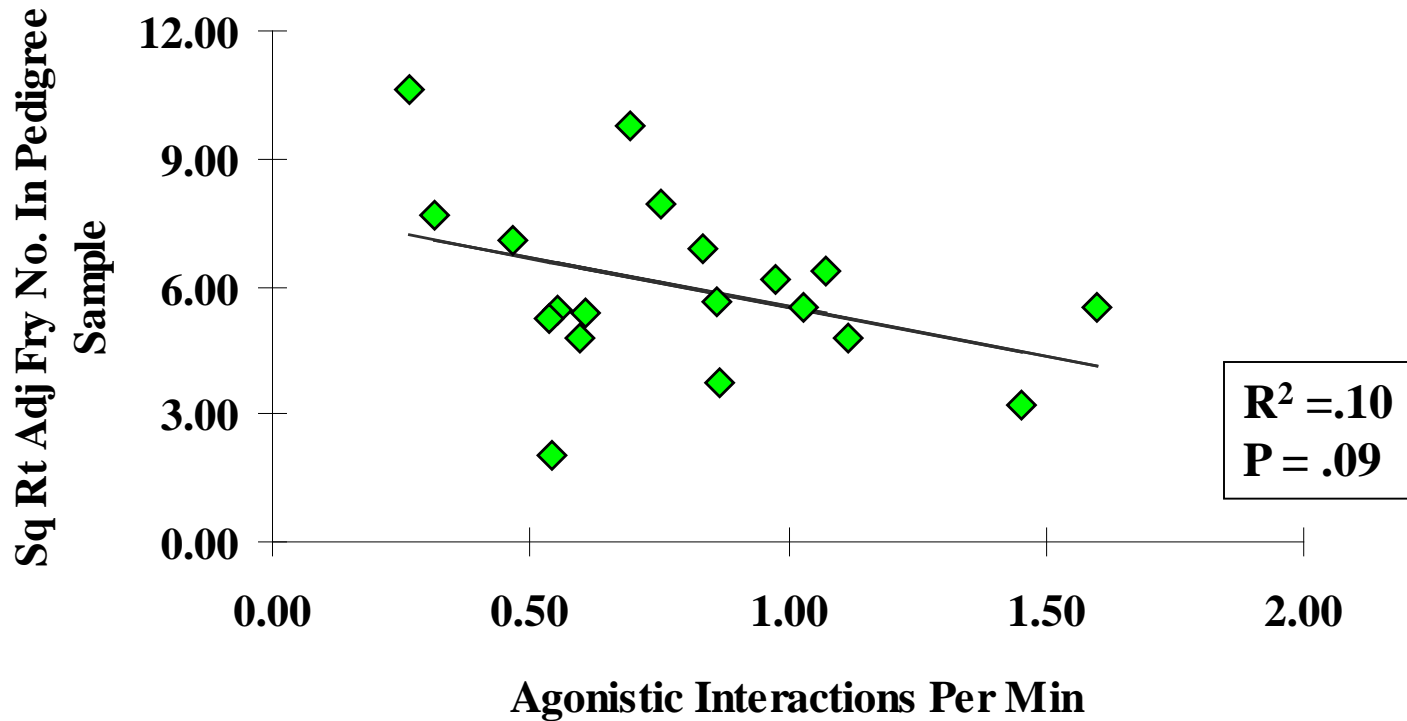


# Influence Of Territory Possession On Agonistic Behavior In Females

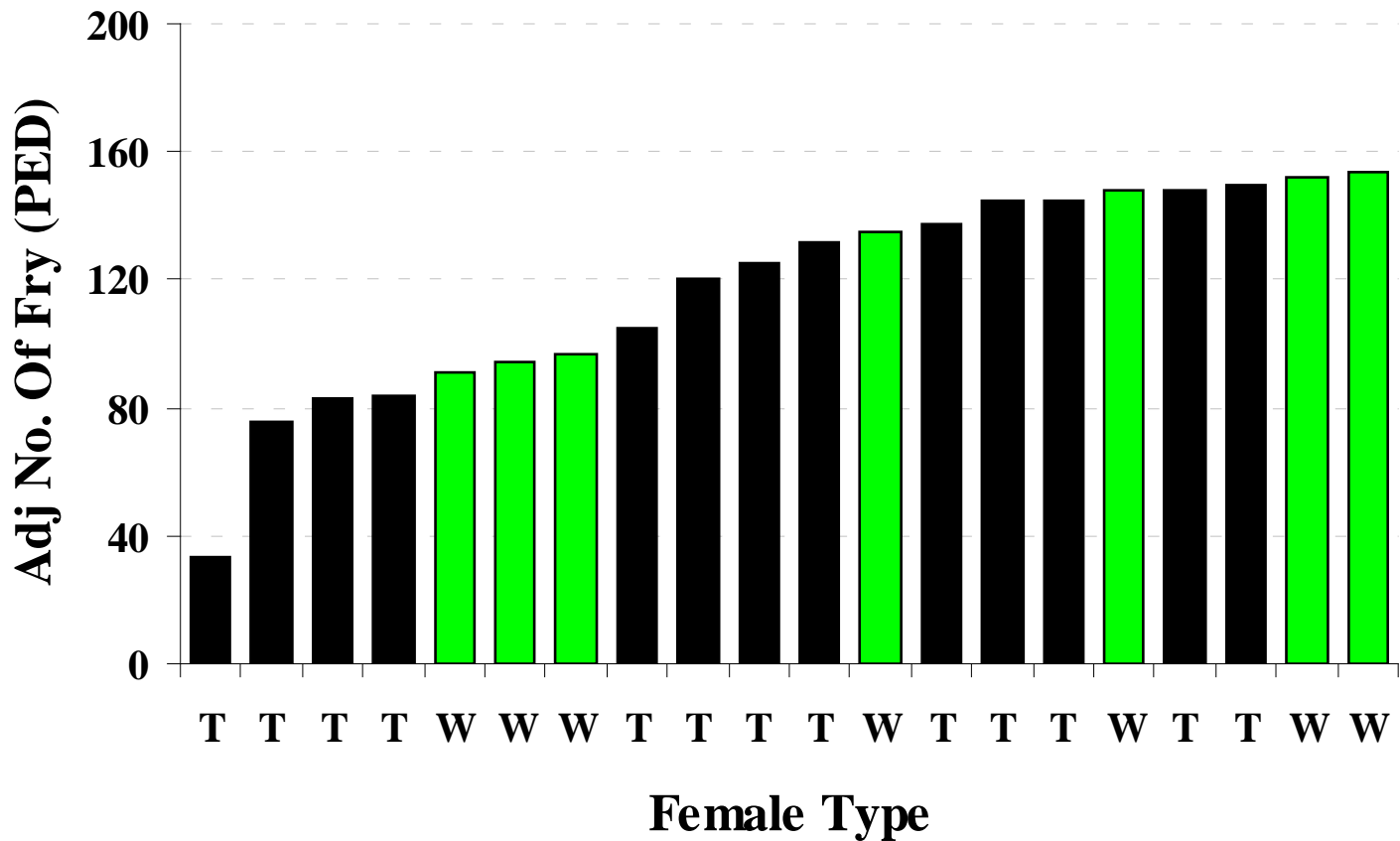


# Relationship Between Agonistic Behavior & Egg-To-Fry Survival: 2001 Lower Population

## Production Of Fry AED

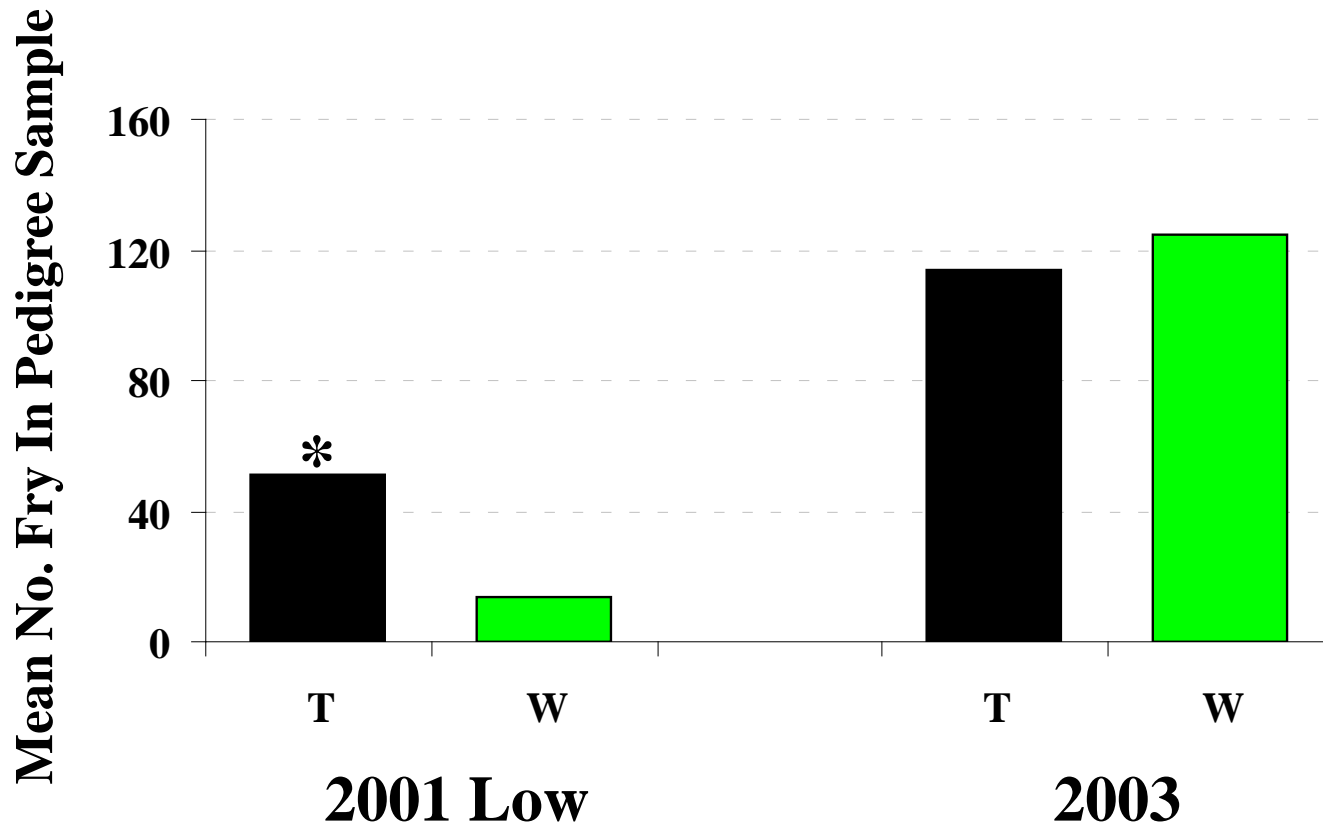


# Fry Production By Territorial & Wandering Females: 2003

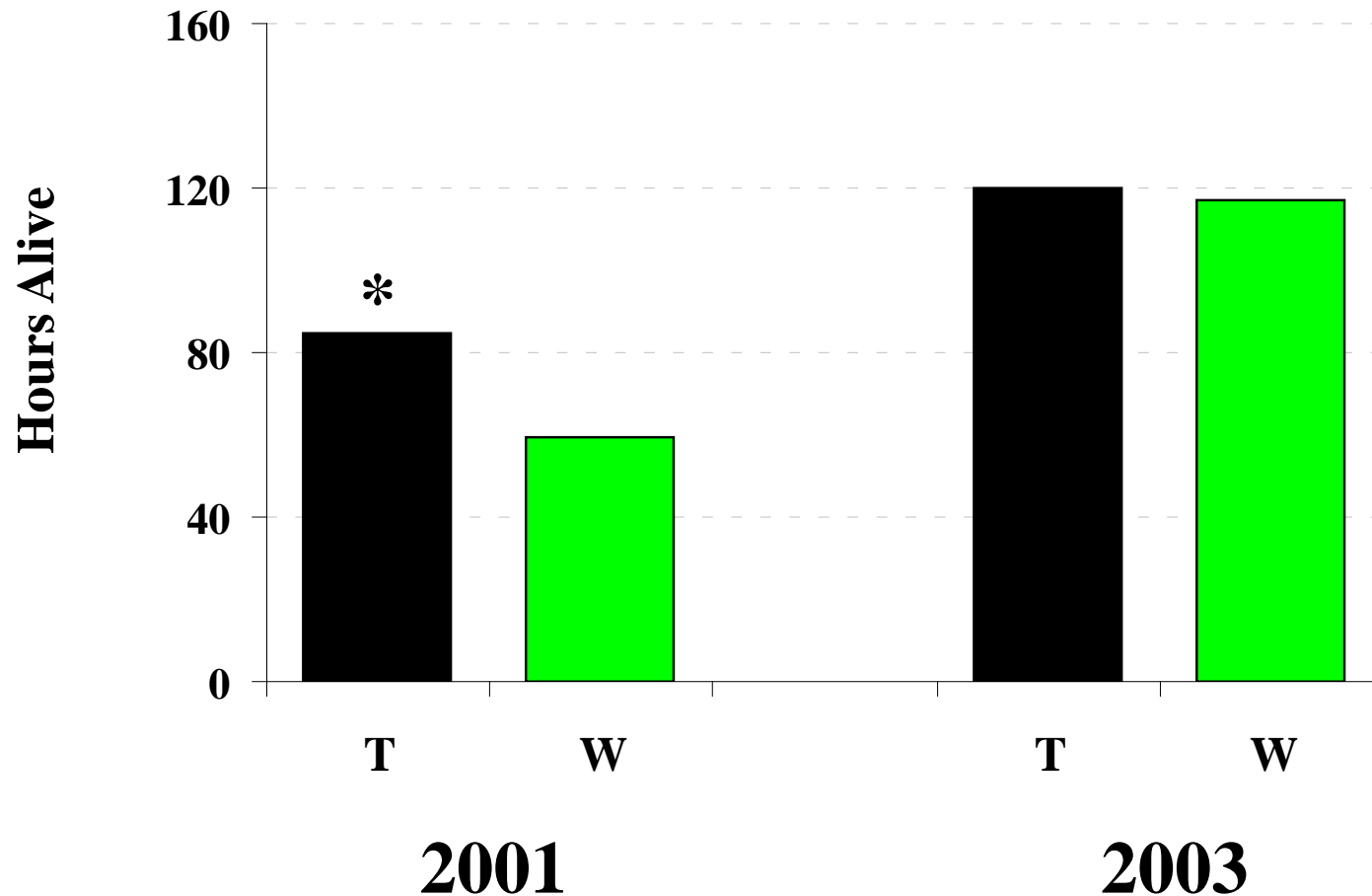


# Fry In Pedigree Samples

## Originating From Terr. & Wandering Females



# Longevity Of Territorial & Wandering Females



# Conclusions: Females

## **Hatchery Females: “High” Density Pops**

Less successful at depositing eggs

(4 –18%)

Poorer egg-to-fry survival (3-10%)

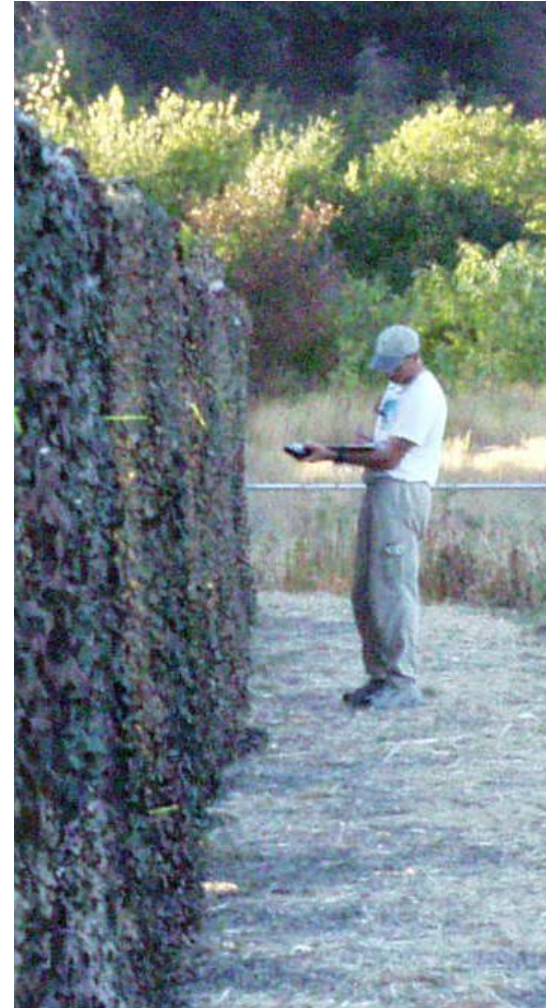
## **Hatchery Females: “ Low” Density Pops**

Comparable or better at depositing eggs

(+12.5%)

Comparable or better egg-to-fry survival

(+3.4%)



# Conclusions: Males

**Male RS more variable than Female**

**Wild 4&5 yr-old** males produced the most fry

**Hatchery 4&5 yr-olds** were on average 85% as effective as Wild 4&5s

**Jacks** were on average 32% as effective as Wild 4&5 yr-old males

**Precocious Males** were on average 17% as effective as Wild 4&5 yr-old males

