

Influence of Carcass Drift on the Carcass Distribution of Hatchery and Natural Origin Female Fall Chinook Salmon in the Hanford Reach of the Columbia River



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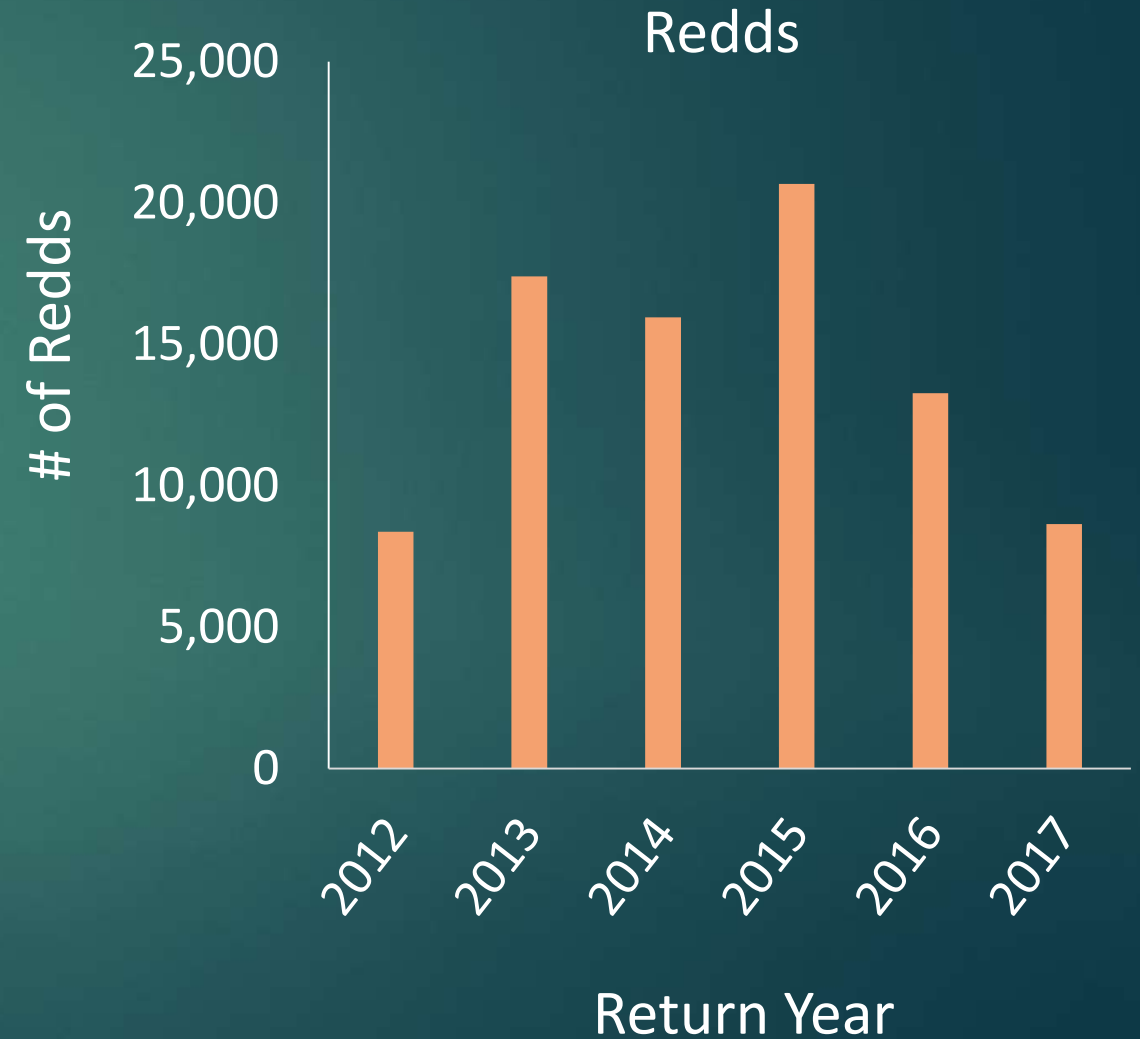
Hanford Reach – Columbia River

Priest Rapids
Hatchery (rkm 663)

Ringold Springs
Hatchery (rkm 571)



Hanford Reach Escapement and Redd Numbers

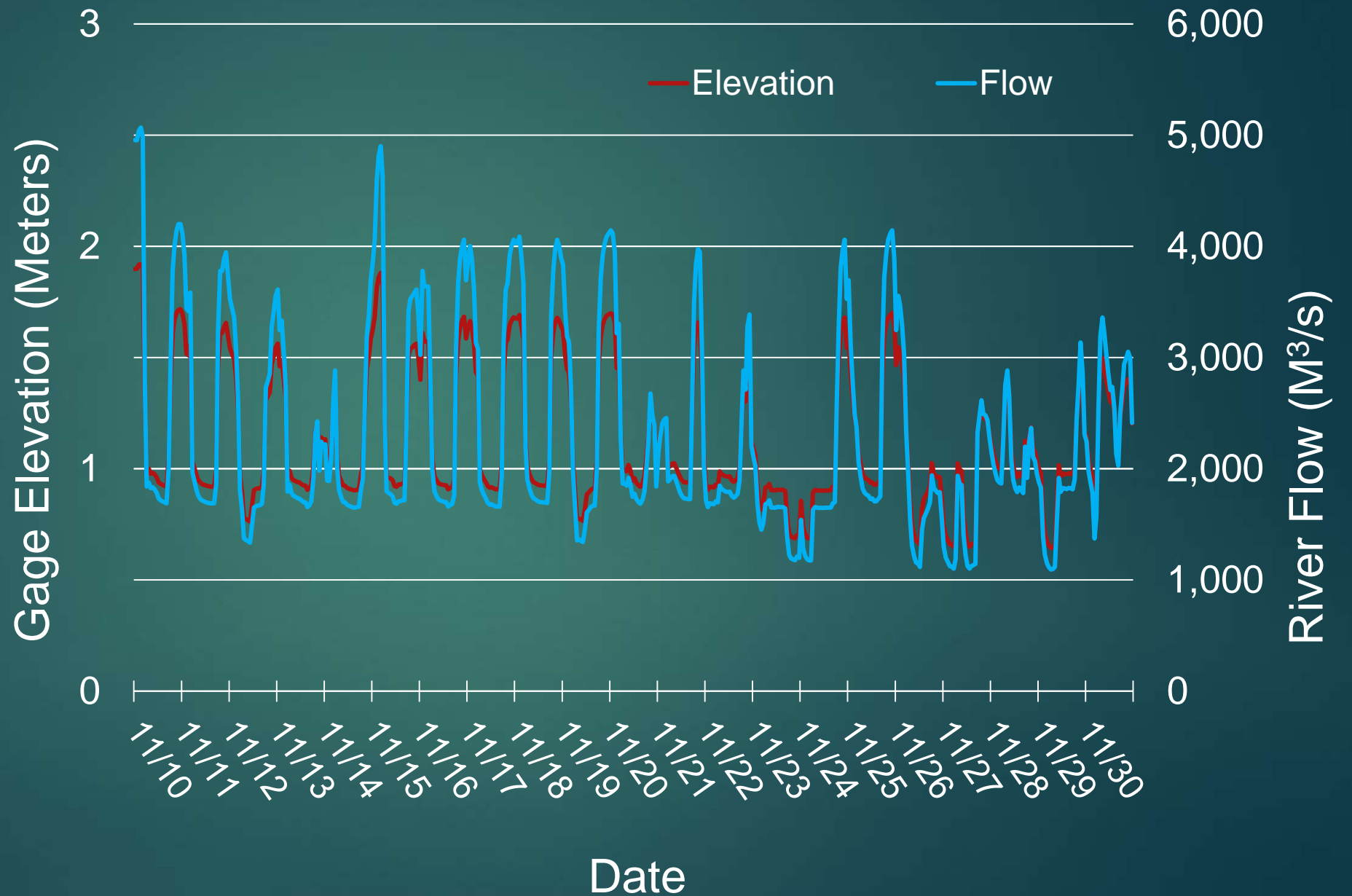


Sources of Bias in Carcass Sampling of Chinook

- ▶ Size Dependent Recovery... Zhou, S. 2002. Trans of the American Fisheries Society 131:1194–1202.
- ▶ Post Spawn Carcass Distribution... Hoffnagle et al. 2008. North American Journal of Fisheries Mgmt 28:148-164
Murdoch et al. 2009. North American Journal of Fisheries Mgmt 29:1206–1213
- ▶ Carcass Drift ... Murdoch et al. 2009. North American Journal of Fisheries Mgmt 29:1206–1213.
Strobel et al. 2009. North American Journal of Fisheries Mgmt 29:702–714

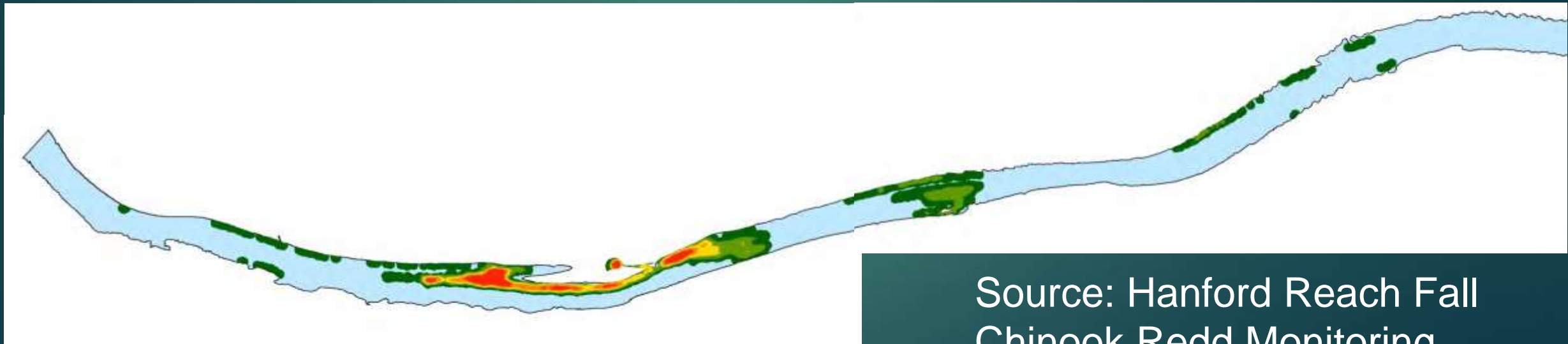
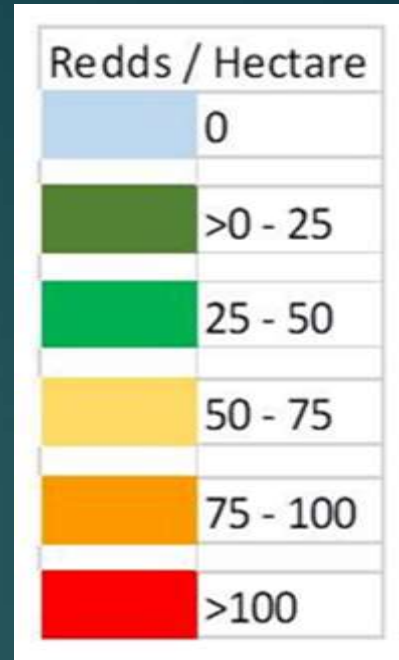
River Flow & Fluctuations

Example:
Nov. 10 – 30, 2017



Data Source:
waterdata.usgs.gov

Example of Redd Density and Proximity to Deep River Channels



Source: Hanford Reach Fall
Chinook Redd Monitoring
Report - RY 2013, US DOE

Hanford Reach

Section 1 - 14 km

Section 2 - 19 km

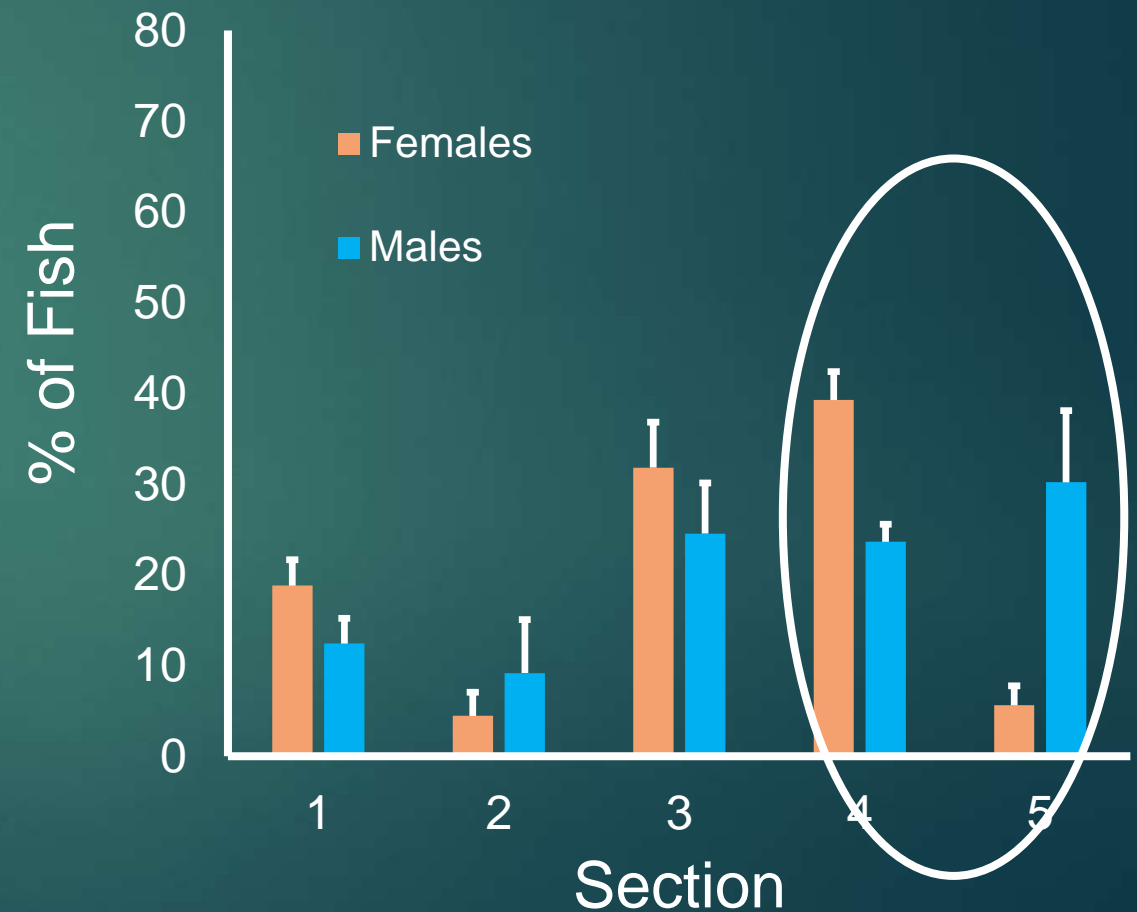
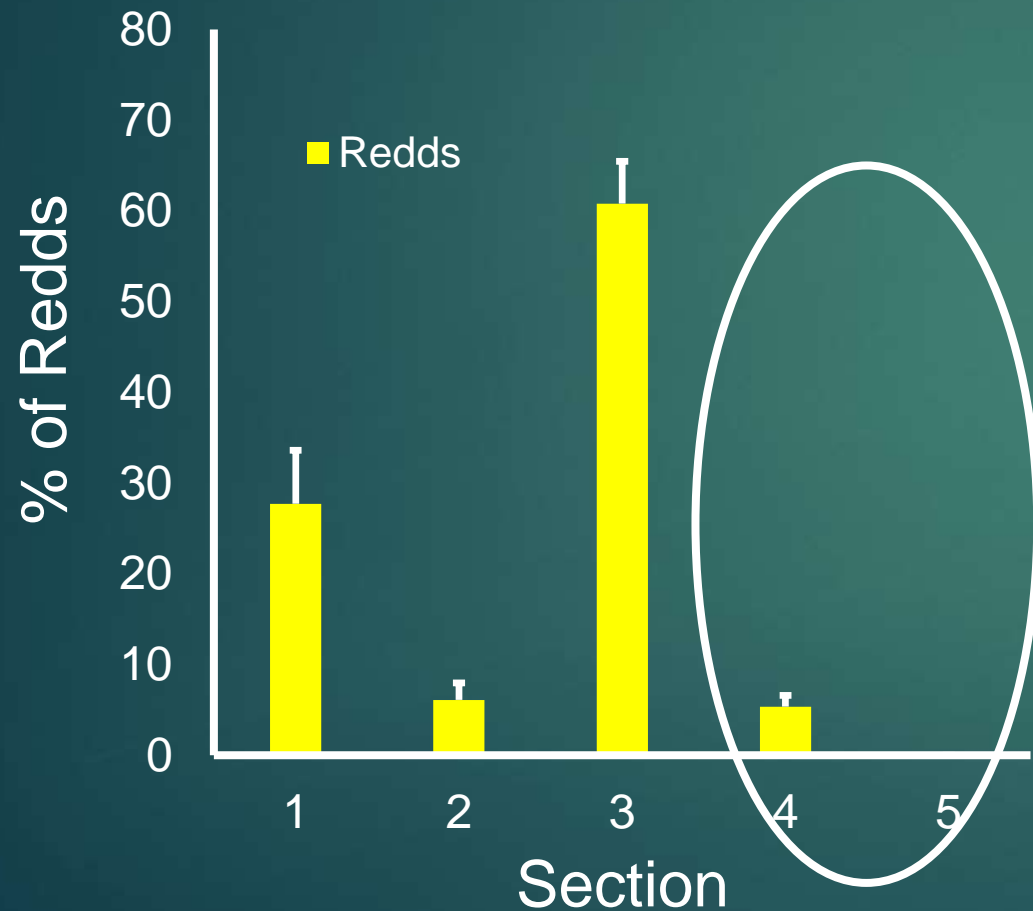
Section 3 - 21 km

Section 4 - 21 km

Section 5 - 19 km



Distributions of Redds and Carcasses by Gender



Objectives

- ▶ Characterize Carcass Drift in the Hanford Reach
- ▶ Illustrate the Impact of Carcass Drift on Interpreting the Relationship of Post Spawn Females and Redds
- ▶ Characterize the Carcass Distribution of Hatchery and Natural Origin Females



Evaluating Bias... Getting Started

2010 - 2017: Size Dependent Carcass
Recovery Bias

2012 – 2017: Carcass Drift Bias



Data Sources

- ▶ Estimates of Fall Chinook Salmon Spawning Escapement to the Hanford Reach
- ▶ Aerial Redd Surveys
- ▶ River Flow Data
- ▶ Carcass Survey Data



Hanford Reach Carcass Survey Goals

- ▶ Survey each River Section 1 or 2 Days weekly.
- ▶ Recovery of carcasses for Coded Wire Tag data (Goal = 10% of spawning escapement)
- ▶ Recovery of carcasses for demographic data (Goal = 2,500 fish)



Carcass Recovery Methods - Data

- ▶ Total Count of Males and Females
- ▶ CWT Recoveries
- ▶ Demographics
 - Size
 - Age
 - Gender
 - Origin
 - Egg Retention



Methods – Tagging and Release

2012 – 2013: Near Shore and Mid-channel Release

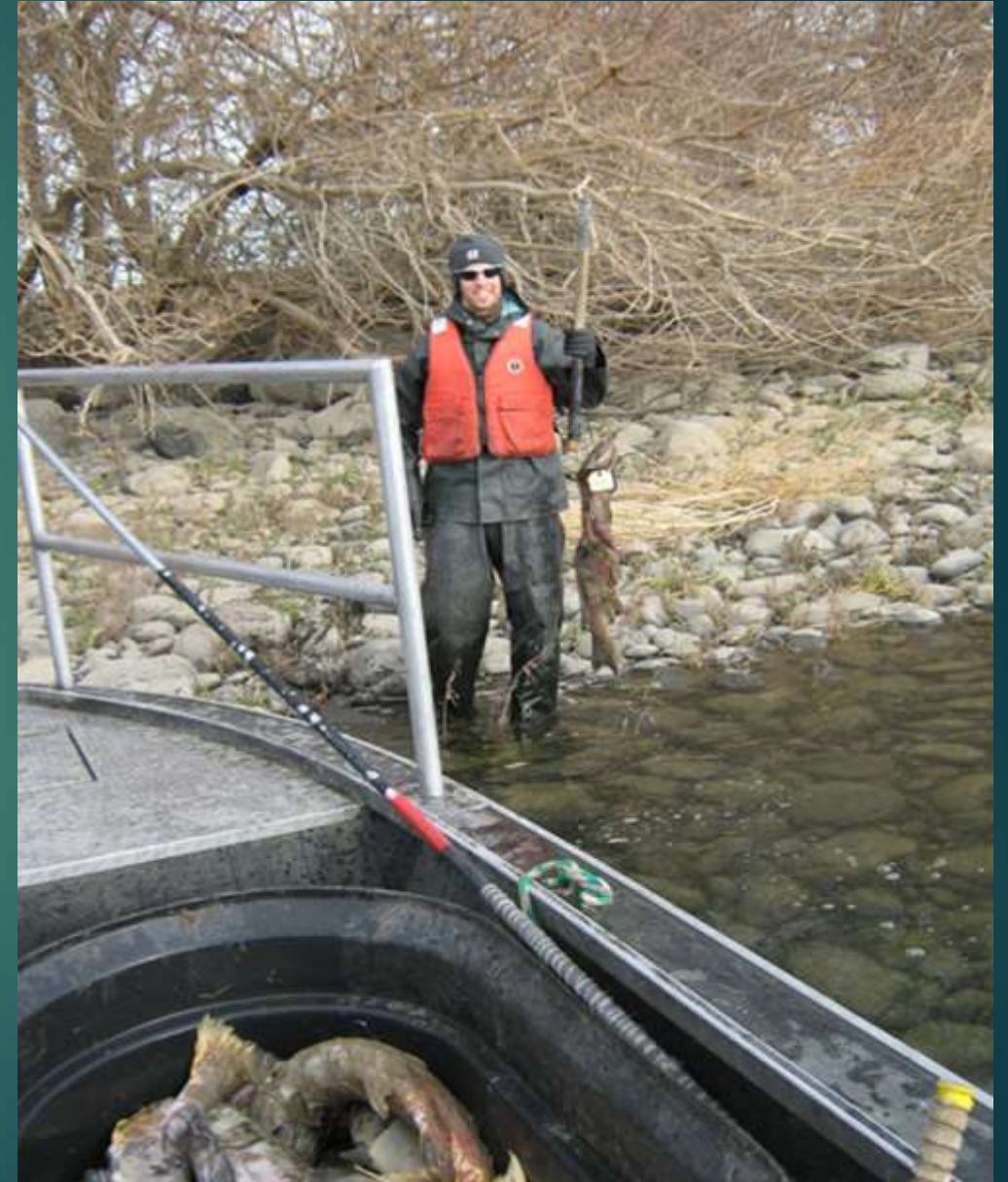
2014: Tag in Place

2015 - 2017: Release Over Specific Redd Areas



Methods – Tag fish released per section by year

Year	Release	Section				Total
		1	2	3	4	
2012	Mid Channel	131	14	129	162	436
2013		97	112	148	112	469
2015	Over Redd Locations	232	60	343	362	997
2016		263	138	332	254	987
2017		290	137	227	327	981



Drift Characteristics of Tagged Groups

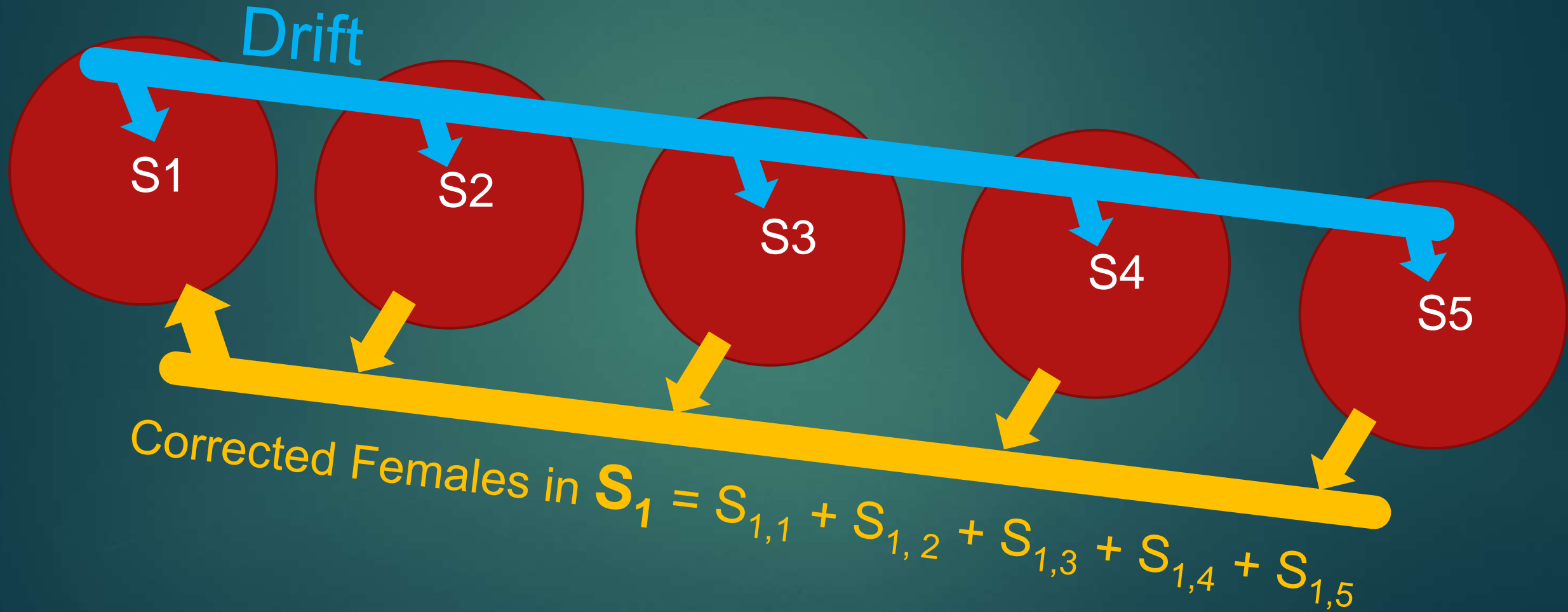
Release Section	Percent Recovery (SD)	Km Drift Mean (SD)	Km Drift Range
1	6.1 (2.2)	31.6 (22.2)	0.8 – 79.6
2	3.3 (2.6)	33.2 (20.1)	12.3 – 62.6
3	6.6 (1.8)	26.9 (12.7)	1.5 – 62.6
4	4.0 (2.1)	8.6 (7.3)	0.3 – 28.4



Where do Tagged Carcasses End Up

Donor Section	% Recovered by Donor Section									
	Recipient 1		Recipient 2		Recipient 3		Recipient 4		Recipient 5	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
1	18.9	12.3	8.6	12.8	49.9	7.4	19.8	8.8	2.9	6.4
2			23.8	37.5	21.3	30.7	30.9	42.0	4.0	8.9
3					32.4	23.1	56.1	26.9	11.4	10.6
4							78.8	16.4	21.2	16.4

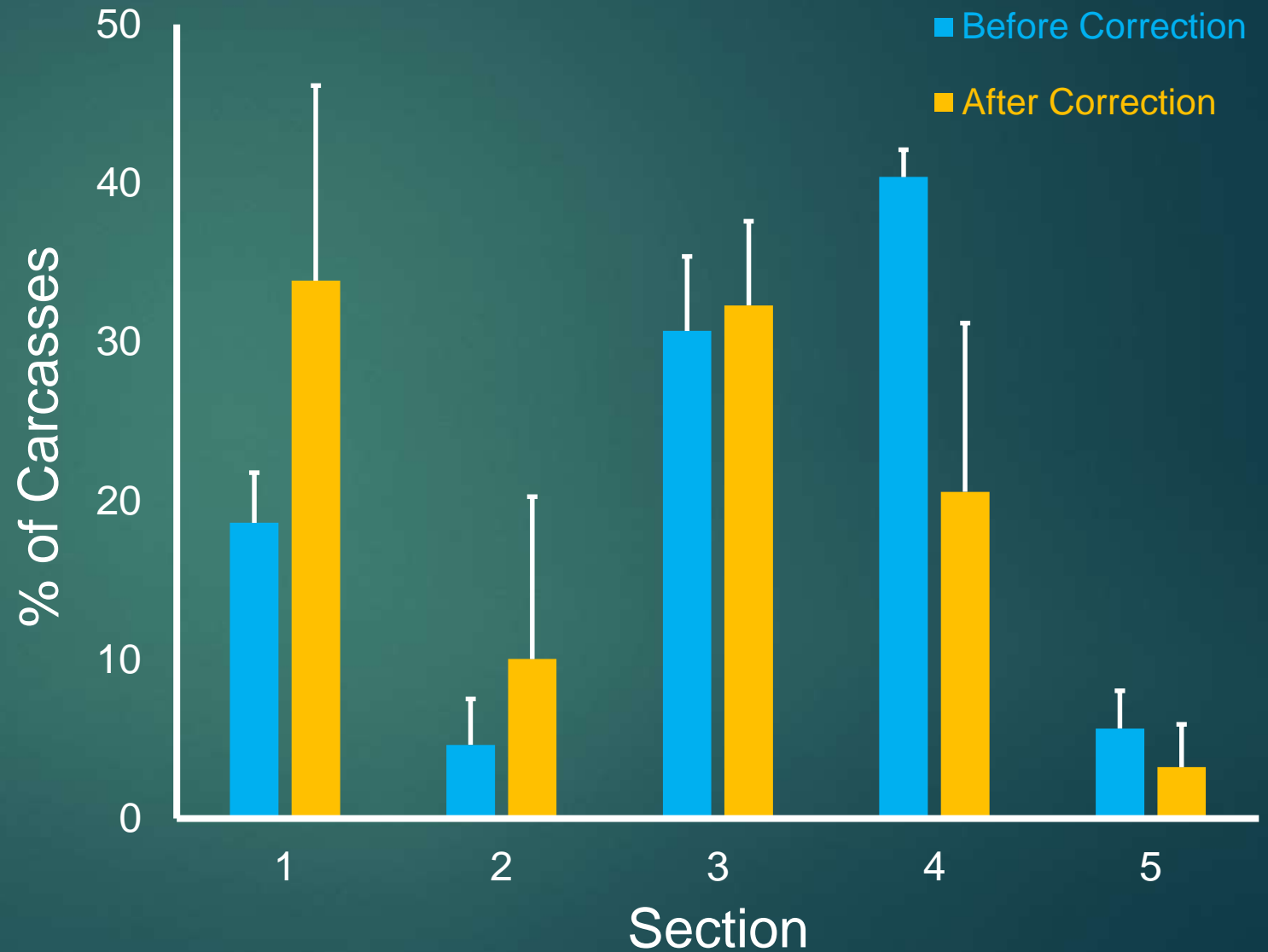
Simplified Example of Correcting For Carcass Drift



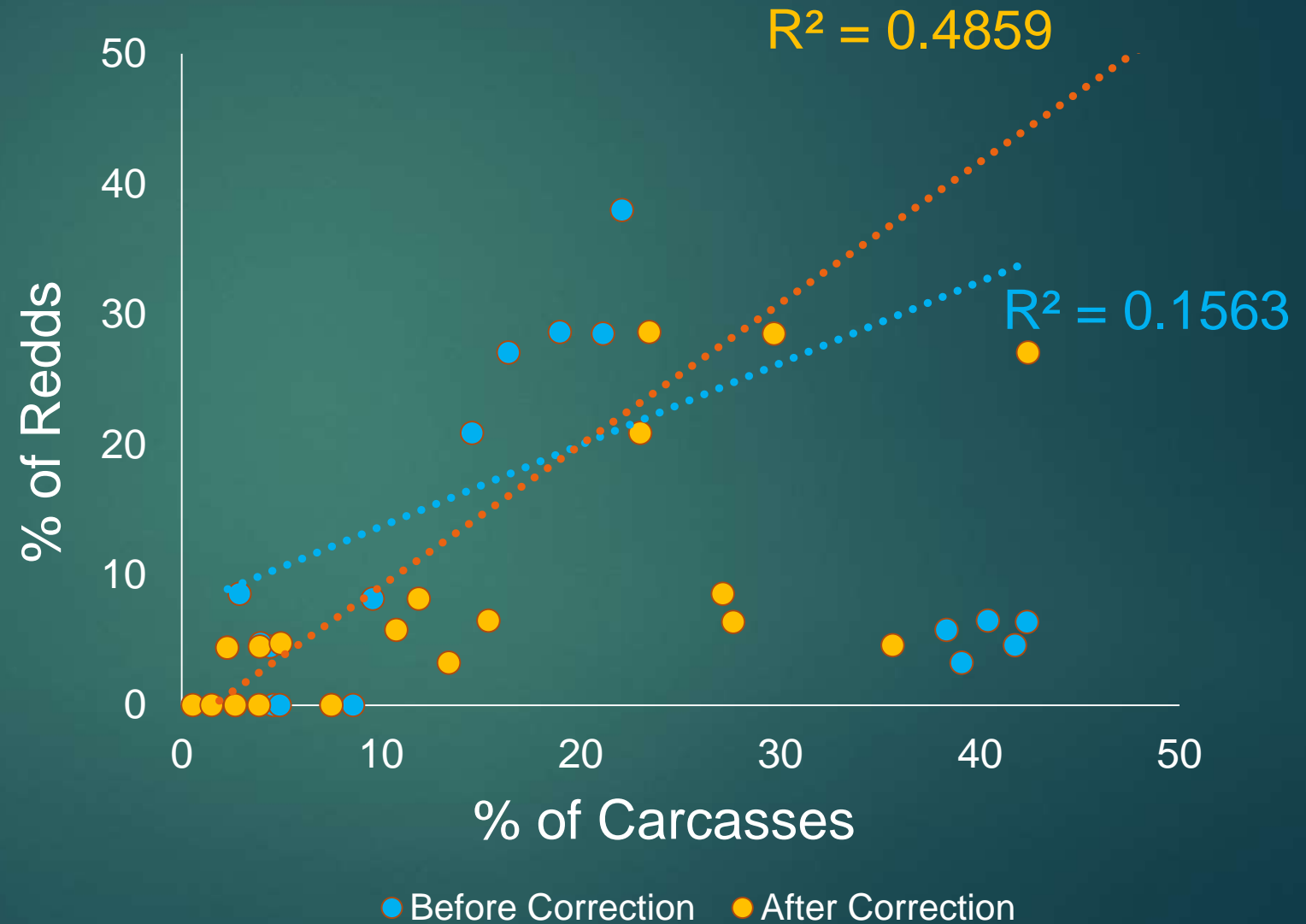
Distribution of Females Before and After Correction

CMH: $P < 0.001$

Woolf: $P < 0.001$



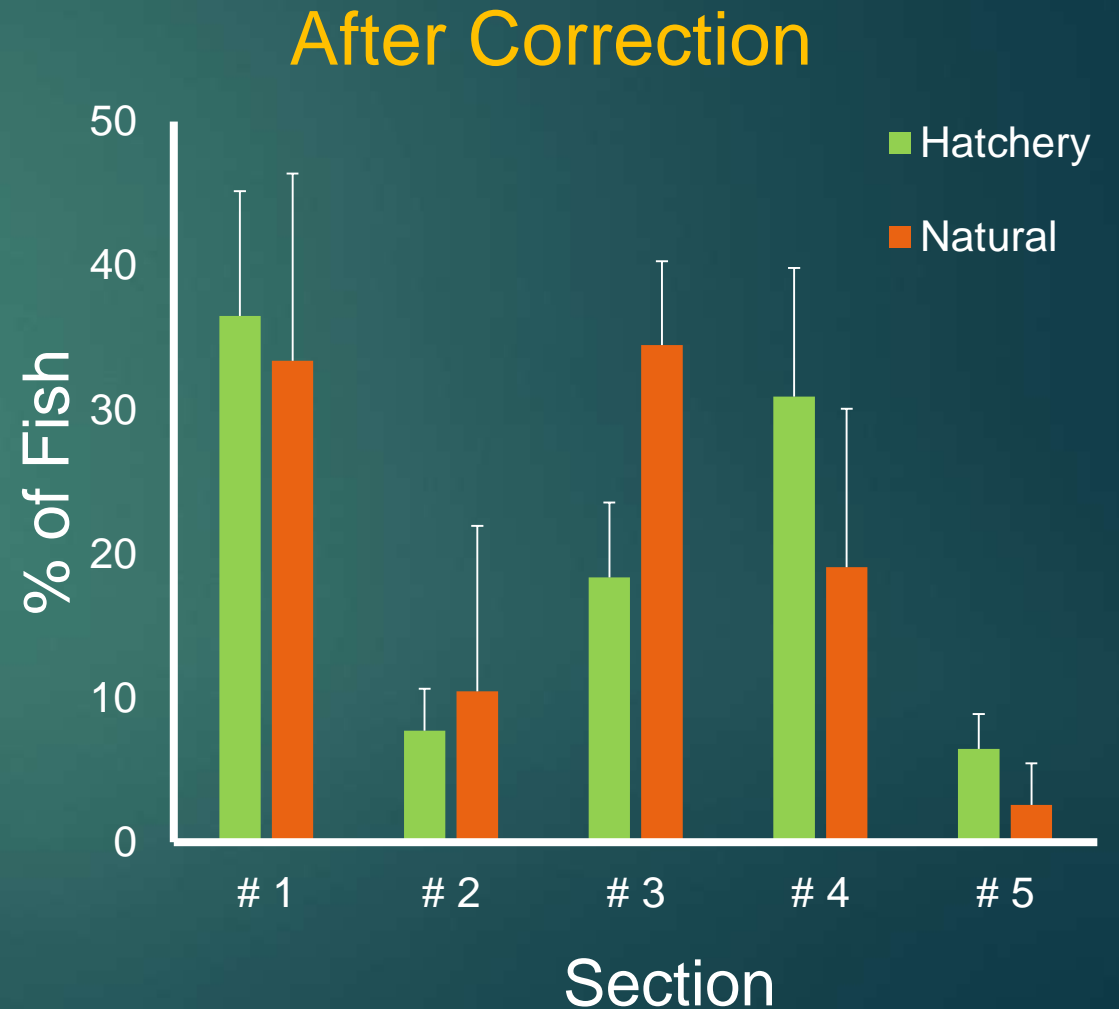
Distribution of Females and Redds Before and After Correction



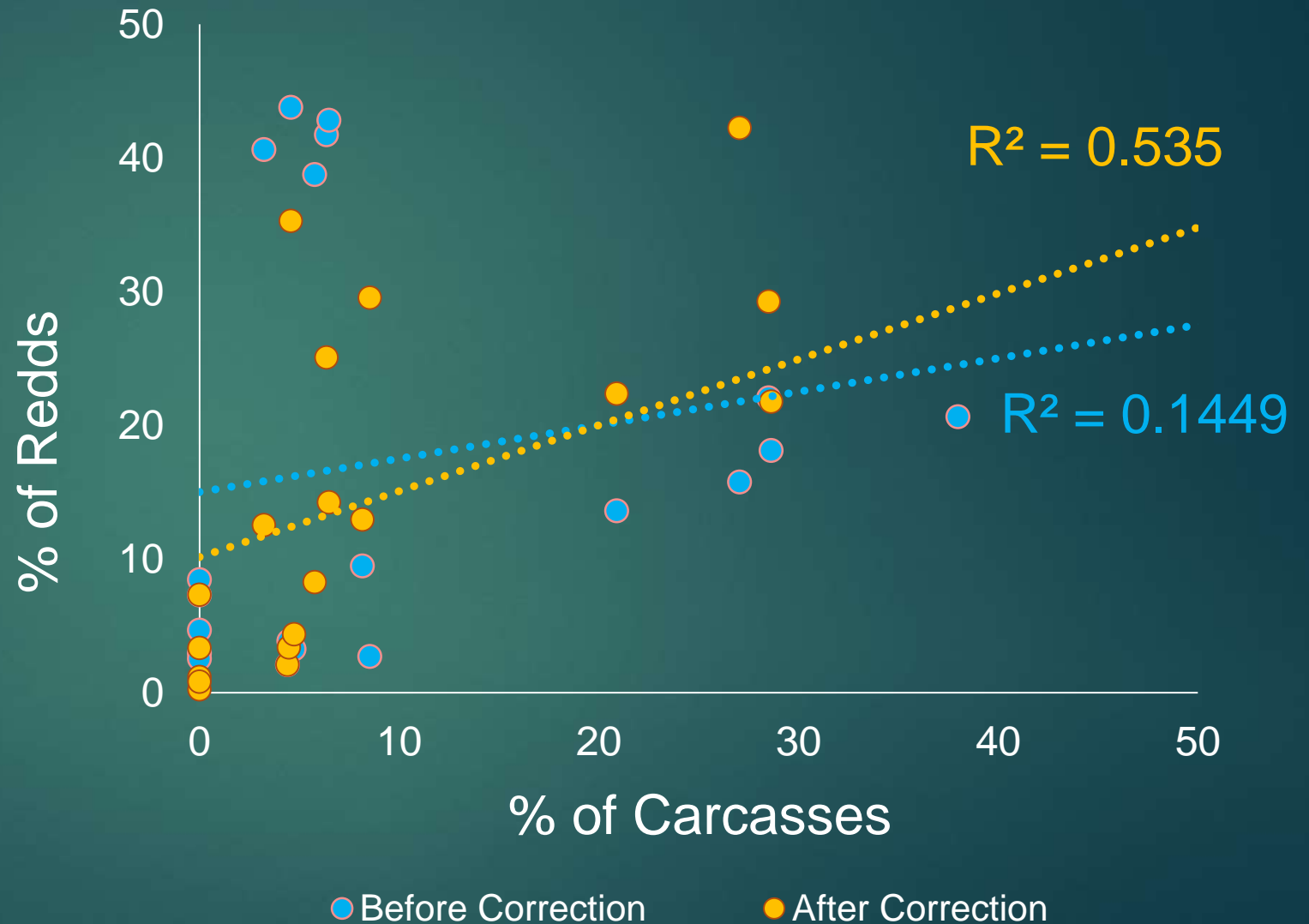
Distribution of Hatchery vs. Natural Origin Females Before and After Correction

CMH: $P < 0.001$

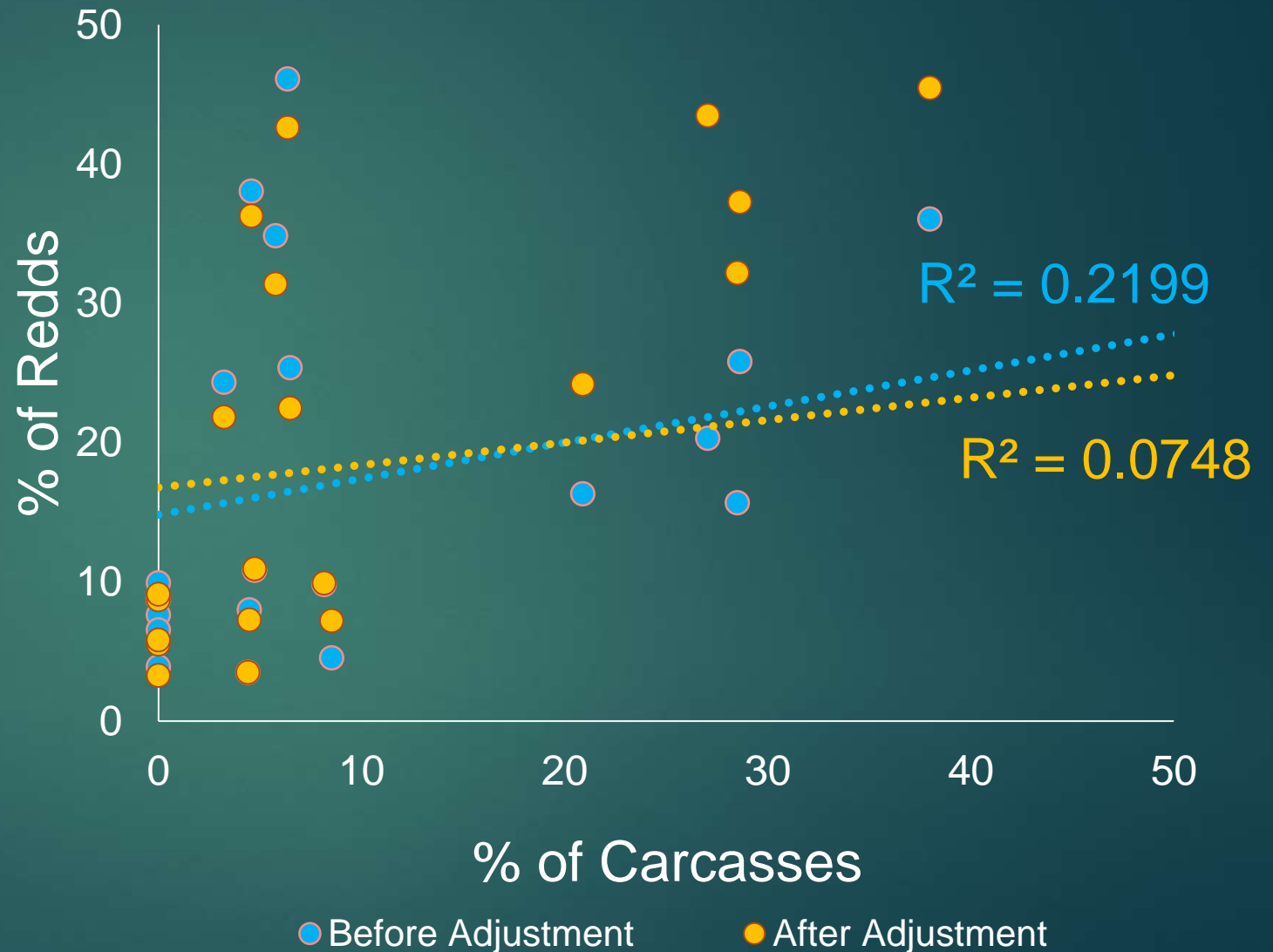
Woolf: $P > 0.05$



Distribution of Natural Origin Females and Redds Before and After Correction



Distribution of Hatchery Origin Females and Redds Before and After Correction



Wrap Up

- ▶ Our correction for carcass drift improves the interpretation of the spawner distribution in the Hanford Reach
 - ▶ Distributions of female carcasses before and after correction were significantly different
 - ▶ Corrected female carcass distribution improved the relationship with the distribution of redds
- ▶ Distribution of natural and hatchery origin female carcasses is different
 - ▶ Correction for drift improved the relationship between natural origin females carcasses and redds
 - ▶ Correcting for drift failed to improve the relationship between hatchery origin female carcasses and redds



District 4 Biologist – Paul Hoffarth

Crew Leads - Dennis Werlau,
Shawna Meehan,
Ashley Andrews

Countless seasonal temporary
staff



Wrap Up

- ▶ Drift appears to have an impact to female carcass distribution.
 - ▶ Resulted in a significant difference between the Raw and Corrected mean distributions of female carcasses.
- ▶ The relationship between the Raw distributions of female carcasses and redds was poor.
 - ▶ Corrected distribution improved the relationship with the distribution of redds.
- ▶ The Corrected distribution yielded differences between Natural and Hatchery origin female carcasses
 - ▶ Corrected distribution improved the relationship between natural origin carcass and redds
 - ▶ Corrected distribution worsened the relationship between natural origin carcass and redds