2013 WHITE SALMON CHINOOK SALMON VSP MONITORING

Jeremy Wilson

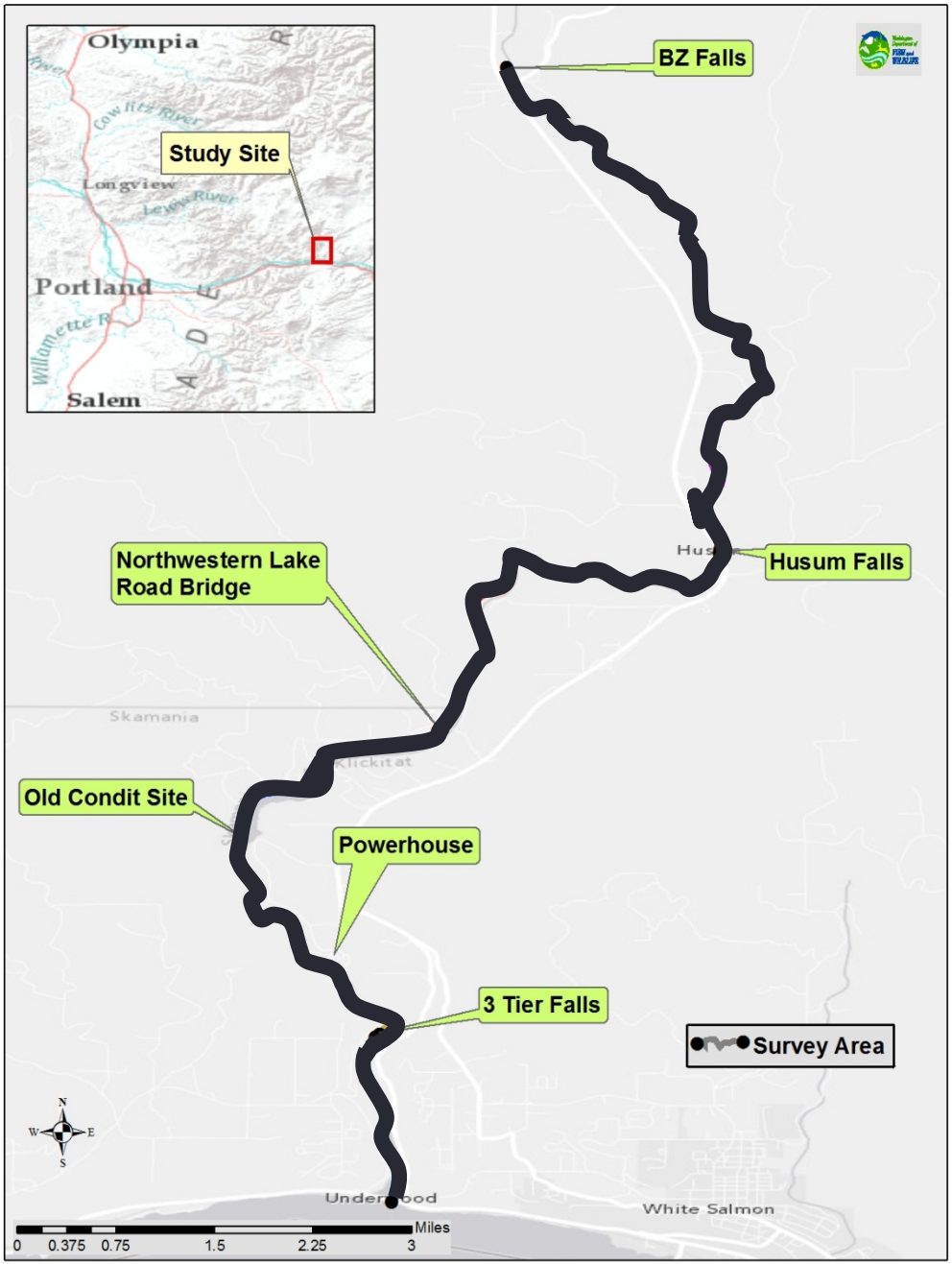
Washington Department of Fish and Wildlife

Outline

- Study Area
- History of WDFW Chinook Monitoring in WS
- 2013 Objectives
- 2013 Study Design
- 2013 Results
- Recommendations

Study Area

- White Salmon enters the Columbia River at rkm 270 (rm168)
- Historically supported tule fall Chinook and spring Chinook populations
- Condit Dam constructed in 1913
- Constrained anadromous fish distribution to the lower 5.3 km (3.3 mi)
- Condit Dam removed in 2011



History of WDFW Chinook Monitoring in the White Salmon

- Abundance, Age, Sex, CWT recovery/expansion
- Tules - 1965 Carcass Tagging; Peak Count Expansion through 2011
- Brights – 1989 Carcass Tagging; Peak Count Expansion through 2010
- No update of historic PCE factor

Peak Count Expansion Factor = Carcass Tag Est. / Peak Count

Abundance = Peak Count Expansion Factor * Peak Count

Evolution of Chinook Monitoring in LCR

- 1999—LCR Chinook Salmon listed as threatened in 1999

- 2008—PSC identified problem areas with the CWT program
  - Low sample rates
  - Non-representative sampling
  - Incomplete escapement sample
  - Bias in estimates

- 2010—New WDFW LCR Chinook VSP monitoring program
  - Abundance, Spatial Structure, Diversity, Productivity
  - 7 techniques to monitor abundance
  - NOAA guidelines for accuracy and precision

- 2011—First year of fully ad-clipped tules returns in LCR
  - Enabled differentiating wild and hatchery CK

2013 White Salmon Study Objectives

- Adult Chinook salmon abundance
  - Carcass Mark Recapture
  - Area Under the Curve (live counts)
  - Redd Expansion
- Spatial distribution of Chinook salmon
- Diversity
  - pHOS
  - Age structure
  - Sex ratio

2013 White Salmon Study Methods

- Counts of lives, deads, and redds
- GPS individual redd locations
- Collect biological data from carcasses
  - Fork length
  - Sex
  - Presence of marks and/or tags
  - Carcass condition/gill color
  - Spawn success
  - Scales (age structure)
  - DNA
  - Otoliths

2013 White Salmon Study Methods

Survey Coverage

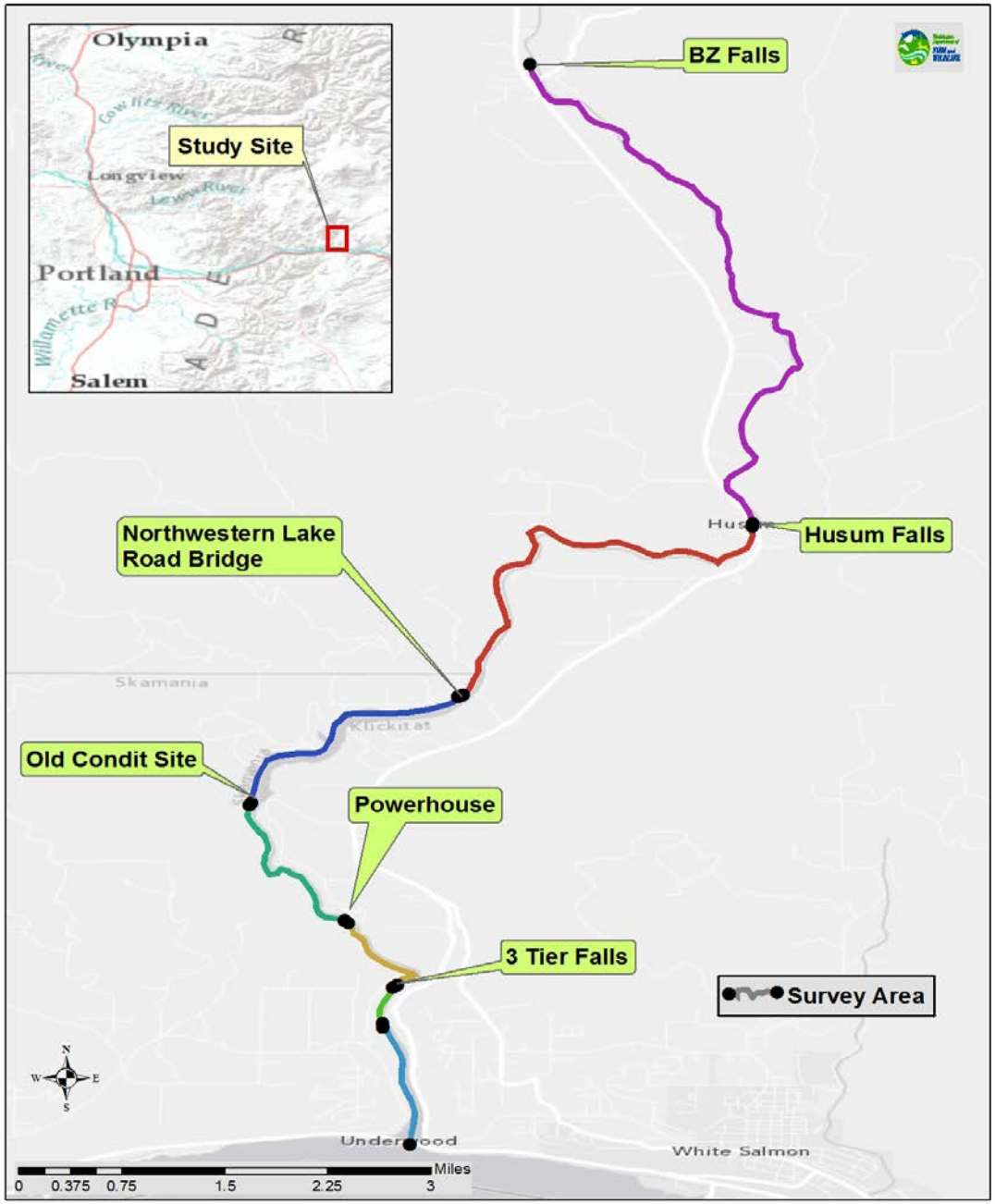
- Goal: Entire Chinook salmon spawning distribution

- Temporally
  - Weekly surveys August through December

- Spatially
  - BZ Falls to mouth for spring Chinook
  - Husum Falls to mouth for tule and bright stock fall Chinook
  - Supplemental from BZ Falls to Husum Falls during peak spawning for each fall stock

2013 Study Design

7 Pre-determined Reaches



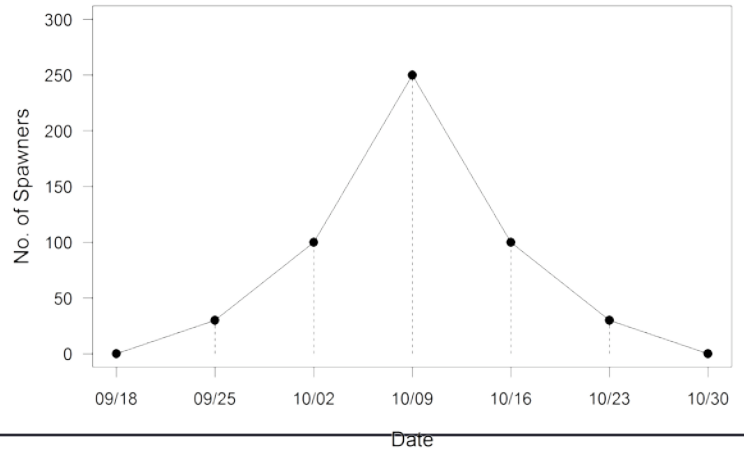
Abundance Methods

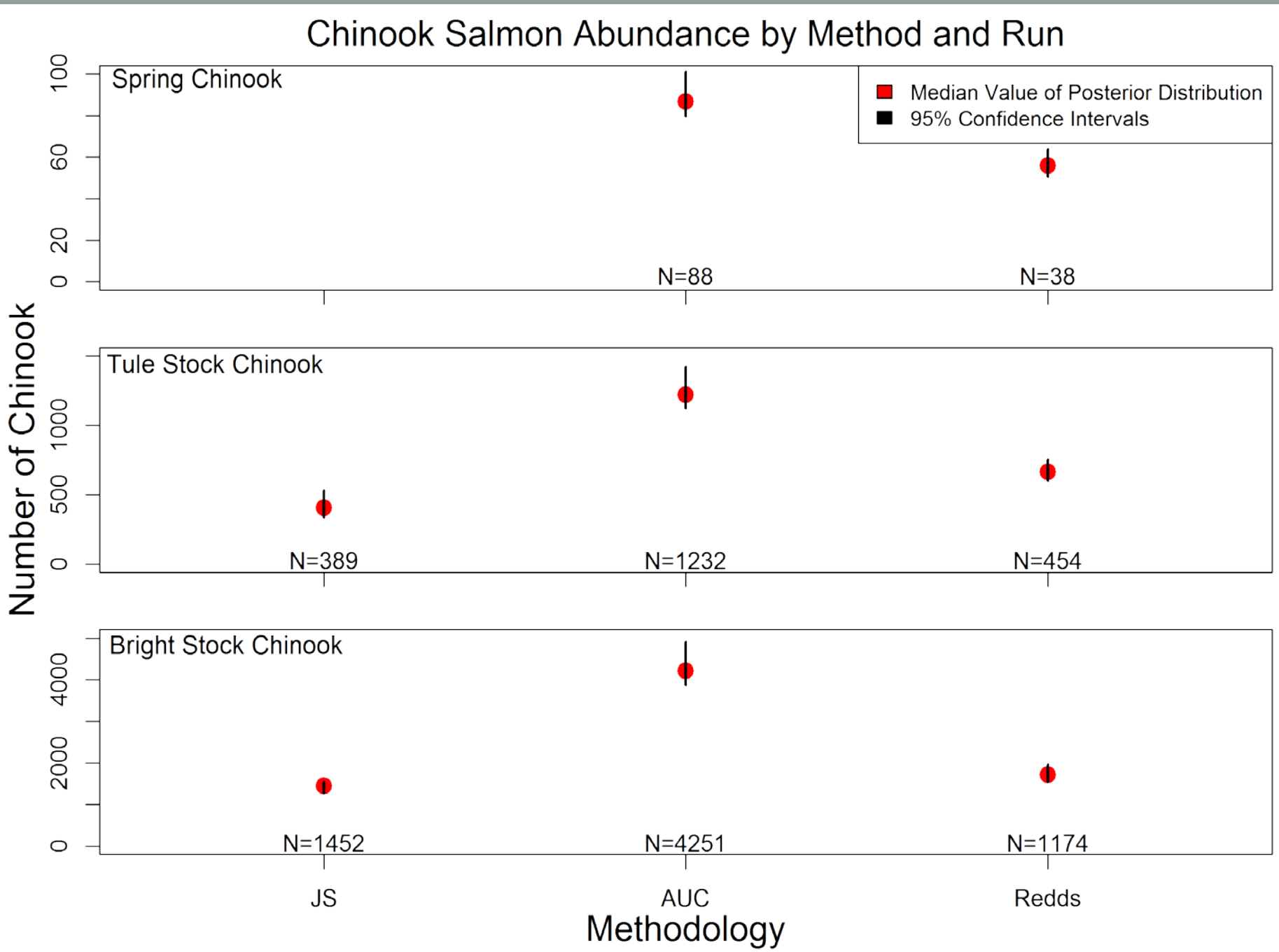
Carcass Tagging	Redd Expansion	Area Under the Curve (AUC
Jolly-Seber Model		
• No handling mortality • Instantaneous sampling • No tag loss • Equal survival between periods • Equal catchability/mixing		

Abundance Methods

Carcass Tagging	Redd Expansion	Area Under the Curve (AUC
Jolly-Seber Model	N= (Total New Redds*FpR) / % Females FpR=Females per Redd	
• No handling mortality • Instantaneous sampling • No tag loss • Equal survival between periods • Equal catchability/mixing	• Representative sampling • Redds accurately identified • Females per redd (FpR) is unbiased	

Abundance Methods

Carcass Tagging	Redd Expansion	Area Under the Curve (AUC
Jolly-Seber Model	N= (Total New Redds*FpR) / % Females FpR=Females per Redd	• N = AUC / Apparent Residence Time • AUC = $0.5 * \Sigma (t_i - t_{i-1}) * (x_i + x_{i+1})$ • Apparent Residence Time (ART) = Stream life * Observer Efficiency • ART calculated over many years and pops in LCR
• No handling mortality • Instantaneous sampling • No tag loss • Equal survival between periods • Equal catchability/mixing	• Representative sampling • Redds accurately identified • Females per redd (FpR) is unbiased	• Representative sampling • "Spawners" accurately classified • ART is unbiased 

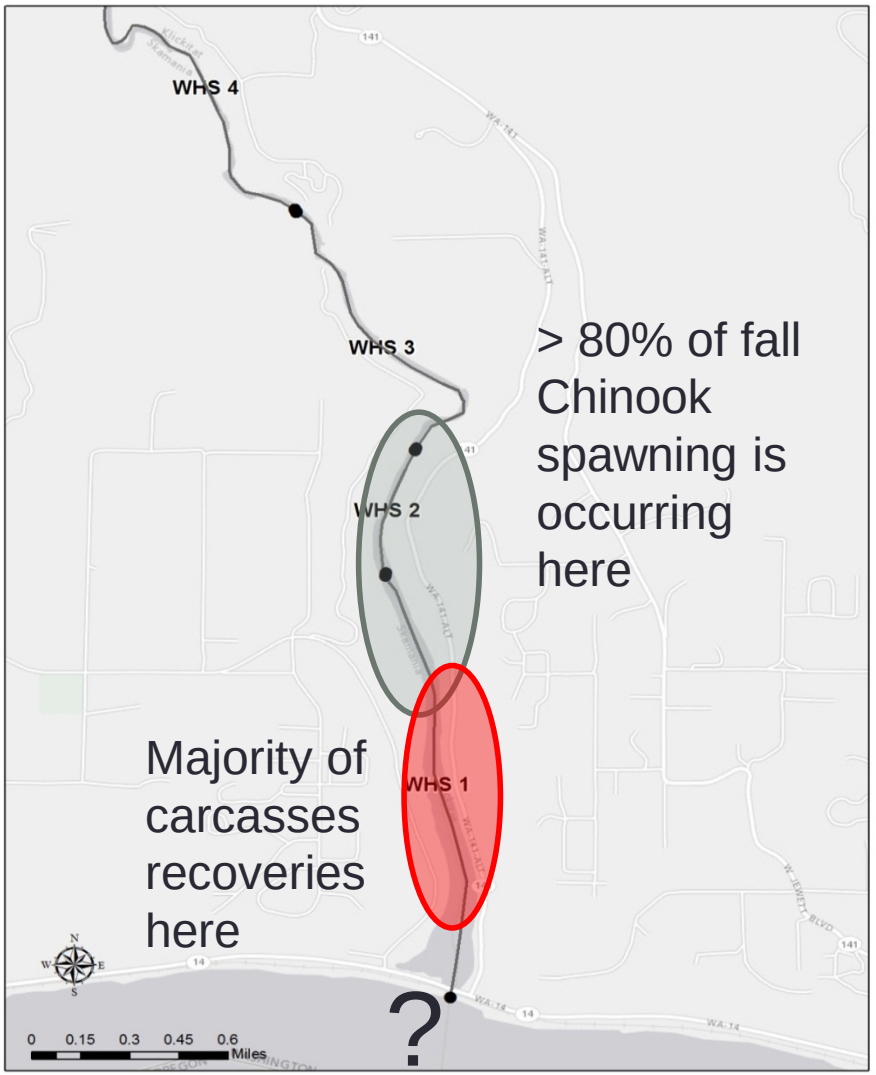

Chinook Salmon Abundance by Method and Run
Spring Chinook
Median Value of Posterior Distribution
95% Confidence Intervals
0
20
60
100
N=88
N=38
Tule Stock Chinook
0
500
1000
N=389
N=1232
N=454
Bright Stock Chinook
0
2000
4000
N=1452
N=4251
N=1174
Number of Chinook
JS
AUC
Redds
Methodology

Carcass Tagging (JS) Estimate Assumption Violations

Assumptions

- No handling mortality
- Instantaneous sampling
- No tag loss
- Equal survival between periods
- **Equal Mixing of Tagging and Untagged Carcasses**

- Potentially higher % of untagged carcasses flushing out of the system compared to tagged carcasses



Redd Based Estimate Assumption Violations

Assumptions:

- Representative sampling
- Females per redd (FpR) is unbiased
- Redds accurately identified
  - Superimposition
    - 80% of fall Chinook spawning occurs in <1 mile stretch
  - Poor Visibility
    - Glacial runoff early in the season
    - Turbulent, fast moving water
  - Skewed sex ratio
    - ~72% females based on carcass recoveries

AUC Based Estimate Assumption Validation

Assumptions

- Representative sampling
- “Spawners” accurately classified
  - Independent spawner counts conducted
  - <1% variation in spawner counts between observers
- ART is unbiased
  - Apparent residence time is unknown in White Salmon
  - Used 5.0 days; mean from four other LCR populations.
  - Derived from tule populations
  - No reason to suspect bias

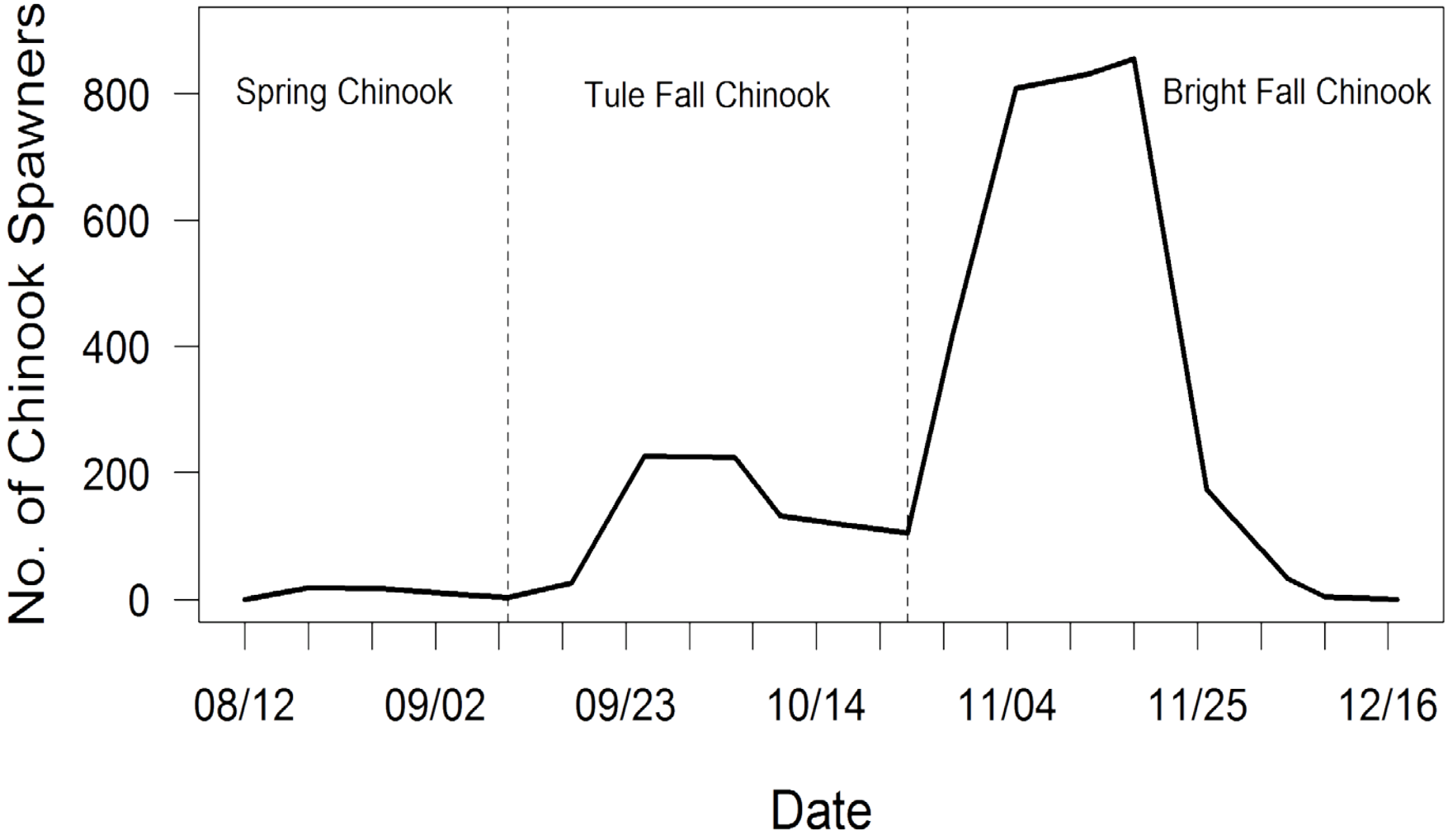
Abundance Methods

Carcass Tagging	Redd Expansion	Area Under the Curve (AUC
Jolly-Seber Model	N= (Total New Redds*FpR) / % Females FpR=Females per Redd	• N = AUC / Apparent Residence Time • AUC = $0.5 * \Sigma (t_i - t_{i-1}) * (x_i + x_{i+1})$ • Apparent Residence Time (ART) = Stream life * Observer Efficiency • ART calculated over many years and pops in LCR
• No handling mortality • Instantaneous sampling • No tag loss • Equal survival between periods • Equal catchability/mixing	• Representative sampling • Redds accurately identified • Females per redd (FpR) is unbiased	• Representative sampling • "Spawners" accurately classified • ART is unbiased ? OK

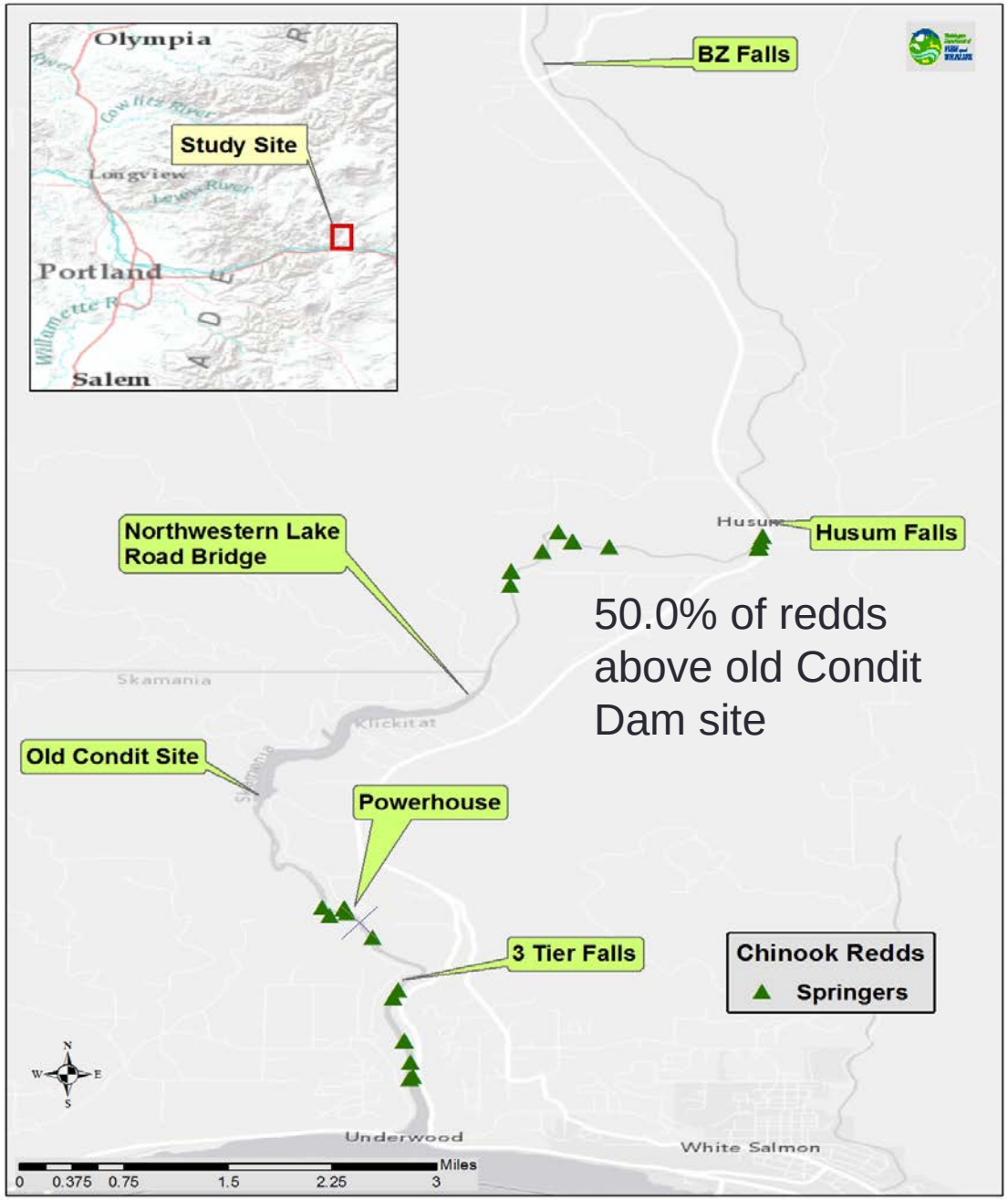
2013 Chinook Spawner Abundance based on Area Under the Curve

- Spring Chinook
  - 88 (95% CI 77-100)
- Tule fall Chinook
  - 1232 (95% CI1088-1409)
- Bright fall Chinook
  - 4251 (95% CI 3755-4861)

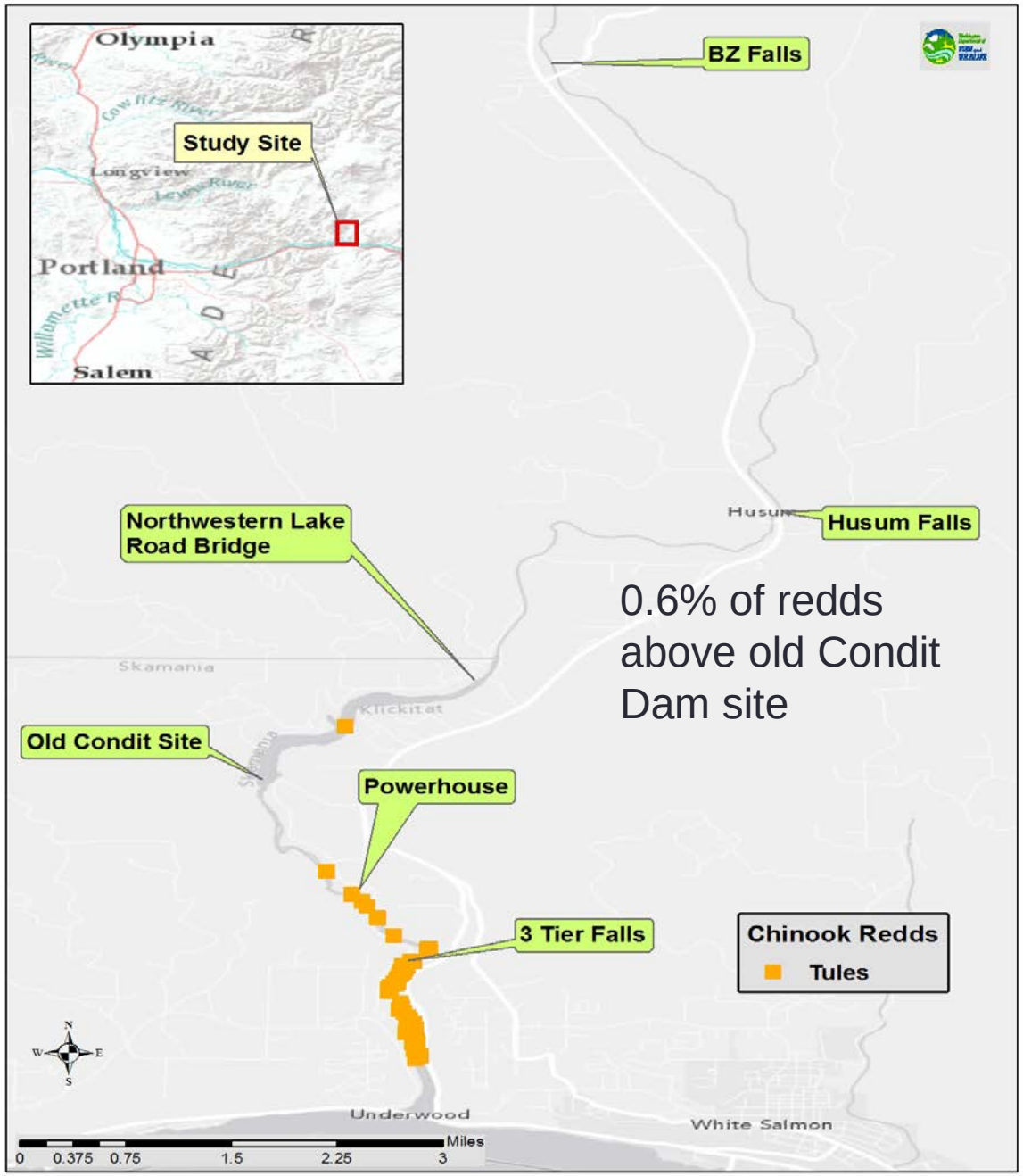
Temporal Distribution Based on Chinook Live Counts



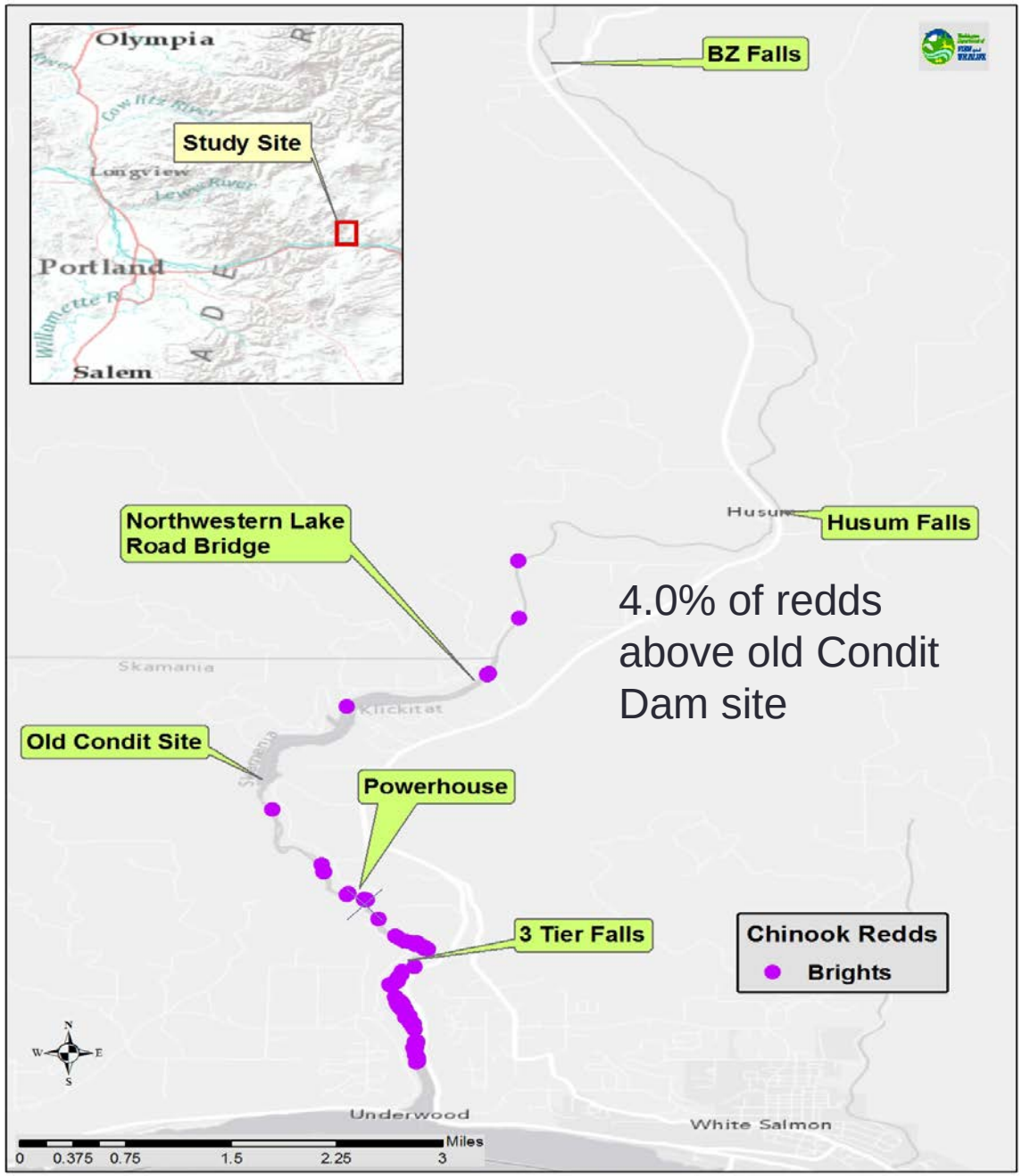
2013 Spring Chinook Salmon Redd Distribution

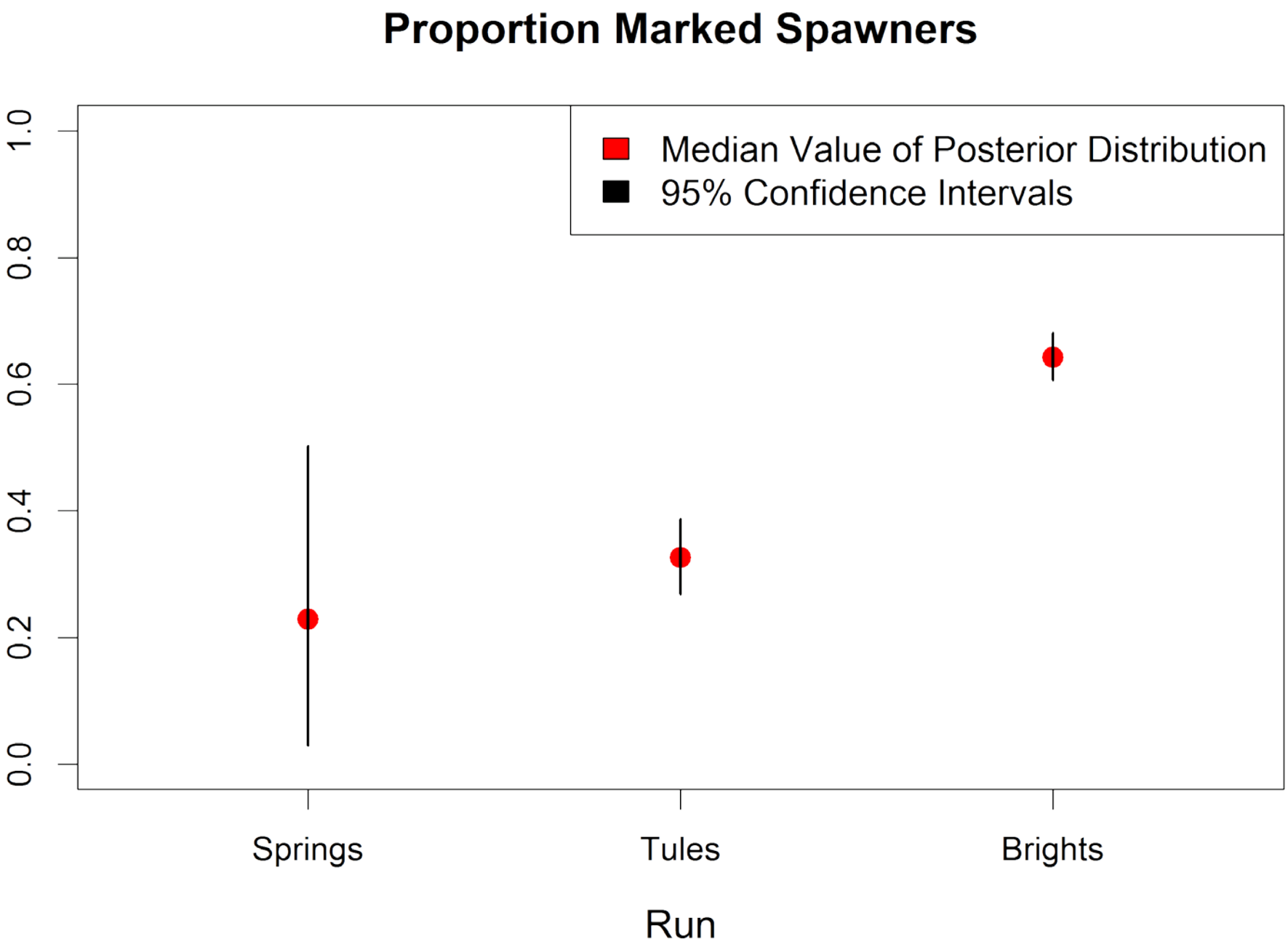


2013 Tule Stock Fall Chinook Salmon Redd Distribution



2013 Bright Stock Fall Chinook Salmon Redd Distribution

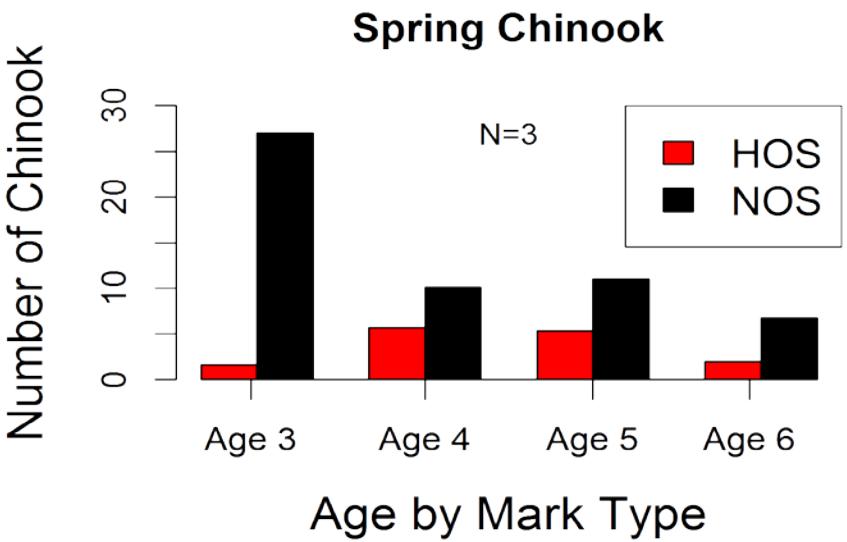


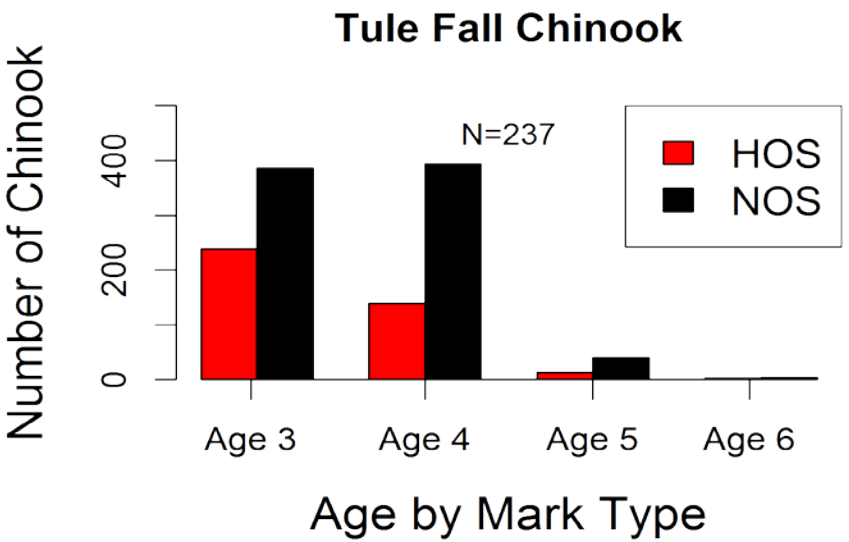

Proportion Marked Spawners
Median Value of Posterior Distribution
95% Confidence Intervals
0.0
0.2
0.4
0.6
0.8
1.0
Springs
Tules
Brights
Run

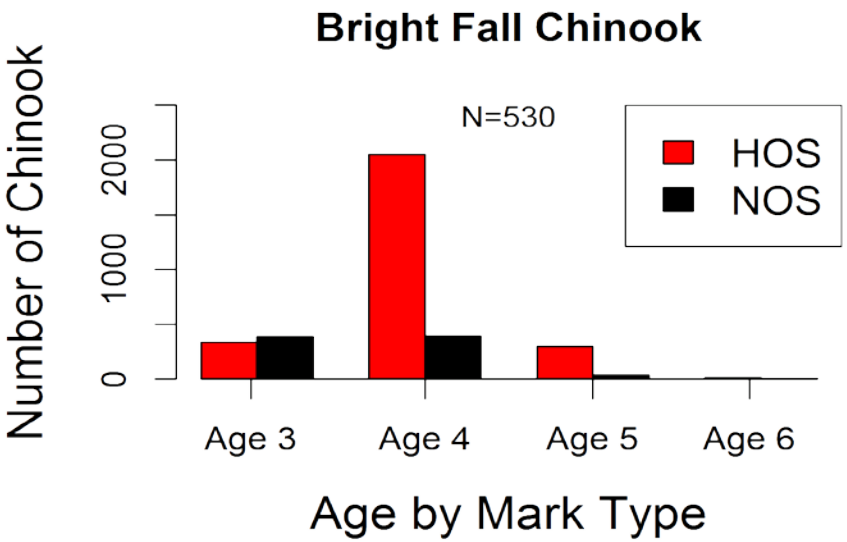
2013 Chinook Salmon CWT Recoveries

Release Location	No. of Unexpanded CWT Recoveries
Spring Creek NFH	1
Little White Salmon NFH	65 (26 DIT)
Priest Rapids Hatchery	1
Grande Ronde (Irrigon Hatchery)	1
Iron Gate Hatchery (CA)	1
Lyons Ferry Hatchery	1

Age by Mark Type







Future Recommendations

- Continued study design improvements:
  - Develop basin specific estimate of ART for AUC estimates
  - Explore census counts and/or other live mark recapture designs
    - Weirs
    - Seining
  - Explore radio tracking to better understand distribution

- Work with members of the White Salmon Work Group to:
  - Develop a comprehensive adult monitoring program for all listed species - Chinook, coho, steelhead
  - Develop a juvenile monitoring program
  - Pursue funding to implement both

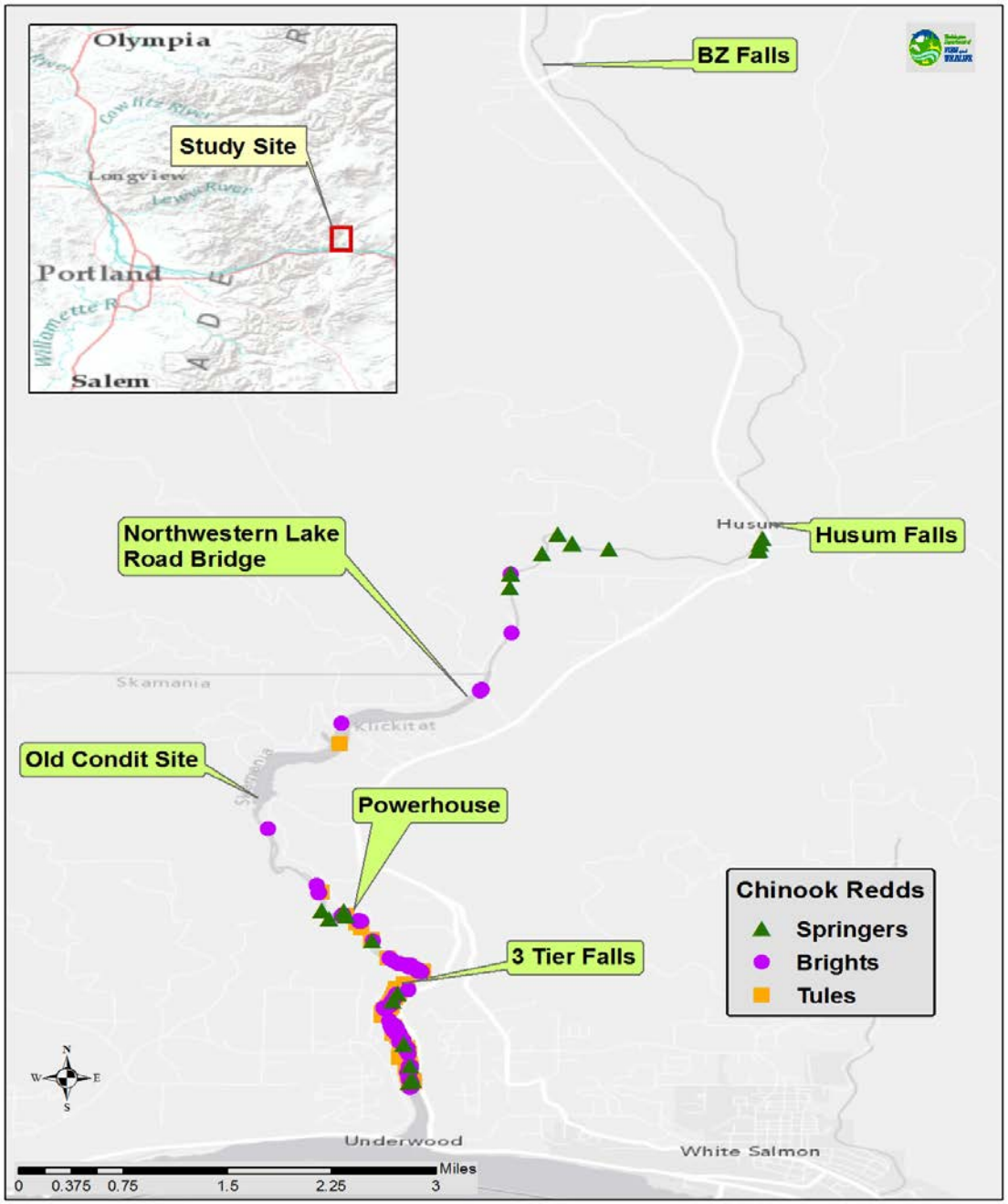
Acknowledgements

- Dan Rawding
- Thomas Buehrens
- Bryce Glaser
- Steve VanderPloeg
- Ann Stephenson

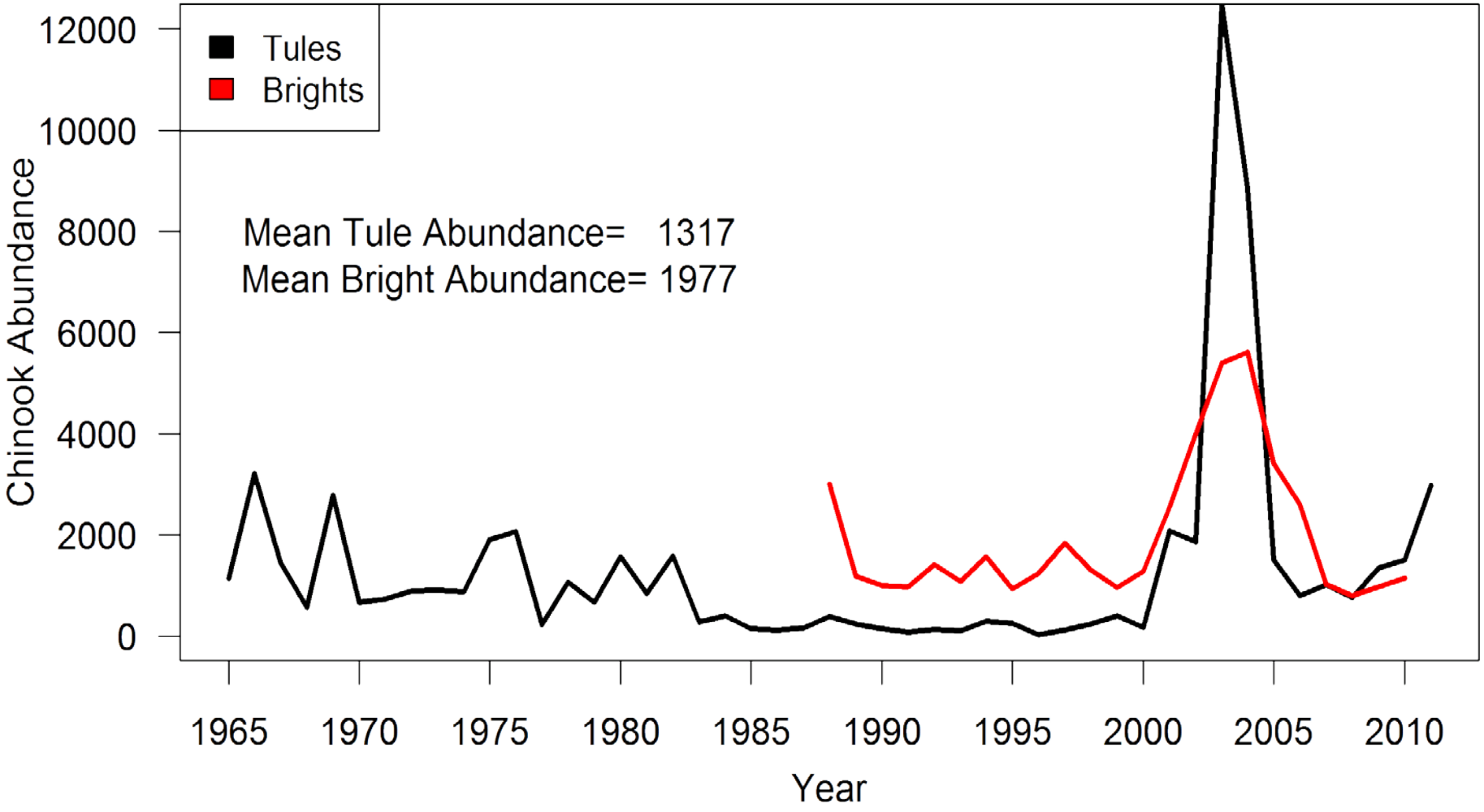
- Pacific Coastal Salmon Recovery Fund and Bonneville Power Administration for funding 2013's VSP Monitoring for Chinook salmon in the White Salmon

Questions?

2013 Chinook Salmon Redd Distribution



Historical PCE Chinook Abundance



Chinook Abundance Estimation Methods Used in SW Washington

- Census
- Genetic Mark Recapture
- Live Mark Recapture (Darroch/Petersen)
- Carcass Mark Recapture (Jolly-Seber)
- Area Under the Curve (live counts)
- Redd Expansion
- Peak Count Expansion