Upper Columbia River Steelhead Overshoot Abundance and Migration Success

Andrew Murdoch (WDFW)

Kevin See (Biomark)

Ben Truscott (WDFW)

UCR Steelhead Population Abundance

Ecological Applications, 0(0), 2020, e02202

Check for updates

A Bayesian nested patch occupancy model to estimate steelhead movement and abundance

LYNN WATERHOUSE [1,2,6] JODY WHITE,[3] KEVIN SEE [4] ANDREW MURDOCH [5] AND BRICE X. SEMMENS [1]

[1]*Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Drive #0202, La Jolla, California 92093-0202 USA*
[2]*John G. Shedd Aquarium, 1200 South Lake Shore Drive, Chicago, Illinois 60605 USA*
[3]*29463 Hexon Road, Parma, Idaho 83660 USA*
[4]*Biomark, 705 South 8th Street, Boise, Idaho 83702 USA*
[5]*Washington Department of Fish and Wildlife, Wenatchee, Washington 98801 USA*

Citation: Waterhouse, L., J. White, K. See, A. Murdoch, and B. X. Semmens. 2020. A Bayesian nested patch occupancy model to estimate steelhead movement and abundance. Ecological Applications 00(00): e02202. 10.1002/eap.2202

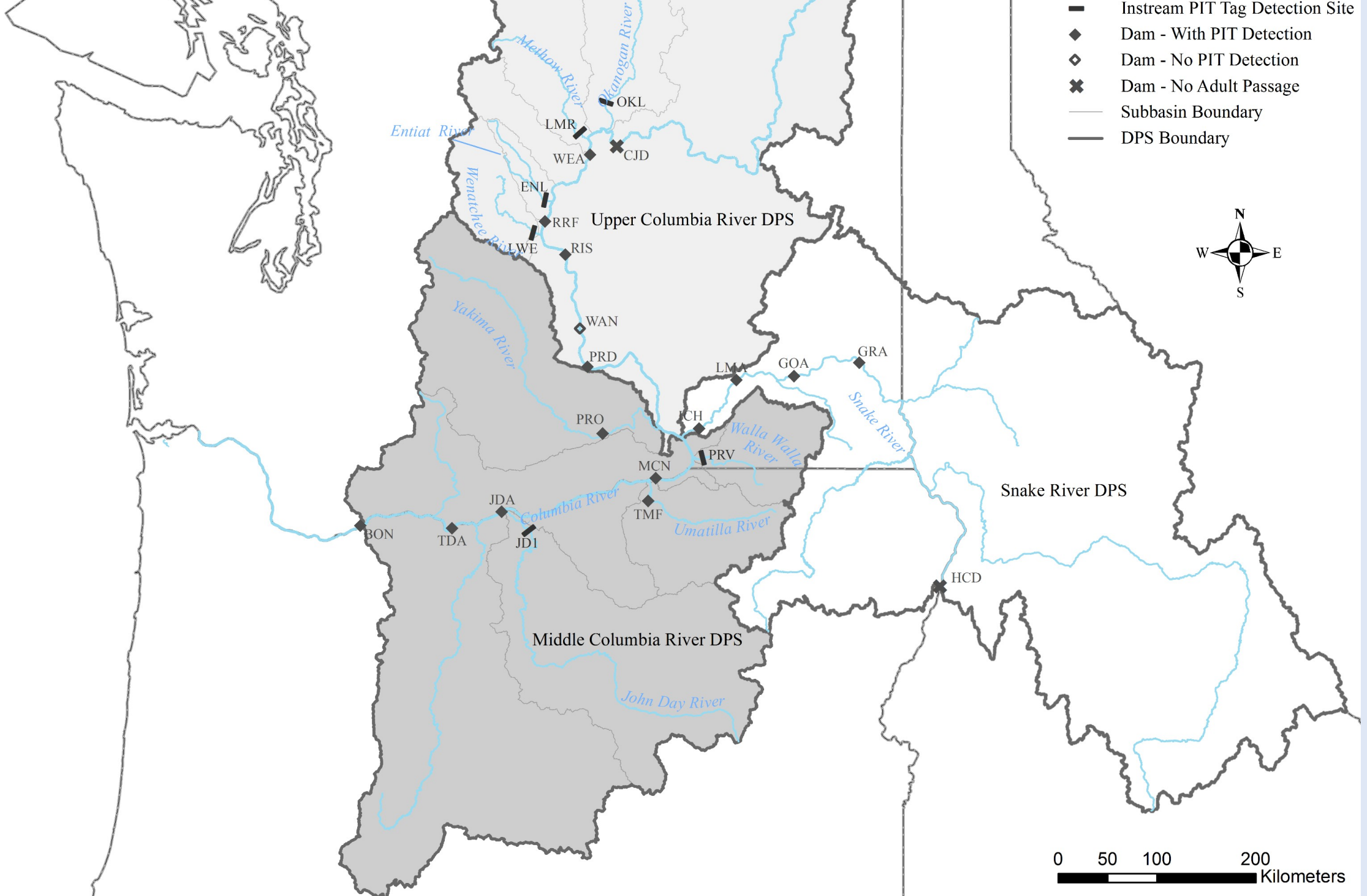
Abstract. Anthropogenic impacts on riverine systems have, in part, led to management concerns regarding the population status of species using these systems. In an effort to assess the efficacy of restoration actions, and in order to improve monitoring of species of concern, managers have turned to PIT (passive integrated transponder) tag studies with in-stream detectors to monitor movements of tagged individuals throughout river networks. However, quantifying movements in a river network using PIT tag data with incomplete coverage and imperfect detections presents a challenge. We propose a flexible Bayesian analytic framework

Objective

- Estimate fallback abundance downstream of Priest Rapids Dam
- Estimate overshoot abundance at Priest Rapids Dam
- Estimate annual proportion of overshoot steelhead that migrated successfully downstream of Priest Rapids Dam prior to spawning

Methods

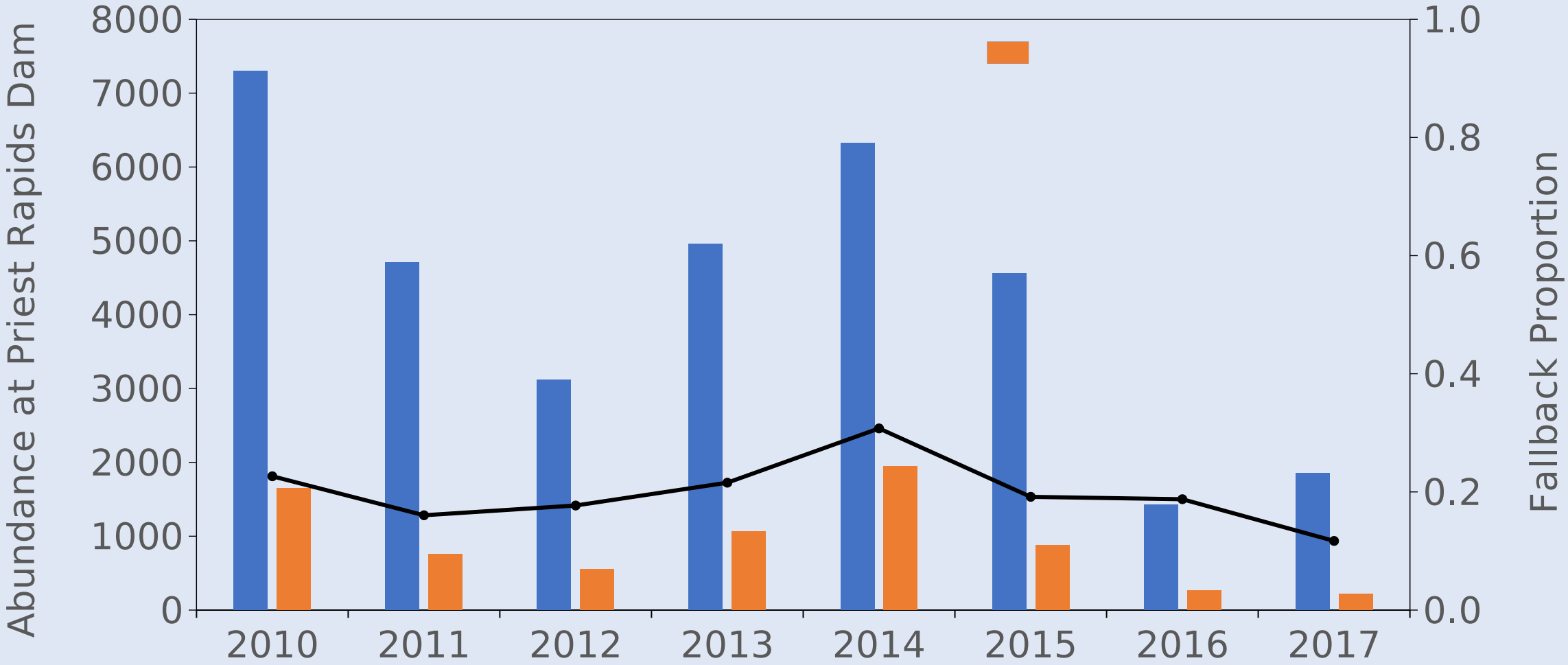
- PIT tag representative sample of the steelhead run at Priest Rapids Dam (~15%)
- Use patch occupancy model to estimate abundance (Waterhouse et al. 2020)


Instream PIT Tag Detection Site
Dam - With PIT Detection
Dam - No PIT Detection
Dam - No Adult Passage
Subbasin Boundary
DPS Boundary
N
W
E
S
Methow River
Okanogan River
Entiat River
Wenatchee River
Yakima River
Walla Walla River
Snake River
Columbia River
Umatilla River
John Day River
OKL
LMR
WEA
CJD
ENL
RRF
LWE
RIS
WAN
PRD
LMA
GOA
GRA
ICH
PRO
PRV
MCN
JDA
TMF
BON
TDA
JD1
HCD
Upper Columbia River DPS
Middle Columbia River DPS
Snake River DPS
0 50 100 200
Kilometers

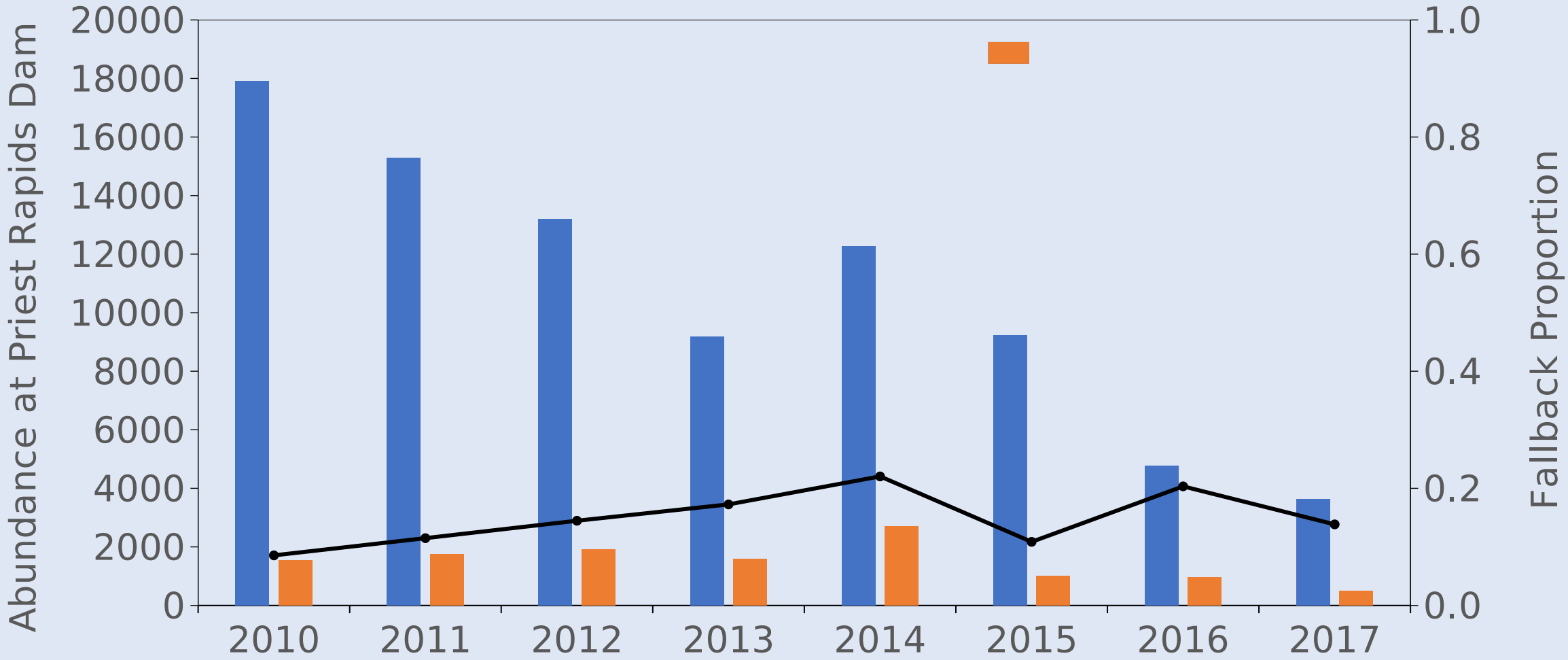
PRD POM Detection Locations

Upstream	Downstream
Wenatchee	Priest Rapids Hatchery
Entiat	Ringold Spring Hatchery
Methow	Yakima (Prosser Dam)
Okanogan (Foster Creek)	Snake (Ice Harbor)
	Walla Walla/Touchet

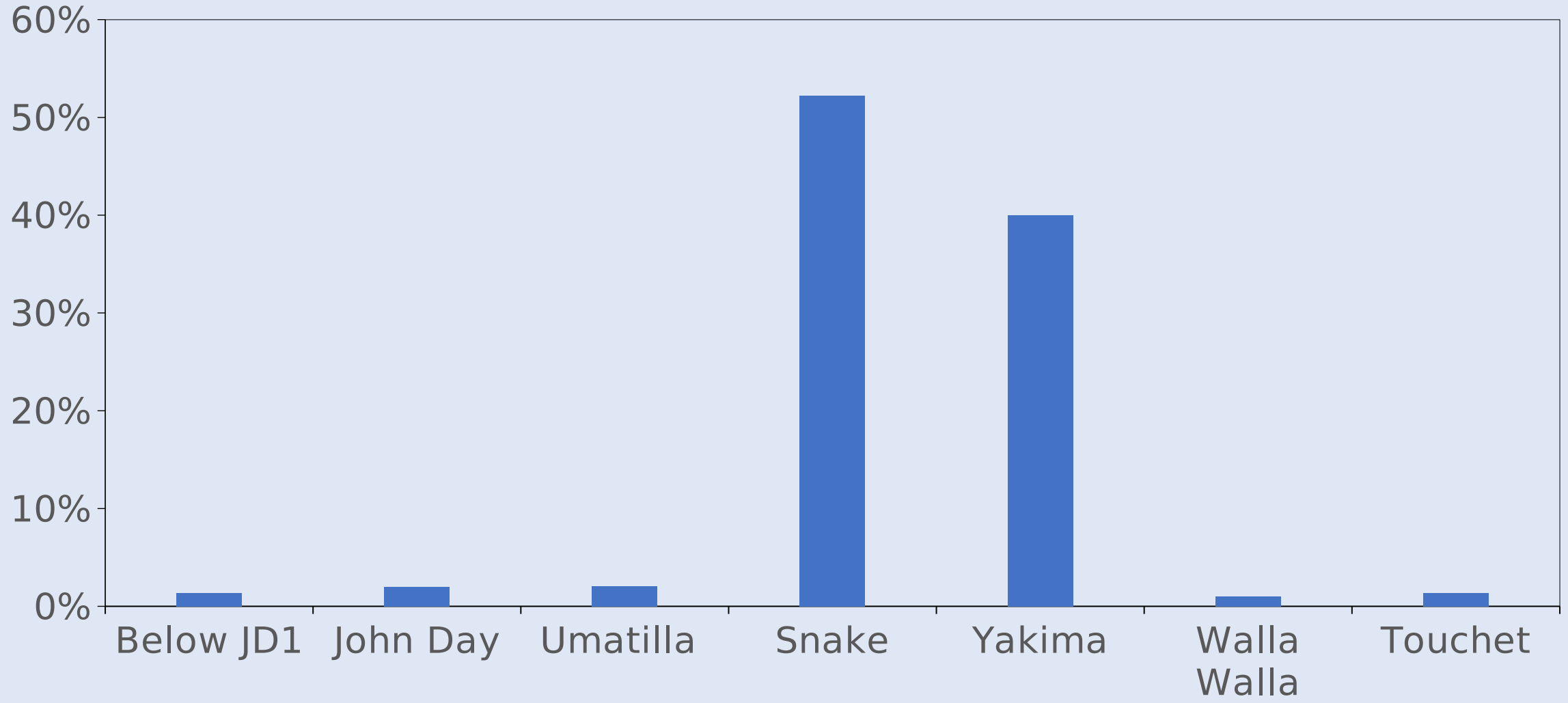
Wild Steelhead



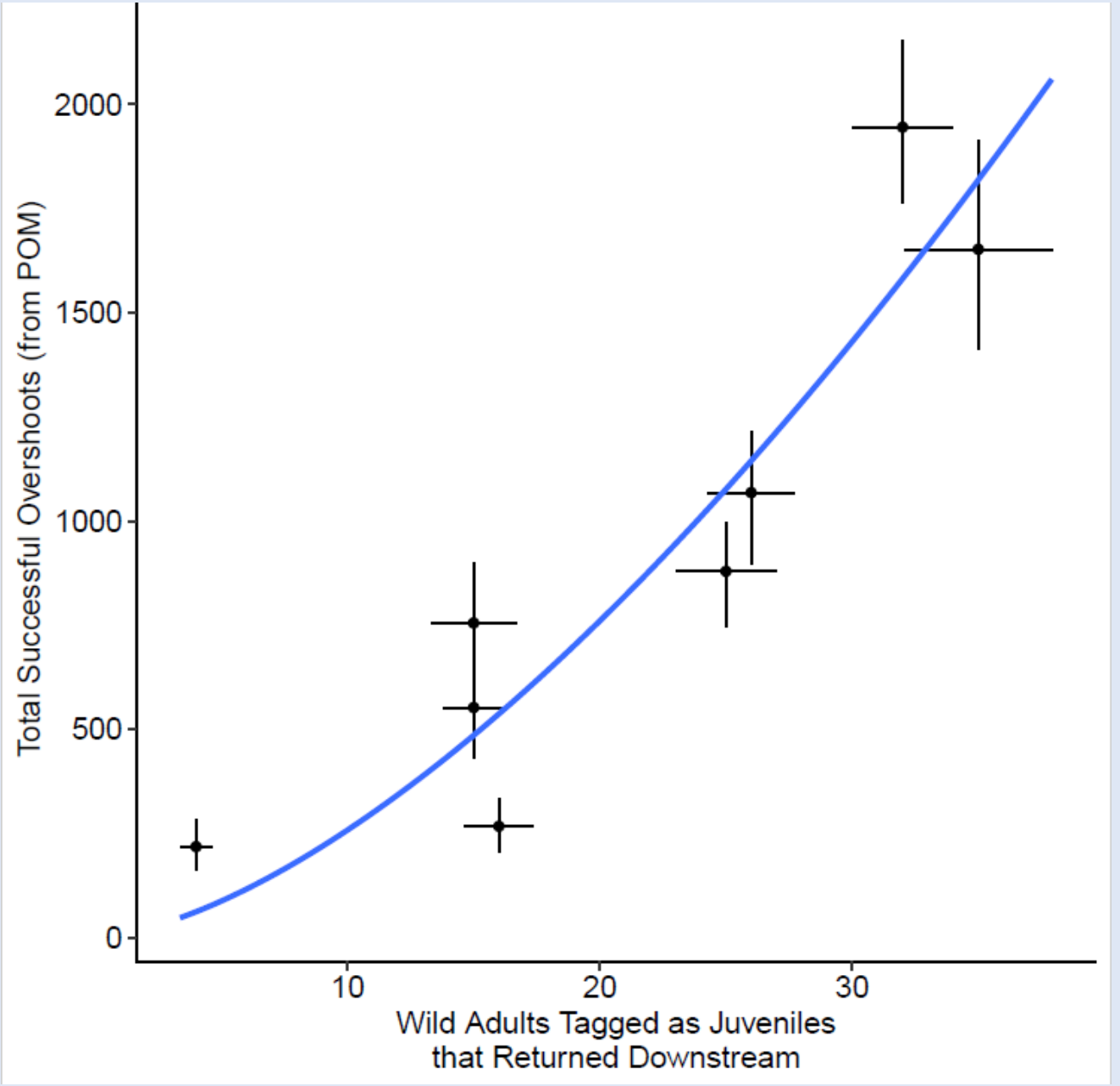
Hatchery Steelhead



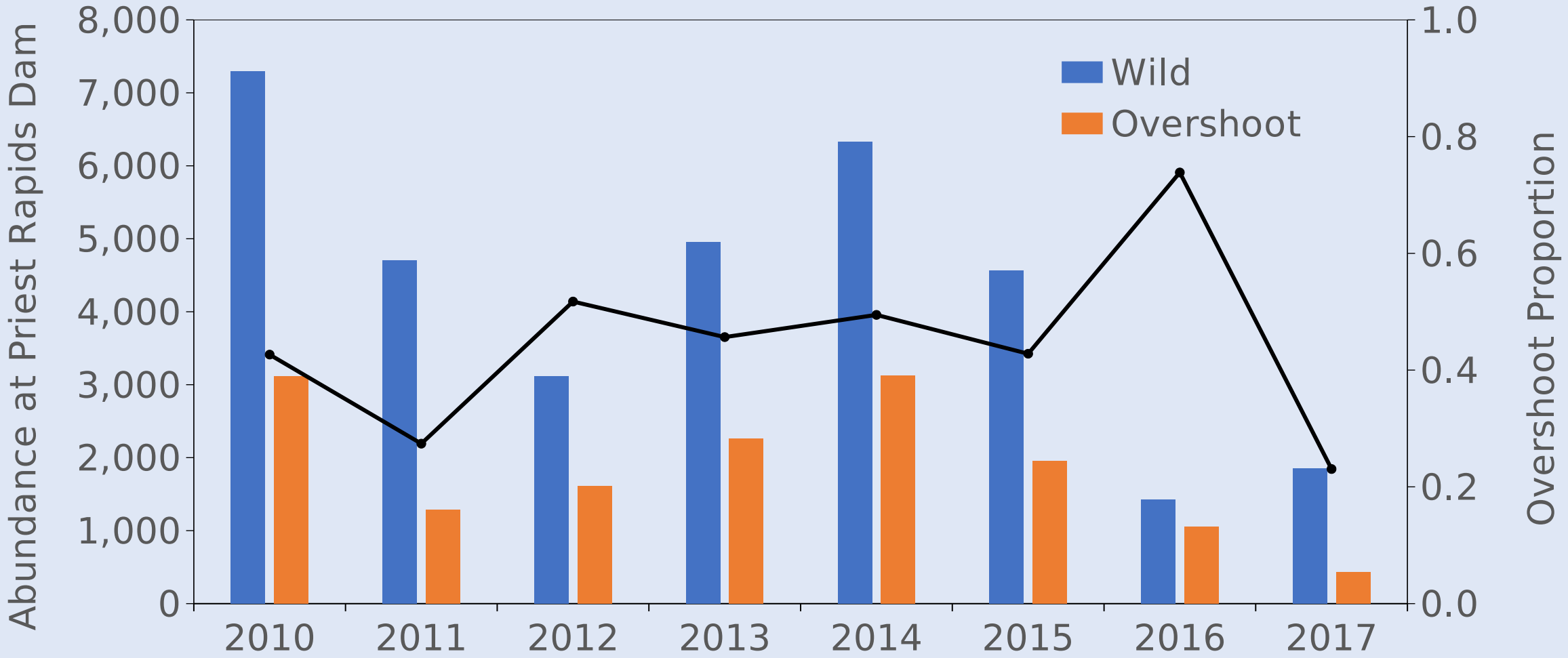
Mean Fallback Distribution



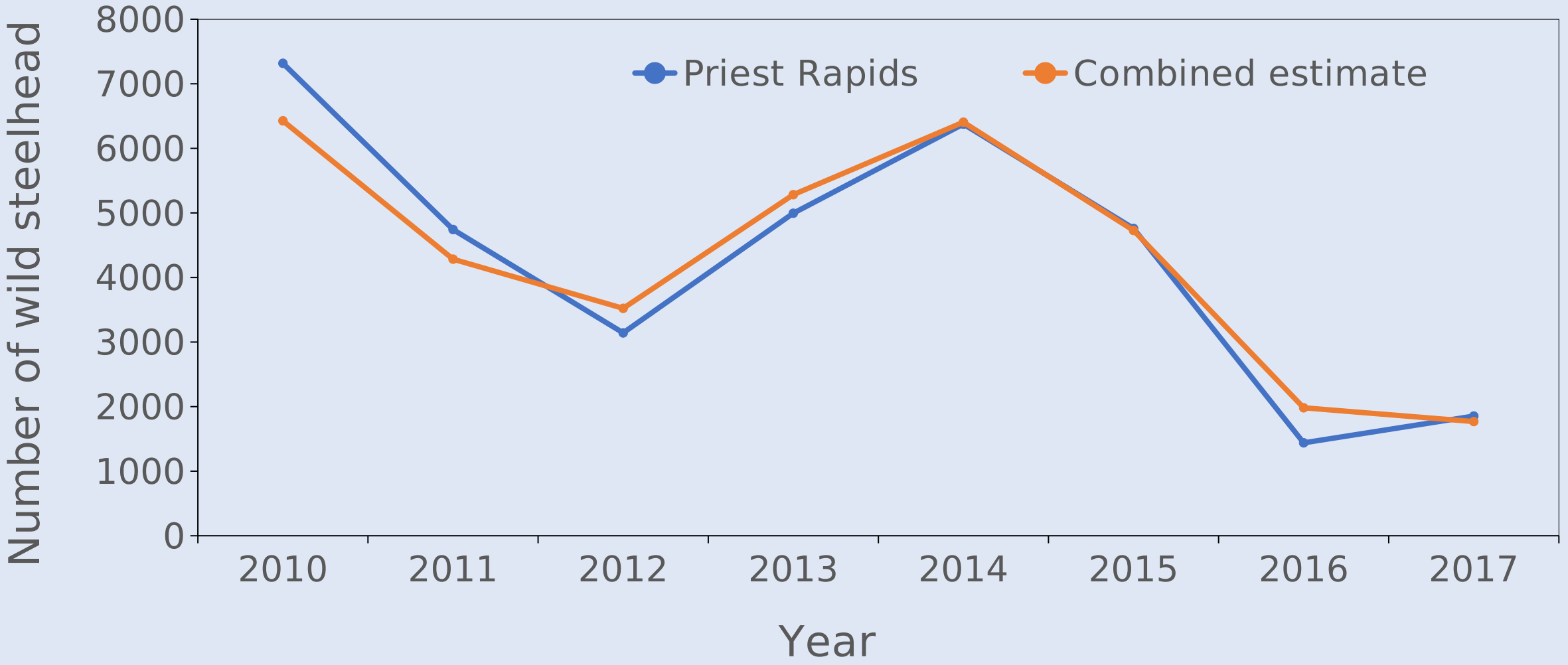
Relationship between estimated known and model fallback abundance



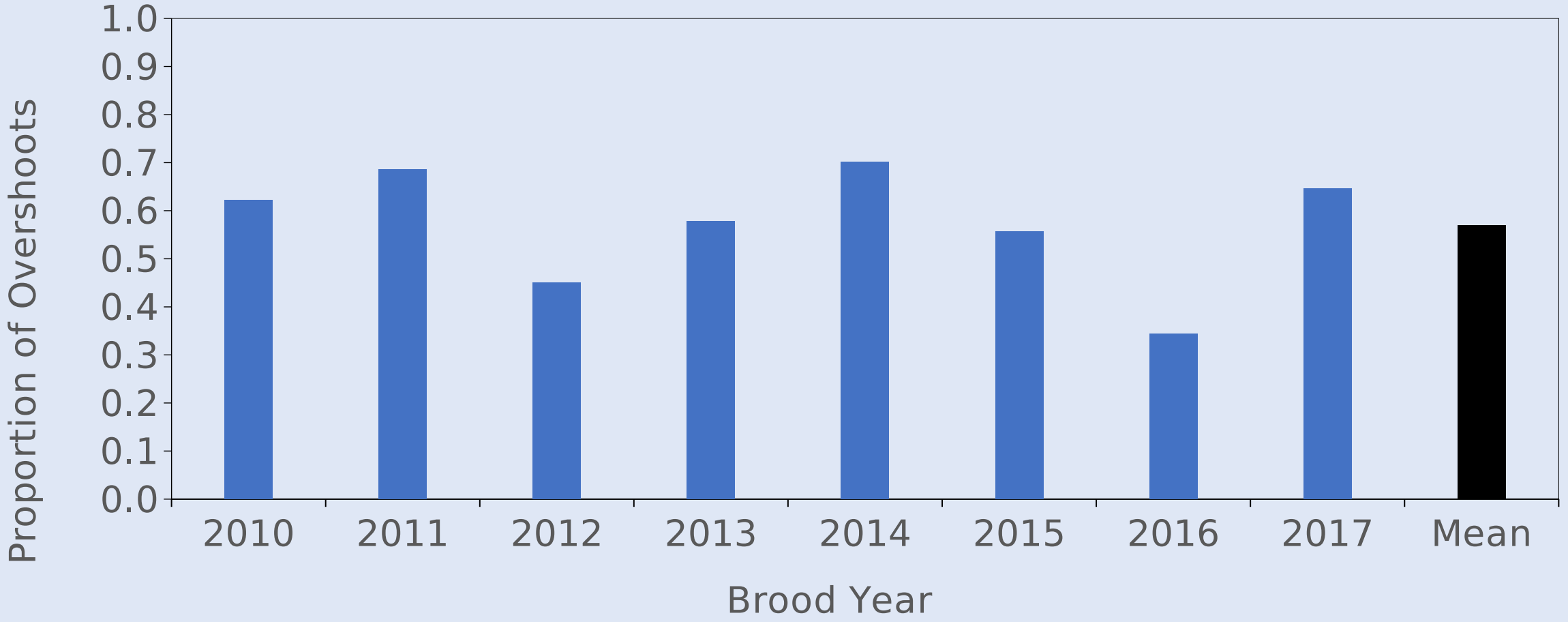
Wild Steelhead



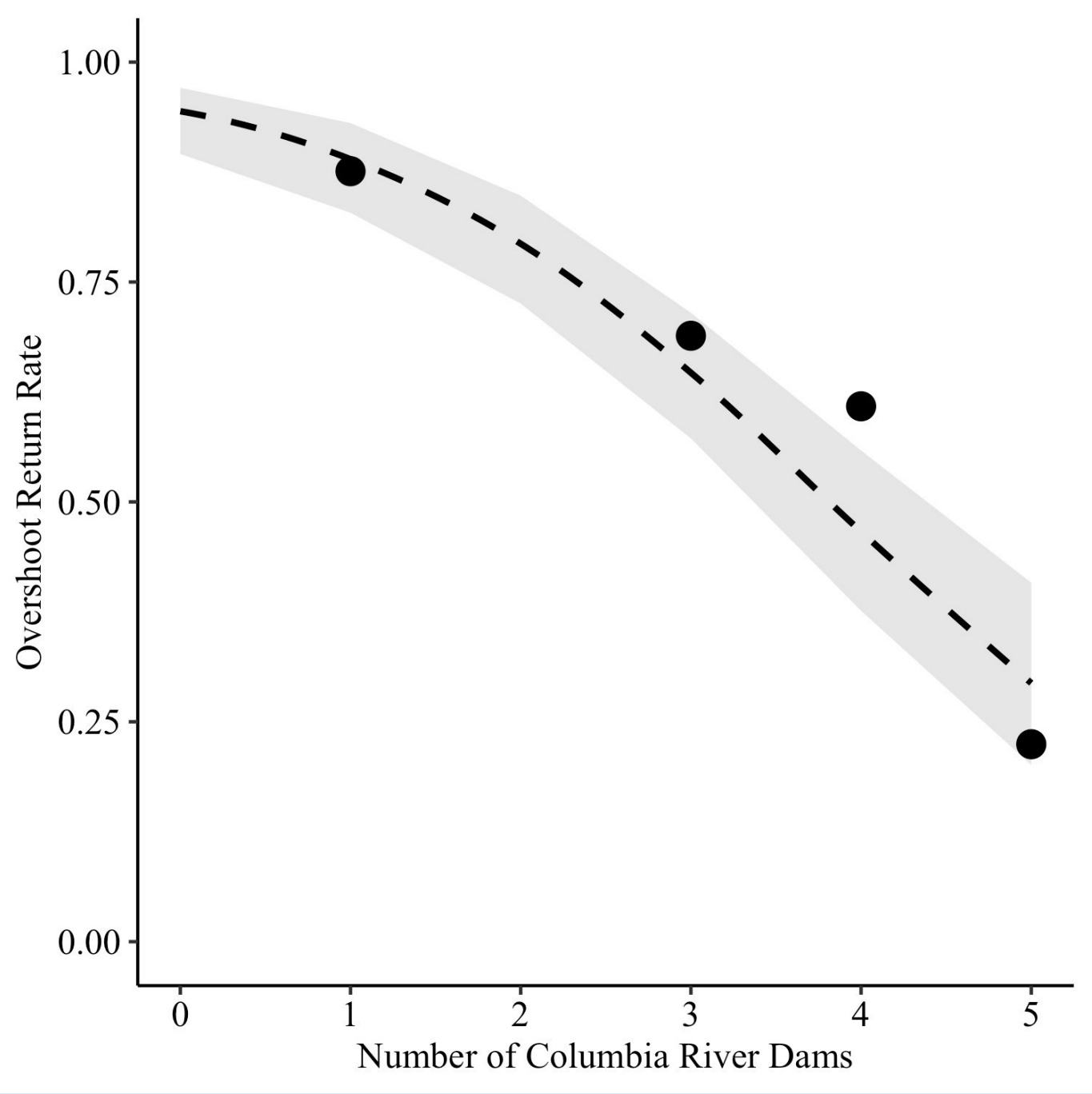
Wild Steelhead



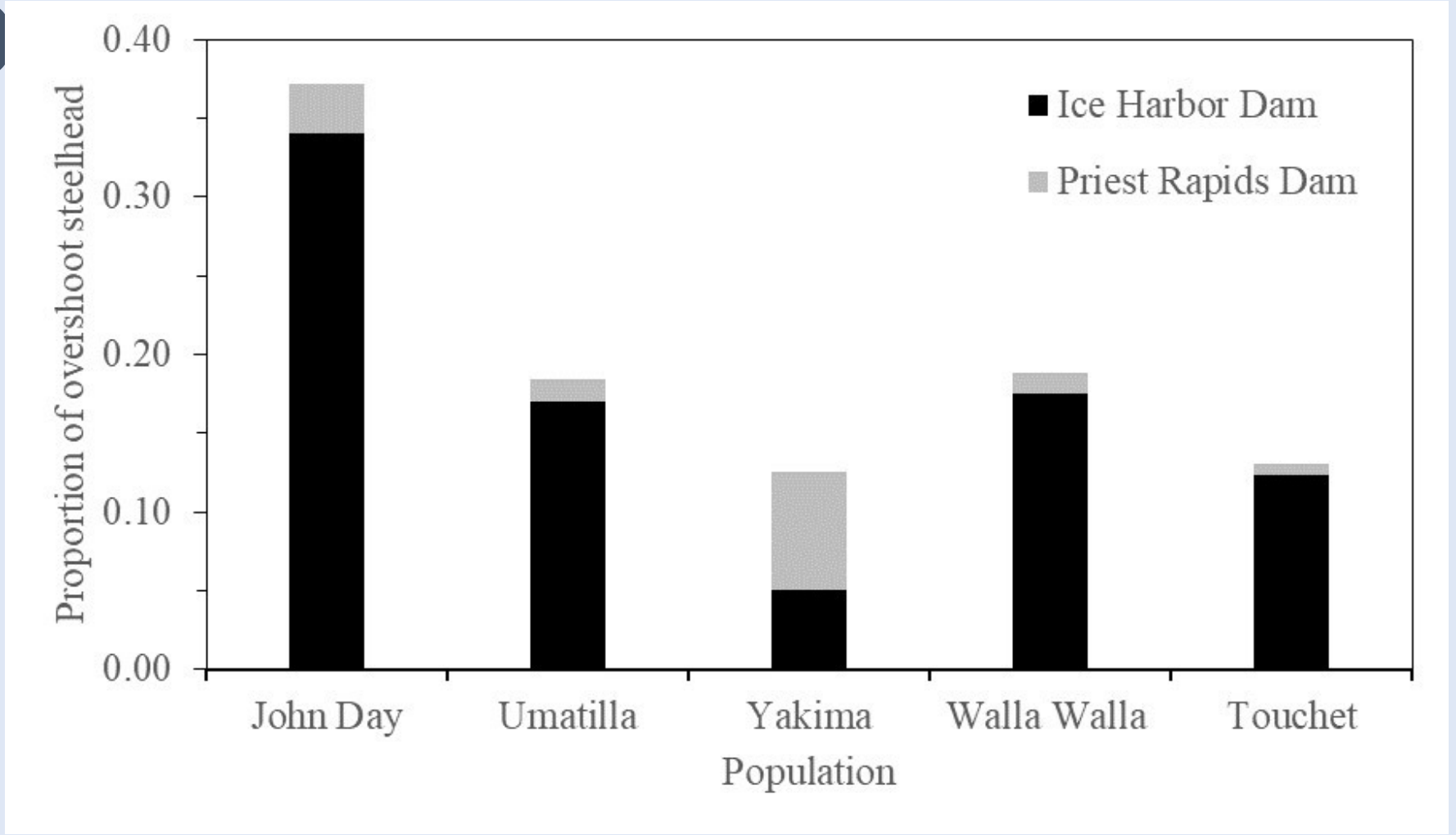
Wild Steelhead: Successful Overshoots



Wild Steelhead: Dam Effect



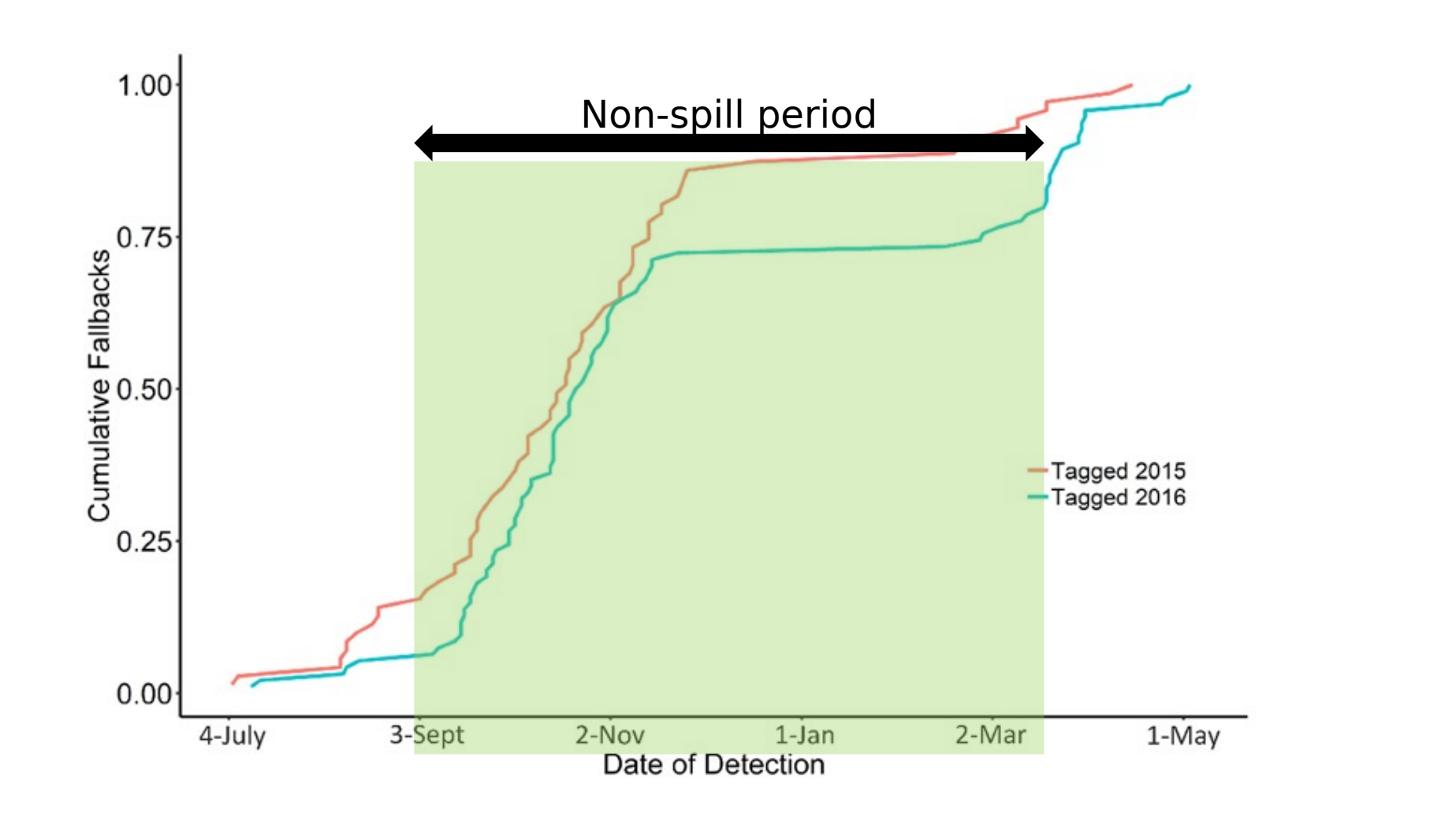
Known Wild Steelhead Overshoots: Mid-Columbia Steelhead DPS (20



Summary

- 2 out of 5 wild steelhead at Priest Rapids Dam are overshoots
  - Only a small proportion (3%) are observed on spawning grounds
- 2 out of 5 overshoots at Priest Rapids Dam don’t make back downstream
- Overshoots may be 6x more abundant in Snake River
  - Similar analysis can be done using Lower Granite Dam data

Downstream Migration at Priest Rapids Dam: Radio-tagged Steelhead (Fuchs et



Recommendations

- During non-spill periods, surface flow downstream passage routes at all hydro-projects could greatly improve downstream passage (Khan et al. 2013)
  - Turbines = 343 ± 305
  - Sluiceway = 6,139 ± 895
- Dalles Dam Sluiceway Operations
  - Closes Dec 15; Opens Mar 1
- 2020 CRS BiOp
  - McNary and 4 SR dams provide surface spill
  - 1 Oct – 15 Nov; 1-30 Mar
  - 4 h for 3/week on non-consecutive days or (12/168 = 7%)
- Develop and implement plan for UCR PUD projects
- Replicate study in SR and use results to adaptively manage surface spill at all projects

Acknowledgements

A big thank you to Janet Eckenberg and staff for decades of service at Priest Rapids Dam and Jay Deason and staff for instream PIT array construction, operations and maintenance. Project was funded by BPA under Project #2010-034-00 with support from CCPUD and GCPUD.

A special thanks to GCPUD for providing WDFW the facilities and access to Priest Rapids Dam for monitoring steelhead for over 30 years.