“Real-time” steelhead escapement estimates to maximize potential hatchery harvest rates

Ben Truscott – WDFW

2021 Pacific Coast Steelhead Management Meeting

A novel steelhead abundance tool, intended to provide fishery managers “real-time” abundance

PIT tag-based estimates by fishery area and origin

Existing methods rely on antiquated and biased data

R Shiny app to automate, visualize, distribute

Tool intended to direct recreational fisheries for maximum benefit

Conservation:

Remove surplus hatchery origin fish

- Reduce pHOS
- Reduce competition on spawning grounds with NORs

Minimize impact to NORs (maintain ESA compliance)

- 2% mortality in UCR

Improved data for harvest/impact analyses (maintain ESA compliance)

Tool intended to direct recreational fisheries for maximum benefit

Recreation:

Increase duration?

Increase effectiveness (i.e., more hatchery fish removed)

Long-term success through better management

PIT tag representative sample of the steelhead run at Priest Rapids Dam (15%)

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]

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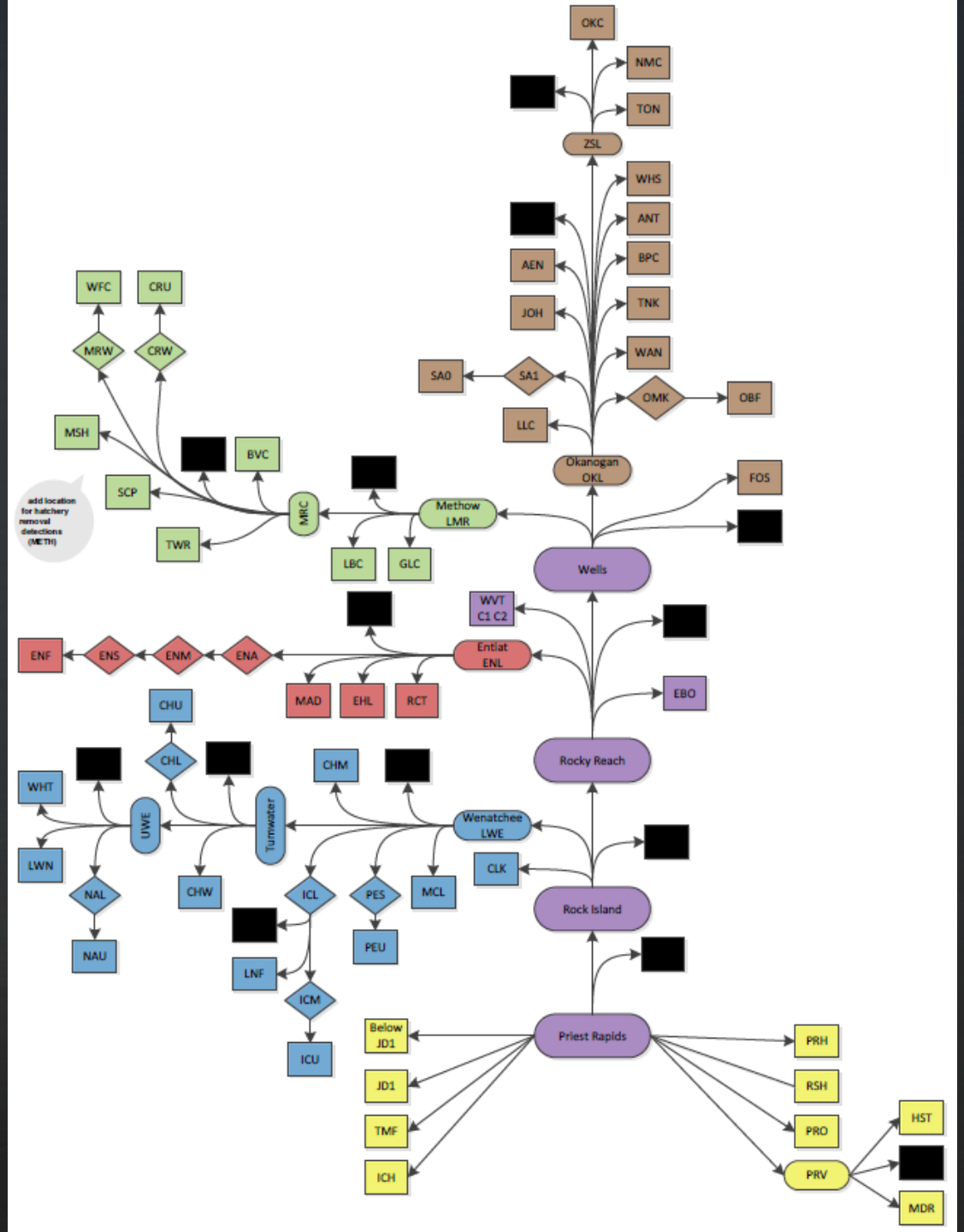
[2]*John G. Shedd Aquarium, 1200 South Lake Shore Drive, Chicago, Illinois 60605 USA*
[3]*29463 Hexon Road, Parma, Idaho 83660 USA*
[4]*Biomark, 705 South 8th Street, Boise, Idaho 83702 USA*
[5]*Washington Department of Fish and Wildlife, Wenatchee, Washington 98801 USA*

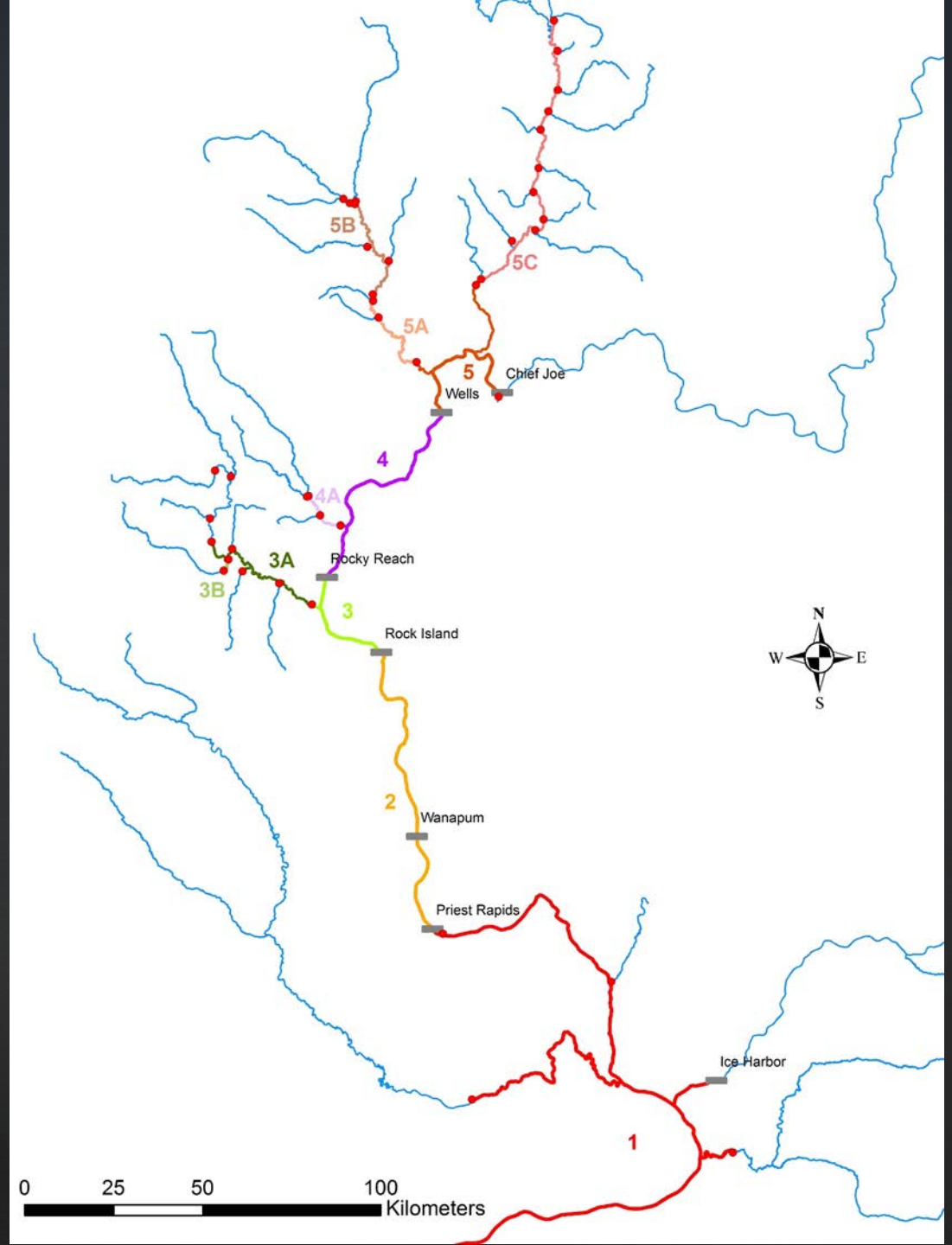
Citation: Waterhouse, L., J. White, K. See, A. Murdoch, and B. X. Semmens. 2020. A Bayesian nested patch occupancy model to estimate steelhead movement and abundance. Ecological Applications 00(00): e02202. 10.1002/eap.2202

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

Use patch occupancy model to estimate abundance (Waterhouse et al. 2020)



Generate abundance estimates after conclusion of spawning



"Real-time estimates"

Generate abundance estimates weekly

Estimates generated at fishery area scale

Columbia Basin Research | Columbia River DART | Status & Trends | Inseason Forecasts | Tools

Columbia Basin

Columbia River DART (Data Access in Real

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BiomarkABS / PITcleanr

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updated the user agent to reflect github.com/BiomarkABS

master

KevinSee committed on Feb 5

Showing 5 changed files with 5 additions and 5 deletions.

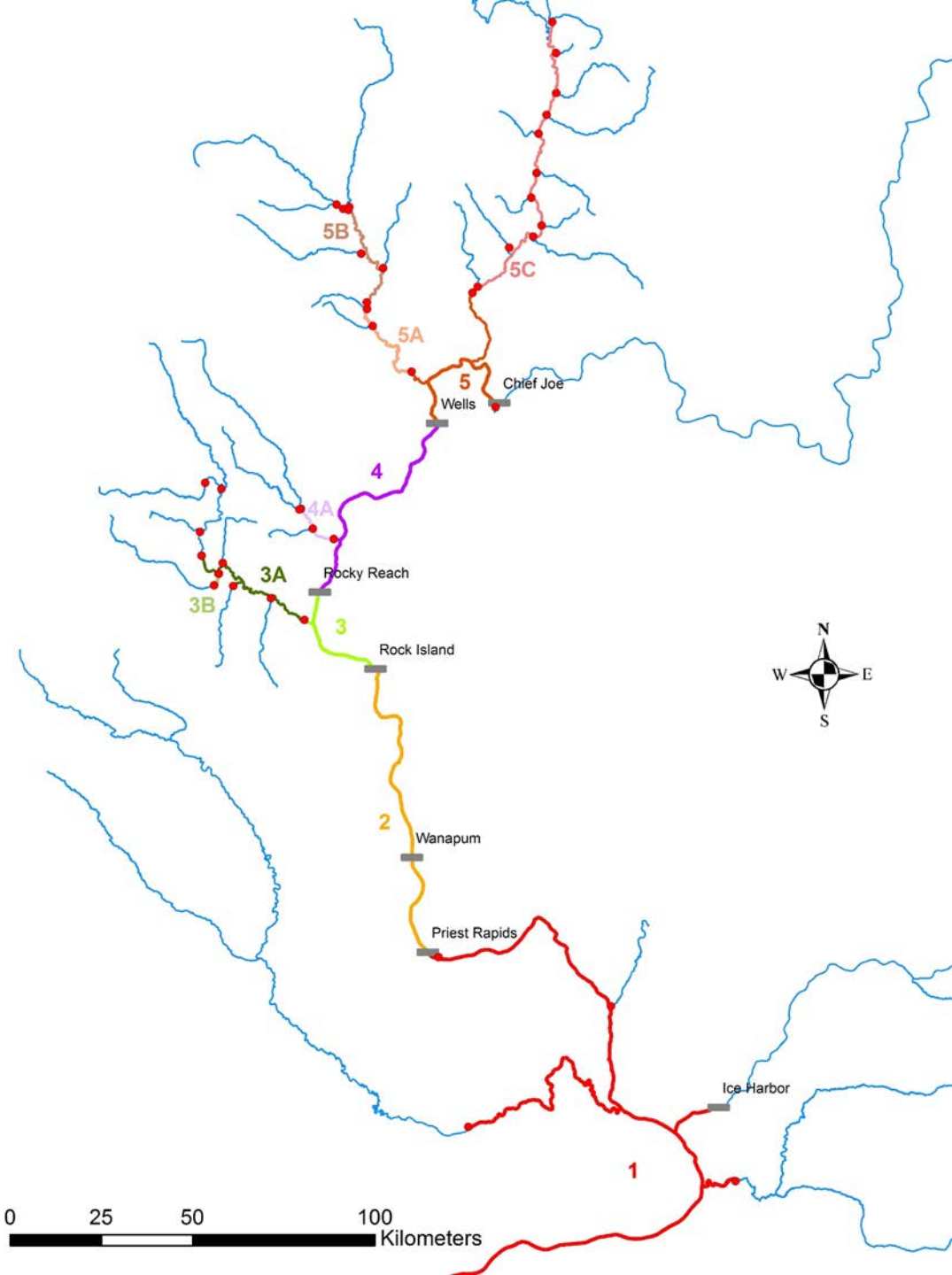
2 R/queryCapHist.R

```
@@ -23,7 +23,7 @@ queryCapHist = function(tagCode = NULL,
    # if(is.null(configuration)) configuration = buildConfig()

    # assign user agent to the GitHub repo for this package
-   ua = httr::user_agent('https://github.com/KevinSee/PITcleanr')
+   ua = httr::user_agent('https://github.com/BiomarkABS/PITcleanr')

    # compose url with query
    url_req = 'http://www.cbr.washington.edu/dart/cs/php/rpt/pit_one
```

Create Query Builder2 Report



Upper Columbia Steelhead Escapement

Escapement | Area Map

Date

- ○ Aug 24, 2020
- ○ Aug 27, 2020
- ○ Sep 03, 2020
- ○ Sep 09, 2020
- ○ Sep 17, 2020
- ○ Sep 23, 2020
- ○ Sep 30, 2020
- ○ Oct 07, 2020
- ○ Oct 14, 2020
- ○ Oct 21, 2020
- ○ Oct 28, 2020
- ○ Nov 04, 2020
- ○ Nov 12, 2020
- ○ Dec 02, 2020
- ○ Dec 10, 2020
- ○ Dec 17, 2020
- ○ Dec 24, 2020
- ○ Jan 06, 2021
- ○ Jan 14, 2021
- ○ Jan 20, 2021
- ○ Feb 04, 2021
- ○ Feb 24, 2021
- ◉ Mar 04, 2021

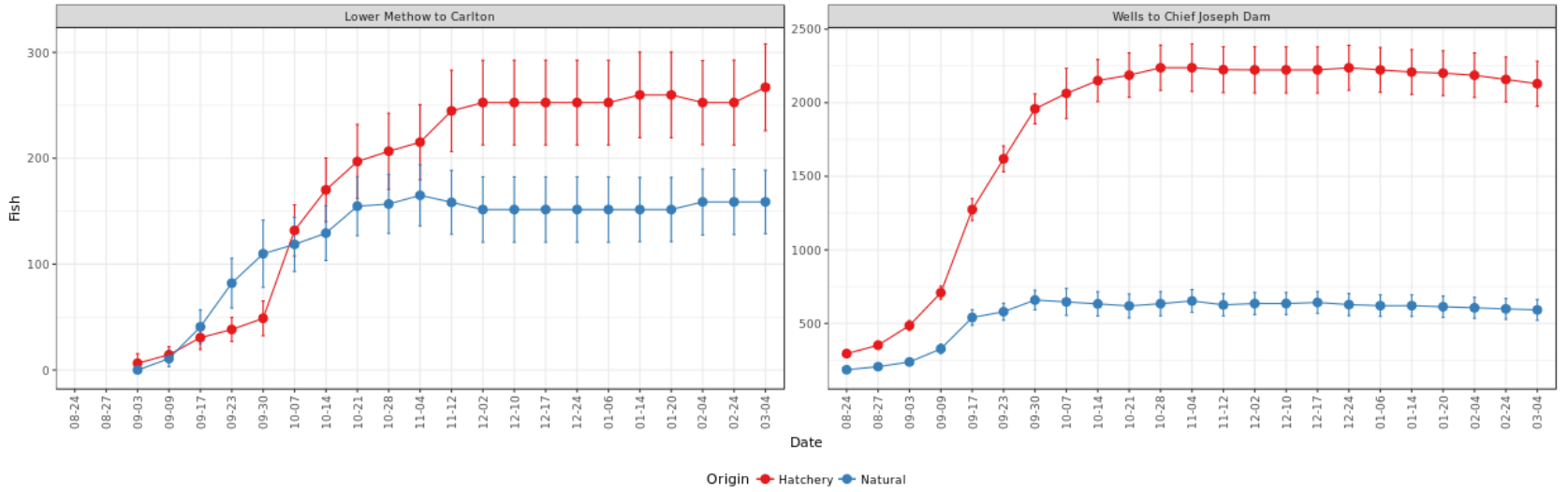
Fishing Areas

- ☐ Downstream of Priest Rapids Dam
- ☐ Priest Rapids to Rock Island Dam
- ☐ Rock Island to Rocky Reach Dam
- ☐ Lower Wenatchee to Tumwater Dam

Current Status

Area	Natural	SE (Natural)	Hatchery	SE (Hatchery)
Lower Methow to Carlton	158.78	15	267.03	21
Wells to Chief Joseph Dam	591.80	36	2129.03	78

Trend



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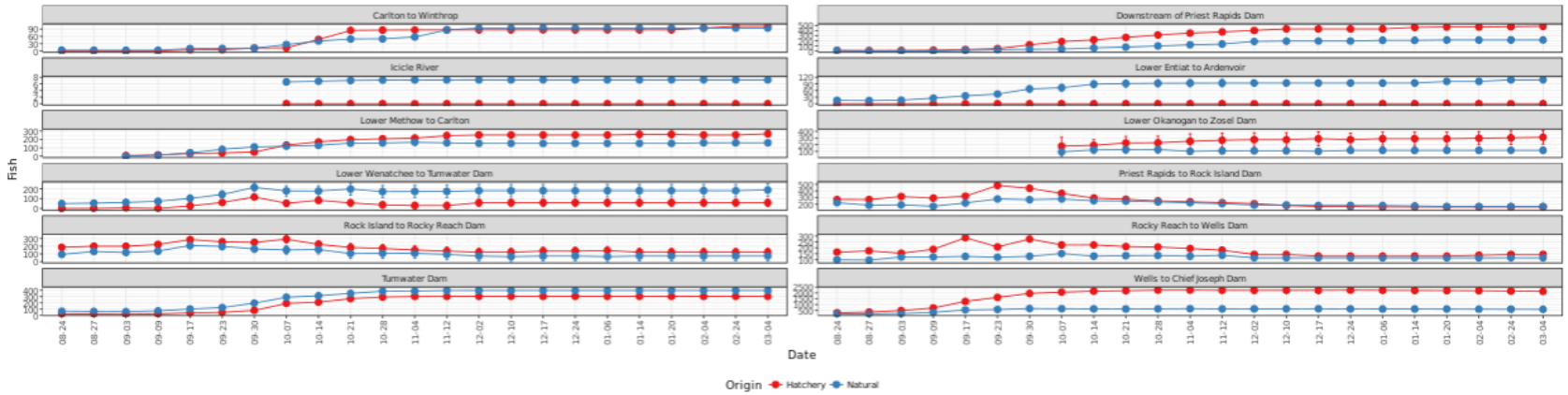
Fishing Areas

- [x] Downstream of Priest Rapids Dam
- [x] Priest Rapids to Rock Island Dam
- [x] Rock Island to Rocky Reach Dam
- [x] Lower Wenatchee to Tumwater Dam
- [x] Icicle River
- [x] Tumwater Dam
- [x] Rocky Reach to Wells Dam
- [x] Lower Entiat to Ardenvoir
- [x] Wells to Chief Joseph Dam
- [x] Lower Methow to Carlton
- [x] Carlton to Winthrop
- [x] Lower Okanogan to Zosel Dam

Current Status

Area	Natural	SE (Natural)	Hatchery	SE (Hatchery)
Carlton to Winthrop	93.82	4	101.04	3
Downstream of Priest Rapids Dam	216.51	10	483.54	12
Icicle River	7.22	0	0.00	0
Lower Entiat to Ardenvoir	108.26	5	0.00	0
Lower Methow to Carlton	158.78	15	267.03	21
Lower Okanogan to Zosel Dam	115.47	20	310.33	53
Lower Wenatchee to Tumwater Dam	187.64	33	57.74	19
Priest Rapids to Rock Island Dam	165.99	11	158.78	15
Rock Island to Rocky Reach Dam	72.17	33	122.69	26
Rocky Reach to Wells Dam	115.47	6	144.34	10
Tumwater Dam	396.94	18	303.12	8
Wells to Chief Joseph Dam	591.80	36	2129.03	78

Trend



Results…?

Results

	Oct	Nov	Total
Total effort hours	8,233	2,876	11,109
Hours/angler	4	4	4.35
Total anglers	1,830	719	2549
Total steelhead caught	1284	214	1498
Ad-absent hatchery retained	612	119	731
Ad-absent hatchery released	0	0	0
Total ad-present released	672	95	767
Ad-present hatchery released	229	33	262
Natural-origin released [1]	443	62	505
Ad-absent hatchery mortality	612	119	731
Ad-present hatchery mortality [2]	11.45	1.65	13.1
Natural-origin mortality [2]	22.15	3.1	25.25
Total steelhead mortality	637.05	123.75	760.8

Oct
H/W 1284
65.50% 841H
443W

Nov
H/W
71.02% 152H
62W

1248 2.02%

[1] Based on an average of 65% natural-origin within the adipose-present population

[2] Calculated using 5% catch and release hooking mortality on natural origin fish

Results

	Oct	Nov	Total
Total effort hours	8,233	2,876	11,109
Hours/angler	4	4	4.35
Total anglers	1,830	719	2549
Total steelhead caught	1284	214	1498
Ad-absent hatchery retained	695	117	812
Ad-absent hatchery released	0	0	0
Total ad-present released	589	97	686
Ad-present hatchery released	51	9	60
Natural-origin released [1]	538	88	626
Ad-absent hatchery mortality	695	117	812
Ad-present hatchery mortality [2]	2.55	0.45	3
Natural-origin mortality [2]	26.9	4.4	31
Total steelhead mortality	724.5	121.9	846

Oct
H/W 1284
58.09 746H
538W

Nov
H/W
59.05 126H
88W

1022 3.06%

[1] Based on an average of 93.1% natural-origin within the adipose-present population

[2] Calculated using 5% catch and release hooking mortality on natural origin fish

Traditional Creel	Real-time Estimates
Overestimated H origin proportion based on angler interviews	H/W ratio is not reliant on angler interviews
Underestimated clip rate in H origin	Unbiased spatiotemporal estimates with uncertainty
Inaccurate biased estimates of escapement	Unbiased spatiotemporal estimates with uncertainty

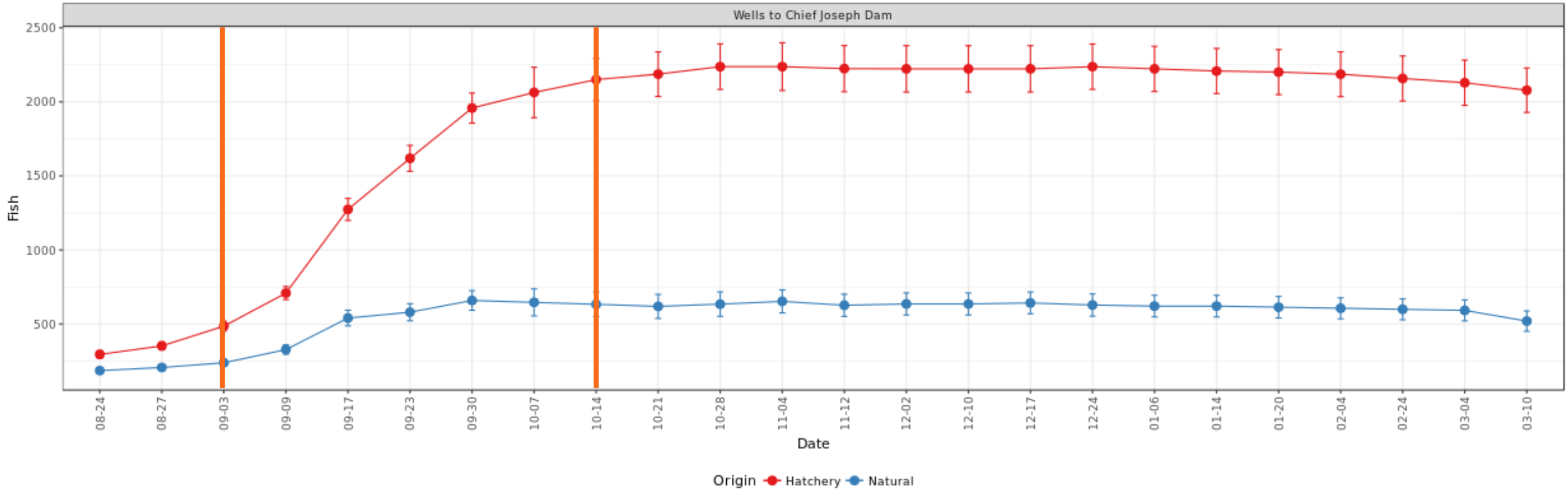
Current Status

Area	Natural	SE (Natural)	Hatchery	SE (Hatchery)
Wells to Chief Joseph Dam	519.63	35	2078.52	77

Trend

Maximize Opportunity

Minimize Impact



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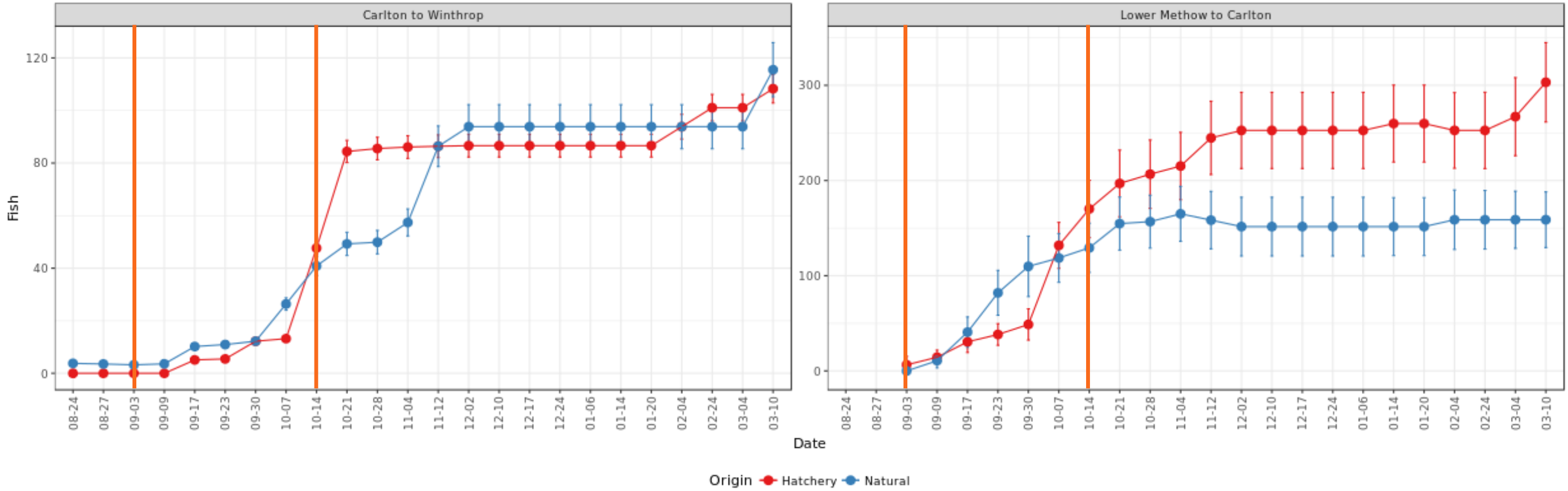

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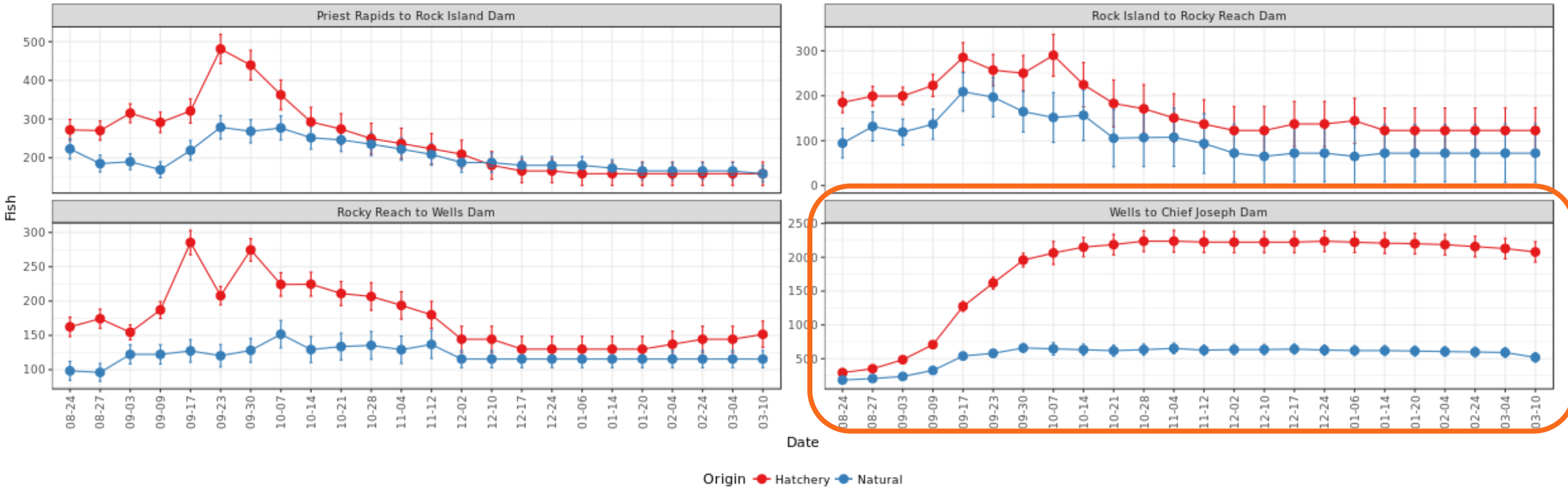
Trend



Conservation:

Remove surplus hatchery origin fish ✓

Minimize impact to NORs (maintain ESA compliance) ✓
2% mortality in UCR

Improved data for harvest/impact analyses ✓
(maintain ESA compliance)

Recreation:

Increase duration? 

With better data available?? 

Increase effectiveness (i.e., more hatchery fish removed) 

Long-term success through better management 

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.

Kevin See (Biomark) and Phil Weyland (WDFW) continue to provide vital technical support.

Project was funded through the Columbia River Salmon and Steelhead Endorsement Fund and BPA (Project #2010-034-00), with additional with support from CCPUD and GPUD.

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