30-YEARS OF MONITORING WILD SNAKE RIVER SPRING/SUMMER CHINOOK PARR WITH PIT TAGS

Jesse Lamb, Gordon Axel, Benjamin Sandford, and Steven G. Smith

Pilot project 1988 – PIT tagging for transport

1991- Idaho Wild Fish Project

ESA Listed 1992

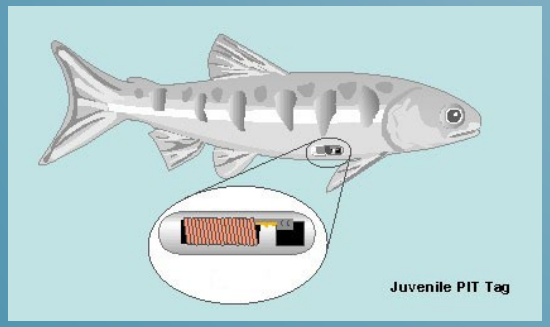
2002- Valley Creek Instream Monitor

2005- Recapture of tagged fish at Little Goose Dam

2010- Single-use PIT Tag needles

2012- Recapture of tagged fish at Lower Granite Dam

2020- Lower Granite Spillway detection operational



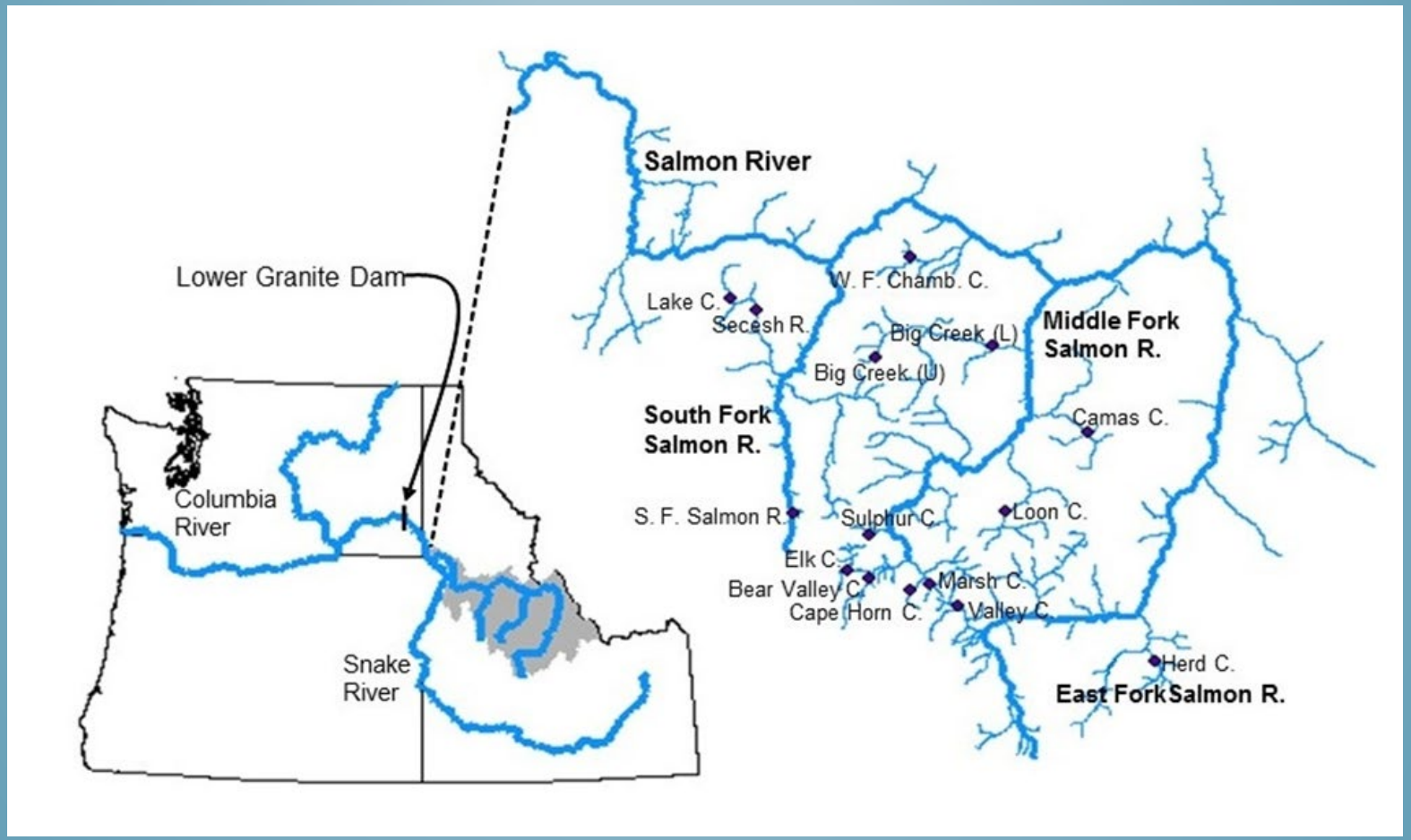
Study Objectives

1)Characterize the migration timing, growth, and estimating parr to smolt survival of different populations of wild Snake River spring/summer Chinook salmon

2)Determine whether consistent migration/survival patterns are changing

3)Determine which environmental factors influence these patterns

Study Area



16 Sampling Locations: Valley Creek, Marsh Creek, Loon Creek, Herd Creek, Camas Creek, Capehorn Creek, Sulphur Creek, Elk Creek, Bear Valley Creek, Big Creek (upper and lower), Chamberlain Creek, WF Chamberlain Creek, SF Salmon River, Lake Creek, and the Secesh River

Fish Collection and Tagging

Annual collection and tagging occurs during July and August. Numbers vary by sampling location (250-2,000) and are based on previous year's redd counts.

Fish collection is done with backpack electro-fishers or through modified seining.

Fish Transport and Holding

Fish are transported from collection crews to the tagging station using a 5-gal carboy on a freighter pack with an oxygenated bubbler.

Approximately 10% of tagged fish are held for 24hrs in order to monitor for delayed mortality and shed tags.

PIT Tagging

Fish that are 55 mm or greater are tagged using single-use pre-loaded needles with 9- or 12-mm PIT tags. Data is collected and stored using a HPR PIT tag reader paired with the P4 software.

Historical Collection and tagging numbers 1991-2023

	Number of fish		Average Length (mm)		Average Weight (g)	
Tagging Year	Collected	Tagged & Released	Collected	Tagged	Collected	Tagged
1991	9,665	9,281		67		4.2
1992	10,093	9,774		72		4.8
1993	9,503	8,065		66		3.9
1994	24,874	18,459		65		3.6
1995	1,885	1,407		63		3.7
1996	1,455	1,360		67		4.4
1997	3,698	2,685		68.4		4.4
1998	11,512	9,933		68		4.2
1999	15,052	10,402		63.9		3.9
2000	4,044	3,536		71.4		4.9
2001	11,183	10,242	66.5	67.1	4	4
2002	18,961	14,290	60.2	63.2	3.6	3.6
2003	25,209	18,346	60.4	63.2	3.2	3.4
2004	30,154	19,886	60.2	63.2	3.1	3.2
2005	15,547	12,826	66.8	66.9	4.2	4
2006	10,593	8,410	64.7	66.2	3.9	3.9
2007	8,594	7,390	69.4	69.8	4.5	4.4
2008	10,775	9,718	67.2	67.7	4.1	4.1
2009	20,202	15,346	62.3	64.6	3.5	3.8
2010	18,163	15,210	63.8	65	3.8	3.6
2011	24,941	17,593	60.6	63.4	3.5	3.5
2012	20,814	13,362	58.8	62.7	3.6	3.5
2013	18,100	13,667	62.9	65.5	3.7	3.6
2014	14,036	12,497	66.8	66.8	4	3.9
2015	17,783	16,148	68.8	69.4	3.8	3.9
2016	16,469	15,063	66.5	66.9	3.9	3.9
2017	14,488	10,935	63.6	64.7	3.4	3.3
2018	6,906	6,406	69.5	68.5	4.6	4.3
2019	11,231	8,421	64	65.5	3.5	3.4
2020*						
2021	7,654	6,232	67.4	67.6	3.7	3.7
2022	6,767	4,051	60.4	62.8	3.1	3.0
2023	6,498	4,663	58.4	63.0	3.1	3.3
Totals/Averages	**426,849**	**335,604**	**64.1**	**66.1**	**3.7**	**3.9**

Monitoring of Out-Migrating Juveniles

Instream PIT tag monitoring systems are designed to detect fish closer to their natal rearing sites and set up to automatically interrogate, store, and transmit data from passing tagged fish.

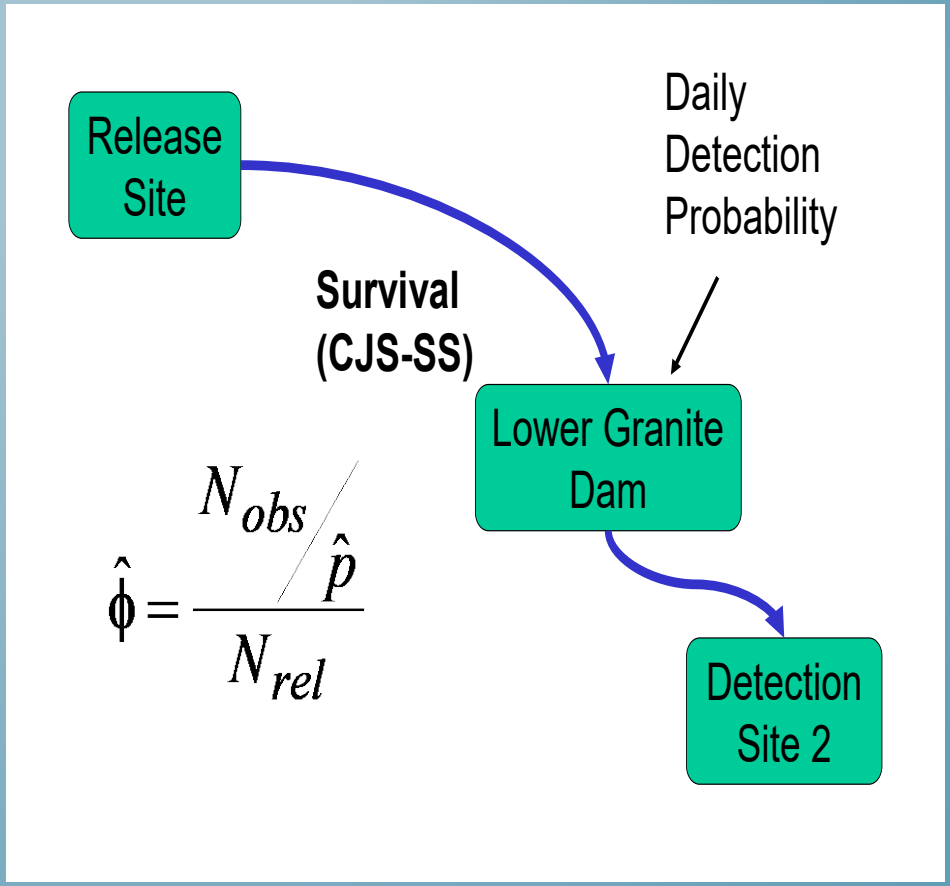
Lower Granite Dam (LGR) on the upper Snake River

- PIT detections at LGR enable us to estimate arrival timing and survival for each sampling site.
- Fish passing the juvenile bypass are recaptured as they pass the dam in order to collect parr to smolt growth data.

Photo Credit: Lewiston Tribune

Estimating detections and survival

- Cormack-Jolly-Seber (CJS) modeling to estimate stream segment survival
- Survival at LGR is based on daily detection probabilities and downstream detections using CJS and the Sandford-Smith method



In-Stream Monitoring

In 2002, the first fully autonomous in-stream detection site was installed on Valley Creek near Stanley, ID

7 Detection Sites

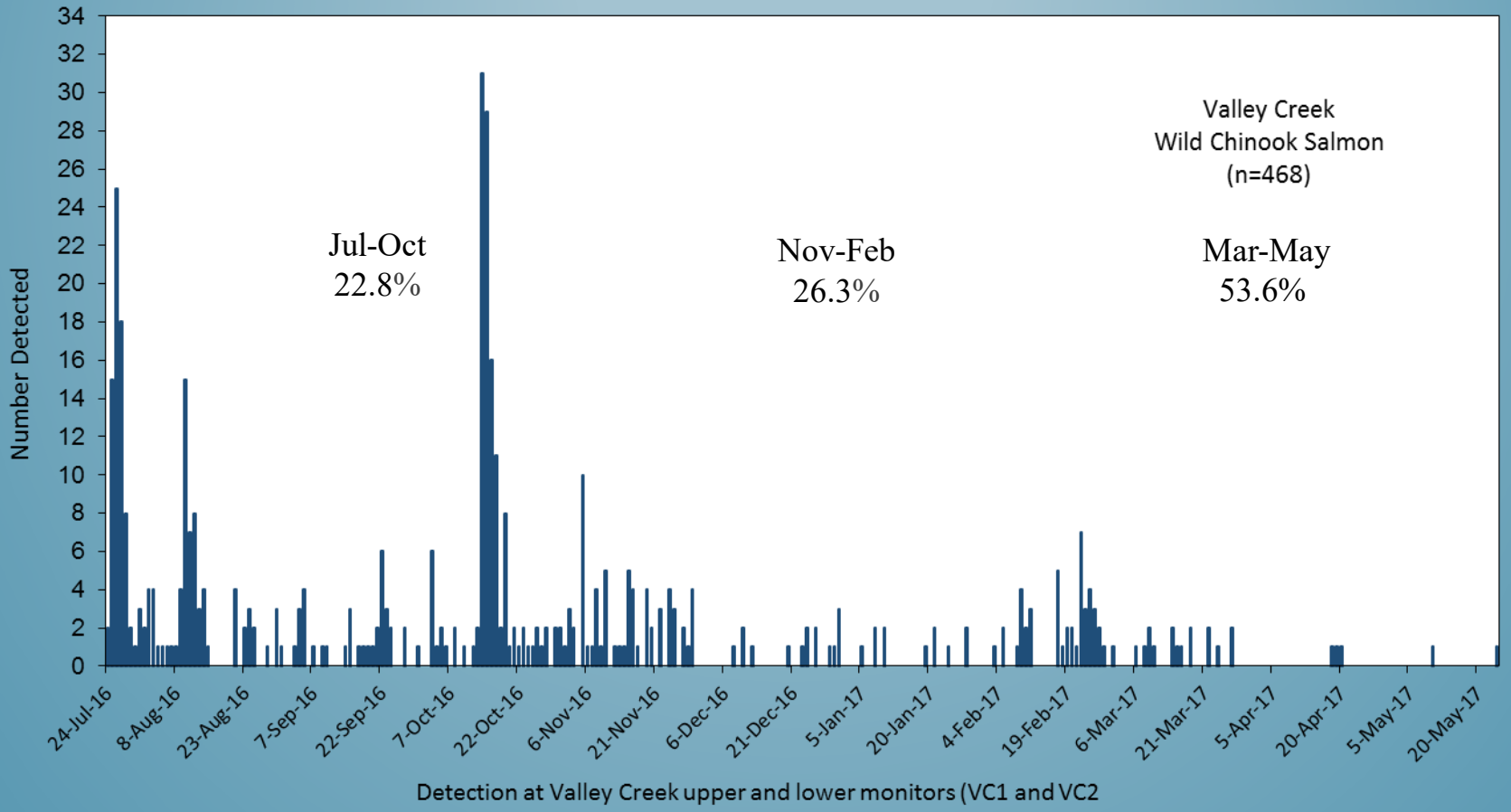
- Valley Creek
- Marsh Creek (rkm 8 at Lola Creek CG)
- Big Creek
  - Upper Big Creek
  - Lower Big-Taylor Ranch
- South Fork Salmon River (Krassel Creek)
- Lower South Fork Salmon River (Guard Station Road Bridge)
- Lower Secesh River (Zena Creek)
- Upper Salmon River sites (USI at rkm 460 and USE at rkm 437)

In-Stream Detection and Timing
2021-2022

Collection site	Released (n)	Instream monitoring systems: Detected (n)	Detected (%)	Detection period (%): Late summer/ fall	Winter	Spring	Instream detection efficiency (%)	Estimated survival (%): To instream monitor	To Lower Granite Dam: From instream monitor	From release site
Valley Creek	1,000	294[a]	29.4[a]	--	--	--	75.6[a]	38.9[a]	19.3[a]	7.3
Upper Big Creek										
Edwardsburg	500	--	--	--	--	--	--	--	--	--
Taylor Ranch	500	29	5.8	34.5	37.9	27.6	16.4	35.4	36.8	20.4
Lake Creek	500	151	30.2	90.1	9.3	0.7	67.8	44.5	50.9	21.7
Secesh River	500	178	35.6	91.0	6.7	2.2	59.4	59.9	46.1	27.4
S Fork Salmon R	750	177	23.6	60.5	24.9	14.7	42.3	55.8	32.2	19.6
Marsh Creek	1,000	551	55.1	87.5	9.1	3.4	93.2	59.2	32.5	19.2
Cape Horn Creek	715	385	53.8	85.4	7.3	7.3	98.4	54.8	28.9	16.0

[a] The Valley Creek instream system was non-operational during a portion of the study period (June 17-Aug 11).

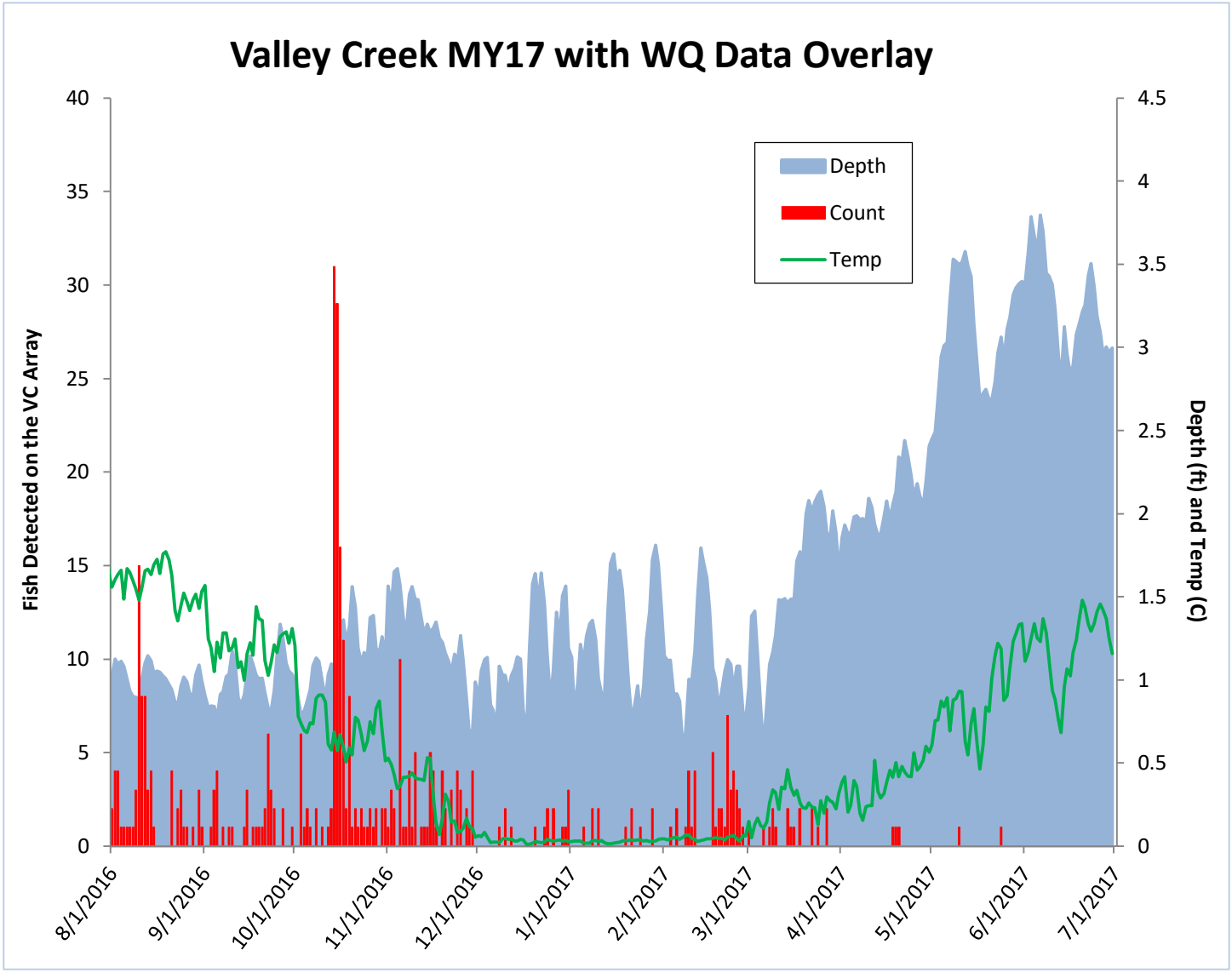
In-stream detections on Valley Creek seasonally and corresponding estimated survival to Lower Granite, 2016-2017



In-stream Water Quality Monitoring

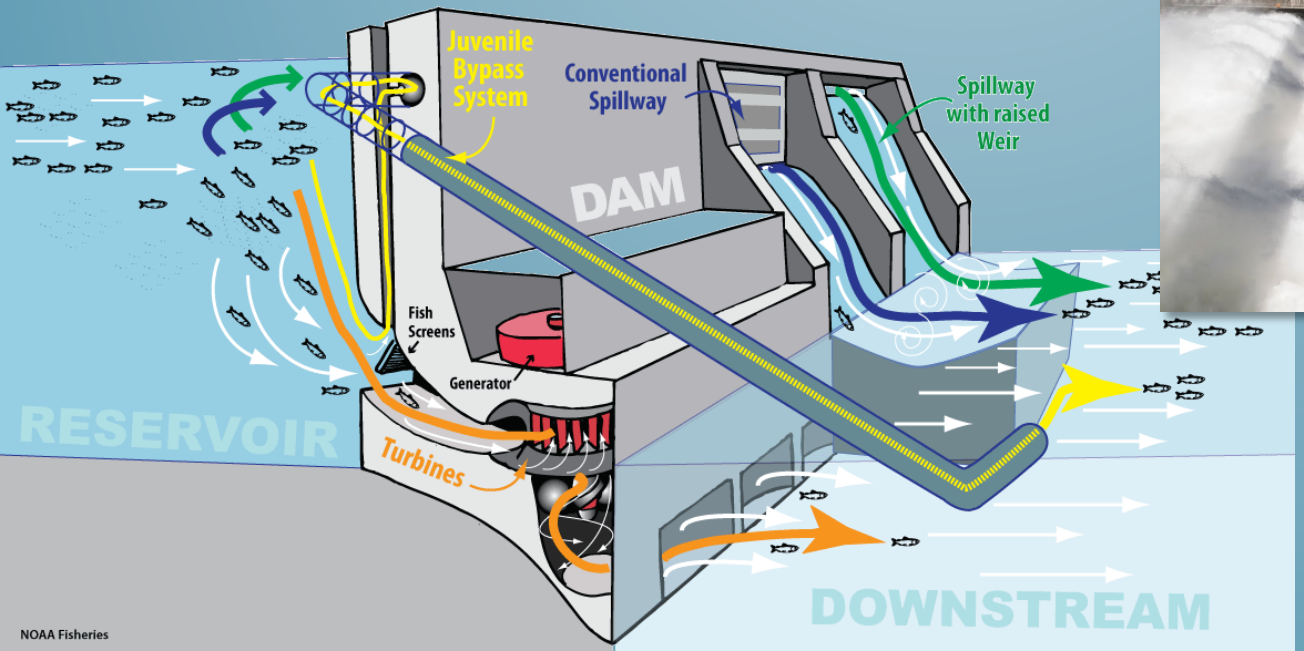
We have 16 sites (near collection and tagging areas) outfitted with water quality monitors that record hourly temperature and depth readings.

Sites are downloaded and maintained annually. Data collected is uploaded to the NOAA Baseline Water Quality database and made available to all researchers.


Valley Creek MY17 with WQ Data Overlay
Depth
Count
Temp
Fish Detected on the VC Array
Depth (ft) and Temp (C)
0
5
10
15
20
25
30
35
40
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
8/1/2016
9/1/2016
10/1/2016
11/1/2016
12/1/2016
1/1/2017
2/1/2017
3/1/2017
4/1/2017
5/1/2017
6/1/2017
7/1/2017

Detection at Lower Granite Dam

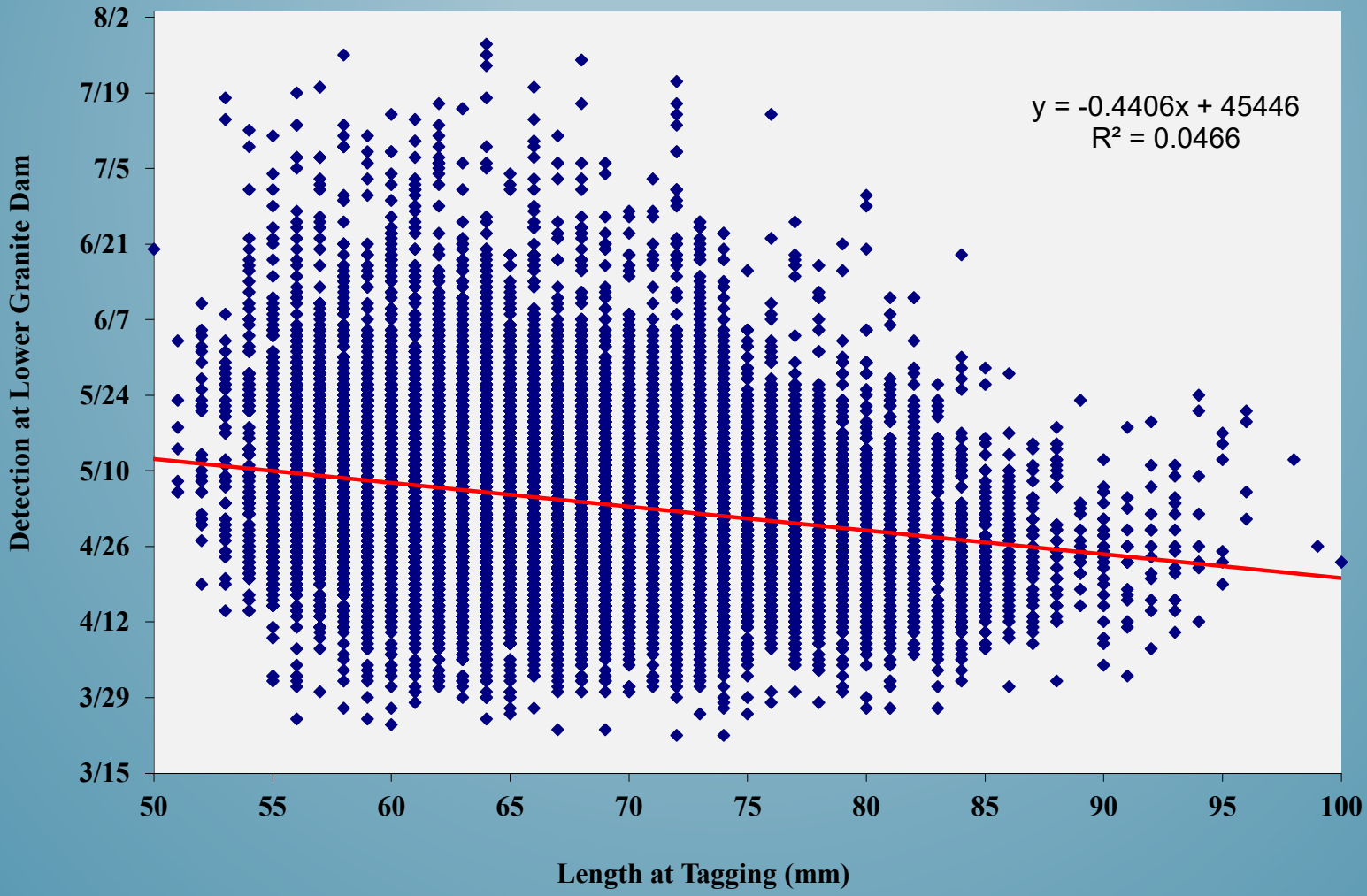
As of 2020, detection is now possible through two different routes at Lower Granite Dam. The ogee detection system known as GRS and the juvenile bypass system GRB.



Annual parr-to-smolt survival estimates to LGR by stream

Stream	Tagged and released (n)	Lower Granite Dam detections, 2021-2022				
		Observed		Expanded (parr-to-smolt survival)		
		(n)	(%)	(n)*	(%)	SE (%)
Loon Creek	250	20	8.0	49	19.6	4.5
Valley Creek	1,000	29	2.9	73	7.3	1.4
Marsh Creek	1,000	79	7.9	192	19.2	2.3
Cape Horn Creek	715	46	6.4	114	16.0	2.4
Bear Valley Creek	594	25	4.2	58	9.8	2.0
Elk Creek	173	10	5.8	22	12.8	1.7
Big Creek (upper)	500	39	7.8	102	20.4	3.3
S Fork Salmon River	750	62	8.3	147	19.6	2.7
Secesh River	500	62	12.4	137	27.4	3.6
Lake Creek	500	49	9.8	109	21.7	3.1
Chamberlain Creek	250	24	9.6	58	23.4	4.7
Totals or averages	**6,232**	**445**	**7.1**	**1,062**	**16.4**	**0.9**

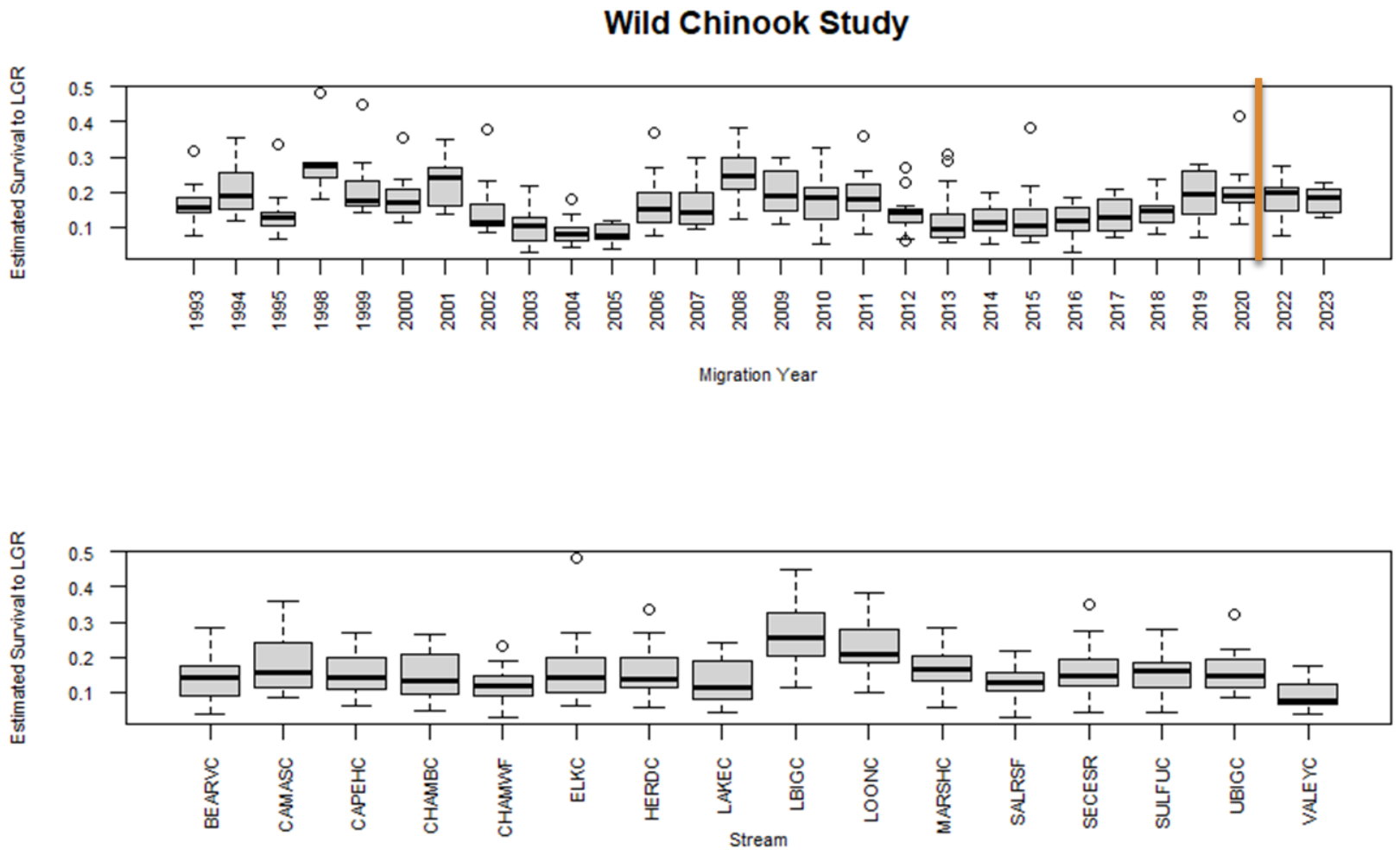
RELATIONSHIP BETWEEN FORK LENGTH OF WILD CHINOOK SALMON PARR AT TAGGING AND DETECTION DATE AT LOWER GRANITE DAM 1994-2023



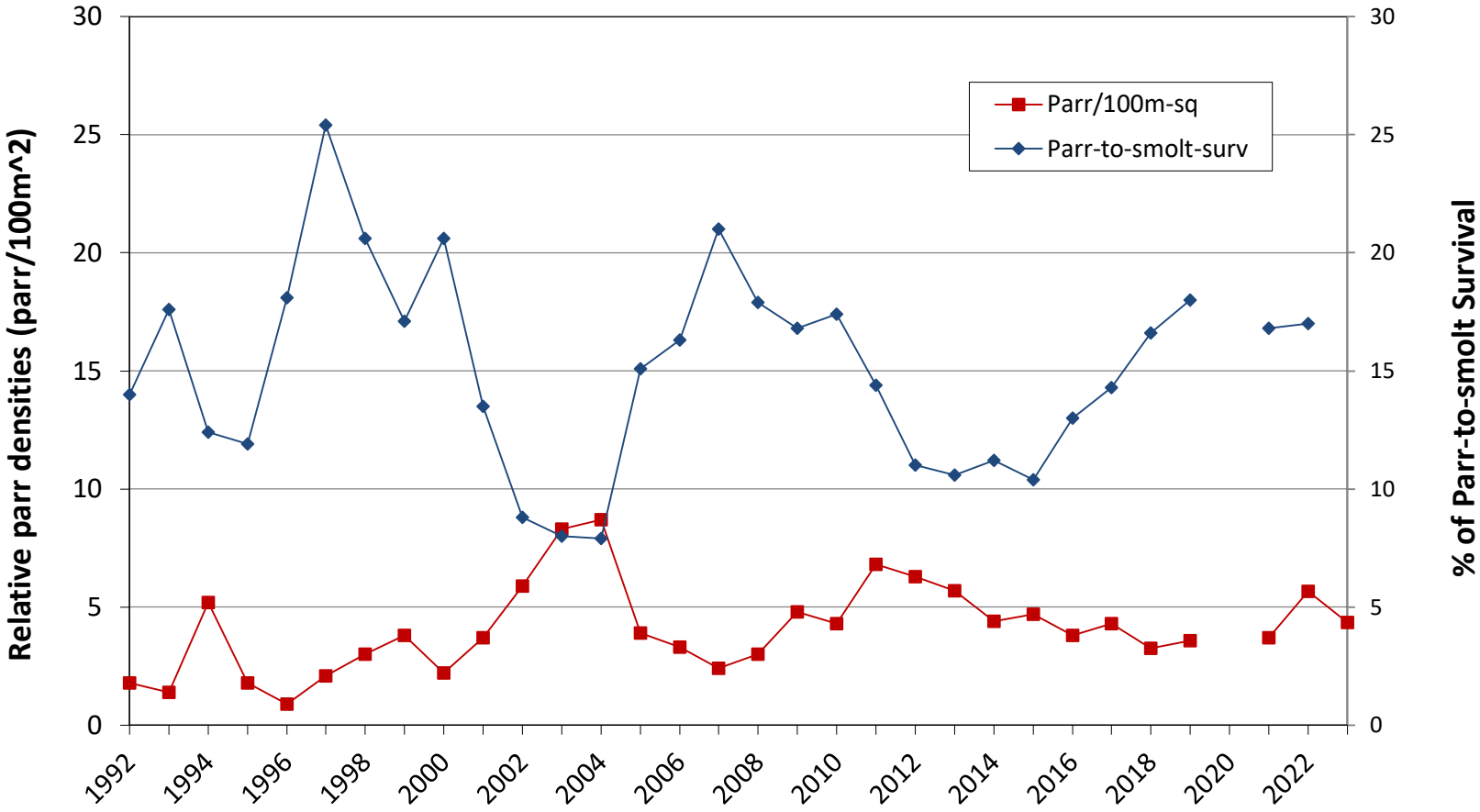
Percentile passage dates at Lower Granite Dam by stream population 1993 to 2023

Stream	Dates of passage at Lower Granite Dam by population percentile									Study years
	10th			50th			90th			
	Mean date	95% CI	SE (d)	Mean date	95% CI	SE (d)	Mean date	95% CI	SE (d)	
Secesh River	14 Apr	11-16 Apr	1	25 Apr	23-28 Apr	1	24 May	18-30 May	3	32
S Fork Salmon River	18 Apr	16-21 Apr	1	6 May	3-9 May	1	29 May	24 May-2 Jun	2	31
Bear Valley Creek	21 Apr	18-23 Apr	1	6 May	3-8 May	1	28 May	24 May-31 May	2	31
Valley Creek	23 Apr	19-26 Apr	2	9 May	6-12 May	2	31 May	27 May-4 Jun	2	30
Elk Creek	19 Apr	17-22 Apr	1	3 May	1 May-6 May	1	26 May	22-29 May	2	30
Lake Creek	15 Apr	13-18 Apr	1	28 Apr	25 Apr-1 May	1	26 May	21 May-1 Jun	3	28
Big Creek (upper)	28 Apr	25 Apr-1 May	1	16 May	12-19 May	2	2 Jun	27 May-7 Jun	3	27
Marsh Creek	20 Apr	17-22 Apr	1	3 May	30 Apr-6 May	1	21 May	18-24 May	1	26
Loon Creek	25 Apr	22-28 Apr	2	6 May	2-9 May	2	18 May	14-21 May	2	22
Cape Horn Creek	22 Apr	19-26 Apr	2	8 May	4-12 May	2	25 May	20-30 May	2	22
Chamberlain Creek	20 Apr	17-24 Apr	2	30 Apr	26 Apr-3 May	2	21 May	14-27 May	3	16

Estimated Parr-to-Smolt survival to Lower Granite Dam from all Idaho streams 1993 to 2023



Annual average density of parr (parr/100 m^2) vs. annual estimated survival to Lower Granite Dam, 1992-2023



Fish recaptured at Lower Granite Dam

2018	Recaptured fish						Weight and condition factor (CF)				
		Days to recapture		Length gain (mm)				Weight gain (g)		Mean CF	
Origin	n	range	mean	n	range	mean	n	range	Mean	release	recapture
	Wild spring/summer Chinook salmon recaptured in SbyC at Lower Granite Dam										
Bear Valley Creek	41	259-305	279	41	24-55	40	27	6.3-15.2	9.7	1.20	1.11
Big Creek (upper)	43	249-293	273	43	18-59	38	37	4.0-15.4	9.8	1.11	1.12
Big Creek (lower)	54	232-267	249	54	20-52	36	40	4.7-14.3	8.7	1.10	1.05
Cape Horn Creek	28	263-302	284	28	26-56	44	18	4.4-13.7	9.3	1.31	1.11
Elk Creek	39	254-309	272	39	14-54	36	38	4.0-15.5	8.5	1.18	1.06
Herd Creek	24	273-312	297	24	20-61	48	22	5.4-16.9	11.2	1.09	1.04
Lake Creek	17	243-283	256	17	19-63	38	16	4.3-15.3	8.2	1.15	1.07
Loon Creek	12	276-309	292	11	41-72	55	3	9.2-13.3	11.9	1.09	1.06
Marsh Creek	59	260-300	279	59	24-56	39	59	4.3-18.3	9.1	1.33	1.08
S Fork Salmon River	41	244-285	266	41	17-54	38	36	3.8-15.3	8.8	1.11	1.06
Secesh River	39	240-283	254	39	20-62	40	39	4.2-20.8	9.4	1.14	1.06
Valley Creek	30	263-325	288	29	27-56	40	20	5.0-13.5	9.8	1.17	1.07
Totals or averages	**468**	**232-325**	**272**	**425**	**14-72**	**40**	**355**	**3.8-20.8**	**9.3**	**1.18**	**1.08**

CONCLUSION

- Over the 30+ years of the project we have seen variable parr to smolt survival among stream populations and across years.
- Complex interrelationships between climate conditions and stream flow play an important role in annual migration timing and survival.
- Since inception of the project, PIT tag technology has allowed us to accurately and efficiently monitor populations of wild juvenile Chinook that would not be possible with other marking techniques.

Acknowledgements

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