

Long Term Analyses of Juvenile Chinook Salmon Abundance Estimates

Trinity River Science Symposium
December 2021

Naturally Spawned Age-0 Juveniles

- Willow Creek
 - 1989-2018
 - Some Years Flagged as 'bad'
 - 1993, 2000, 2006
- Pear Tree
 - 2003-2018
 - Bad Years
 - 2005, 2006
- Mark-Recapture weekly stratified abundance estimates
 - Only Age-0 estimated
 - Weekly samples of fork length

Measures of Abundance

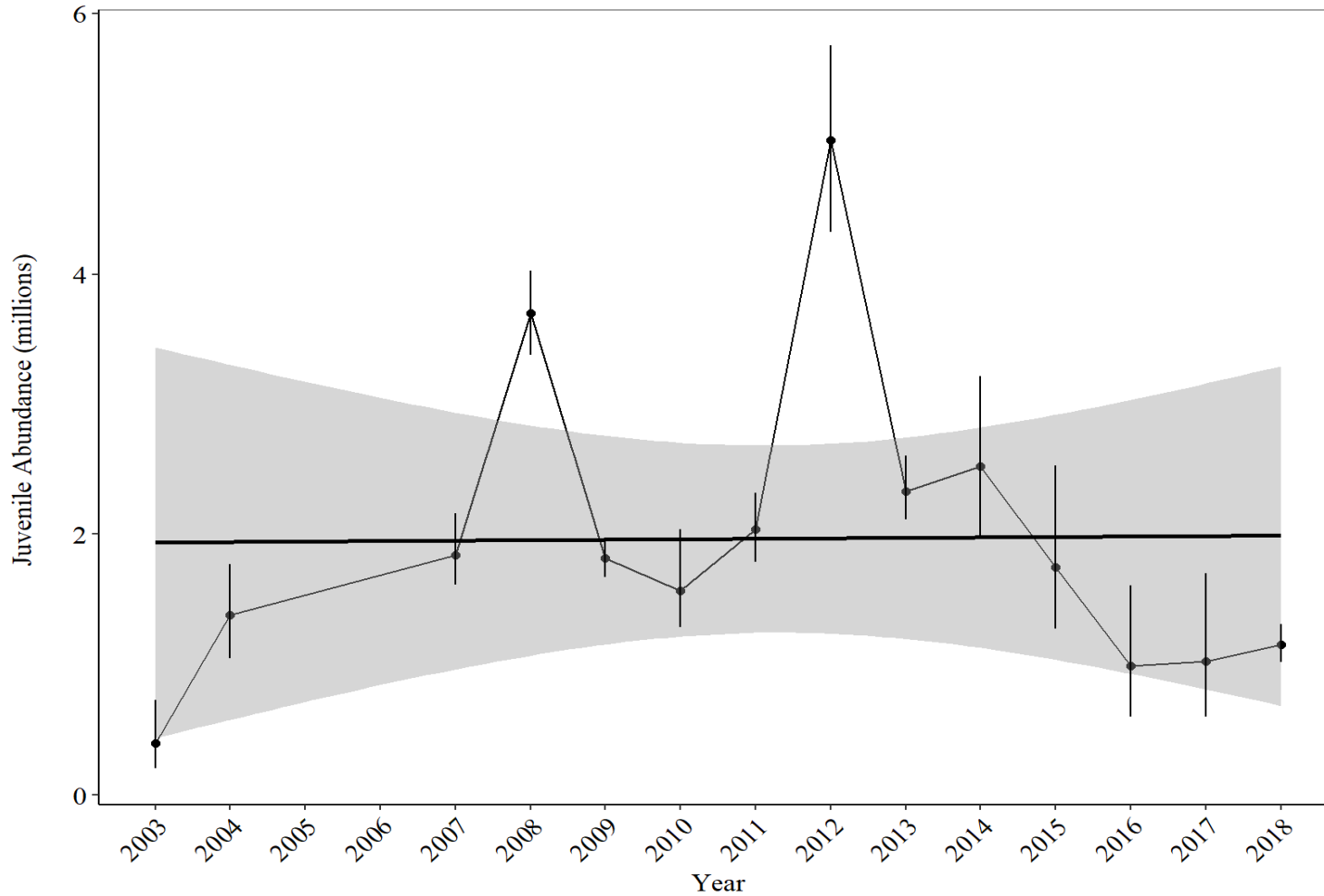
- Population estimates (number of individual fish)
- Biomass (population estimates x fish size)

- Corrected for Spawner Abundance
 - Individuals per Spawner
 - Biomass per Spawner

- Stock-Recruit models can be useful for assessing density dependent effects between Spawner Abundance and Juvenile Abundance

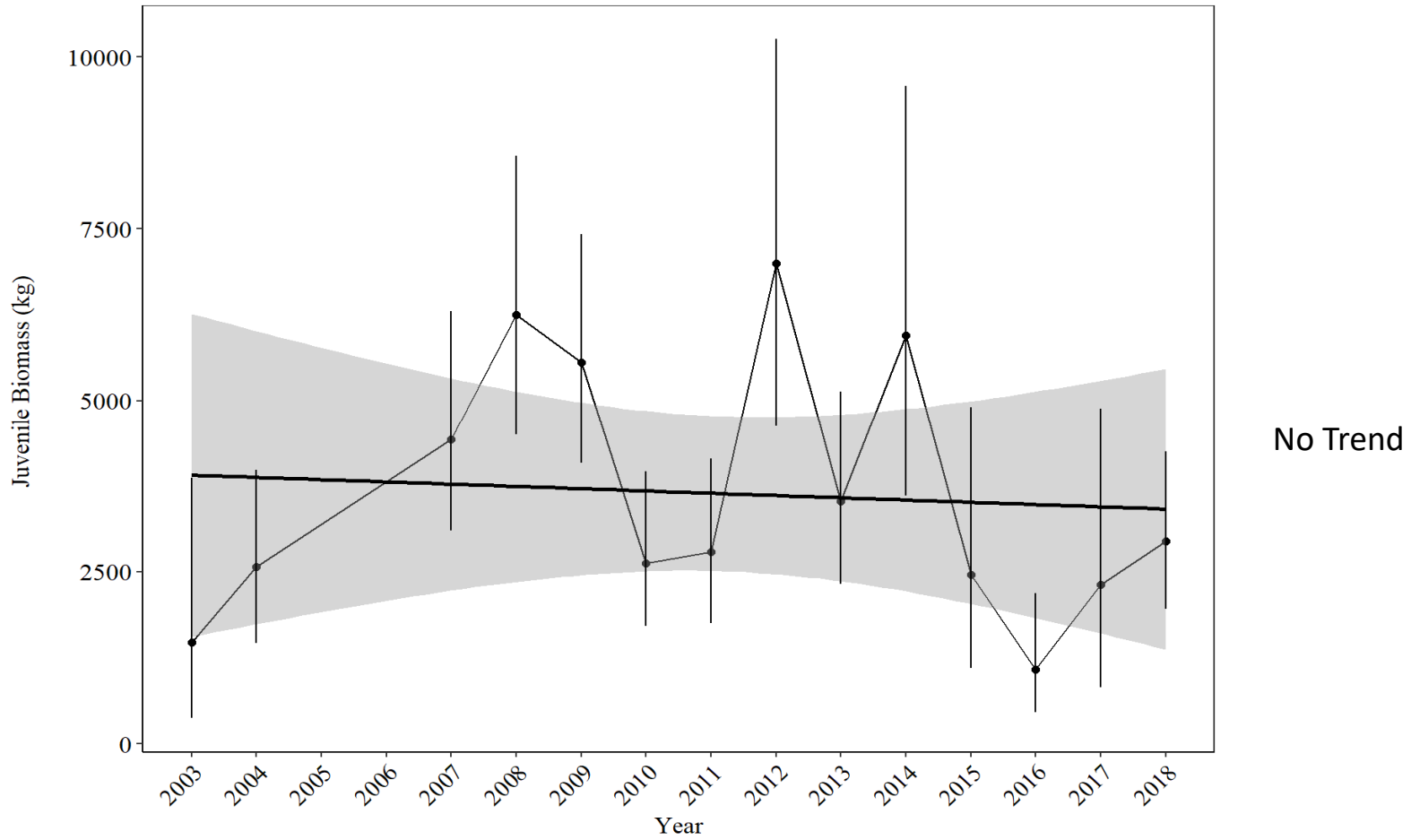
Abundance and Biomass

Pear Tree Abundance

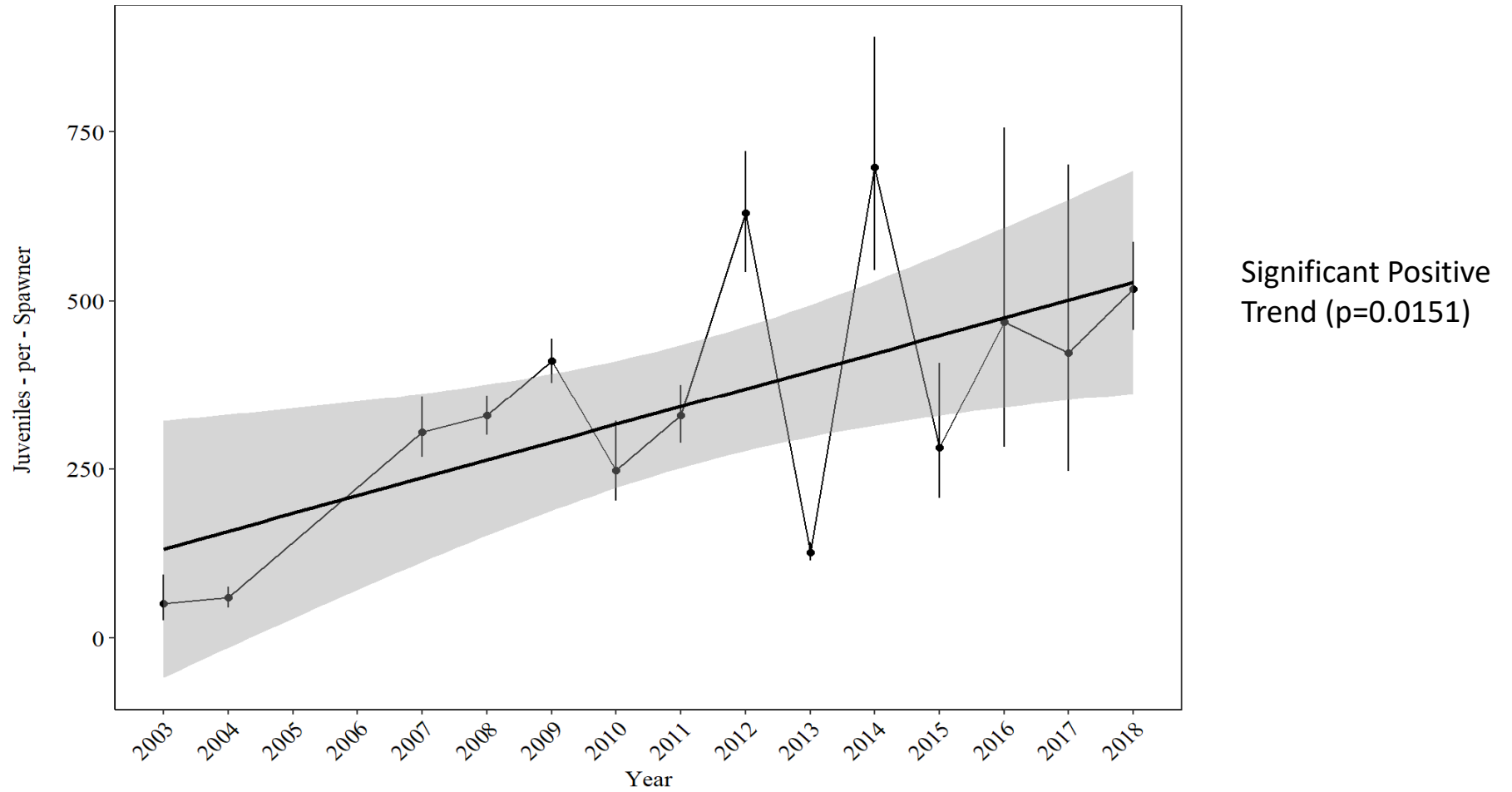


• No Trend

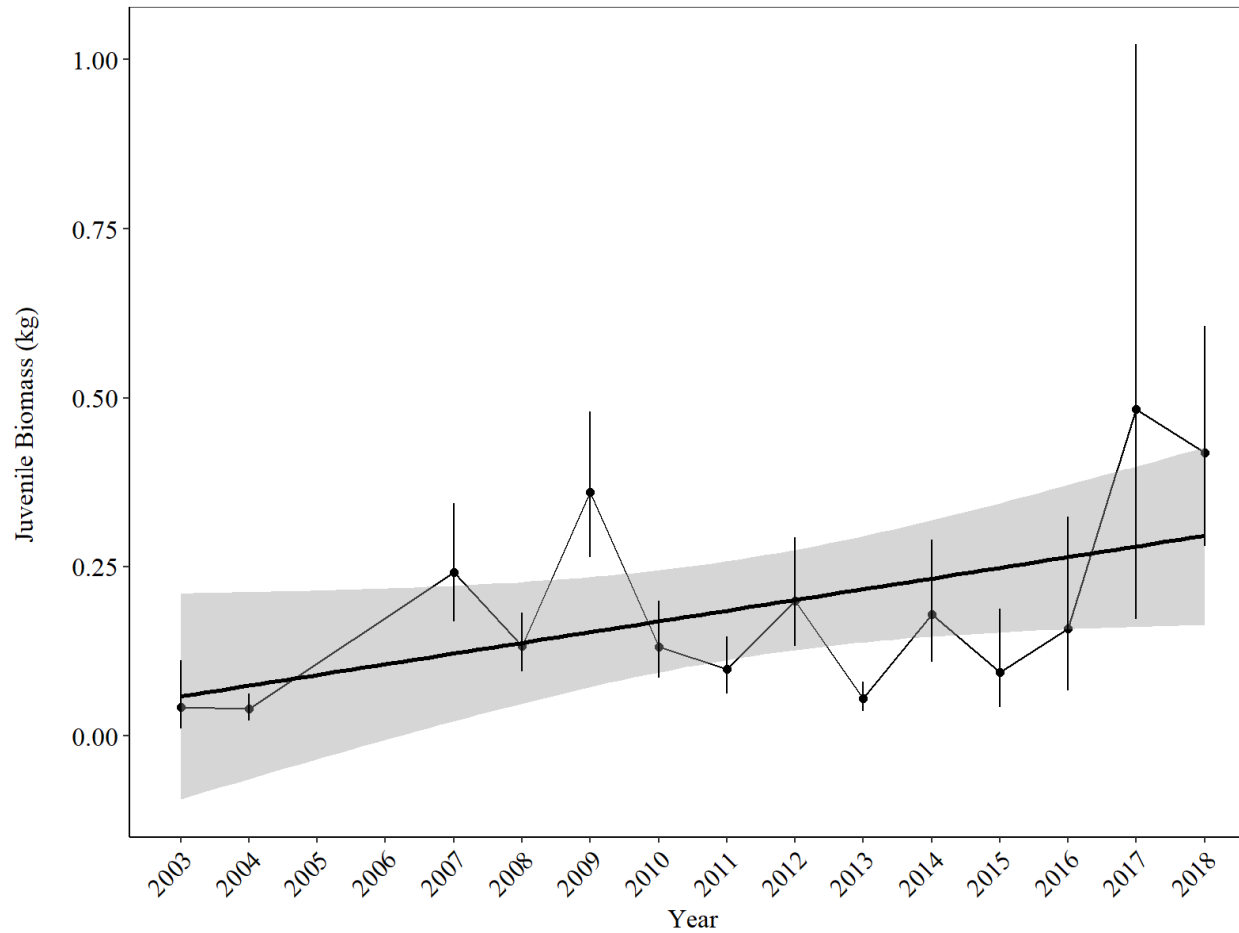
Pear Tree Juvenile Biomass



Pear Tree Juveniles per Spawner

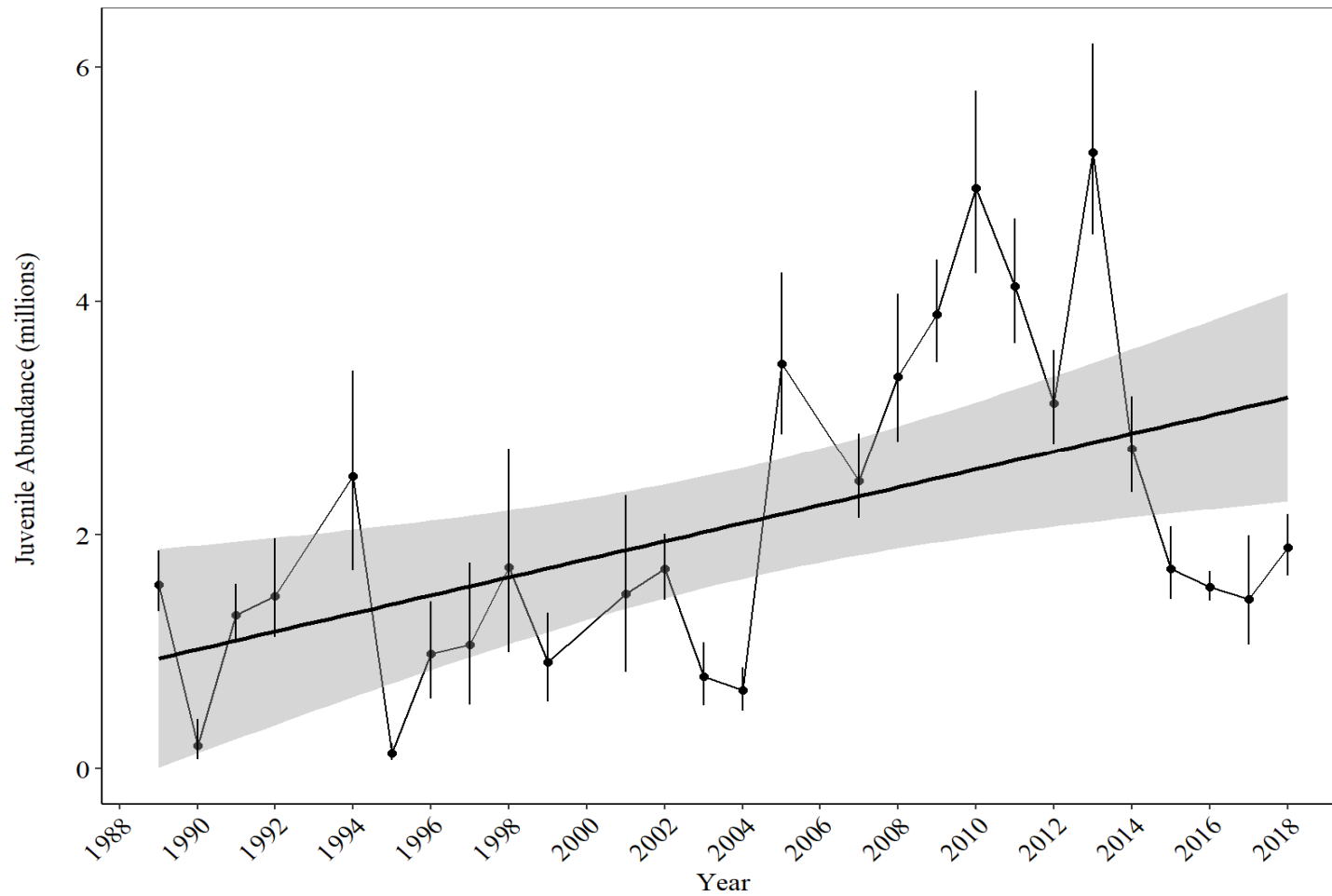


Pear Tree Biomass per Spawner



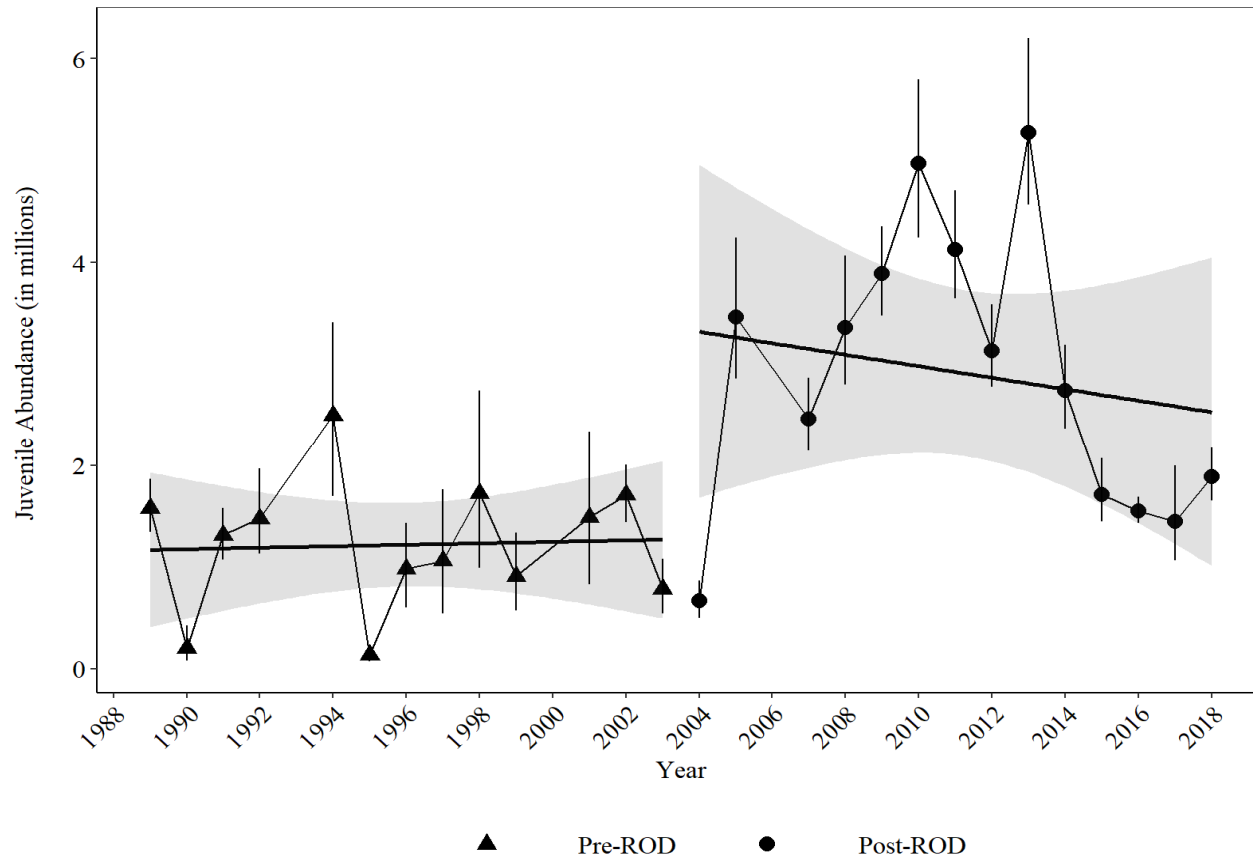
Weak Positive Trend
($p=0.0552$)

Willow Creek Abundance



Significant Positive
Trend ($p=0.0068$)

Willow Creek Abundance Pre- Post-ROD



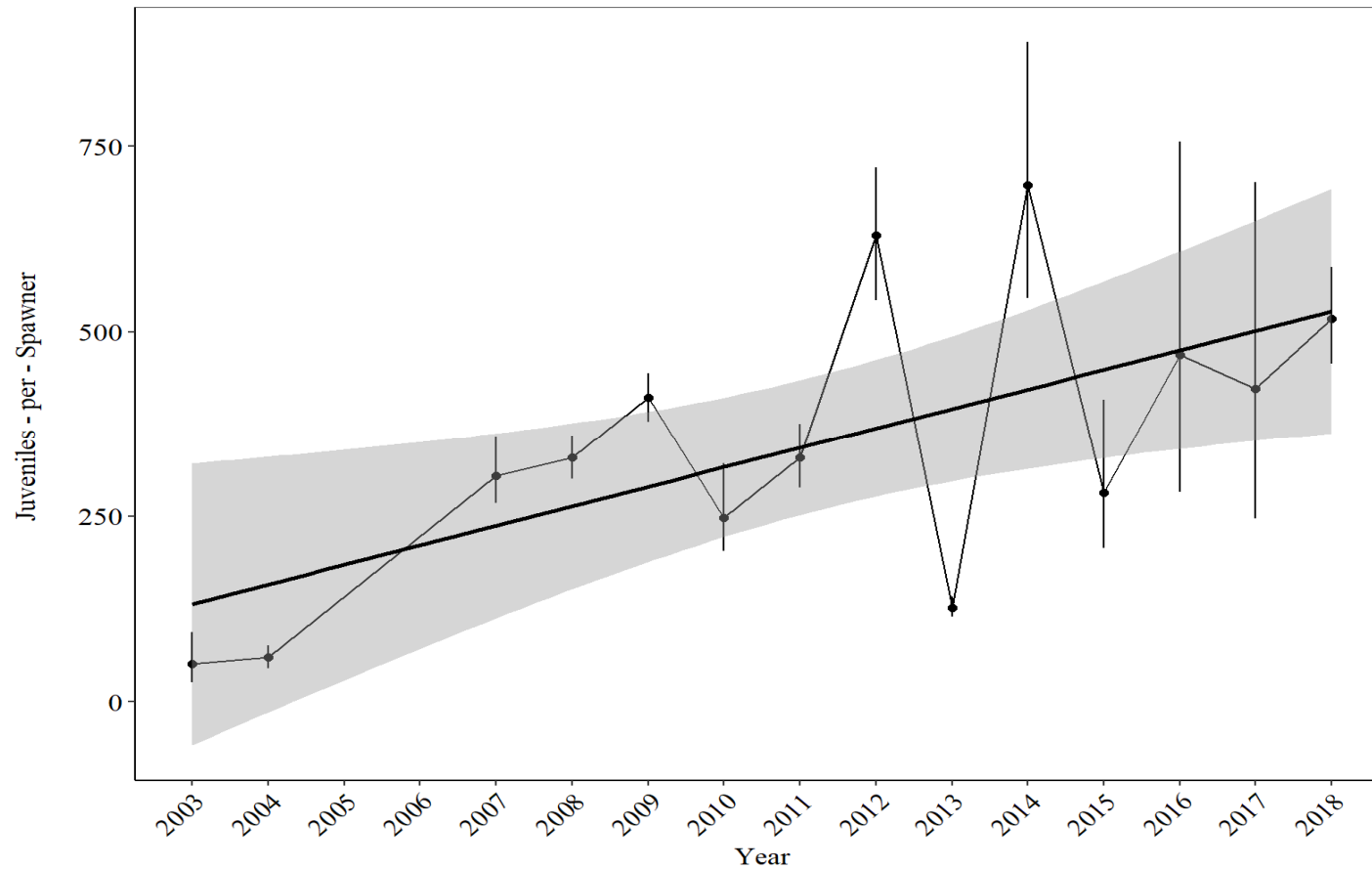
No significant trend pre or post

Post-ROD mean = **2.63** x Pre-ROD Mean

Stock Recruit

- Non-linear models fit better than linear
 - Evidence of Density Dependent effects
 - Higher Spawning Population Size
 - Leads to less Juveniles-per-Spawner
- Significant Increase in Juveniles-per-Spawner (JPS) post-ROD

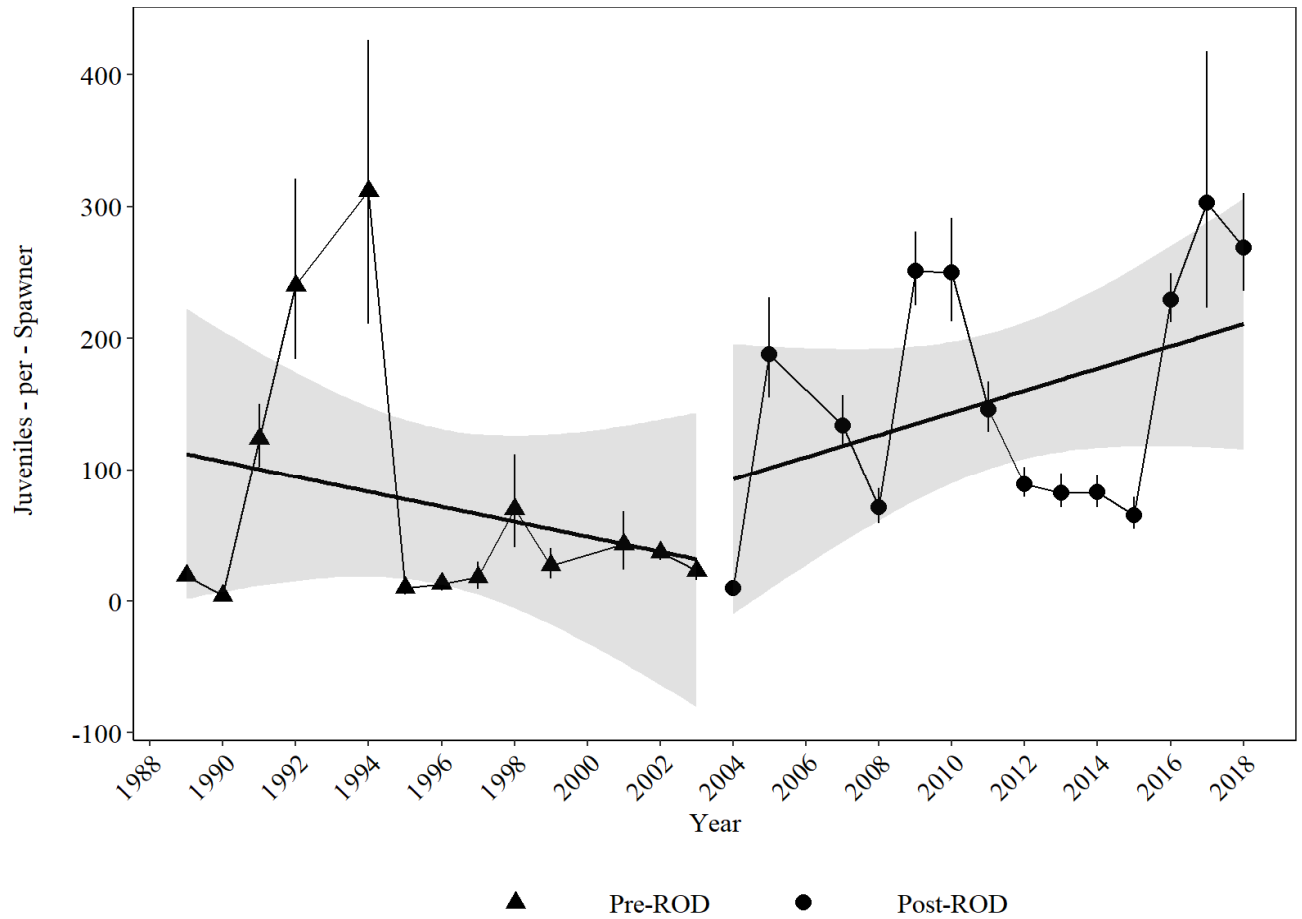
Pear Tree Juveniles per Spawner



Significant Positive
Trend ($p=0.0151$)

Caution: 2005 and
2006 are 'missing'
years

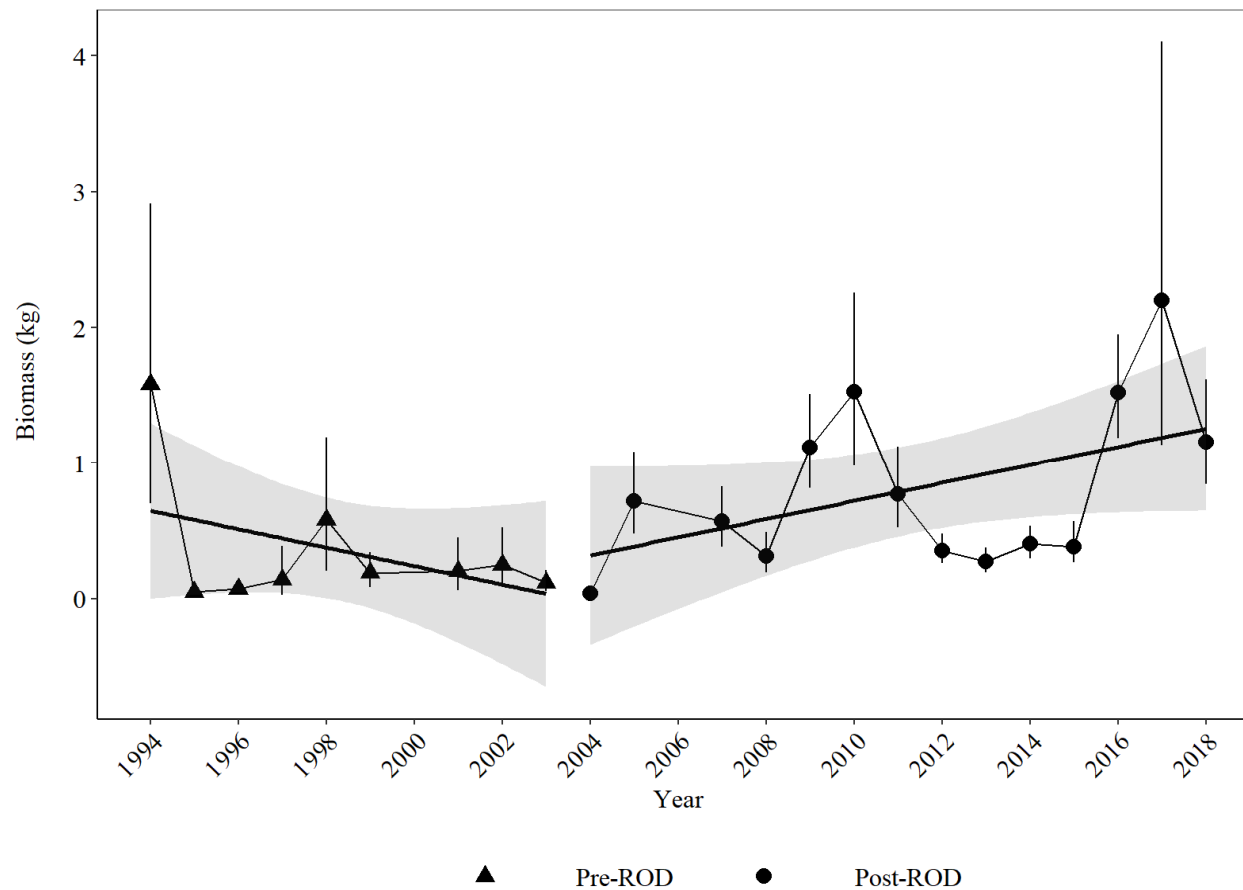
Willow Creek Juveniles per Spawner



No significant trend Pre-ROD
($p = 0.884$) or Post-ROD ($p = 0.154$)

Post-ROD mean is **2.35** x Pre –
ROD mean

Willow Creek Biomass per Spawner



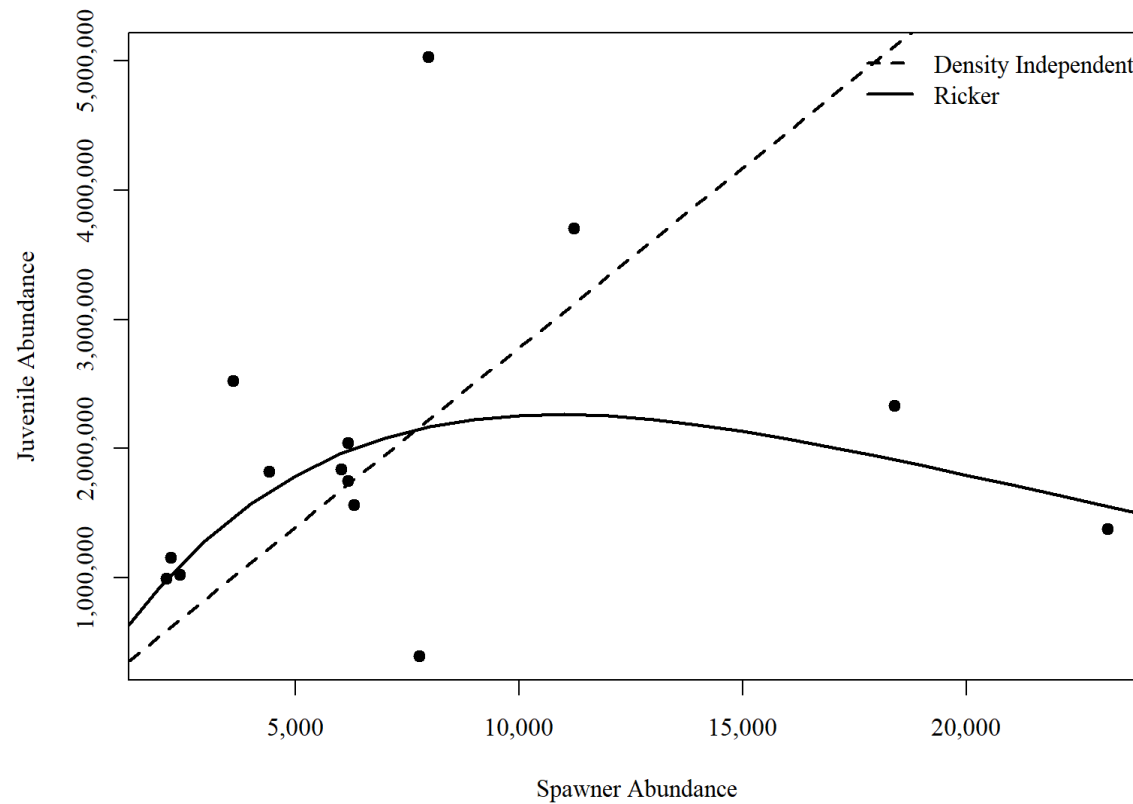
No significant trend Pre-ROD
($p = 0.234$) or Post-ROD ($p = 0.0829$)

Post-ROD mean is **2.29** x Pre –
ROD mean

Stock Recruit Models

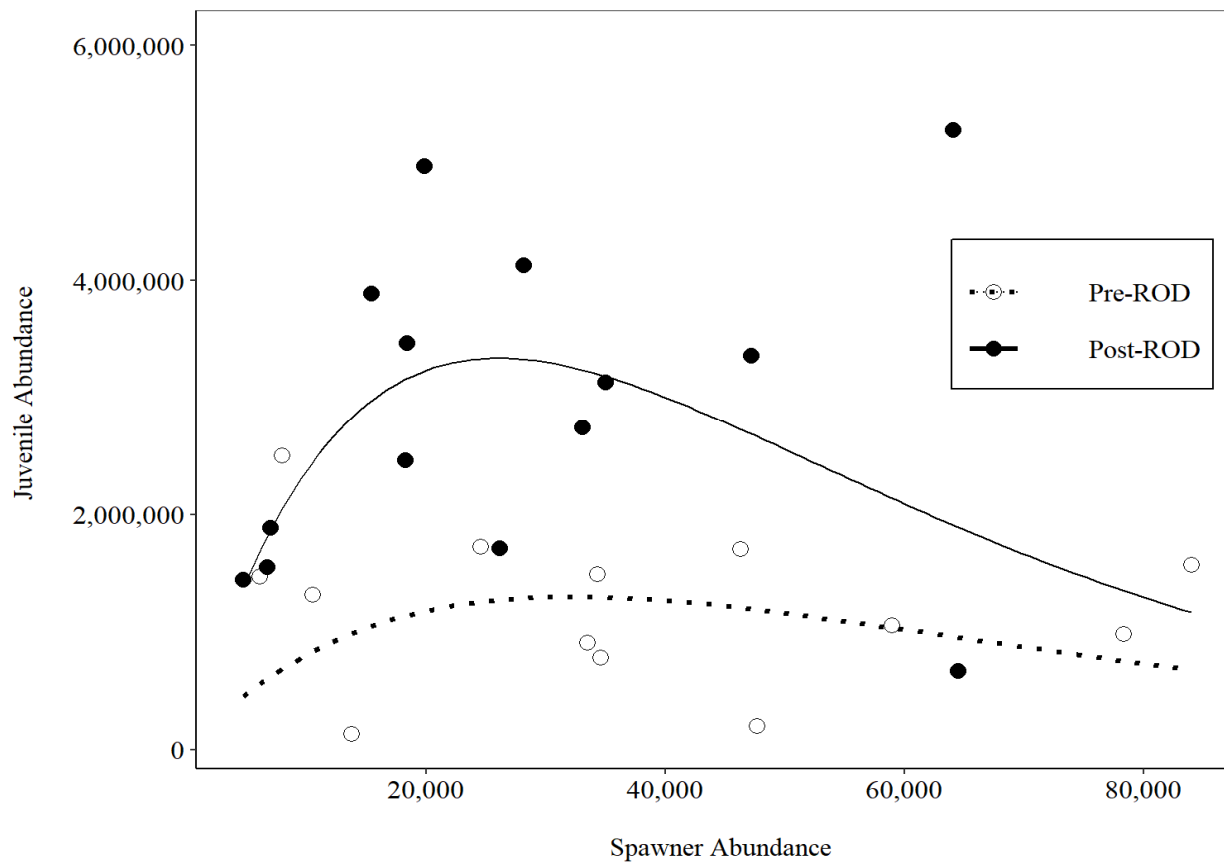
- Compare 'Recruits' (in this case, juvenile Chinook Salmon) to 'Stock' (adult Chinook Salmon spawning population)
- Stock Recruit Models are nonlinear
 - Assume some maximum 'yield' from the spawning stock
 - Traditional uses of stock recruit models are to keep the spawning population near that maximum yield
 - Recruits per Spawner are depressed at high spawner stock size

Pear Tree Spawner-Recruit



Density Dependent Model
(Ricker) is better fit than
Density Independent
($p=0.00496$)

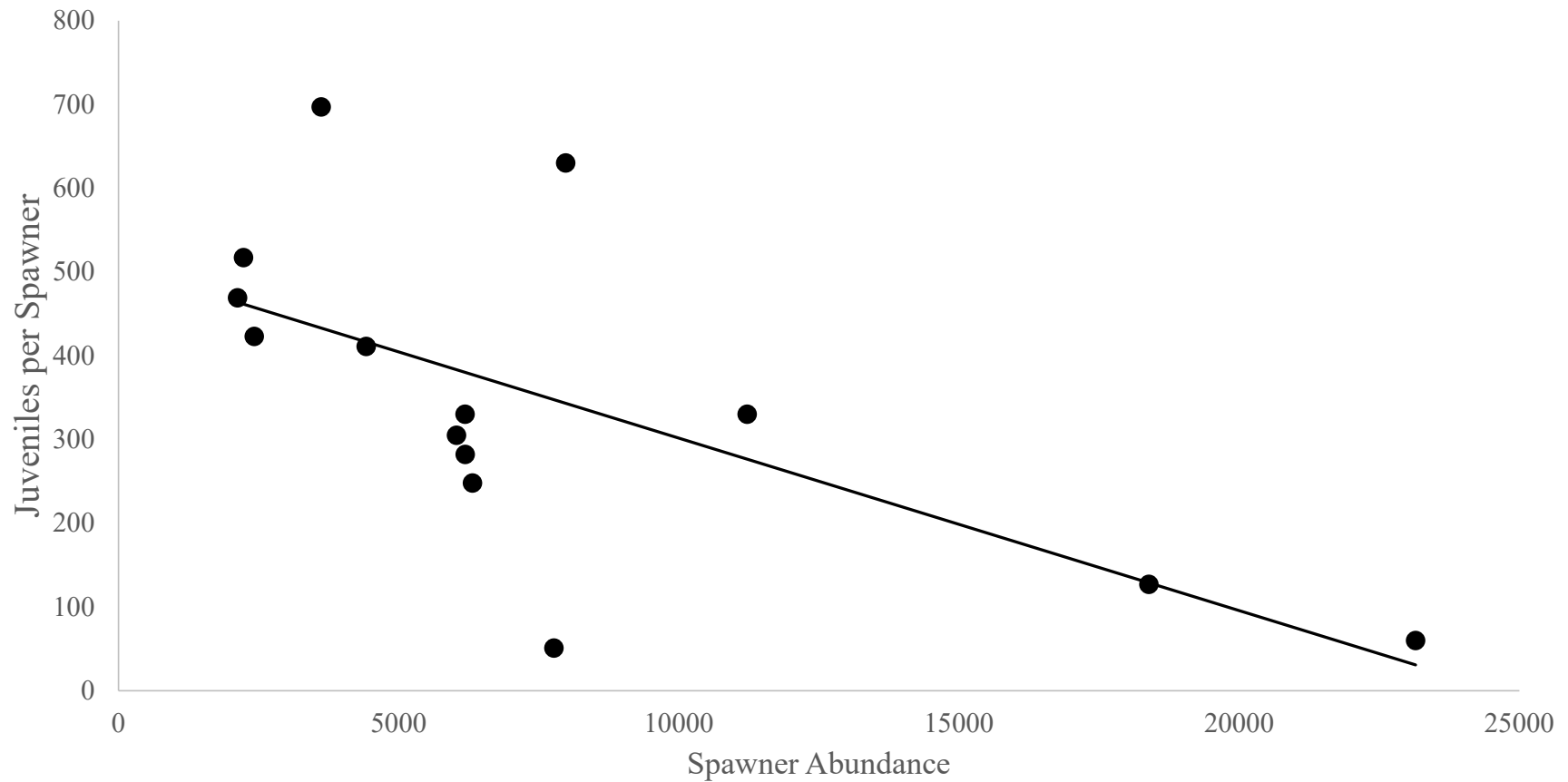
Willow Creek Spawner-Recruit



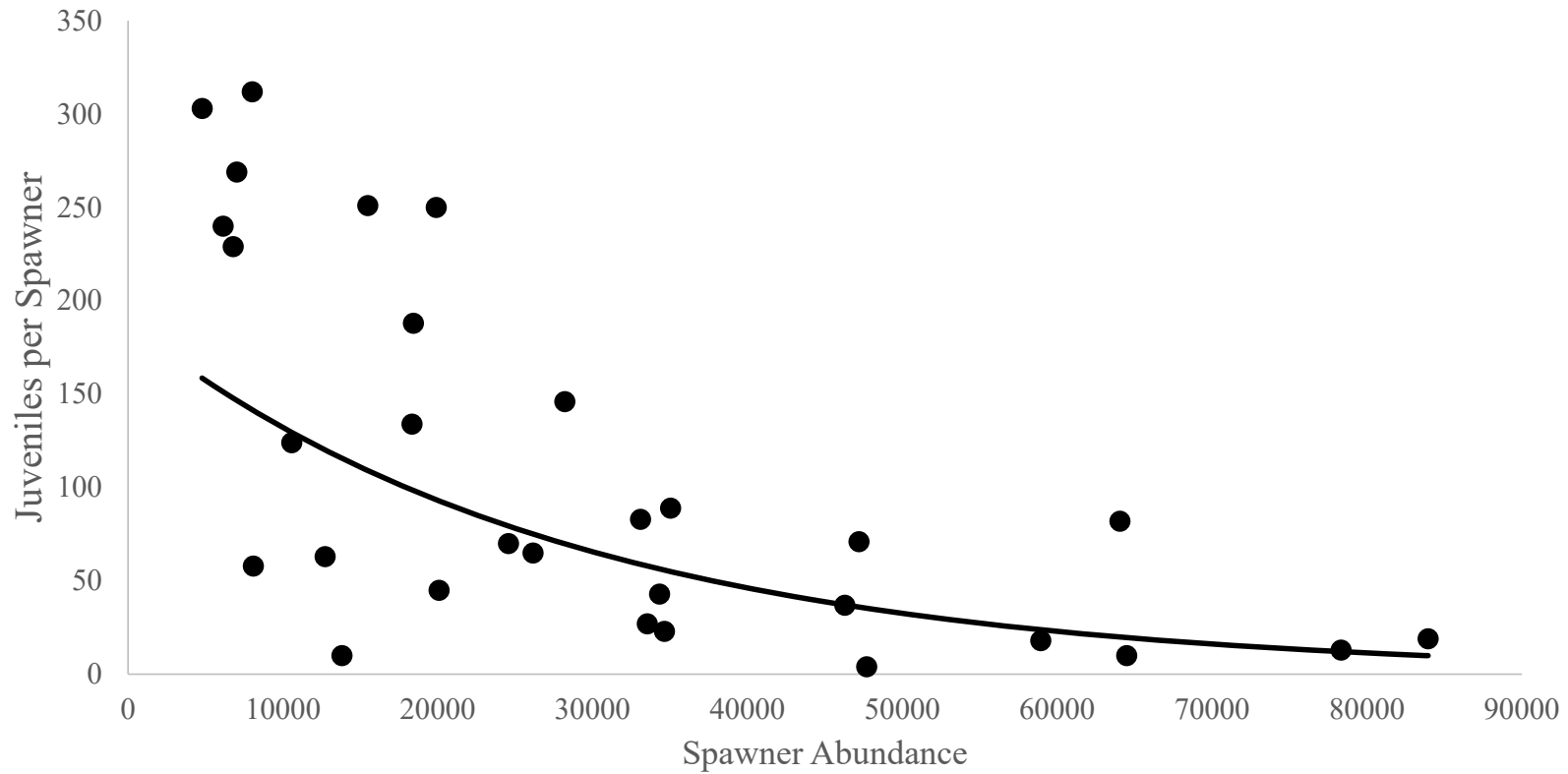
Density Dependent Model (Ricker) is better fit than Density Independent (Pre-ROD $p=0.021$; Post-ROD $p=0.0002$)

Pear Tree

Juveniles-per-Spawner vs. Spawner

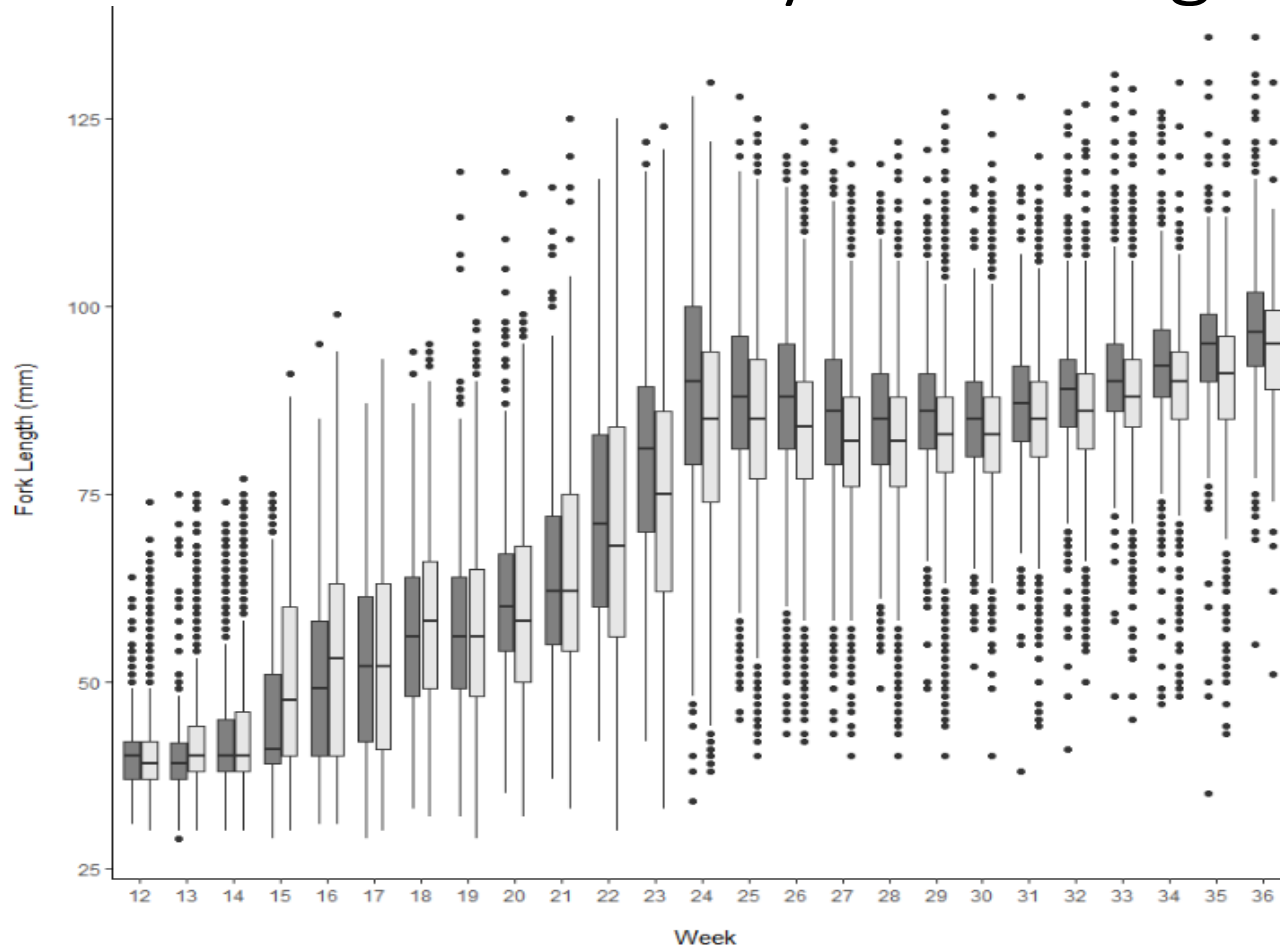


Willow Creek Juveniles-per-Spawner vs. Spawner



ROD Flows Effects on Juvenile Chinook Salmon Growth

Willow Creek Weekly Fork Length



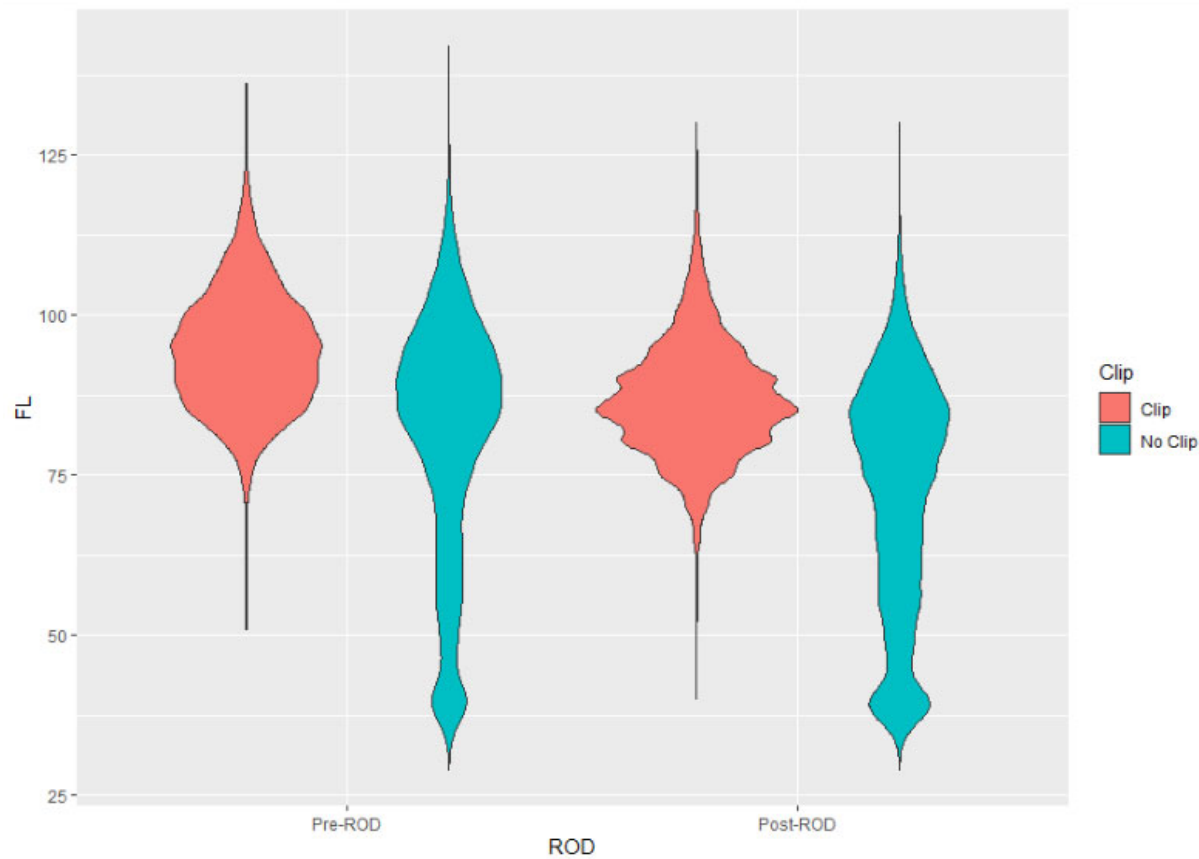
Post-ROD mean FL > Pre-ROD
--Weeks 13, 15, 16, 18

Post-ROD mean FL < Pre-ROD
--Weeks 20, 22-36

Data include non-clipped hatchery fish

ROD
■ Pre-ROD
□ Post-ROD

Fork Length Juvenile Chinook Salmon (WC)



Ad-Clipped fish significantly smaller post-ROD ($p < 0.0001$)

No Clip fish significantly smaller post-ROD ($p < 0.0001$)

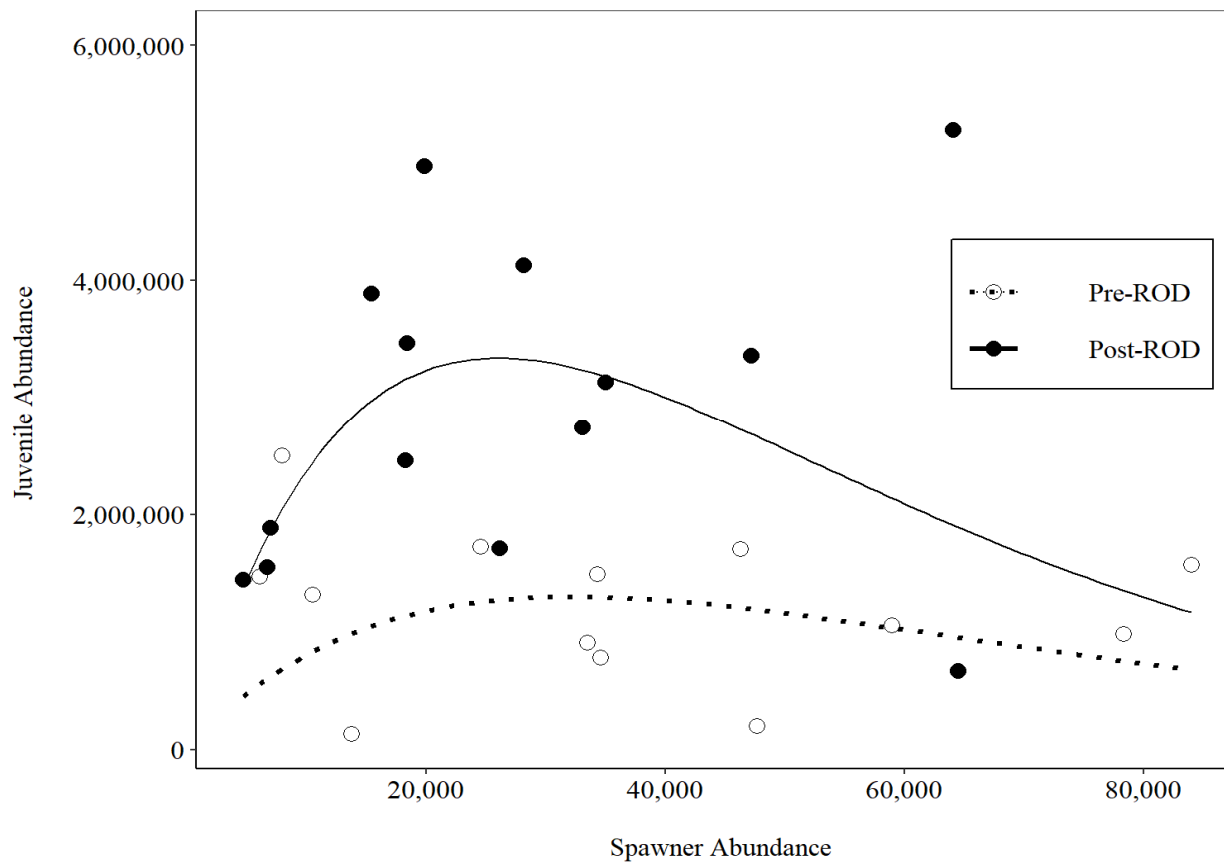
Preliminary Conclusions

- Significant Increase pre vs post-2004 (WC)
 - Abundance (2.63x)
 - Juveniles per Spawner (2.35x)
 - Biomass per Spawner (2.29x)
- No significant trend post-2004
 - Juvenile Abundance and Biomass
 - PT
 - WC
- Significant positive trend post-2004
 - Juveniles per Spawner & Biomass per Spawner
 - PT
 - WC
 - Significant Shift upwards in Juveniles per Spawner Ricker Curve (more JPS produced post 2004)
- Mean FL of juvenile Chinook Salmon is significantly smaller post-2004
 - Ad-Clipped
 - Non-Clipped

Juvenile Chinook Salmon Metric

- Juveniles-per-Spawner (and Biomass-per-Spawner)
 - Useful for assessing capacity of system, especially at low spawner size
 - But, to maximize JPS we must keep adult population low
- Stock-Recruit Model Parameters
 - Perhaps a better metric
 - Allows for a measure of capacity
 - Also, allows us to track the spawning population size that will maximize production of juveniles

Willow Creek Spawner-Recruit



Density Dependent Model (Ricker) is better fit than Density Independent (Pre-ROD $p=0.021$; Post-ROD $p=0.0002$)

Hatchery Fish

