Possible Adaptation of Columbia Basin Sockeye Salmon to Warming Climate?

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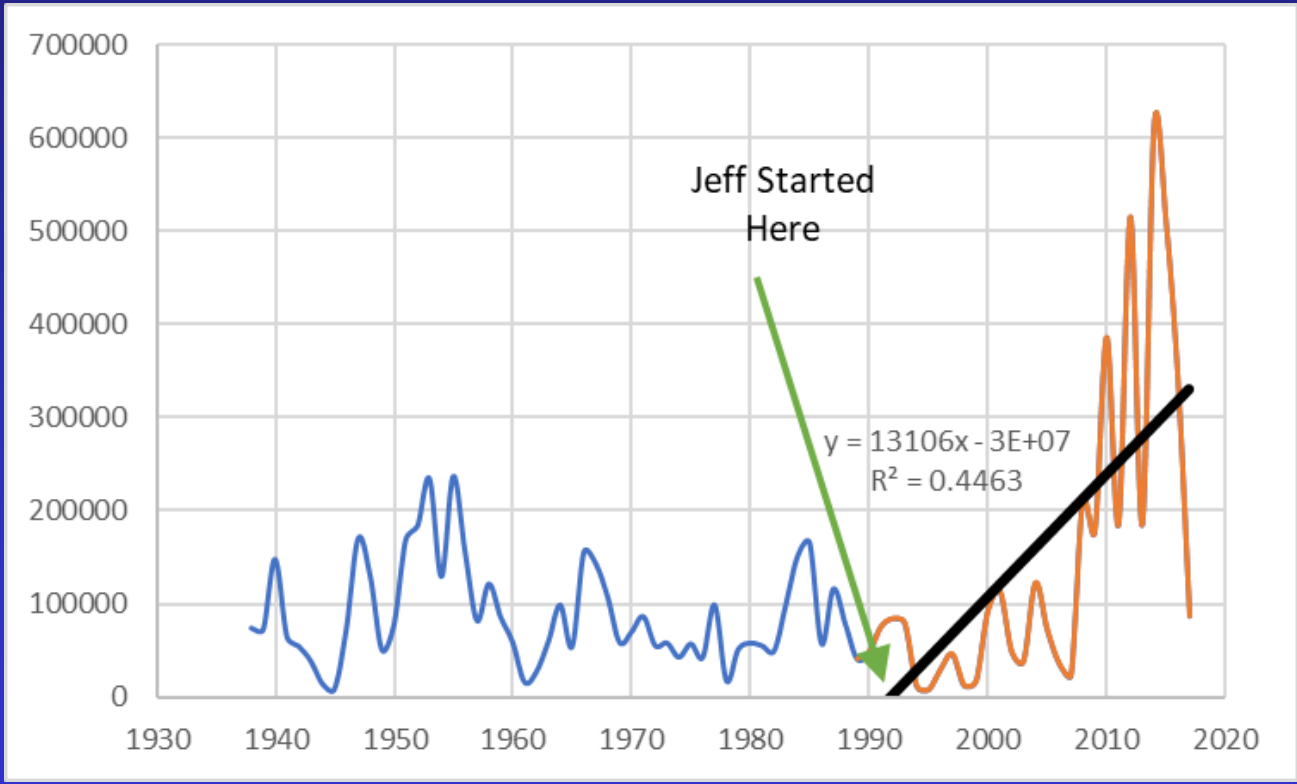
Columbia River Inter-Tribal Fish Commission

Washington-British Columbia AFS Meeting
March 21, 2018

A few observations after 31 years doing more or less the same thing (sockeye, Bonneville, Hanford) …

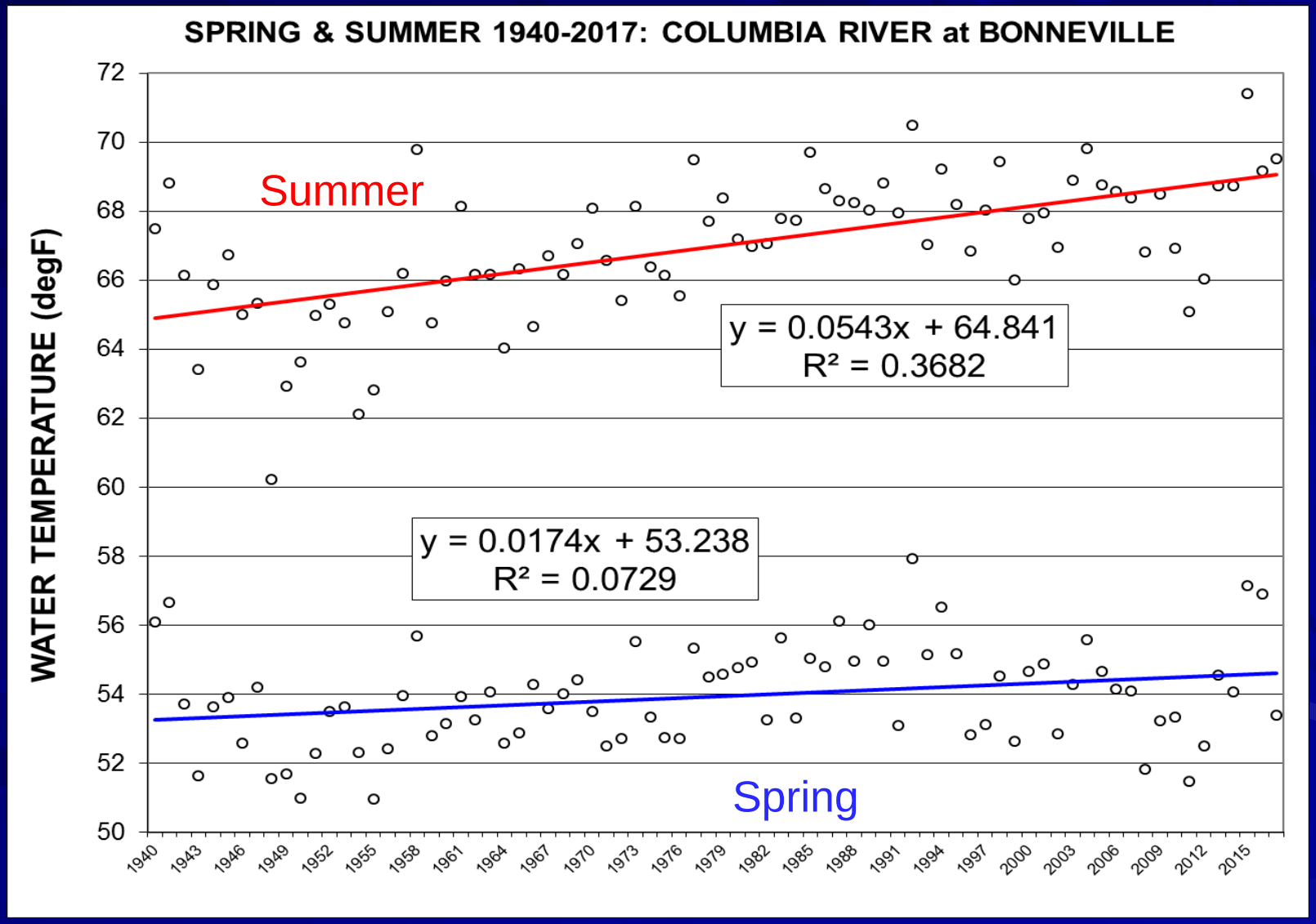
Bonneville Sockeye Counts since 1938



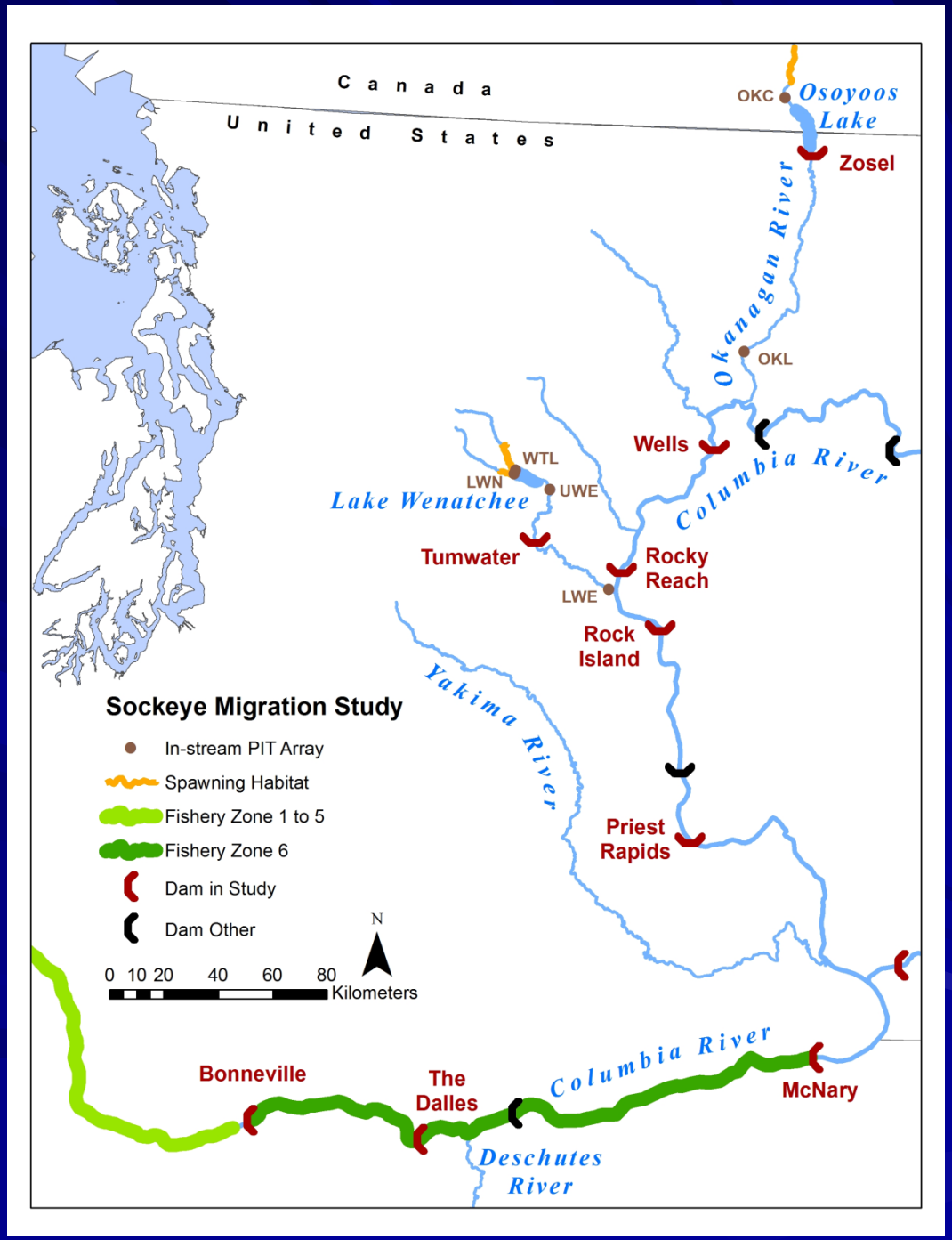
A few observations after 31 years doing more or less the same thing (sockeye, Bonneville, Hanford) …

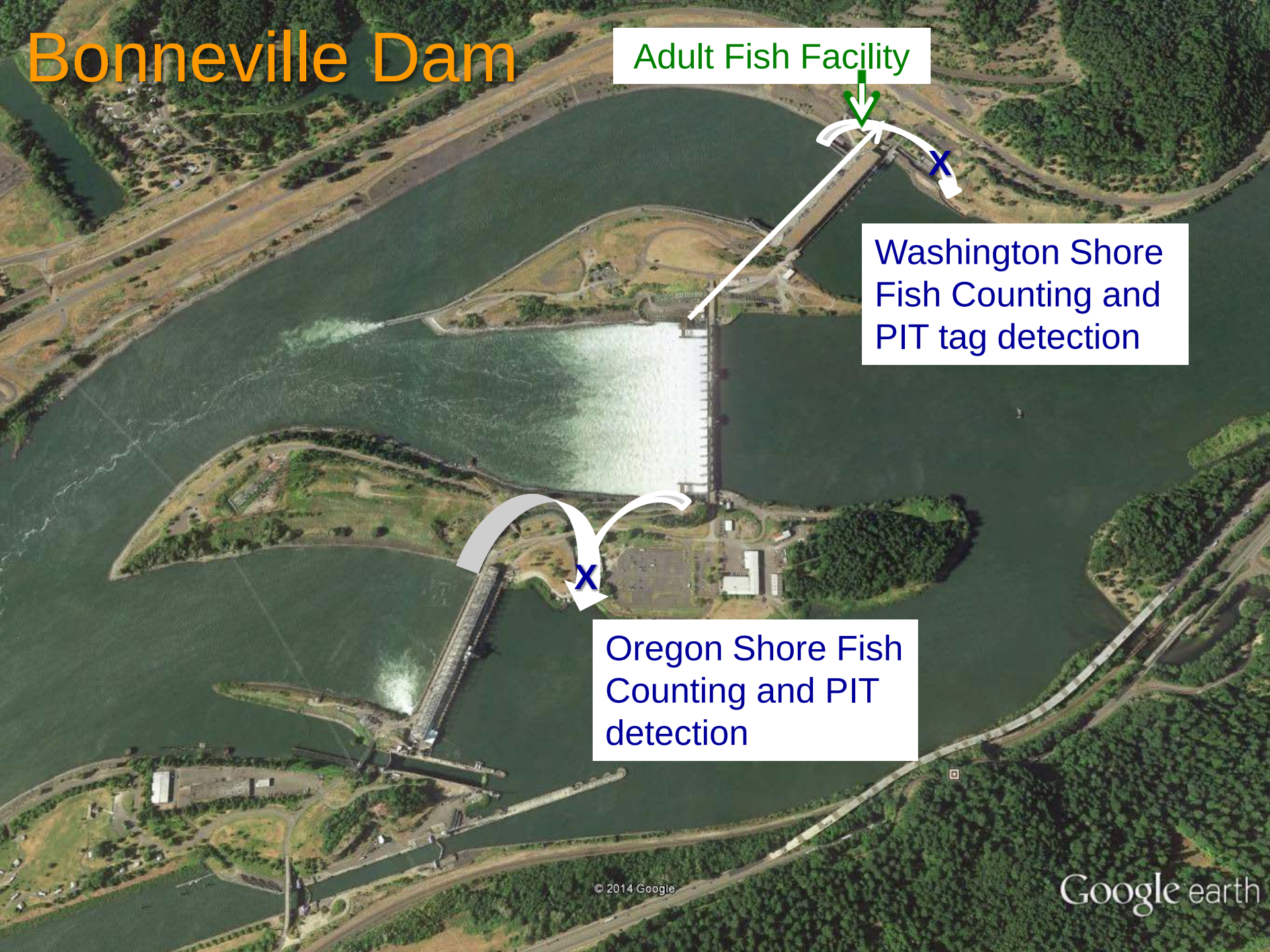
- Hanford
  - Changes in flows
  - Incredible abundance (new normal?)
- Changes in migration at Bonneville Dam
  - Spring Chinook much later
  - Sockeye earlier (into May?) and a lot more (new normal?)!
  - Distribution of sockeye run has changed (Okanogan vs Wenatchee)

Columbia River Temperature Trends



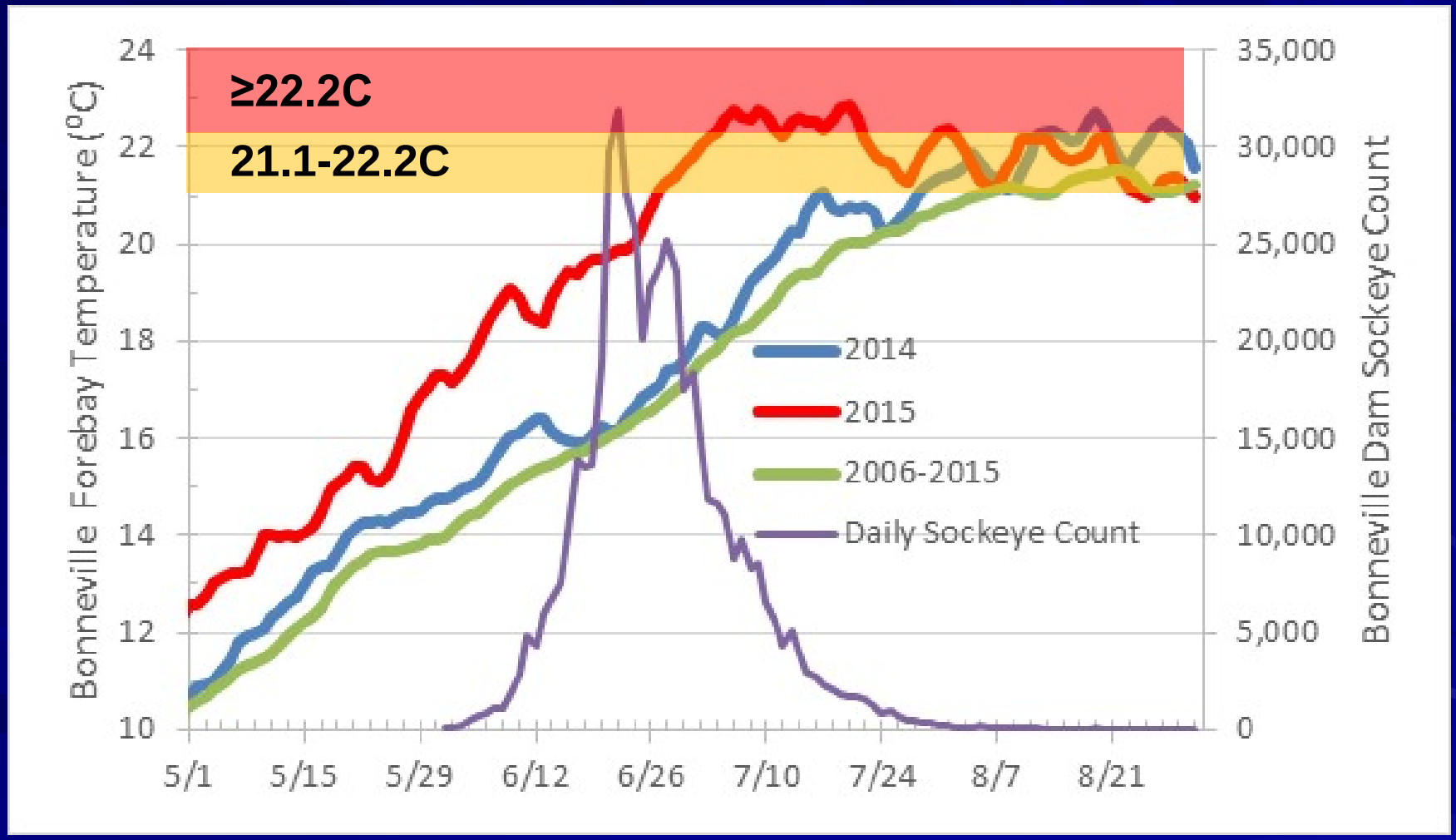
Mainstem Columbia River, dams and Sockeye stocks




Bonneville Dam
Adult Fish Facility
X
Washington Shore Fish Counting and PIT tag detection
X
Oregon Shore Fish Counting and PIT detection
© 2014 Google
Google earth


EUNDENE
JORDAN

2015 water temperatures at Bonneville Dam compared to 10 year average



Spokane Spokesman Review-July 17

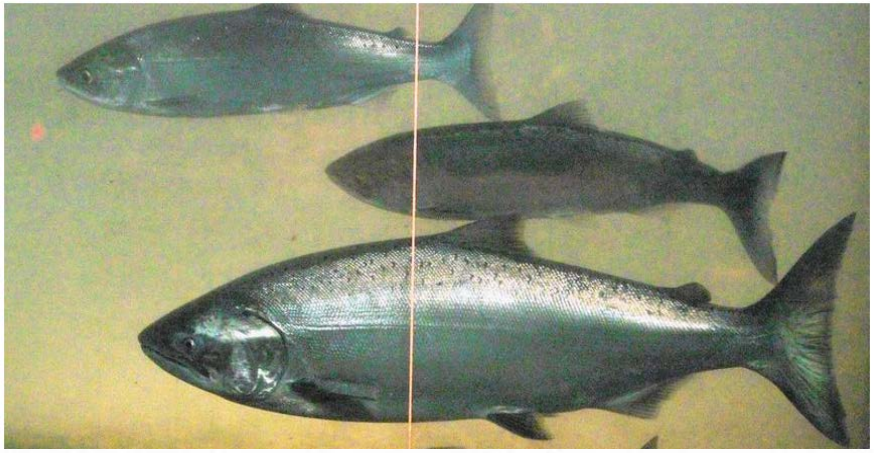
FRIDAY, JULY 17, 2015, 4:54 P.M.

Sockeye salmon suffer infections in warm Columbia River system

FISHING -- "Catastrophic" is a word that's being used as scientists begin to unravel the mystery of why at least 200,000 sockeye that moved over Bonneville Dam have

Heat and drought devastate sockeye salmon fishing and spawning on Washington rivers

LA Times 8/3/2015



Heat, drought cook fish alive in Pacific Northwest

Doyle Rice, USA TODAY 7:17 p.m. EDT July 31, 2015

USA Today, 7/31/2015

(Photo: Chris Kozfkay, AP)

Freakishly hot, dry weather in the Pacific Northwest is killing millions of fish in the overheated waters of the region's rivers and streams.

"We've lost about 1.5 million juvenile fish this year due to drought conditions at our hatcheries," Ron


July 15th - 16th, 2015
Sockeye Salmon
Drano Lake, WA


At Priest Rapids Dam…

% of Sockeye tagged at Bonneville Dam detected at The Dalles Dam (74 km upstream) in 2014-15

Week	2015 Bon. Water Temp (C)	2015 Bon tagged adults	2014 Bon tagged adults	2015 returning Columbia River juveniles	2015 returning Snake juv.
23	16.8	100.0%	100.0%		
24	18.7	94.4%	95.5%	93.8%	100.0%
25	19.6	90.8%	92.9%	92.6%	88.4%
26	20.7	**89.9%**	95.6%	91.4%	87.8%
27	22.3	**72.8%**	92.5%	82.1%	75.5%
28	22.5	**?**	95.7%	64.5%	37.2%
29	22.5	**?**	79.1%	75.0%	27.9%
30	21.8	**86.7%**	75.9%	42.9%	37.5%
31	21.8	**75.0%**	69.0%	60.0%	33.3%

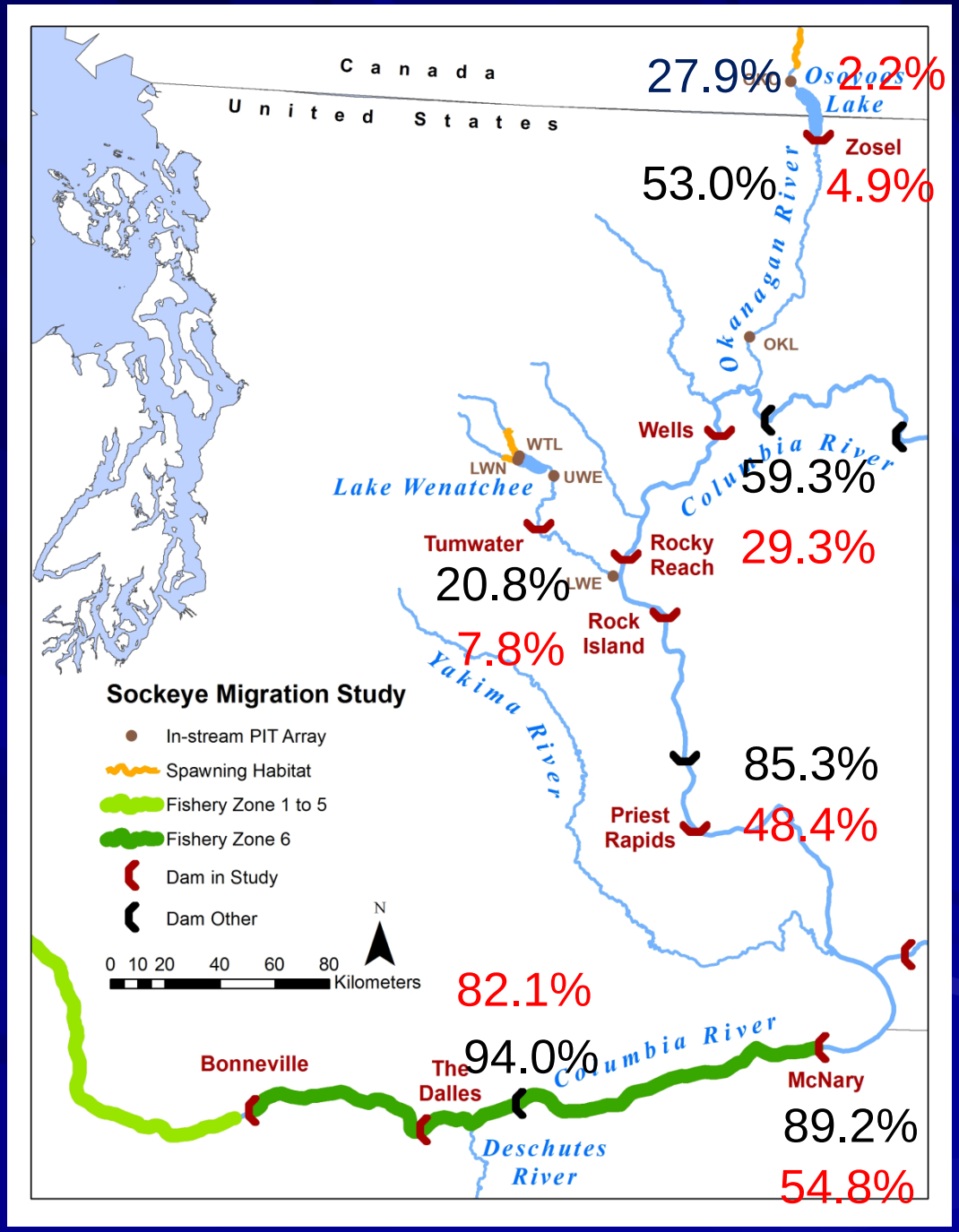
Red indicates AFF temperature restrictions in effect

% of Sockeye tagged at Bonneville Dam detected at McNary Dam (236 km upstream) in 2014/15

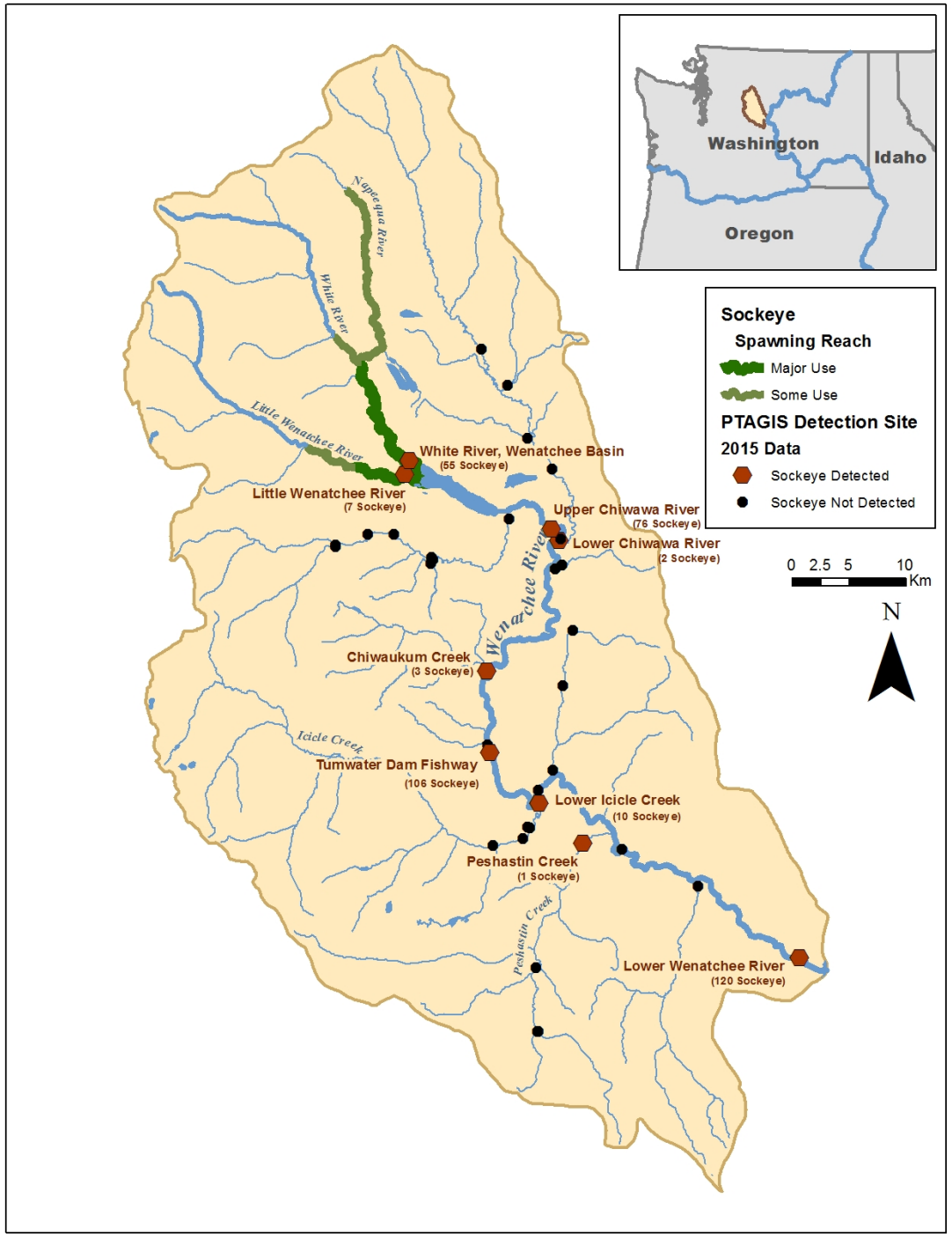
Week	2015	2014	2015 returning Columbia River juveniles	2015 Returning Snake juv.
23	96.6%			66.7%
24	91.2%	81.8%	87.5%	55.8%
25	82.0%	88.5%	87.7%	27.9%
26	**74.6%**	86.0%	73.7%	10.8%
27	**23.1%**	80.0%	26.2%	1.7%
28	**?**	91.7%	16.1%	7.4%
29	**?**	73.7%	12.5%	6.3%
30	**40.0%**	66.7%	14.3%	0.0%
31	**40.0%**		40.0%	66.7%

Red indicates AFF temperature restrictions in effect

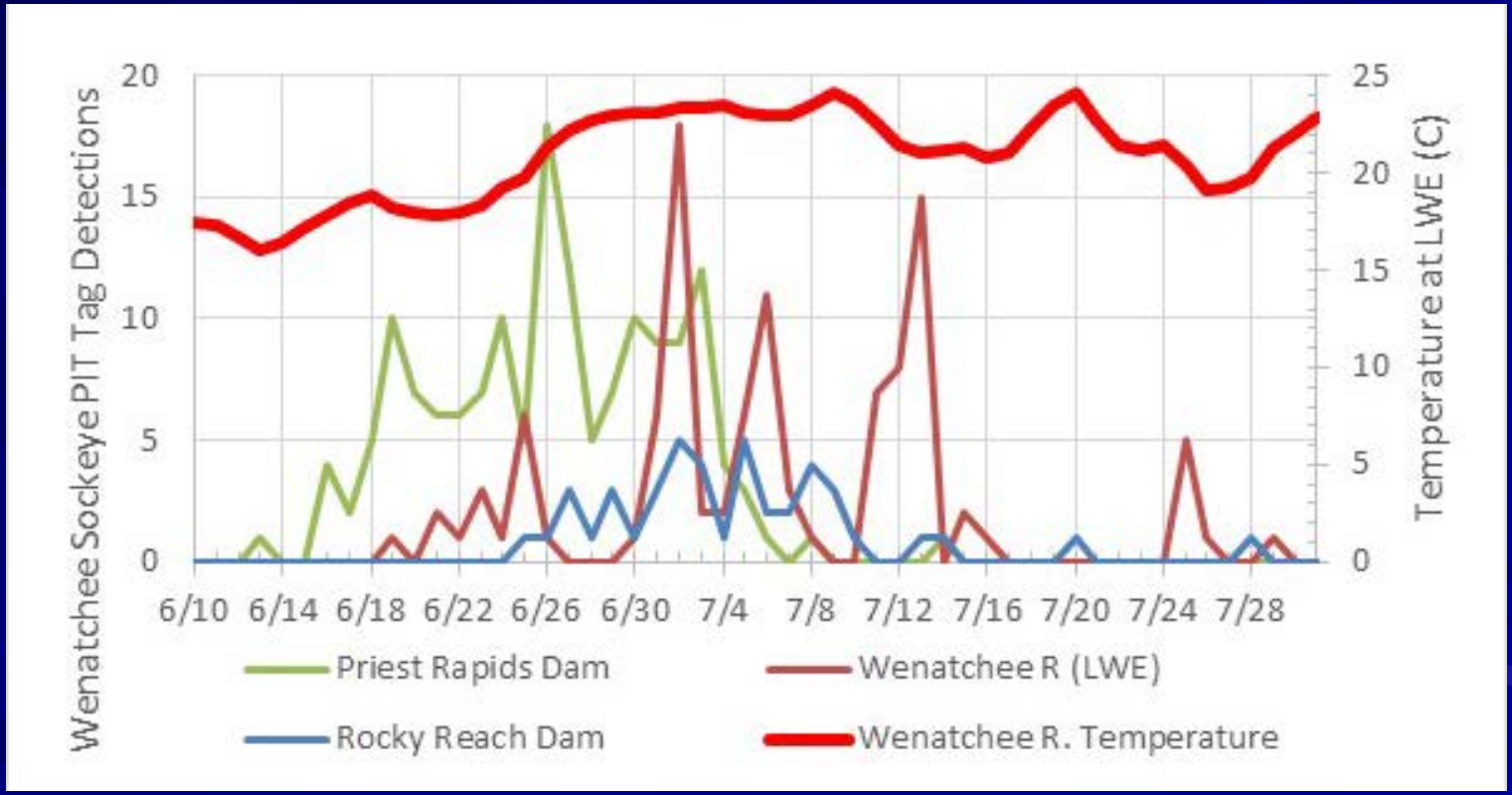
Percentage of sockeye estimated to reach upstream locations in 2015 and 2016 estimated from Bonneville Dam PIT tagging



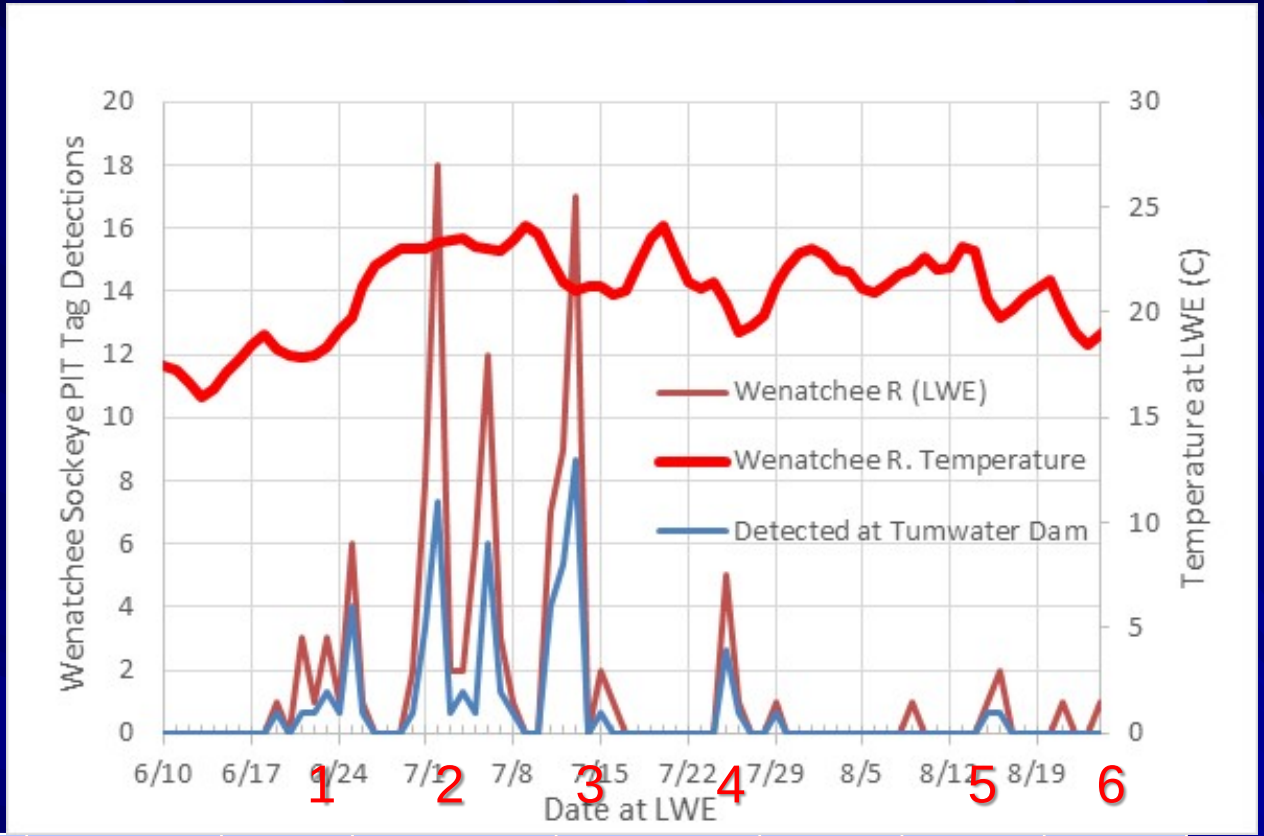
Wenatchee Basin PIT Tag Detection Sites



Detections of Wenatchee stock Sockeye Salmon (GSI) by date at Priest Rapids, Rocky Reach dams and in the Lower Wenatchee River (LWE) with LWE Temperatures by Date in 2015



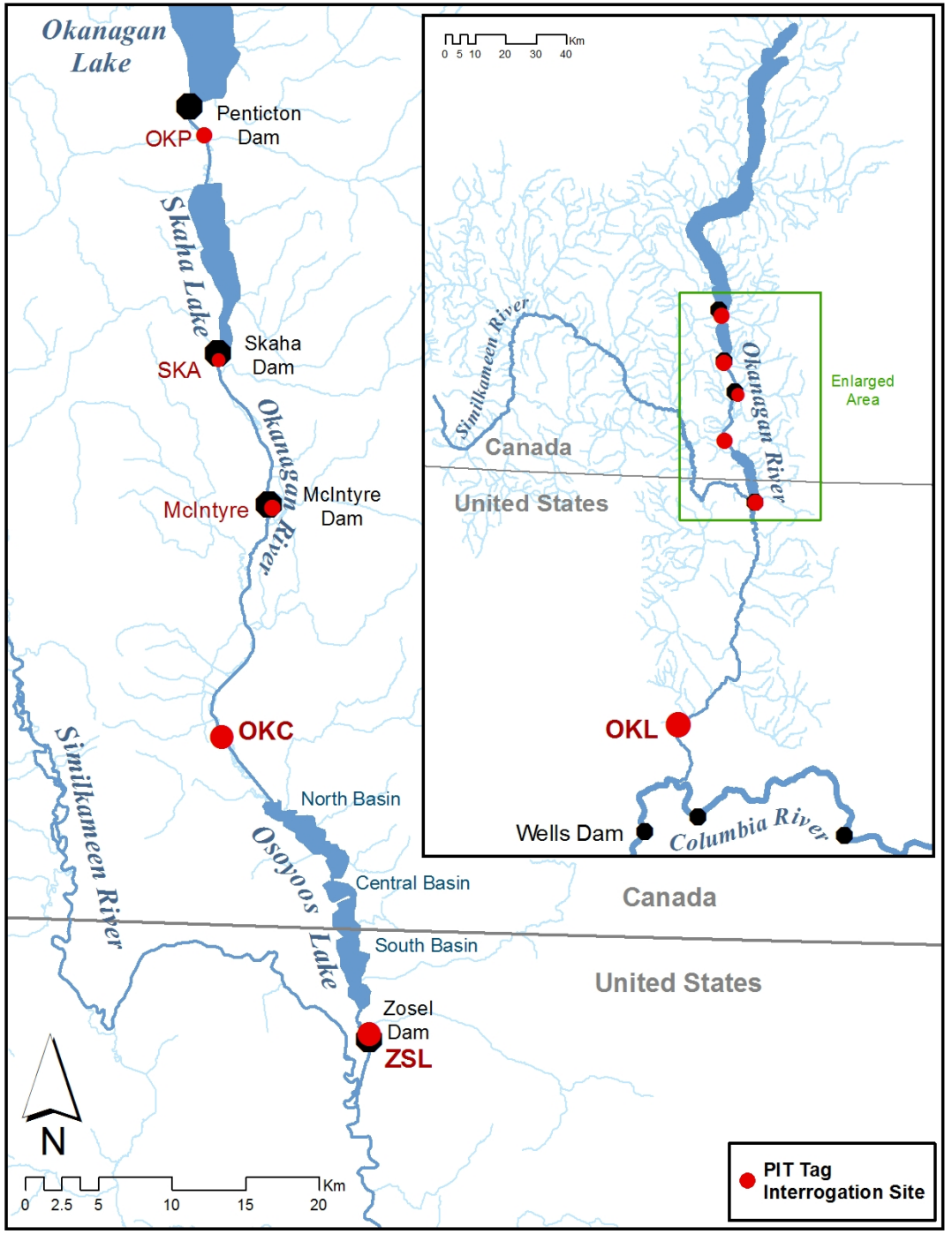
Number of PIT tagged sockeye at LWE and Tumwater Dam by date at LWE in 2015



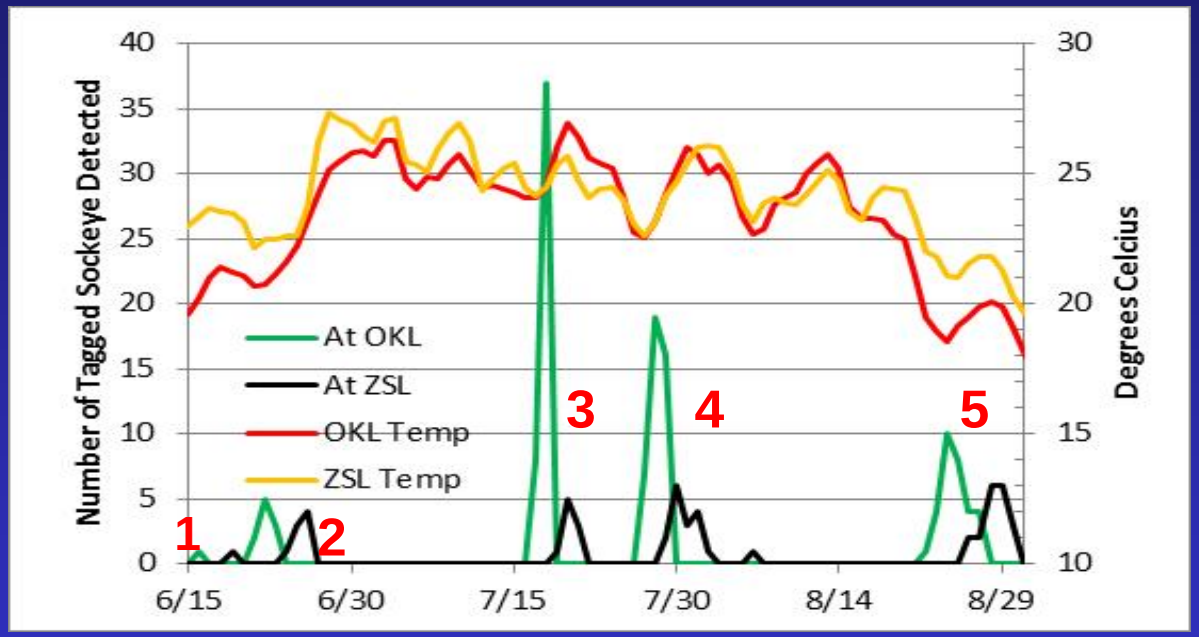
	Date at LWE	LWE Temp	# at LWE	% Straying (ICL+PSH)	% to Tumwater	% Tum to Sp Grds	% LWE to Sp Grds	LWE to TUF days
1	June 19-26	17.9-21.3	16	0.0%	86.7%	61.5%	53.4%	14.4
2	June 30-July 8	22.9-23.5	54	11.1%	66.0%	60.6%	40.0%	10.1
3	July 11-15	20.9-22.6	36	2.8%	84.8%	82.1%	69.7%	6.9
4	July 25-29	19.1-21.4	7	14.3%	85.7%	16.7%	14.3%	7.8
5	August 9-16	19.8-23.1	4	0.0%	50.0%	50.0%	25.0%	11.4
6	Aug 21-Sept 20	14.4-20.6	5	20.0%	0.0%	NA	0.0%	14.4
			122	**7.4%**	**71.3%**	**60.9%**	**43.4%**	**13.2**

2017: 5.0
2016: 4.2

Okanagan Basin PIT Tag Detection Sites

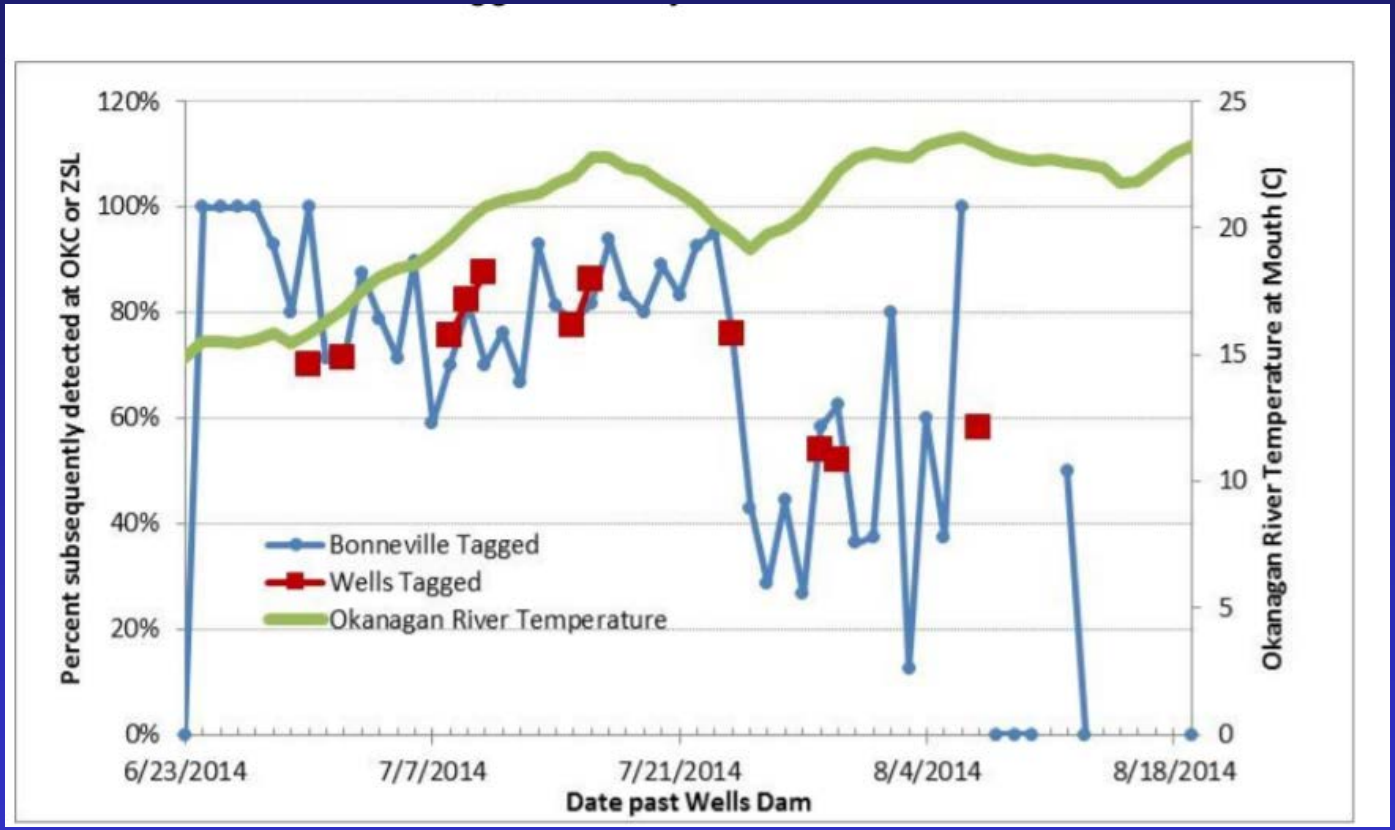


Number of PIT tagged sockeye entering the Okanogan River (OKL) and at Zosel Dam (ZSL) by date in 2015



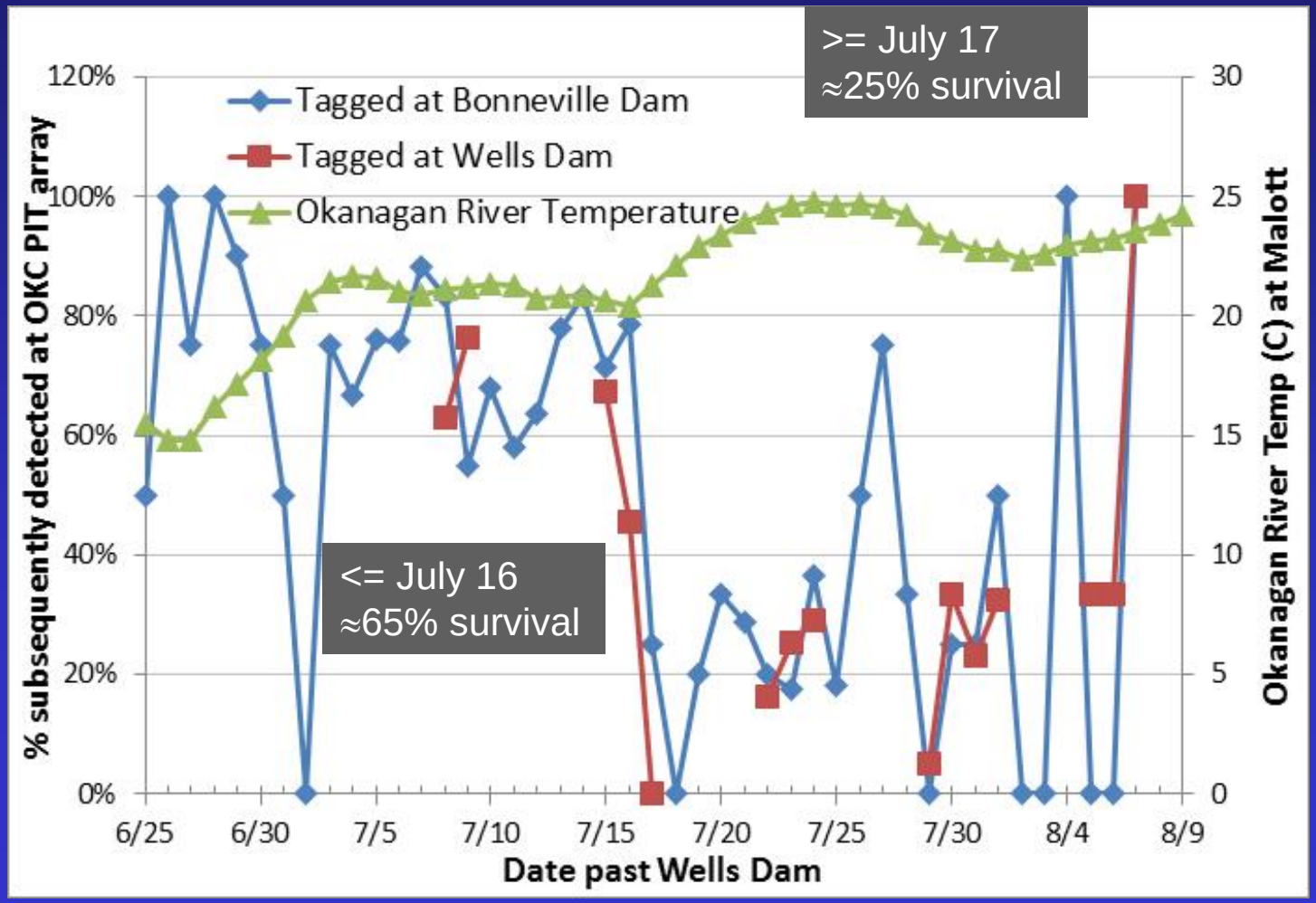
	Date at OKL	N at OKL	% to Zosel	% OKL to OKC
1	6/16	1	100.0%	100.0%
2	6/21-6/23	10	80.0%	30.0%
3	7/17-7/18	46	15.2%	4.3%
4	7/27-7/29	41	34.1%	17.1%
5	8/22-8/27	32	59.4%	25.0%
	Total	130	37.7%	16.2%

Percentage Survival from Wells Dam to Zosel Dam 2014

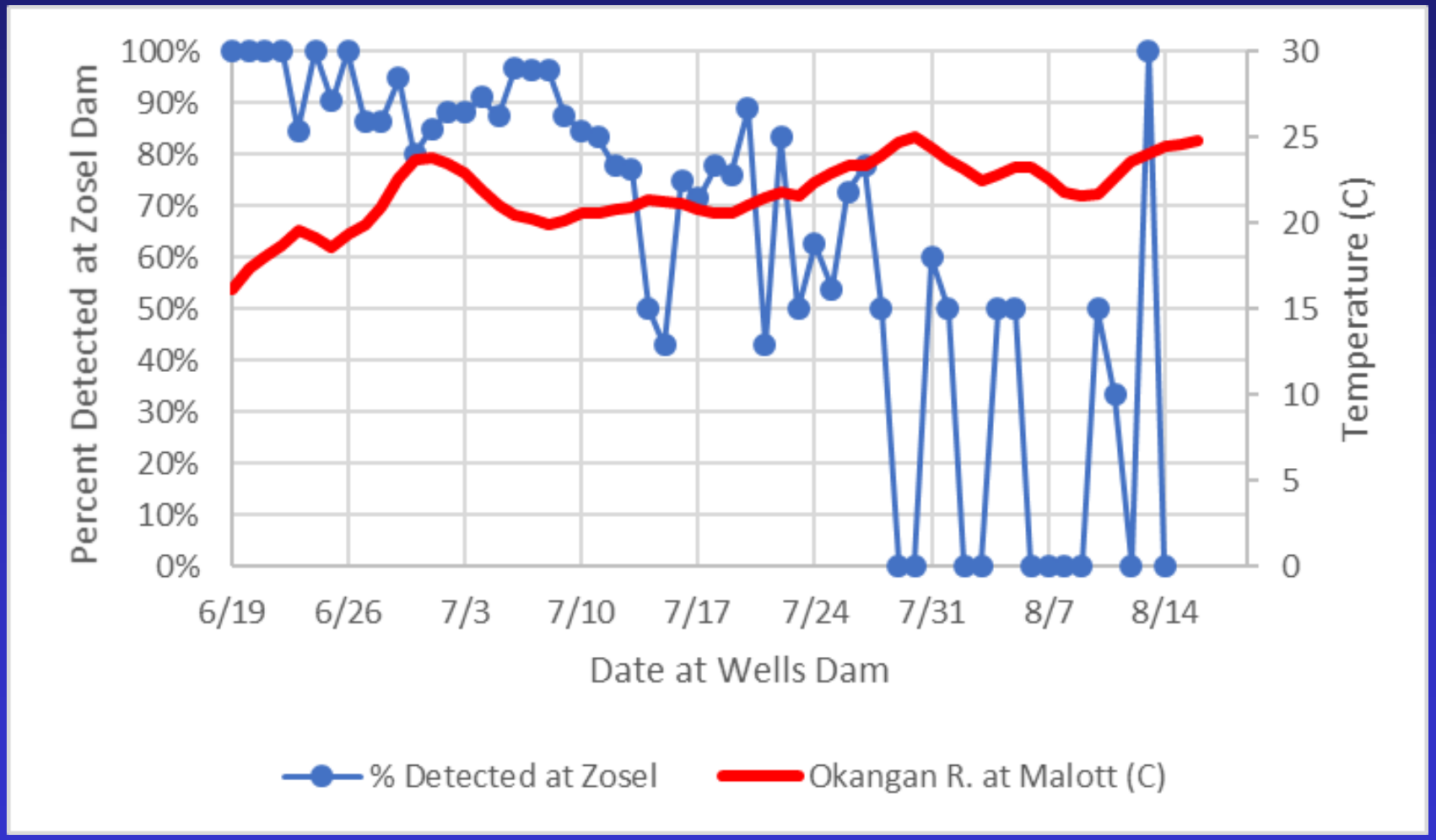


At Wells on or before July 23, 80.6% survival, after ≈50%

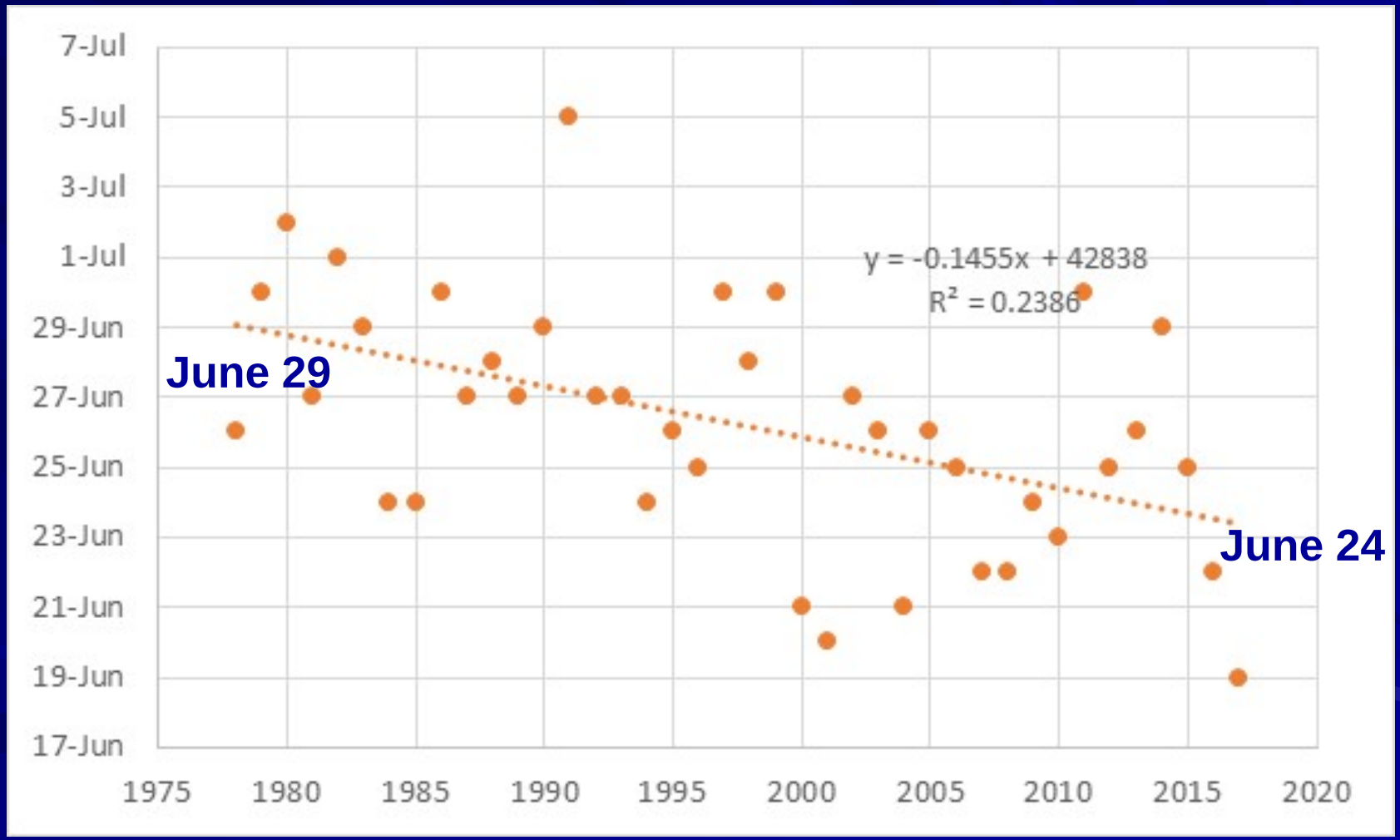
Percentage of Sockeye PIT tagged at Bonneville and Wells dams detected on spawning grounds (OKC) by date at Wells Dam in 2013



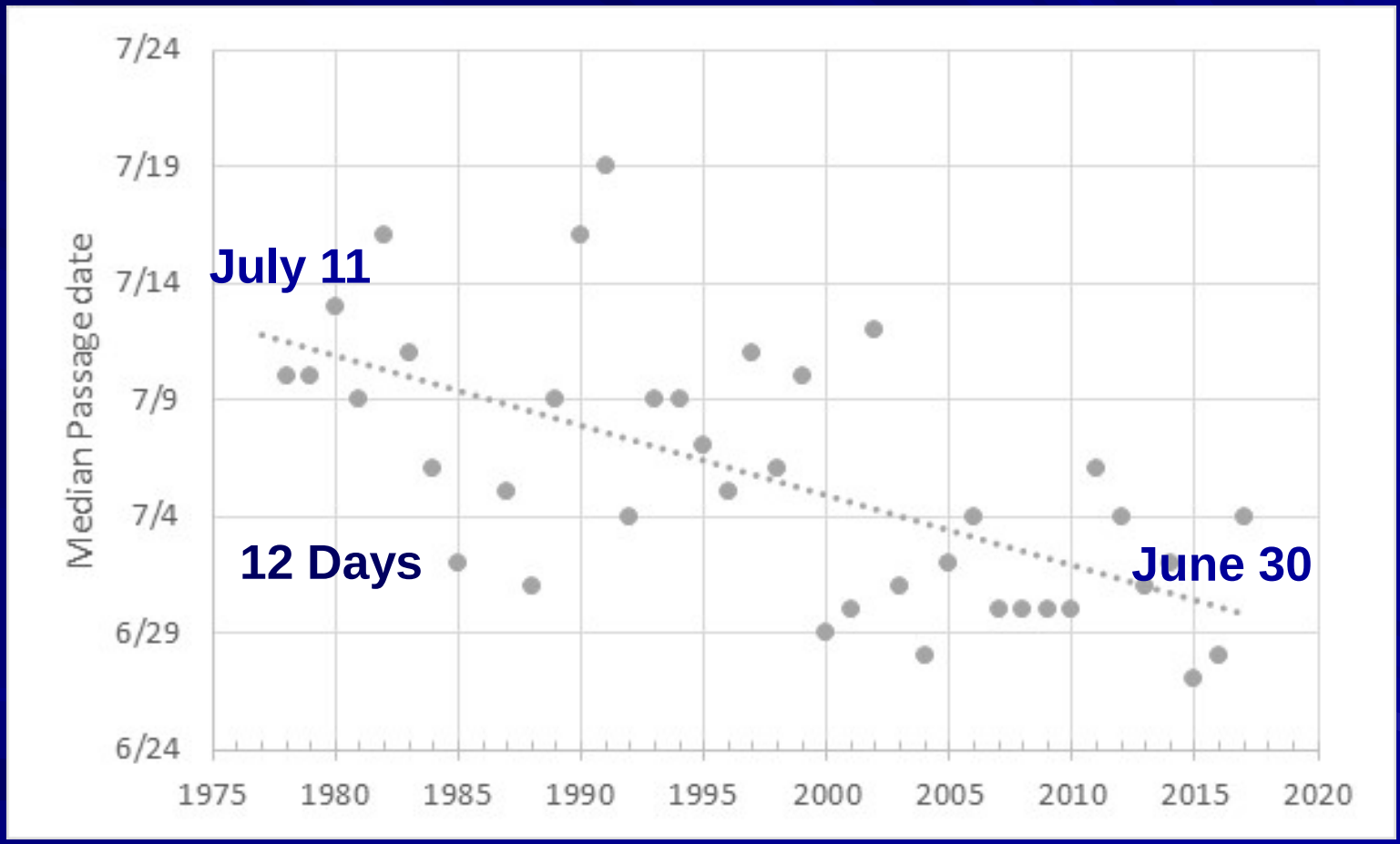
Survival from Wells Dam to Zosel Dam of Sockeye PIT tagged at Bonneville Dam by date passing Wells Dam in 2016



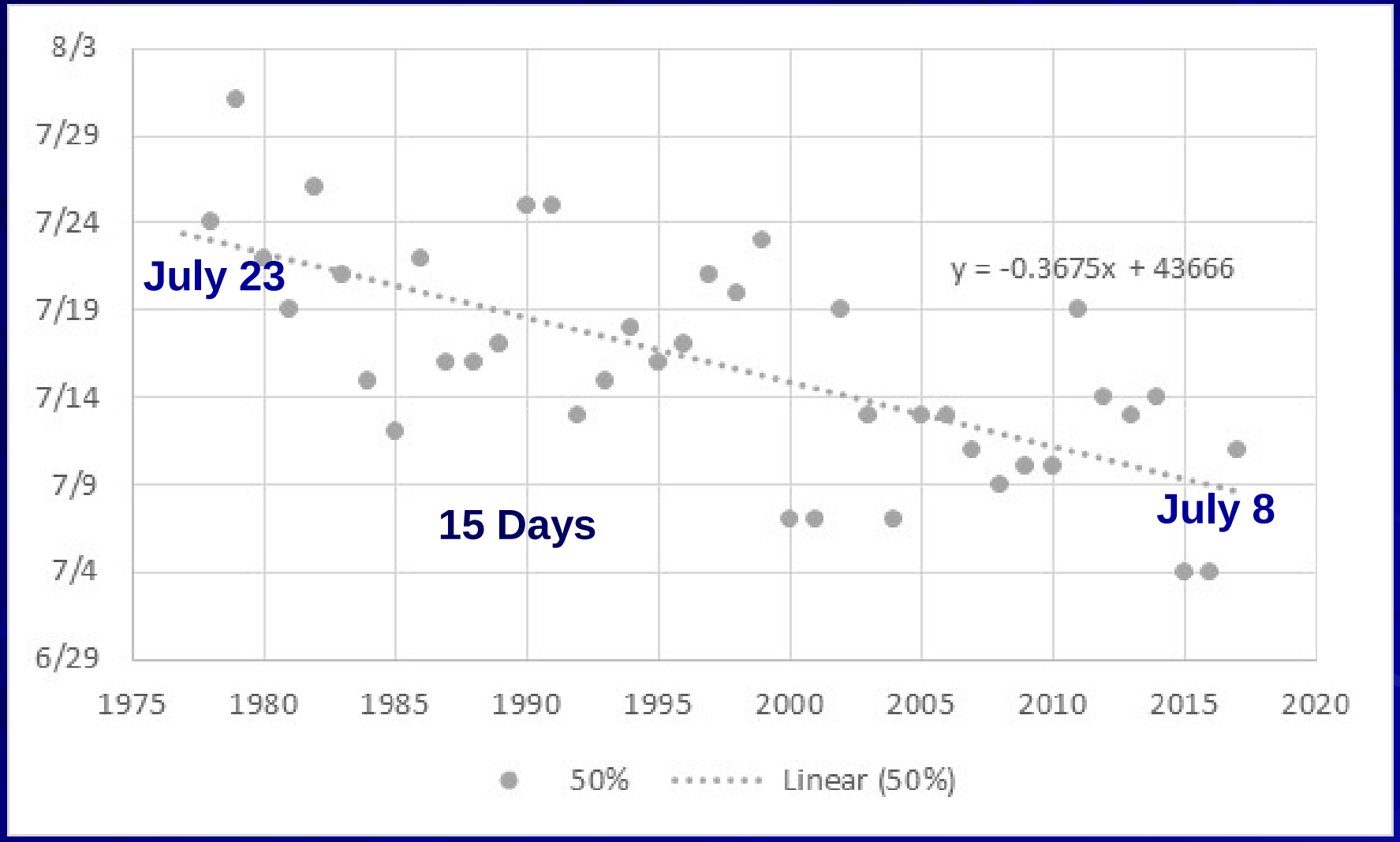
Median Sockeye Salmon Passage Date at Bonneville Dam 1978-2017



Median Sockeye Salmon Passage Date Difference between Rocky Reach and Rock Island Counts (Wenatchee) 1978-2017



Median Sockeye Salmon Passage Date at Wells Dam 1978-2017



Conclusions

- 2015 was a bad year for Sockeye Salmon with earlier migrating Sockeye having better survival.
- For the Okanagan stock, an earlier migration past Wells Dam has consistently provided higher survival to Canada in recent years. (Possibly aided by, or a response to, flow management which has improved Osoyoos Lake holding conditions as well as access to Skaha Lake? Will access to Okanagan Lake result in even earlier runs?)
- For the Wenatchee stock, survival in the Wenatchee River to Tumwater Dam has been consistently high except for 2015. Do they have a clue what to do with hot water?
- Could an earlier migration be a possible strategy to deal with a warmer climate, at least for Okanagan Sockeye Salmon?

Acknowledgements

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