April 5, 2016

MEMORANDUM

TO: **Council members**

FROM: Jim Ruff – Manager, Mainstem Passage and River Operations

SUBJECT: Presentation on NOAA Fisheries' 2015 Adult Sockeye Passage Report

BACKGROUND:

Presenters: The presenter will be Ritchie Graves, Chief of the Columbia Hydropower Branch at NOAA Fisheries. In addition, staff from the Corps of Engineers and Idaho Department of Fish and Game will be on the conference line to answer questions that may arise.

Summary: ***2015 River Conditions***
In 2015, low flow conditions, coupled with extremely high air temperatures and warm water in the major tributaries to the lower Snake and Columbia rivers, resulted in the highest mainstem temperatures recorded in the Columbia River from roughly mid-June to mid-July. Although water temperatures were much higher than normal, releases from depth in the large water storage projects (e.g., Grand Coulee Dam, Dworshak Dam and Brownlee Dam), reduced temperatures in downstream reaches. For example, Hells Canyon Dam outflows (downstream of Brownlee Reservoir) were 5^{o}C (or more) cooler than the Snake River gauge temperatures at Weiser. Releases of cool water at Dworshak Dam began earlier in 2015 in response to the higher temperatures. Unlike late June and July river temperatures, August water temperatures in 2015 were high, but not outside the range of observations in recent years.

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Sockeye Salmon Abundance and Survival

The adult sockeye salmon return in 2015 was large compared to recent decades – the ladder count at Bonneville Dam was 510,706 fish (compared to a 2005-14 average of 241,351 fish). Idaho Department of Fish and Game (IDFG) estimates that about 4,000 ESA-listed Snake River sockeye salmon passed Bonneville Dam. NOAA Fisheries estimates about 472,000 sockeye salmon from the upper Columbia River (UCR) populations (unlisted Lake Wenatchee and Okanogan River sockeye salmon) passed Bonneville Dam – for a total of about 476,000 sockeye (correcting the ladder counts for fallback and re-ascension rates).

All three populations of sockeye salmon were substantially affected by the higher water temperatures in the mainstem and tributary migration corridors. PIT tag detections indicate that sockeye behavior became increasingly erratic and survival rates declined after water temperatures exceeded 20-21^{o}C at The Dalles Dam (mid to late June). Columbia River stocks migrated about one week earlier than endangered Snake River sockeye salmon based on PIT tag detections at Bonneville Dam and were less affected by these conditions. Returning Snake River sockeye salmon adults that migrated inriver as smolts passed Bonneville Dam nearly a week earlier, and were similarly less affected, than those that were transported as juveniles. In the Bonneville Dam to McNary Dam reach, NOAA Fisheries estimates that survival rates were about 60% for UCR sockeye, and 26% (inriver) and 5% (transported) for Snake River sockeye.

About 78% of the Columbia River sockeye survived from McNary to Rock Island Dam and nearly all of those fish bound for the Okanogan River survived from Rock Island to Wells Dam. However, only about 12% of these fish survived migration through the Okanogan River to reach Zosel Dam, near their spawning grounds in Lake Osoyoos (located in both Washington and British Columbia). About 33% (inriver) and 0% (transported) of the Snake River sockeye salmon survived from McNary to Lower Granite Dam. Of the fish surviving to Lower Granite Dam, only about 29% were detected in the Sawtooth Valley. All told, of those fish passing Bonneville Dam, the fisheries managers estimate that only about 10-15% of Lake Wenatchee, 3-4.5% of Okanogan River, and < 1% of Snake River sockeye escaped to the spawning grounds.

Management Actions at Lower Granite and Little Goose Dams

Aside from system-wide releases of water from federal storage projects, several management actions (turbine unit priority, closing surface weirs and spilling though conventional bays only, etc.) were implemented at Lower Granite and Little Goose dams in an effort to improve tailrace and fishway entrance conditions for adult passage (and the number of adults that could be collected and transported by IDFG). These actions took many days or weeks to coordinate through the regional Technical Management Team. Although ladder counts increased initially, results were not conclusive.

Adult Transport at Lower Granite Dam

Fisheries managers decided to implement an emergency "trap and haul" operation at Lower Granite Dam on July 13. A total of 51 adult sockeye salmon were captured in the adult trap in the fish ladder and transported to the Eagle Fish Hatchery for holding. Of these fish, 35 (69%) were assigned to the Snake River sockeye salmon genetic stock (3 were natural-origin and 32 were hatchery-origin). The remaining 16 fish were determined to be from the upper Columbia River genetic stocks and were therefore culled. Of the 35 Snake River sockeye salmon that were trapped, one died at the hatchery and one was a non-productive female. The remaining 34 (16 females and 17 males) were spawned and contributed to brood year 2015 production. The trap and haul effort was discontinued on August 5 as the number of adult sockeye salmon declined to very low levels.

A total of 56 adults (30 females, 26 males) successfully migrated back to the basin without transportation (11 were natural-origin and 45 were hatchery-origin). The surviving fish transported from Lower Granite Dam in 2015 therefore represented about 38% of the overall return. Without the trap-and-haul operation it is likely that none of the Snake River sockeye salmon adults that passed over Lower Granite after July 16th would have survived their migration to the Sawtooth Valley.

Comparisons of egg survival to the eyed stage between trapped and hauled adults (84%) and those collected at the Redfish Lake Creek trap (67%) indicate that there was some loss of egg viability for those that migrated in-river from Lower Granite to the Sawtooth Valley.

Conclusions and Recommendations

NOAA Fisheries concludes that, although June and July river temperatures in 2015 were unprecedented, it is reasonable to expect that similar events could occur in the future. If rare, events are unlikely to have a large or lasting impact to the viability of sockeye salmon populations because their complex life histories provide resiliency against catastrophic events. However, should similar events occur frequently, sockeye salmon populations in the Columbia River basin would be substantially impacted. NOAA Fisheries is recommending a number of measures for consideration by regional parties to address uncertainties, improve future decision-making, and reduce, to the extent practicable, the negative impacts of high summer temperatures on adult sockeye salmon.

Relevance: The Council's 2014 Fish and Wildlife Program includes a sub-strategy which addresses mainstem hydrosystem flow and passage operations. It has an objective to manage dams and reservoir operations to protect and restore ecosystem function and habitat, as well as to improve fish passage and survival through the hydrosystem. Many of the Program's current

measures, including ongoing actions such as those outlined in the mainstem flow and passage operations strategy, represent priorities from earlier Fish and Wildlife Programs which are expected to continue in the 2014 Program. In addition, a principle in the Investment Strategy section urges the federal action agencies to meet their FCRPS Biological Opinion implementation and mitigation obligations.

Workplan: This presentation addresses Council work plan item 2.B, which promotes regional fish and wildlife recovery by prioritizing and implementing 2014 Fish and Wildlife Program actions.

Background: This is a follow-up presentation to the federal agencies' 2015 Dry Year Operations Implementation Strategy briefing to the Council at the June 10, 2015, meeting in Coeur d'Alene, Idaho.
http://www.nwcouncil.org/media/7149268/4.pdf

More Info: None.

NOAA FISHERIES
West Coast Region

DRAFT - 2015 Sockeye Salmon Passage Report

Presented to the

Northwest Power and Conservation Council

Ritchie Graves (NMFS)
April 13, 2016

Columbia River Basin

2015 Runoff Volumes

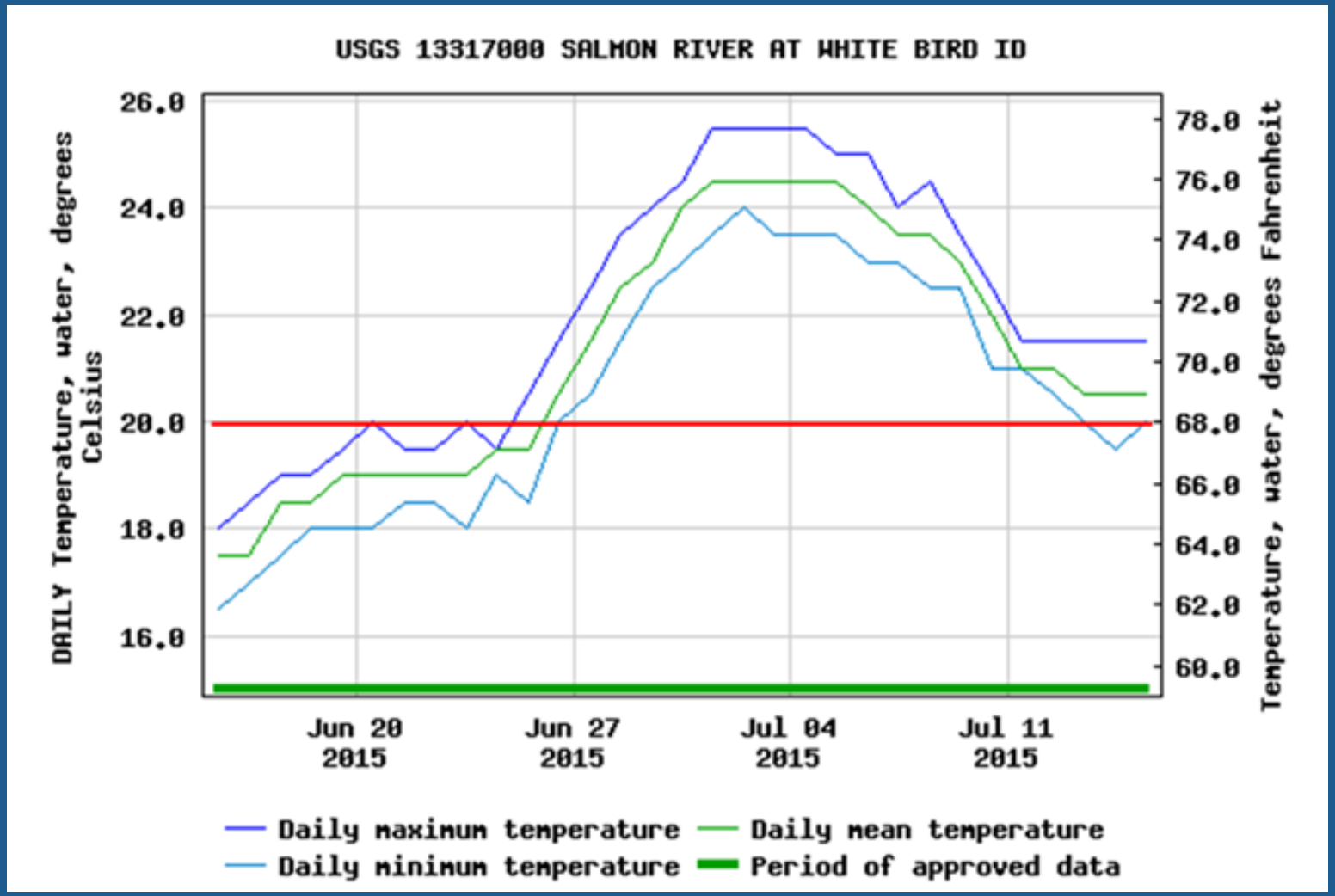
Location	Period	Rank (out of 56 years)	Runoff volume (kaf)	Percent (of 30 year avg)
Columbia River at The Dalles	January – July	46	82,951	83
Columbia River at The Dalles	April – August	54	58,407	67
Snake River at Lower Granite	January – July	53	12,397	56
Snake River at Lower Granite	April – August	53	11,466	54

2015 Air Temperatures

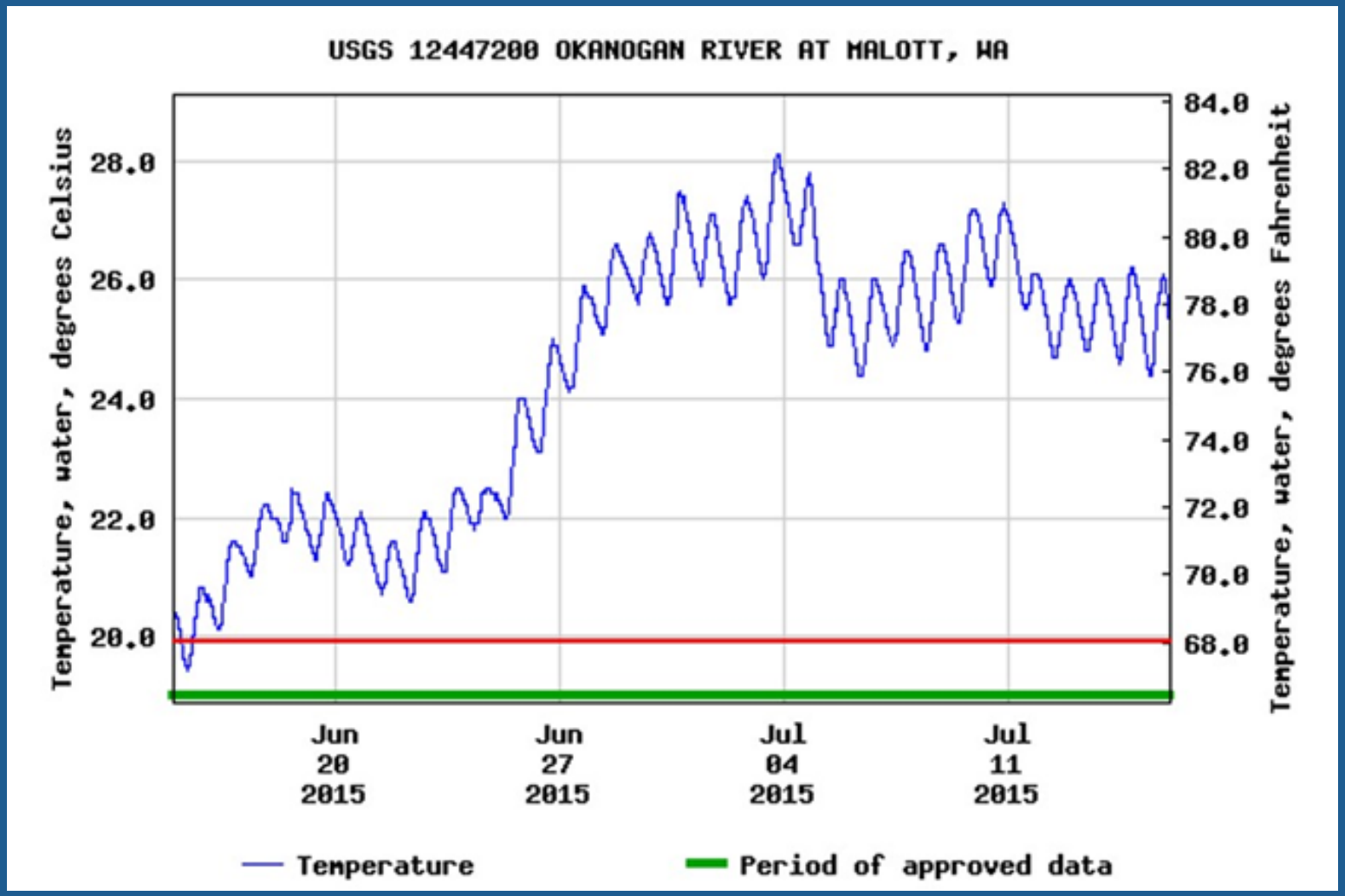
Monthly air temperature departures from average at locations within the Columbia River Basin.

Temperature Departure °F	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Avg °F	Avg °C
Arrow	4.3	-1.1	4.7	5.6	7.6	6.0	0.5	2.3	7.4	2.4	0.0	**3.9**	**2.0**
Grand Coulee	4.4	-2.2	3.2	5.5	6.2	4.6	0.2	2.7	6.4	2.4	1.5	**3.2**	**1.8**
Ice Harbor	4.4	-2.2	3.2	5.5	6.2	4.6	0.2	2.7	6.4	0.2	1.6	**3.0**	**1.7**
The Dalles	4.6	-1.4	4.0	5.9	7.0	5.6	0.4	2.9	7.4	1.9	1.9	**3.7**	**2.0**
Willamette	3.9	-0.1	2.8	5.1	5.0	4.6	-0.3	2.2	5.4	3.3	1.7	**3.1**	**1.7**

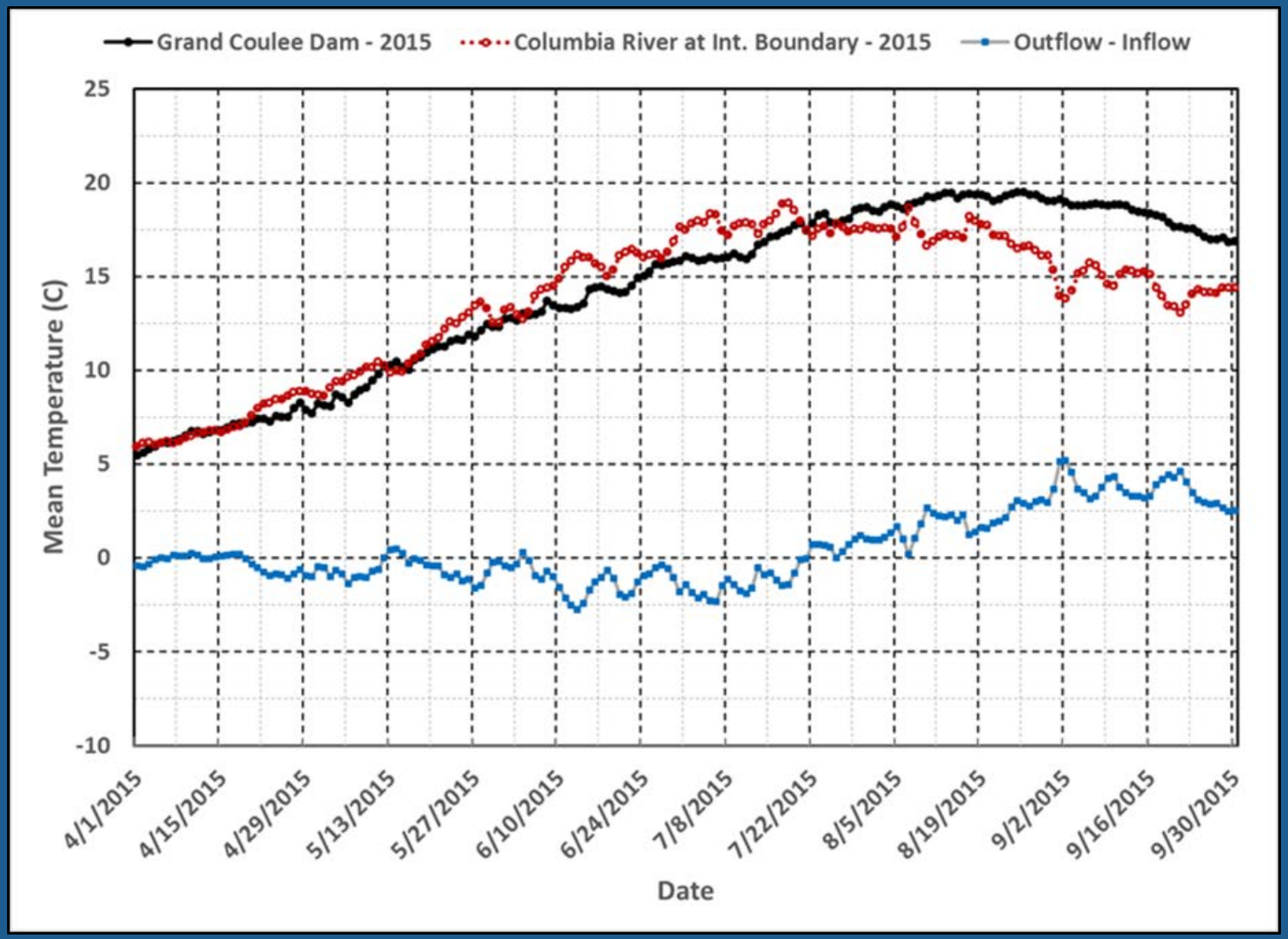
2015 Salmon River Temperatures



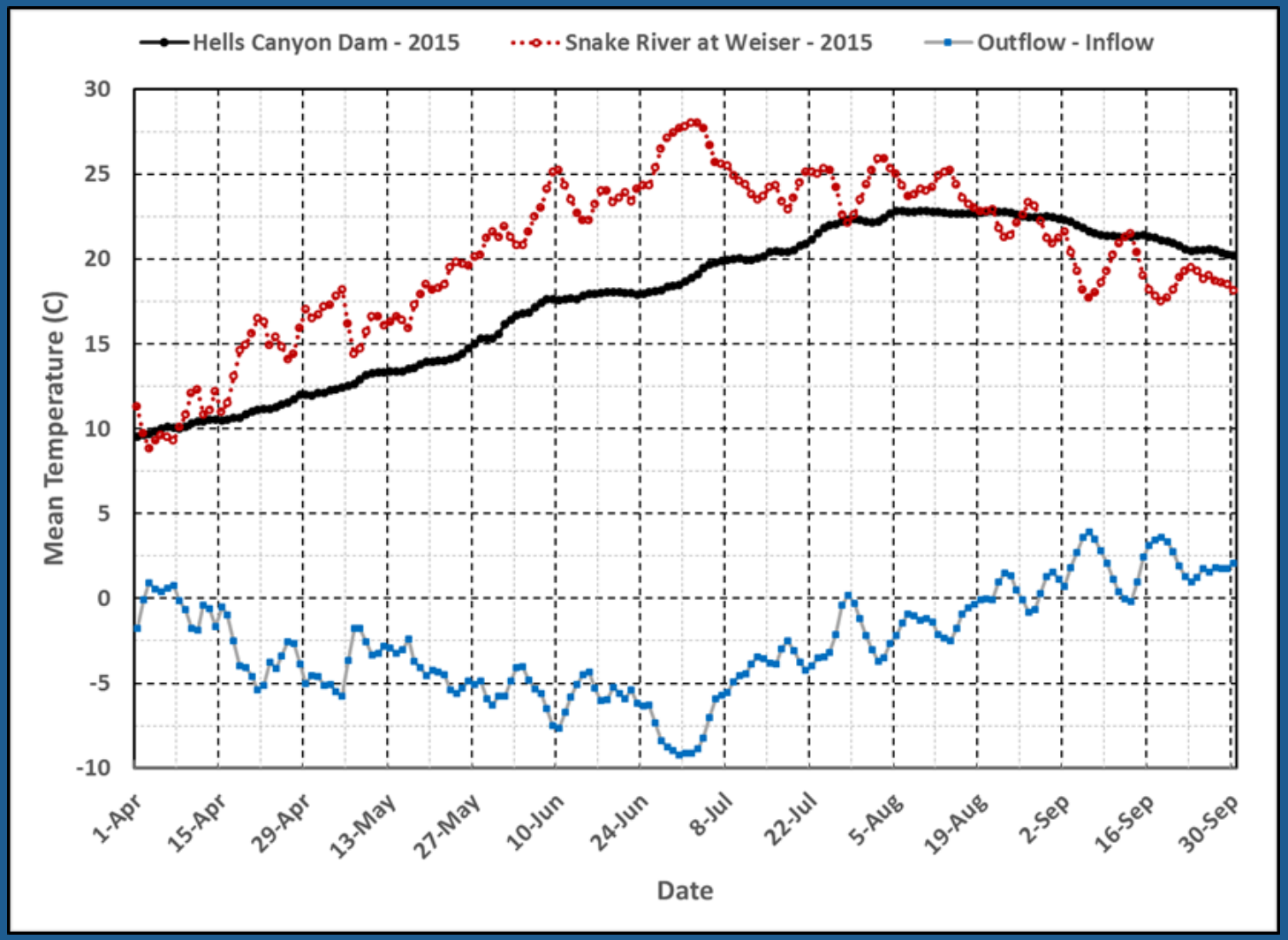
2015 Okanogan River Temperatures



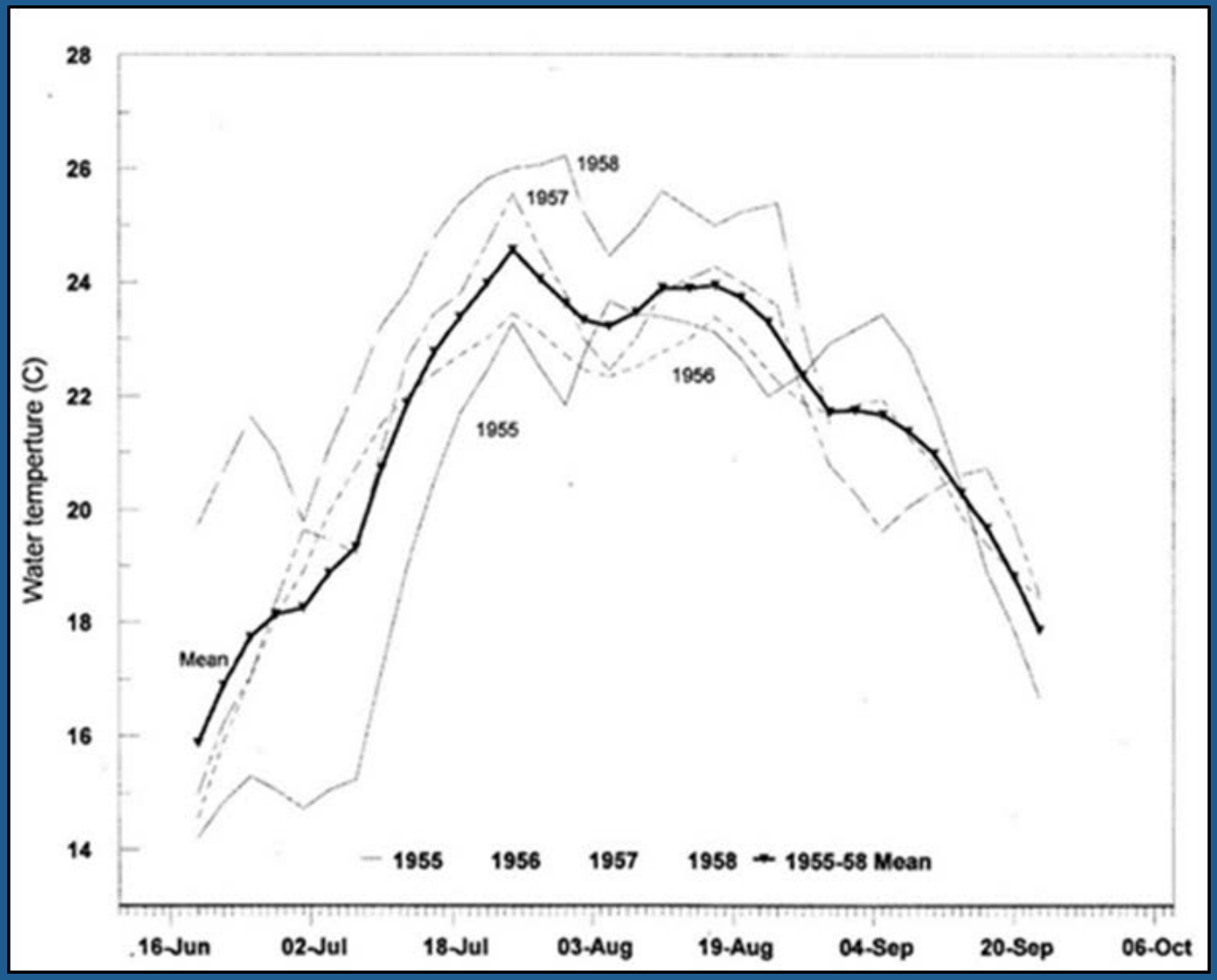
2015 Grand Coulee Temperatures



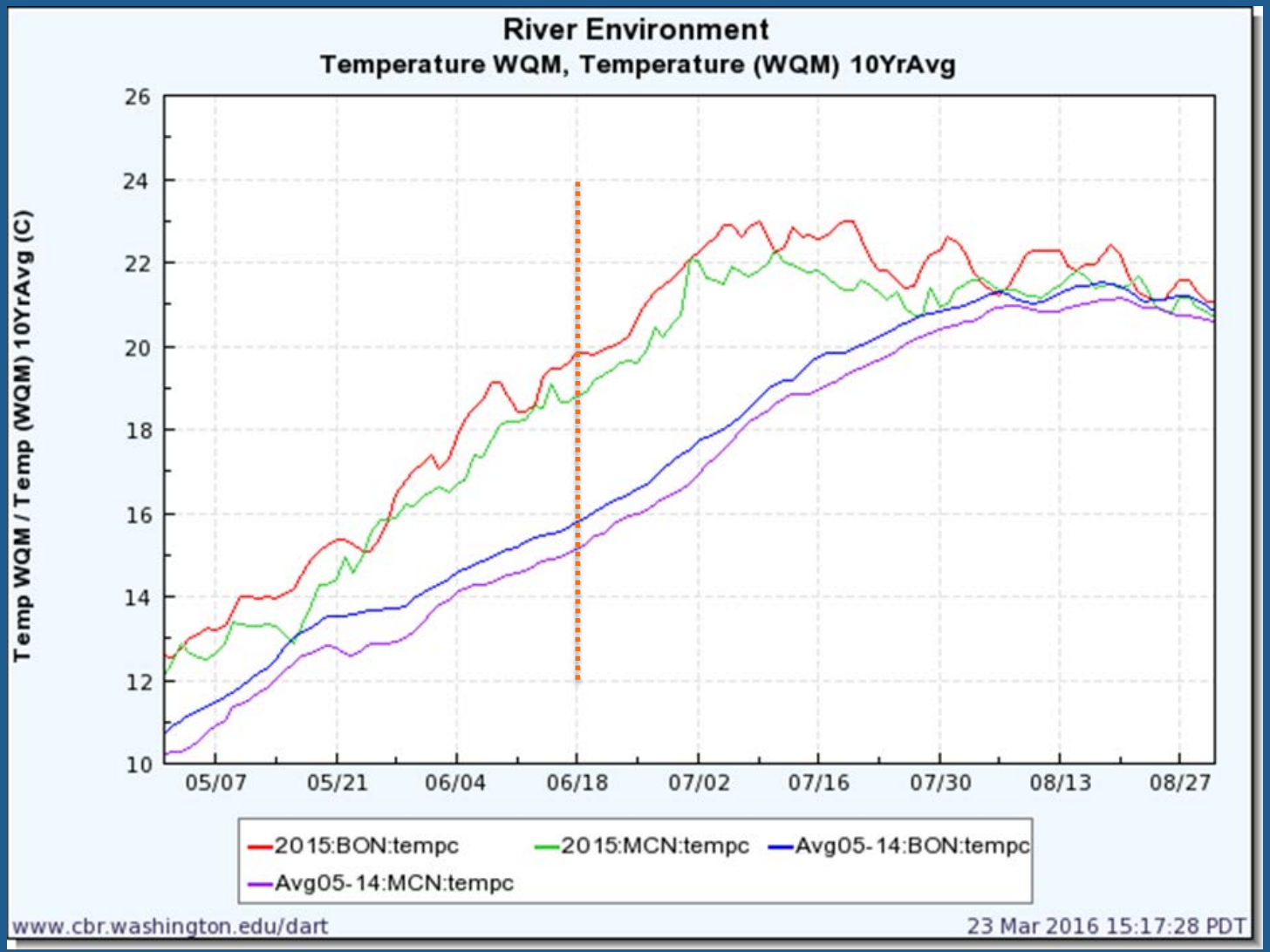
2015 Hells Canyon Complex Temperatures



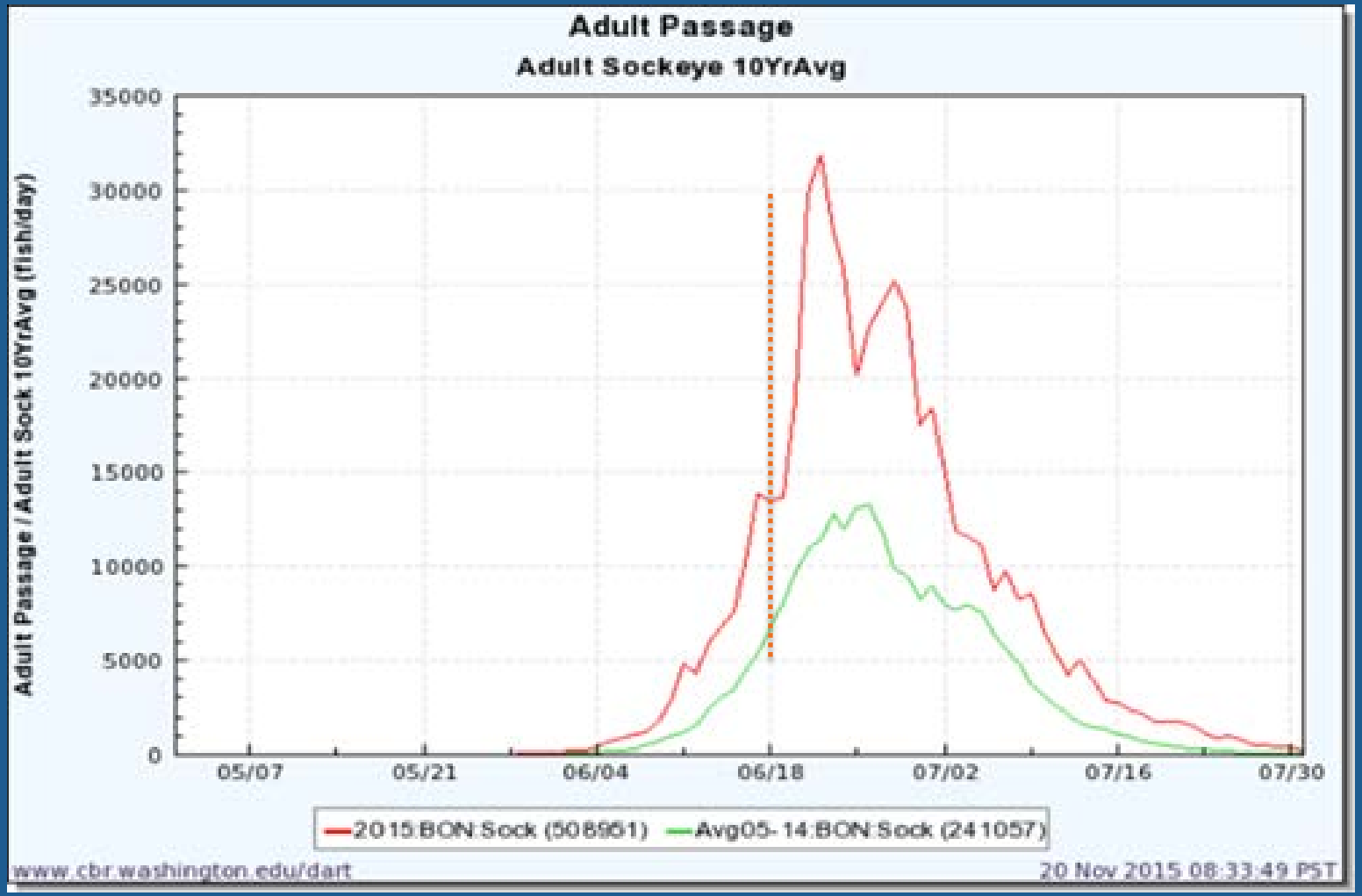
Historic Summer Temperatures at the mouth of the Snake River



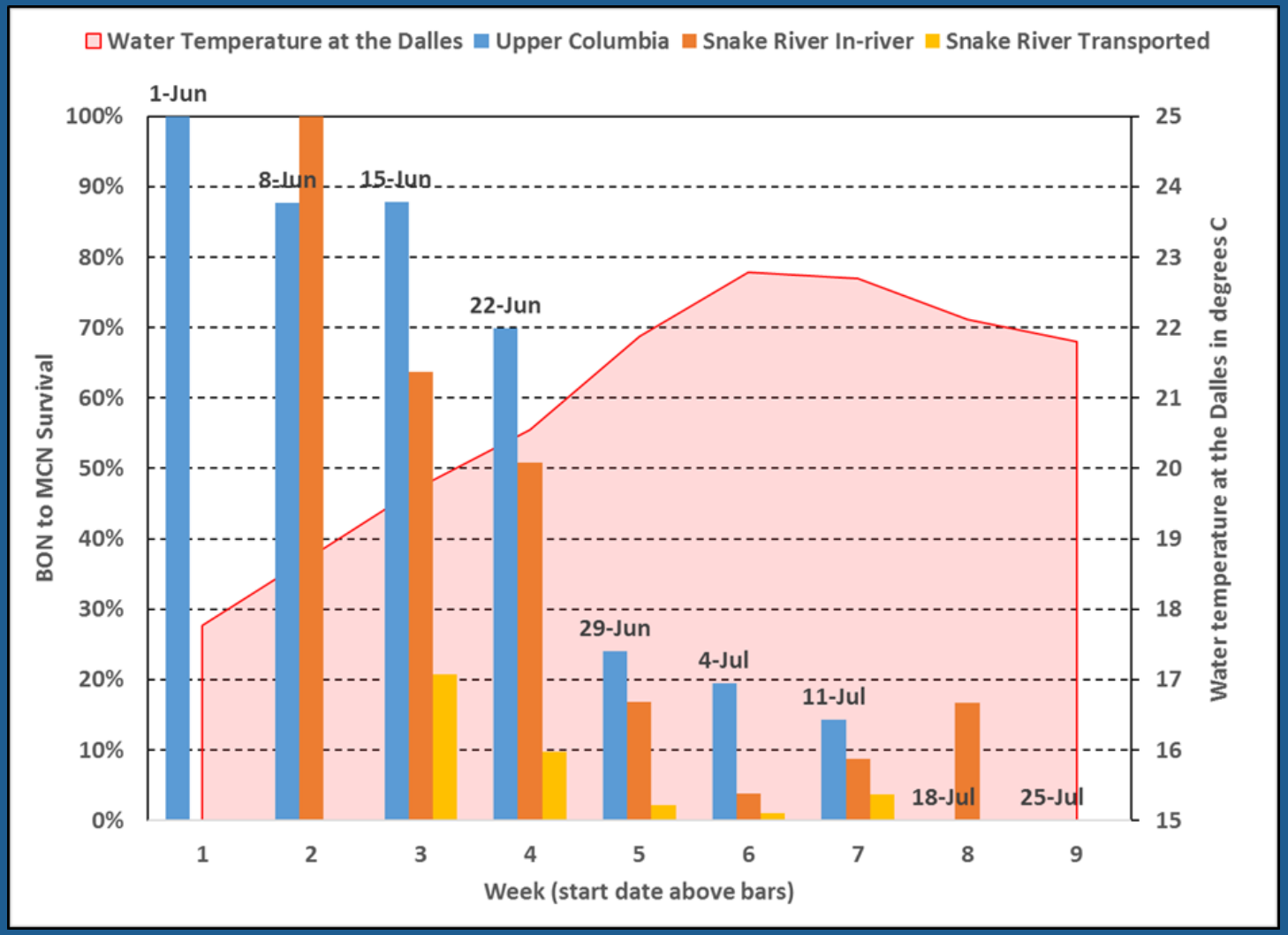
2015 Lower Columbia River Temperatures



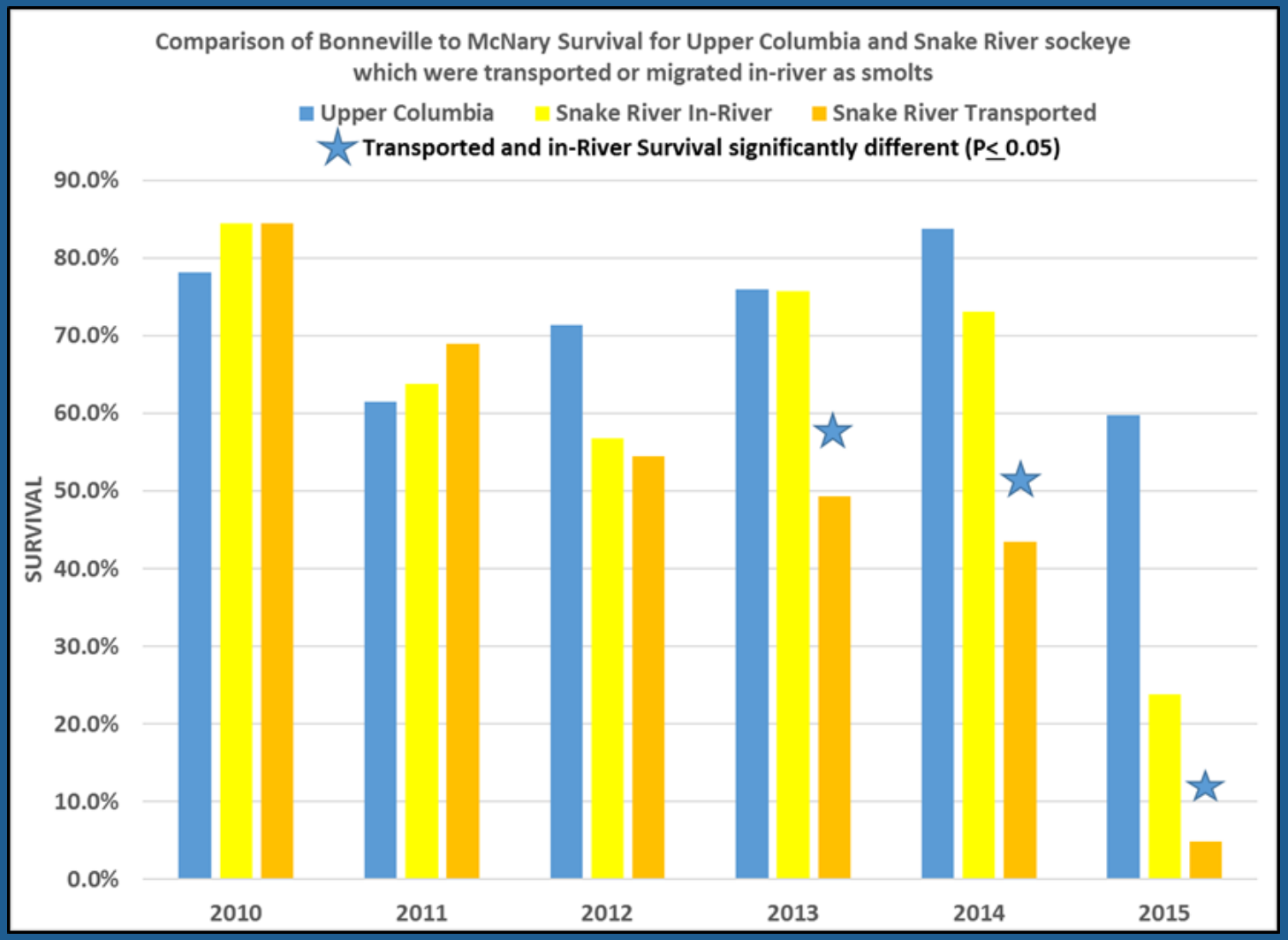
2015 Migration Timing



2015 BON to MCN Survival Estimates by Week



2010-2015 BON to MCN Survival Estimates



2010-15 Snake River Sockeye Survival Rates

YEAR	Juvenile Migration History	# at BON	Survival Estimates (%)			
			BON to MCN	MCN to LGR	BON to LGR	LGR to Sawtooth Valley
2010	Inriver	32	84	96	***81***	77
	Transported	8	88	74	***63***	80
2011	Inriver	307	64	97	***62***	75
	Transported	209	69	95	***66***	77
2012	Inriver	111	57	94	***53***	64
	Transported	11	55	67	***36***	50
2013	Inriver	136	76	76	***57***	33
	Transported	69	49	38	***19***	31
2014	Inriver	216	71	93	***66***	56
	Transported	129	43	95	***41***	55
2015	Inriver	320	26	33	***8***	29*
	Transported	357	5	0	***0***	0

* There were 27 detections of PIT tagged fish at Lower Granite Dam: 3 were transported and 24 migrated instream. Of these 24, seven (29%) were detected in the Sawtooth Valley.

2010-15 Columbia River Sockeye Survival Rates

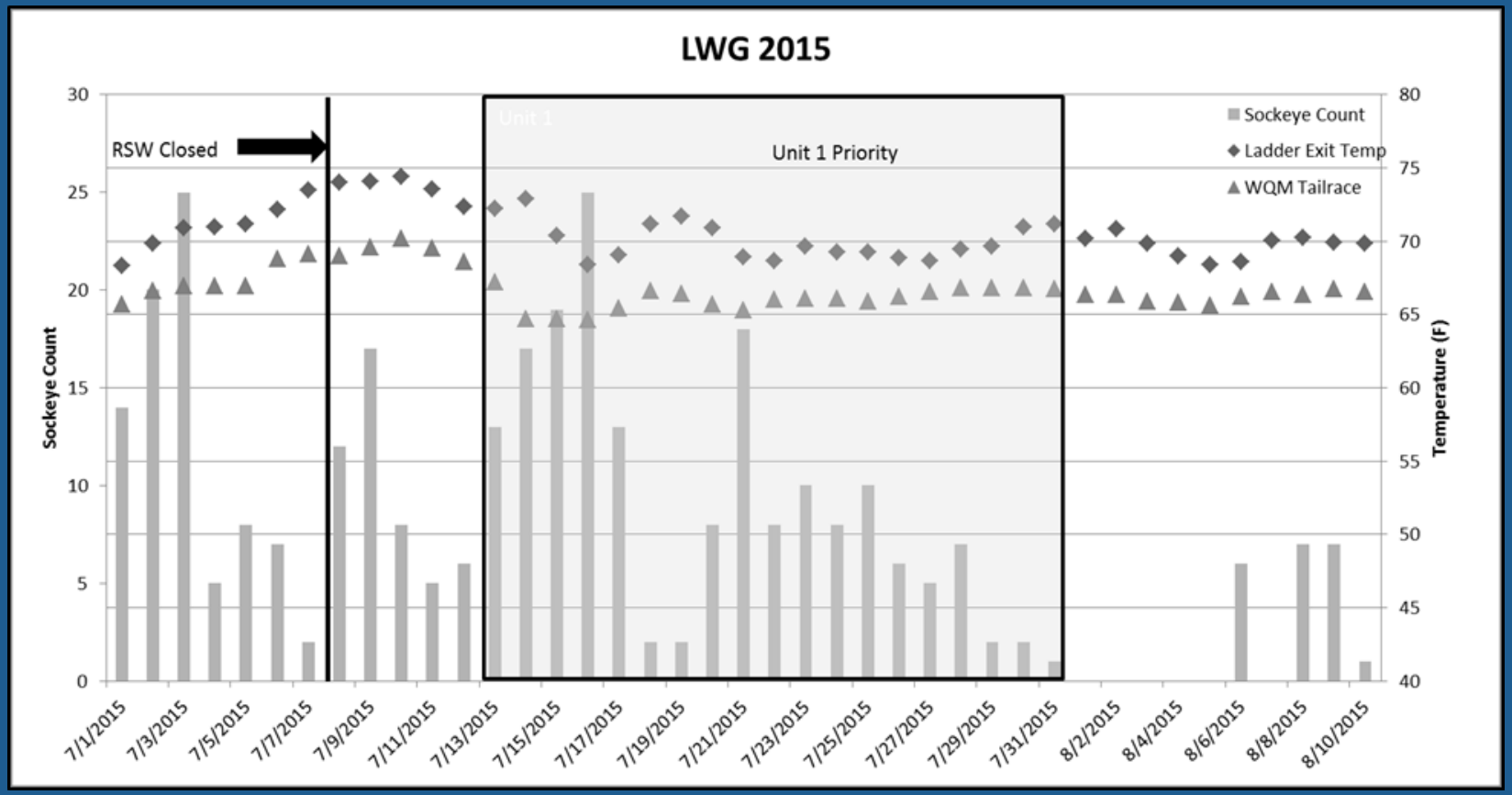
YEAR	Juvenile Migration History	# at BON	Survival Estimates (%)			
			BON to MCN	MCN to RIS	RIS to WEL*	WEL to Zosel*^
2010	Inriver	957	82	95	88	77
2011	Inriver	651	69	86	78	75
2012	Inriver	572	74	91	63	39
2013	Inriver	157	77	88	85	70
2014	Inriver	323	88	88	80	69
2015*	Inriver	425	60	78	100	12

* Okanogan River sockeye salmon only.

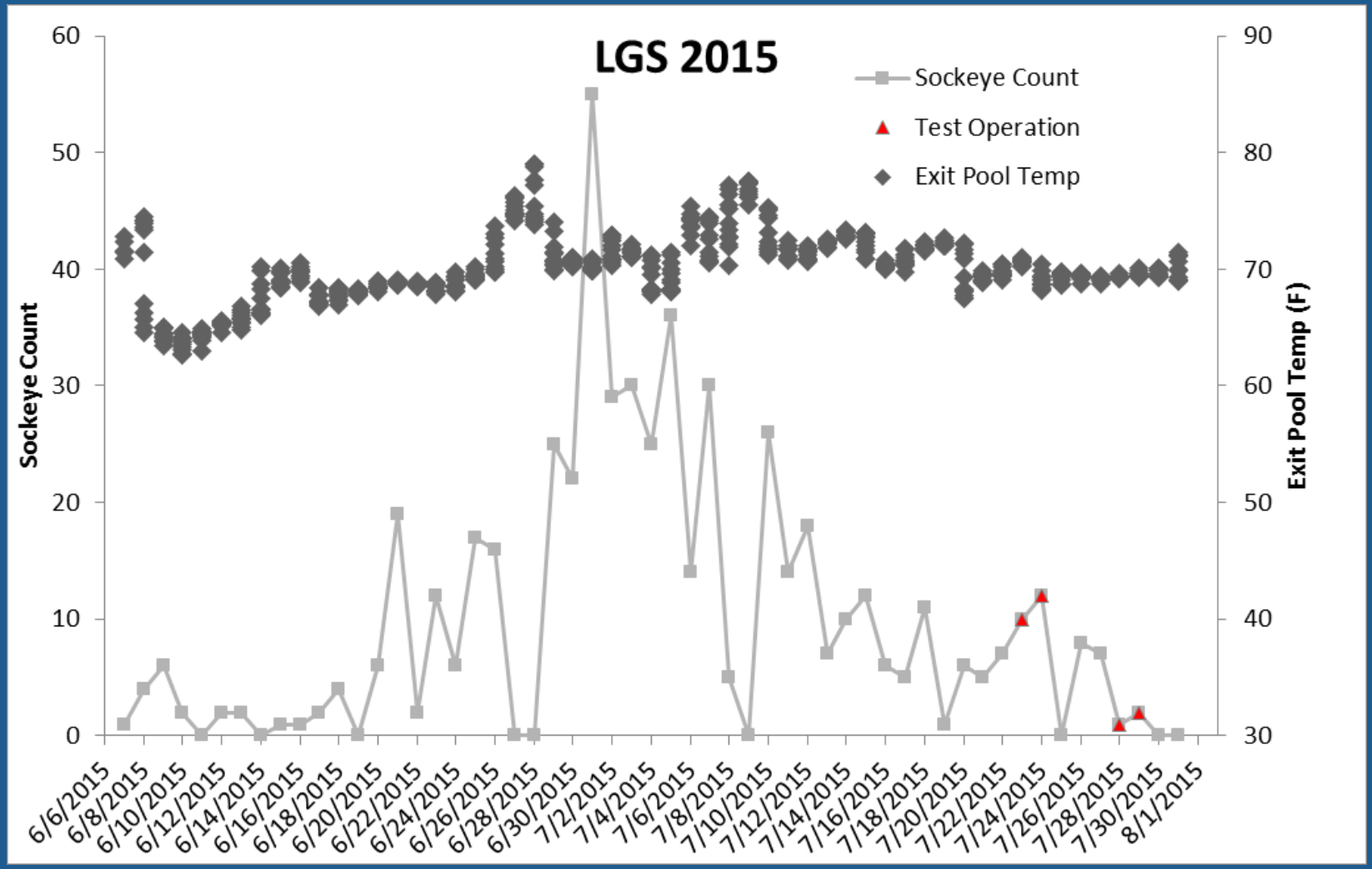
^ Prior to 2014, >5% of PIT tagged fish were detected at Zosel dam. Beginning in 2014, additional detectors were added and detection probabilities have been greatly improved.

Note: Estimated escapement of Lake Wenatchee and Okanogan River sockeye in 2015 was 10-15% and about 2%, respectively.

Lower Granite Operations

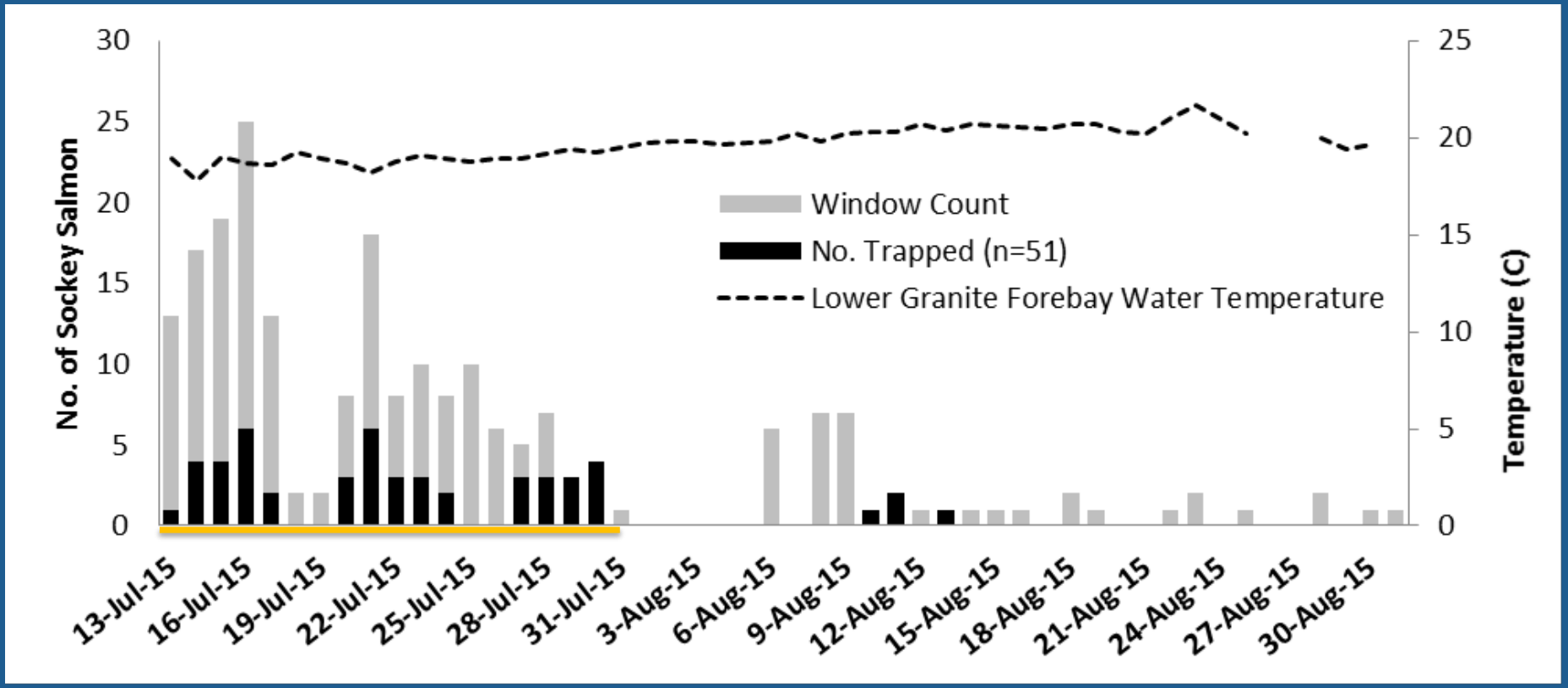


Little Goose Operations



Transportation

Number of adult Sockeye salmon trapped and transported from LGR to EFH (black bars) and the daily window counts (grey bars). Water temperatures at the LGR forebay are also plotted (broken line).



2015 Transport and Broodstock Summary

56 Adult Migrants (30 females and 26 males)

- 11 natural origin / 45 hatchery origin
- 4 females were non-productive
- 5 allowed to spawn naturally in Pettit Lake
- No fish passing LGR after July 16 are known to have survived

51 Adults Transported

- 16 (31%) Columbia River adults culled
- 35 (69%) Snake River adults
  - 1 died at hatchery; 1 female was non-productive
  - 33 (16 females and 17 males) contributed to BY 2015 production (38% of overall total)

Spawning Results

Spawning results for females collected at Lower Granite Dam (LGR) and transported to the Eagle Fish Hatchery (EFH) and those collected the Redfish Lake Creek (RFLC) trap.

	LGR Trap and Haul	*Returning to RFLC trap*
Number of Females	16*	21*
First Spawn Date	9 October	22 September
Last Spawn Date	12 November	12 November
Total Eggs (green)	33,288	55,596
Average Fecundity	2,081	2,647
Total Eyed Eggs	28,074	38,843
Survival to Eyed Stage	84%	67%
Average Eggs per gram	15 (larger eggs)	21 (smaller eggs)

Lessons Learned 1

- Throughout the CRB, air and river temps in June and July were much warmer in 2015 than historically available data
- Operation of large storage reservoirs (GCL, HCC, DWR) reduced temperatures (compared to inflows), but temperatures were still high and these affects attenuated rapidly
- Adult ladder counts may be biased during high temperature periods (increased fallback/re- ascension and straying)
- Ladder temperature monitoring and reporting could be improved
- Faster decision-making could have benefitted adult SR sockeye in 2015

Lessons Learned 2

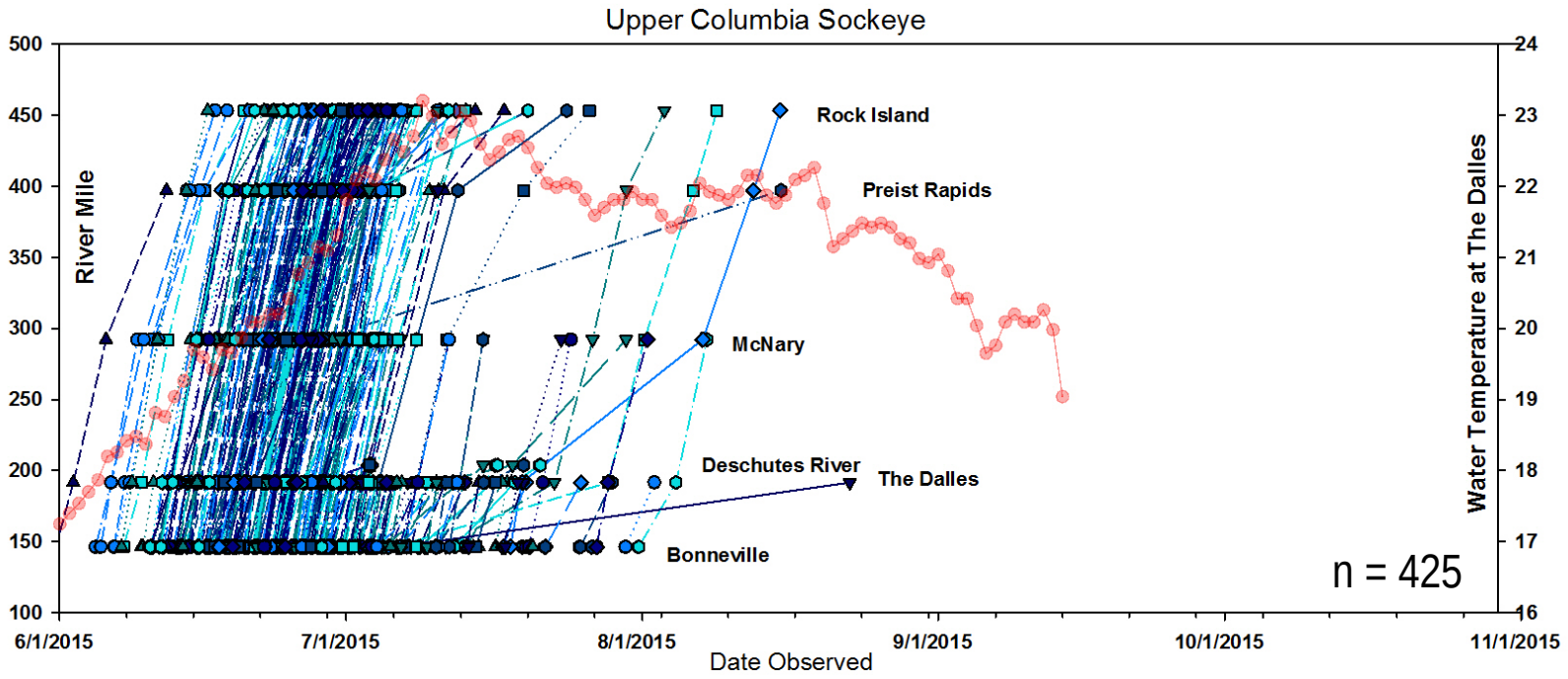
- Snake River sockeye salmon that migrate later, are exposed to higher temperatures and can die at higher rates in the BON to MCN reach than Columbia stocks
- Adult Sockeye transported as juveniles survived at lower rates than those that migrated inriver
- The highest losses were in the lower Columbia reaches and from Lower Monumental to Little Goose dams
- Adult losses in the Salmon and Okanogan Rivers were also high
- Adult Sockeye transportation appeared to be an effective “hedge” strategy

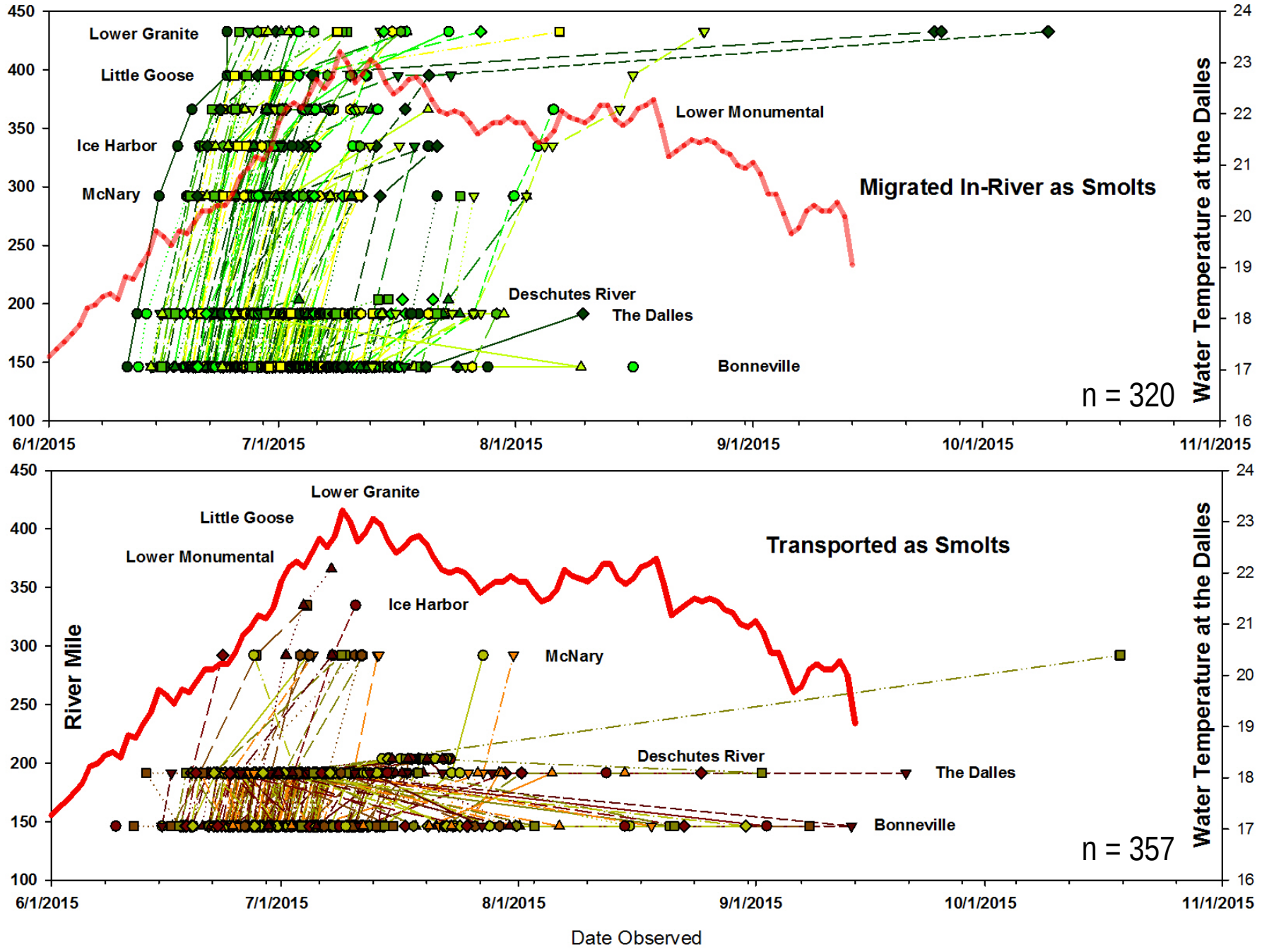
NEXT STEPS / NMFS' Recommendations

- Improve ladder temperature monitoring and identify ladders with substantial temperature differentials (>1ºC)
- Develop triggers and contingency plans
- Improve PIT tag detection systems and improve transport vs inriver assessments
- Develop and Implement Alternative Solutions
  - Hydro Ops / Structures
  - Adult Trap and Haul
- Evaluate Effectiveness and Adaptively Manage

QUESTIONS

Photograph of an adult sockeye taken in the vicinity of Drano Lake in July of 2015.
The white areas on the surface of the fish appear to be a fungus, possibly Saprolegnia sp., which is known to affect fish subjected to thermal stress (Roberts 2012).


Upper Columbia Sockeye
River Mile
Water Temperature at The Dalles
Date Observed
Rock Island
Preist Rapids
McNary
Deschutes River
The Dalles
Bonneville
n = 425
500
450
400
350
300
250
200
150
100
24
23
22
21
20
19
18
17
16
6/1/2015
7/1/2015
8/1/2015
9/1/2015
10/1/2015
11/1/2015


Lower Granite
Little Goose
Lower Monumental
Ice Harbor
McNary
Migrated In-River as Smolts
Deschutes River
The Dalles
Bonneville
n = 320
Water Temperature at the Dalles
Transported as Smolts
River Mile
n = 357
Date Observed
6/1/2015
7/1/2015
8/1/2015
9/1/2015
10/1/2015
11/1/2015