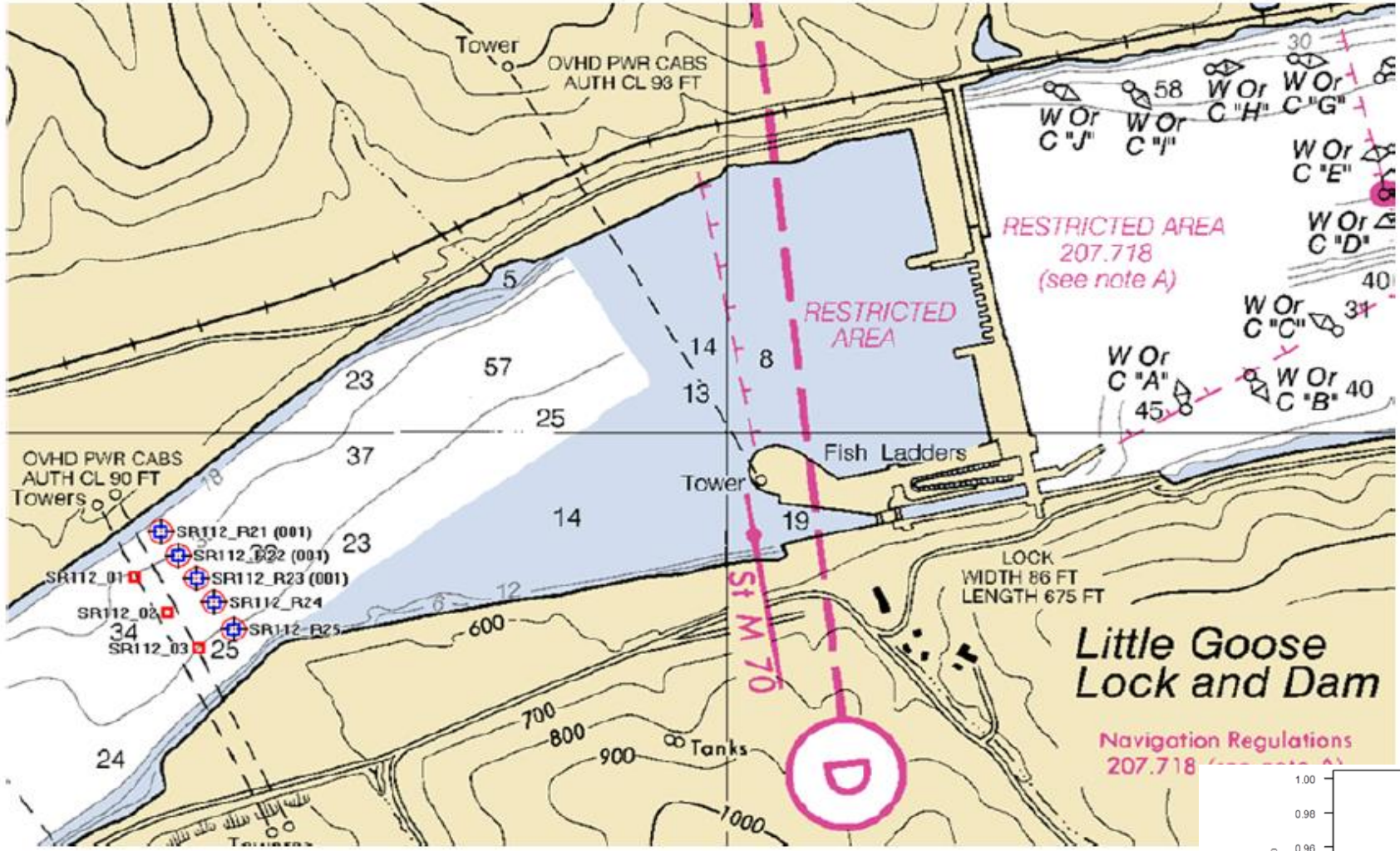


Figure 3.6. Little Goose Dam tailrace fish release locations (red circle with blue sq
position 1 (SR112_R21) is near the north shore and release position nu
(SR112__R25) is near the south shore.

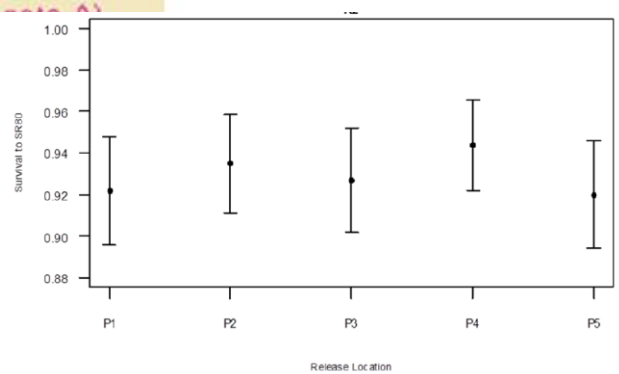


Figure 3.5. Single-release survival estimates (±2 SE) of subyearling Chinook salmon (CH0) from each position (P1 to P5) in the tailrace release location downstream of Little Goose Dam (R2; rkm 112) to the first array downstream (rkm 80). See Figure 3.6 for a map of the release positions.

Conclusion

If 25 cfs of water pumped from 80 feet depth would have been added to the ladder exit in 2015, the number of hours the water temperature in the fish ladder exit exceeded 68° F (20.0° C) would have been reduced 49% (927 h to 469 h). In addition, the 25 cfs of water pumped from 80 feet depth added to the ladder exit in 2015 would have resulted in 0 hours the water temperature in the fish ladder exit exceeded 72° F (22.2° C) or the water temperature differential exceeding 2° C. This analysis assumes the flow/temperature augmentation from Dworshak Dam would continue.

Table 1. Frequency (h) the water temperature in the fish ladder exit exceeded 68° F (20.0° C).

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
April	0		0	0													0
May	0	0	0	0		1								0			1
June	31	27	0	20	62	3	63	0	0	0	0	0	0	21		186	413
July	478	611	422	506	24	603	740	658	84	480	78	3	169	617		367	5840
August	533	619	308	650		559	62	617	375	610	489	405		701	422	346	6696
September	27	155	0	180		22		129	6	147	0	39		510	139	28	1382
October			0											0			0
Grand Total	**1069**	**1412**	**730**	**1356**	**86**	**1188**	**865**	**1404**	**465**	**1237**	**567**	**447**	**169**	**1849**	**561**	**927**	**14332**

Table 2. Frequency (h) the water temperature in the fish ladder exit would exceed 68° F (20.0° C) with addition of 25 cfs into the ladder exit pumped from 80 feet depth in the forebay.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
April	0		0	0													0
May	0	0	0	0		0								0			0
June	0	0	0	0	0	0	0	0	0	0	0	0	0	0		66	66
July	0	0	0	0	0	292	683	491	0	193	0	0	0	405		242	2306
August	0	0	0	0		162	61	253	109	216	224	112		243	374	159	1913
September	0	0	0	0		6		0	0	32	0	0		409	58	2	507
October			0											0			0
Grand Total	**0**	**0**	**0**	**0**	**0**	**460**	**744**	**744**	**109**	**441**	**224**	**112**	**0**	**1057**	**432**	**469**	**4792**

Table 3. Frequency (h) the water temperature in the fish ladder exit exceeded 72° F (22.2° C).

Row Labels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
April	0		0	0													0
May	0	0	0	0		1								0			1
June	0	1	0	0	0	0	13	0	0	0	0	0	0	0		38	52
July	65	159	56	78	0	83	128	240	0	198	0	0	13	40		103	1163
August	37	206	0	77		57	0	65	46	28	11	0		20	21	0	568
September	0	0	0	59		0		0	0	0	0	0		66	0	0	125
October			0											0			0
Grand Total	**102**	**366**	**56**	**214**	**0**	**141**	**141**	**305**	**46**	**226**	**11**	**0**	**13**	**126**	**21**	**141**	**1909**

Table 4. Frequency (h) the water temperature in the fish ladder exit would exceed 72° F (22.2° C) with addition of 25 cfs into the ladder exit pumped from 80 feet depth in the forebay.

Row Labels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
April	0		0	0													0
May	0	0	0	0		0								0			0
June	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
July	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
August	0	0	0	0		0	0	0	0	0	0	0		0	0	0	0
September	0	0	0	0		0		0	0	0	0	0		0	0	0	0
October			0											0			0
Grand Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 5. Frequency (h) the Little Goose Dam fish ladder water temperature differential exceeded 2° C.

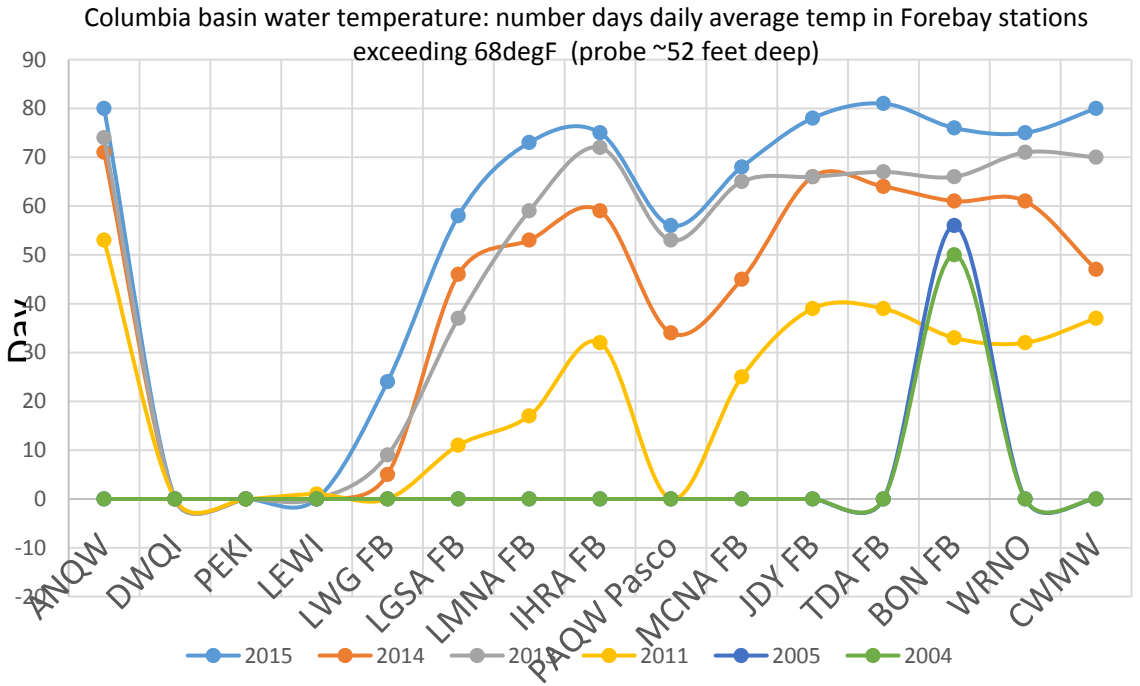
Row Labels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
April	0		7	3													10
May	0	65	17	11		7								0			100
June	64	106	75	35	135	8	42	2	2	0	0	0	2	55		47	573
July	106	184	125	96	0	65	100	180	38	212	0	0	110	45		48	1309
August	33	266	33	69		120	0	43	69	51	2	0		13	14	0	713
September	45	1	24	63		0		29	21	13	2	0		99	0	0	297
October			0											0			0
Grand Total	**248**	**622**	**281**	**277**	**135**	**200**	**142**	**254**	**130**	**276**	**4**	**0**	**112**	**212**	**14**	**95**	**3002**

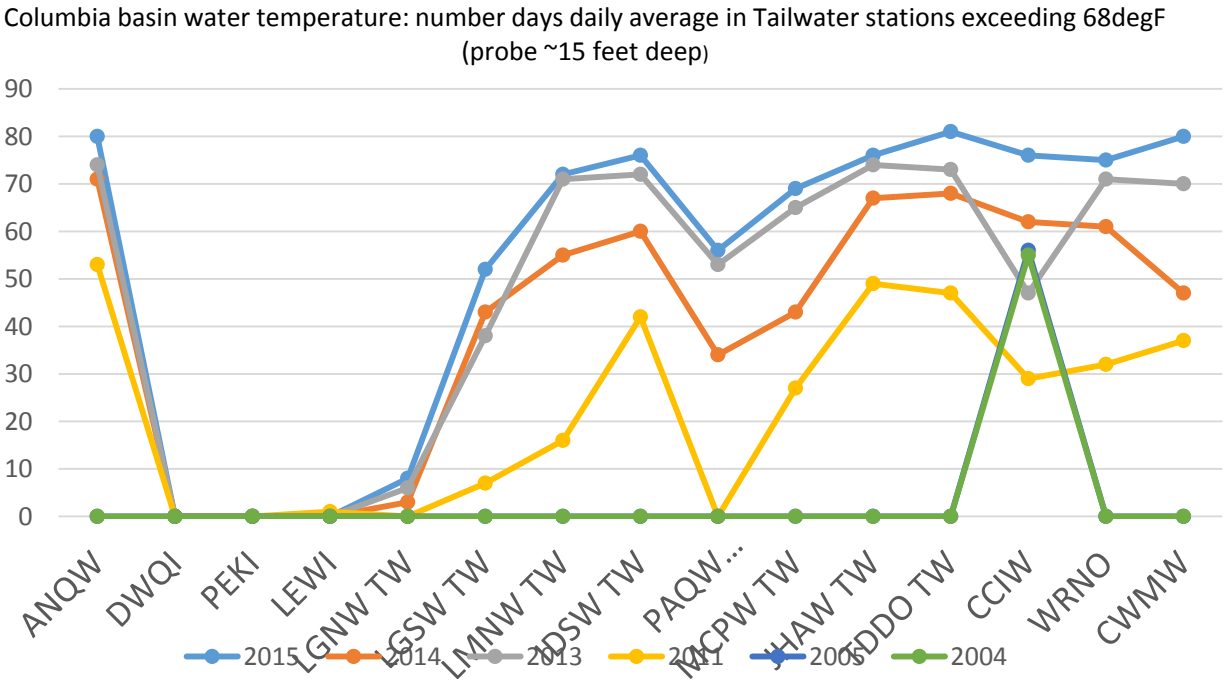
Table 6. Frequency (h) the w the Little Goose Dam fish ladder water temperature differential exceeded 2° C with addition of 25 cfs into the ladder exit pumped from 80 feet depth in the forebay.

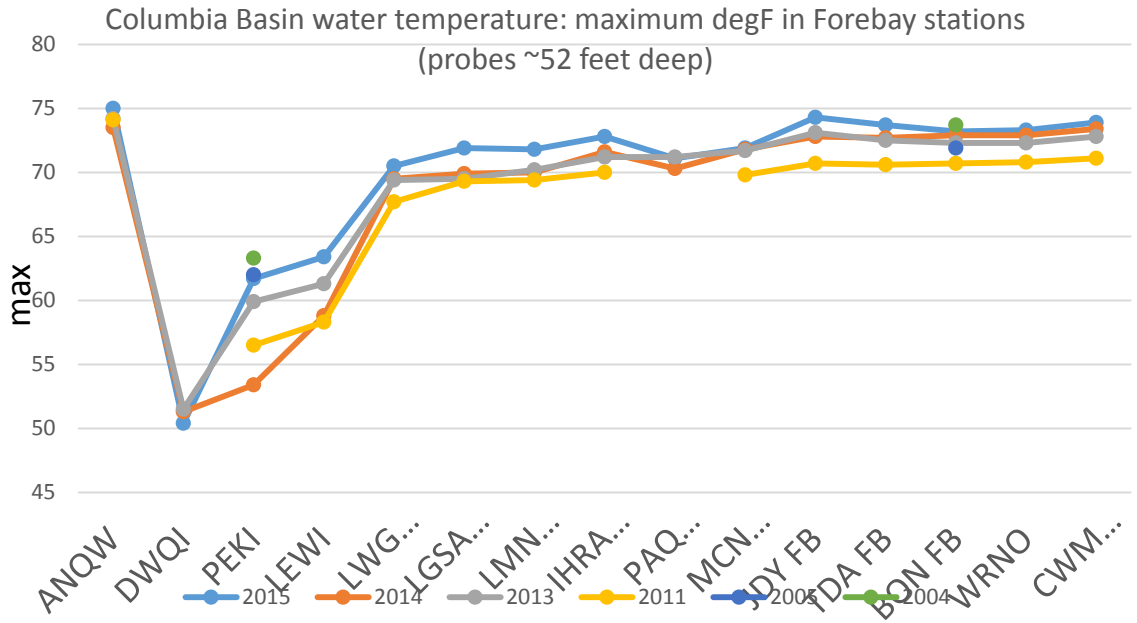
Row Labels	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
April	0		0	0													0
May	0	0	0	0		0								0			0
June	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
July	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
August	0	0	0	0		0	0	0	0	0	0	0		0	0	0	0
September	0	0	0	0		0		0	0	0	0	0		0	0	0	0
October			0											0			0
Grand Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

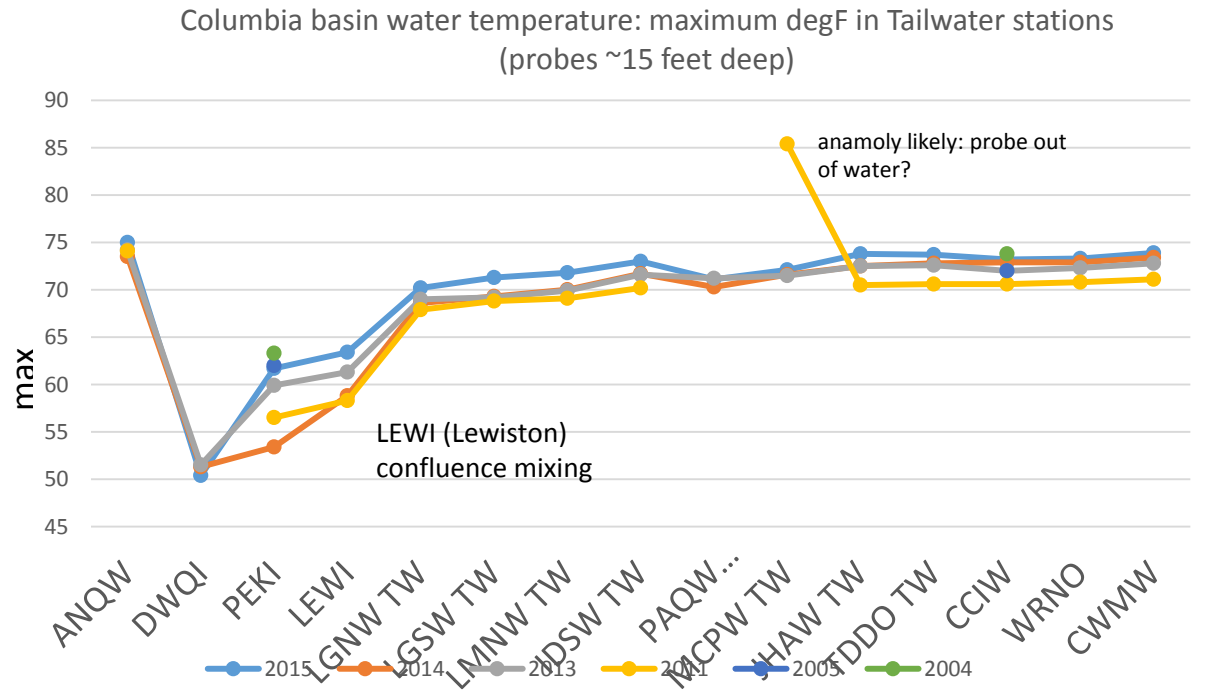
Simple graphing from TMT website/Water Temperature Data button/Temperature Exceedence Summaries button/2015… shows important influence of depth of probes and consistency in depths of probes at each location. Important that trend in exceedance and max temperatures with dates for 2015 (and other years in graphs) shows days exceeding 68degF increases as water is mixed passing through each downriver confluence and each dam spilling to their specific FPP operations (again influenced/represented of depth of probes). http://www.nwd-wc.usace.army.mil/tmt/documents/ops/temp/annual/2015.html

Gauge Name	Gauge ID	Date of First Daily Average Temperature over 68°F	Date of Last Daily Average Temperature over 68°F	Days with Daily Average Temperature over 68°F	Maximum Daily Temperature During Year	Date of Maximum Daily Temperature
Libby Dam and Lake Koocanusa near Libby	LBQM	n/a	n/a	0	58.0°F	Sep 05
Albeni Falls forebay	ALFI	Jun 11	Aug 30	77	76.4°F	Jul 04
Albeni Falls tailwater	ALQI	Jun 11	Sep 01	77	76.5°F	Jul 04
Chief Joseph Dam forebay	CHJ	n/a	n/a	0	67.6°F	Aug 15
Chief Joseph tailwater	CHQW	n/a	n/a	0	67.5°F	Aug 13
Anatone - Snake River Near Anatone	ANQW	Jun 20	Sep 12	80	75.0°F	Aug 13
Dworshak - N. Fork Clearwater R at Ahsahka	DWQI	n/a	n/a	0	50.4°F	Nov 08
Peck - Clearwater River at Peck	PEKI	n/a	n/a	0	61.7°F	Jun 10
Lewiston - Clearwater River near Lewiston	LEWI	n/a	n/a	0	63.4°F	Jun 11
Lower Granite Dam forebay	LWG	Jul 07	Aug 28	24	70.5°F	Aug 23
Lower Granite tailwater - Snake R. below dam	LGNW	Jul 06	Jul 13	8	70.2°F	Jul 10
Little Goose Dam forebay	LGSA	Jun 20	Sep 02	58	71.9°F	Jul 14
Little Goose Dam tailwater (Snake R. below Little Goose)	LGSW	Jun 21	Aug 29	52	71.3°F	Jul 14
Lower Monumental Dam forebay on Snake River	LMNA	Jun 24	Sep 04	73	71.8°F	Jul 18
Lower Monumental tailwater below the dam on Snake River	LMNW	Jun 24	Sep 03	72	71.7°F	Jul 18
Ice Harbor Dam forebay	IHRA	Jun 25	Sep 07	75	72.8°F	Jul 23
Ice Harbor tailwater- Snake R. below Goose Is.	IDSW	Jun 24	Sep 07	76	73.0°F	Jul 13
Pasco - Columbia Rivers	PAQW	Jun 30	Aug 29	56	71.1°F	Aug 13
McNary Dam forebay on Columbia R.	MCNA	Jun 27	Sep 02	68	71.9°F	Jul 12
McNary Dam tailwater on Columbia R.	MCPW	Jun 26	Sep 02	69	72.1°F	Jul 12
John Day Dam forebay	JDY	Jun 24	Sep 12	78	74.3°F	Jul 09
John Day Dam tailwater	JHAW	Jun 24	Sep 07	76	73.8°F	Jul 09
The Dalles Dam forebay on Columbia R.	TDA	Jun 22	Sep 13	81	73.7°F	Jul 10
The Dalles tailwater Downstream	TDDO	Jun 22	Sep 13	81	73.7°F	Jul 10
Bonneville Dam forebay	BON	Jun 24	Sep 13	76	73.2°F	Jul 20
Cascade Island	CCIW	Jun 24	Sep 13	76	73.2°F	Jul 20
Warrendale	WRNO	Jun 24	Sep 13	75	73.3°F	Jul 20
Camas / Washougal	CWMW	Jun 21	Sep 13	80	73.9°F	Jul 20
Systemwide Project-Day Total				1488		


Columbia basin water temperature: number days daily average temp in Forebay stations exceeding 68degF (probe ~52 feet deep)
Day
90
80
70
60
50
40
30
20
10
0
-10
ANQW
DWQI
PEKI
LEWI
LWG FB
LGSA FB
LMNA FB
IHRA FB
PAQW Pasco
MCNA FB
JDY FB
TDA FB
BON FB
WRNO
CWMW
2015
2014
2013
2011
2005
2004


Columbia basin water temperature: number days daily average in Tailwater stations exceeding 68degF (probe ~15 feet deep)
90
80
70
60
50
40
30
20
10
0
ANQW
DWQI
PEKI
LEWI
LGNW TW
LGSW TW
LMNW TW
ADSW TW
PAQW…
MCPW TW
JHAW TW
TDDO TW
CCIW
WRNO
CWMW
2015
2014
2013
2011
2005
2004

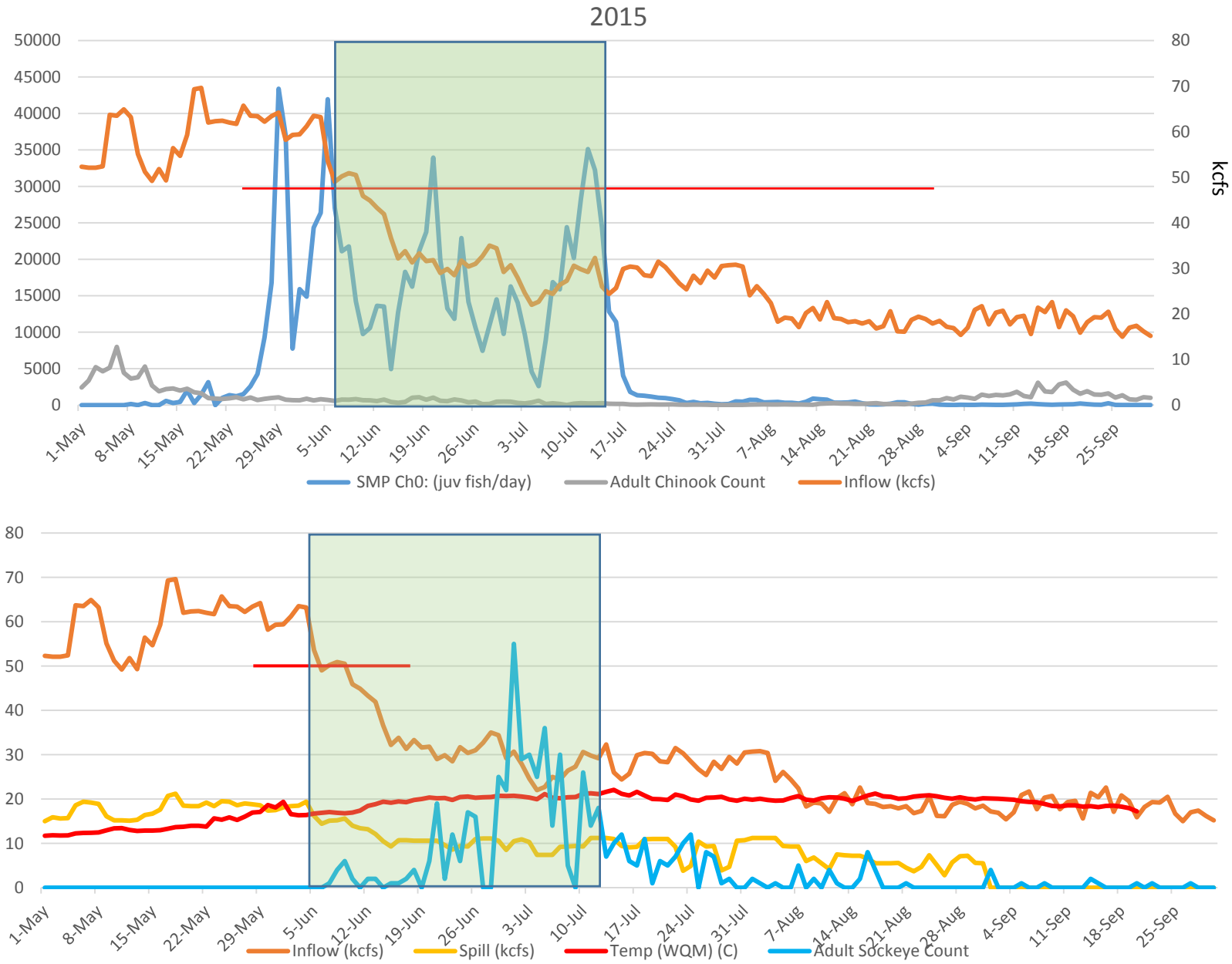

Columbia Basin water temperature: maximum degF in Forebay stations (probes ~52 feet deep)
max
80
75
70
65
60
55
50
45
ANQW
DWQI
PEKI
LEWI
LWG…
LGSA…
LMN…
IHRA…
PAQ…
MCN…
JDY FB
TDA FB
BON FB
WRNO
CWM…
2015
2014
2013
2011
2005
2004


Columbia basin water temperature: maximum degF in Tailwater stations (probes ~15 feet deep)
max
90
85
80
75
70
65
60
55
50
45
anamoly likely: probe out of water?
LEWI (Lewiston) confluence mixing
ANQW
DWQI
PEKI
LEWI
LGNW TW
LGSW TW
LMNW TW
ADSW TW
PAQW…
MCPW TW
JHAW TW
TDDO TW
CCIW
WRNO
CWMW
2015
2014
2013
2011
2005
2004

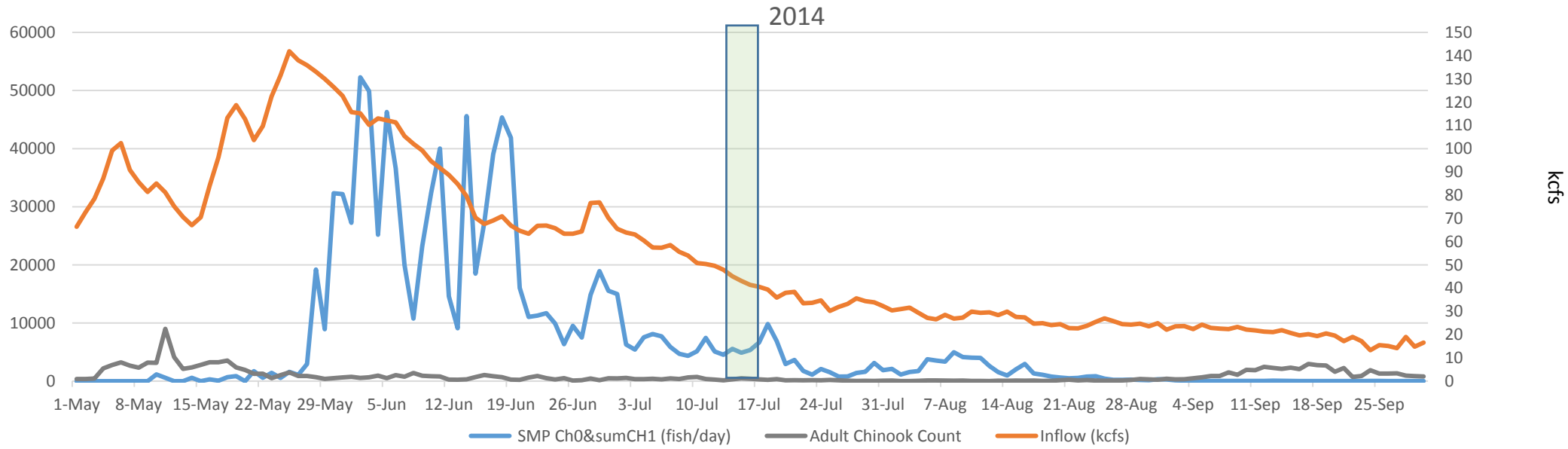
50 Kcfs date and temperature at Little Goose 2001-2015

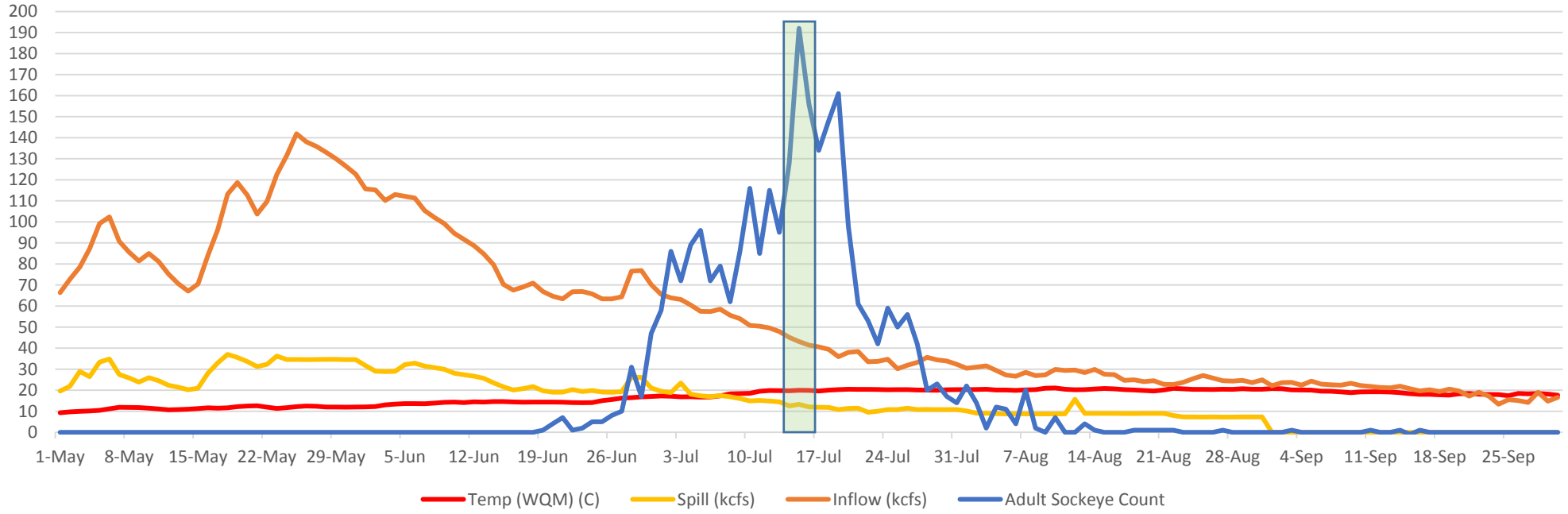
Year	50 Kcfs Date	~ 52’ deep Temperature degC @ 50 Kcfs	
2015	6 JUNE	16.9	
2014	12 JULY	19.9	
2013	16 JUNE	16.6	
2012	5 JULY	17.3	
2011	1 AUGUST	19.6	
2010	12 JULY	17.9	
2009	13 JULY	19.6	
2008	12 JULY	18.2	
2007	15 JUNE	15.1	20 degC ~ 8 JULY
2006	1 JULY	19.6	
2005	12 JUNE	14.3	20 degC ~ 14 JULY
2004	19 JUNE	16.3	20 degC ~ 29 JUNE
2003	25 JUNE	17.4	
2002	3 JULY	17.1	
2001	2 JUNE	15.6	20 degC ~ 6 JULY

50 kcfs = 6 June = 258,565 juv CH0 & sum Ch1 to pass (26.9%) = 16.9 degC = 53,357 Adult Chinook to pass (35.9%) = 260 Adult Sockeye to pass (44.4%).
IDFG Proposal: SW maintained: 6/19 – 7/17; 49% of smolt index affected.

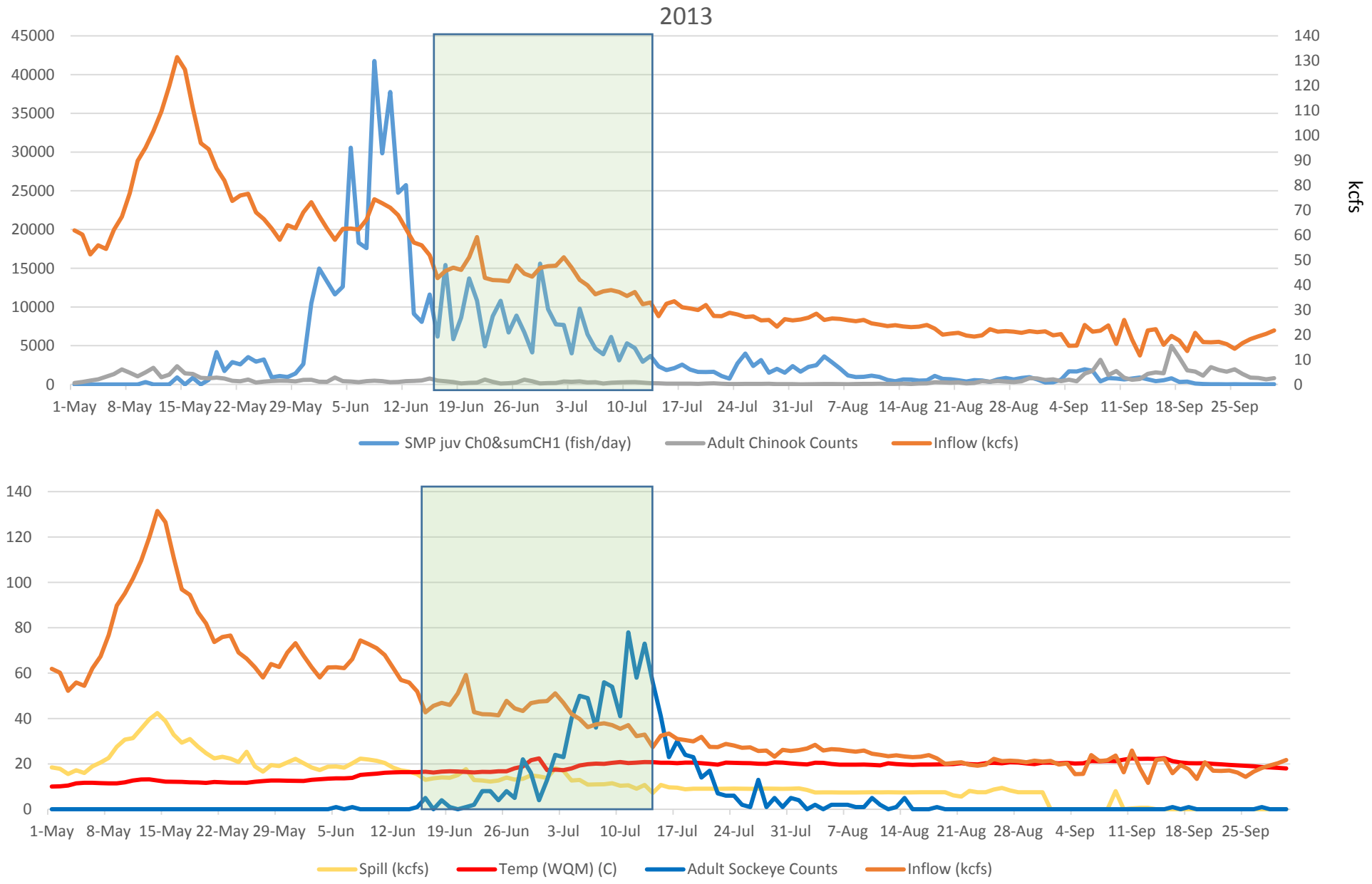


50 kcfs = 12 July = 125,606 juv CH0 & sumCh1 to pass (12.0%) = 19.9 degC = 51,265 Adult Chinook to pass (36.8%) = 1,772 Adult Sockeye to pass (63.0%).
IDFG Proposal: SW maintained: 7/13 – 7/24; 5% of smolt index affected.

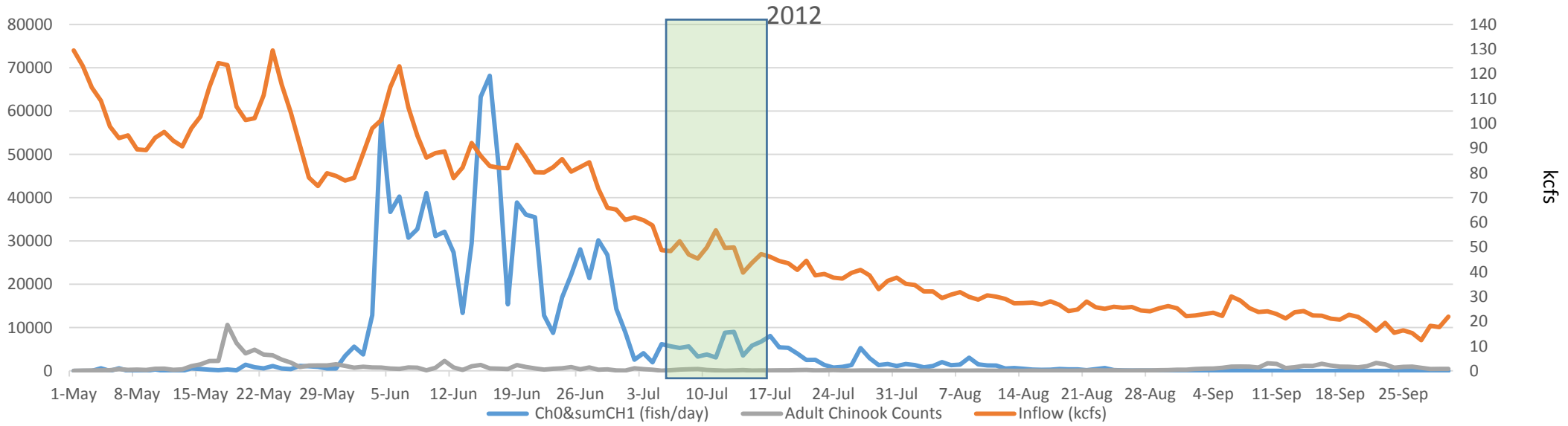


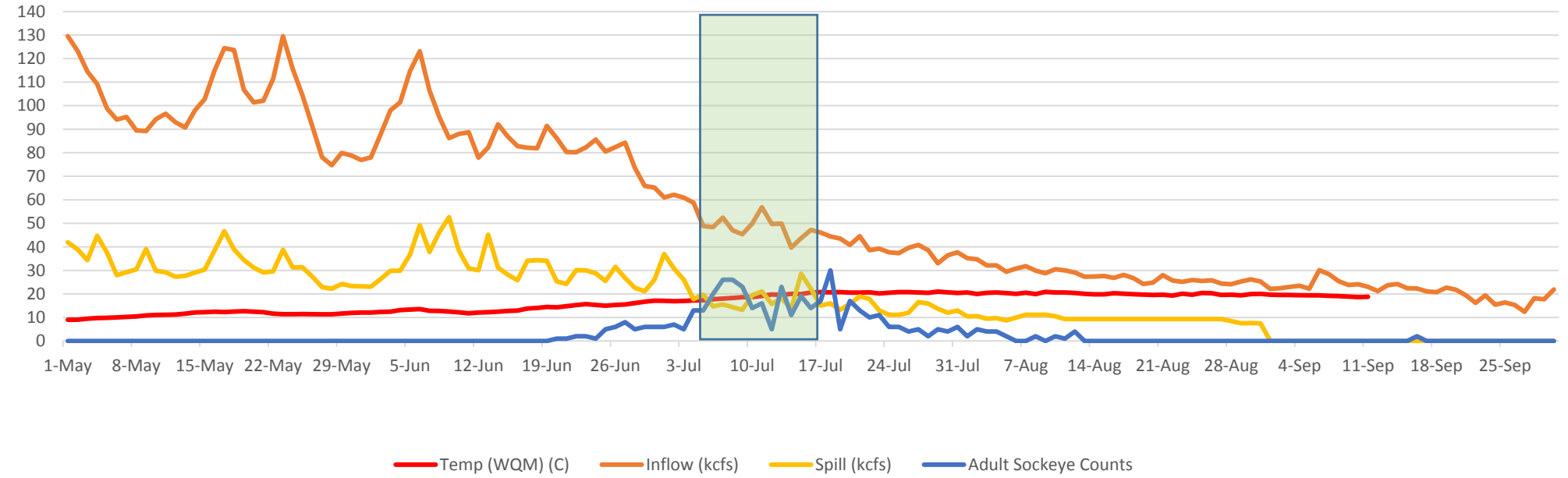


50 kcfs = 16 June = 292,394 juv CH0 & sumCh1 to pass (45.6%) = 16.55 degC = 59,207 Adult Chinook to pass (63.2%) = 989 Adult Sockeye to pass (99.7%).
IDFG Proposal: SW maintained: 6/22 – 7/17; 25% of smolt index affected.



50 kcfs = 5 July = 134,077 juv CH0 & summ Ch1 to pass (12.8%) = 17.3 degC = 35,030 Adult Chinook to pass (31.0%) = 379 Adult Sockeye to pass (83.7%).
IDFG Proposal: SW maintained: 7/13 – 7/22; 5% of smolt index affected.





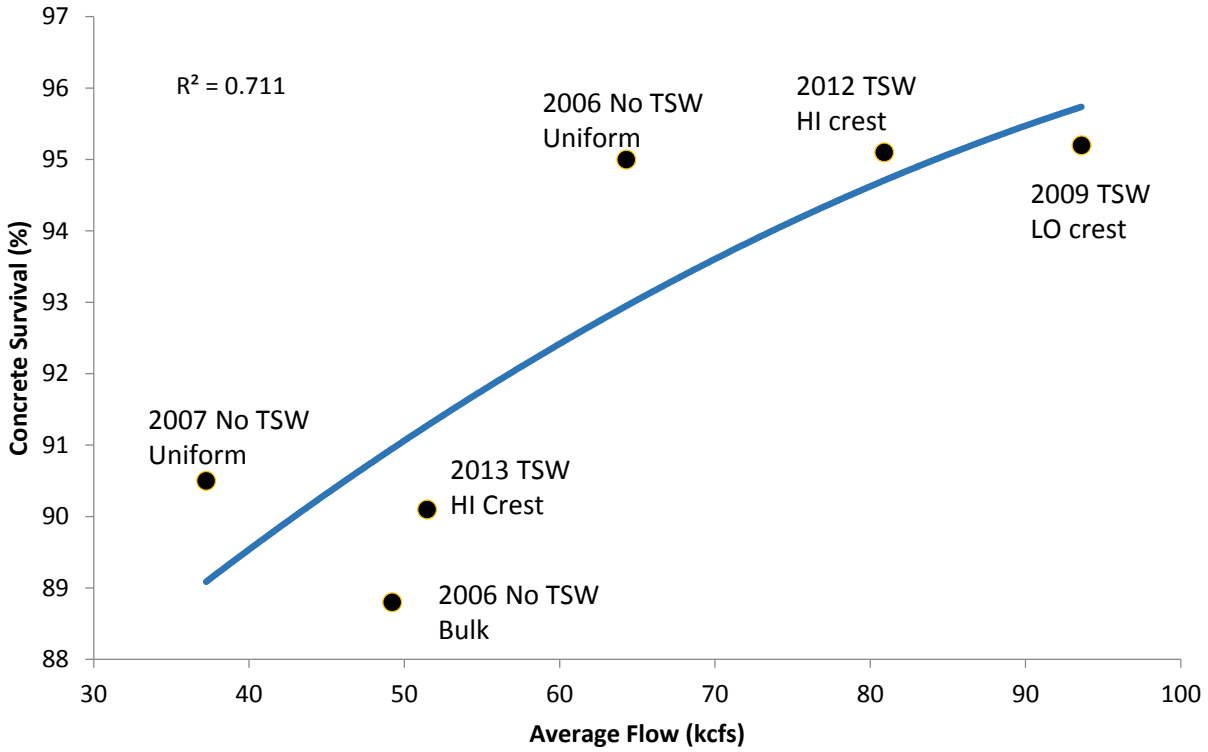


Table 3-4. Dam Operations, Survival, and Flow/Spill Metrics during the Juvenile Survival Studies for Subyearling Fall Chinook Salmon in 2006 through 2013*

Little Goose Subyearlings		Survival	Average Flows	Minimum Flows	Maximum Flows	Average % Spill	Notes
2006	Bulk Spill	88.8	49.22	20.89	86.87	0.305	most losses occur during the day
2013	Overall Spill	90.1	51.46	36.30	74.20	0.304	
2007	Uniform Spill	90.5	37.24	16.09	75.24	0.305	most losses occur during the day
2006	Uniform Spill	95.0	64.29	16.07	150.95	0.277	day/night similar
2012	Overall Spill	95.1	80.90	49.10	123.70	0.385	
2009	Modified Uniform Spill	95.2	93.60	43.70	164.80	0.295	day/night similar

*In order of summer-run migrant subyearling fall Chinook salmon estimated dam survival (Figure 3-1)

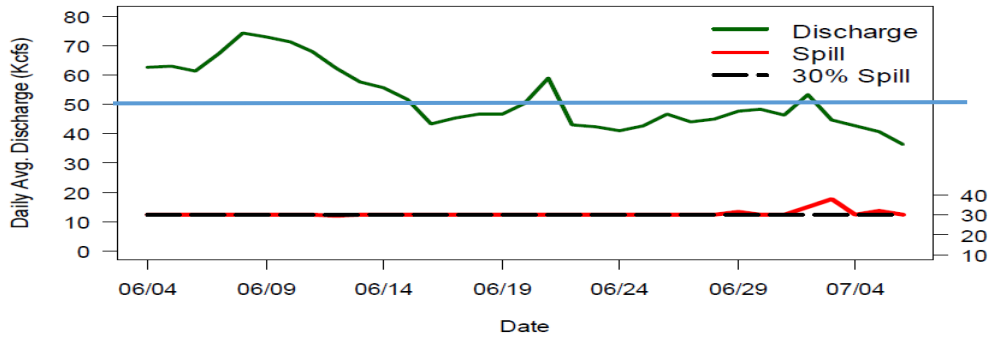
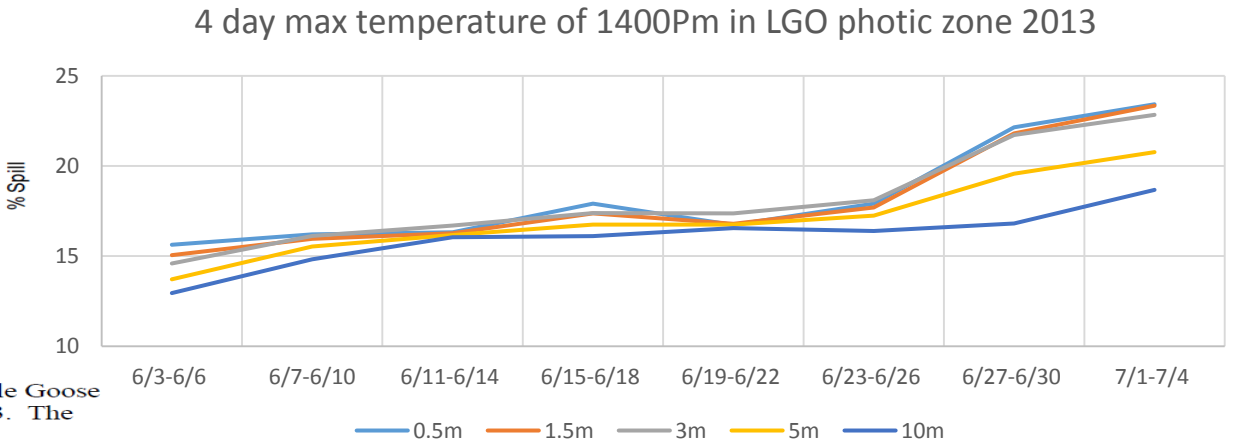


Figure 3.1. Daily average total discharge (kcfs) (green line) and percent spill (red line) at Little Goose Dam during the summer subyearling Chinook salmon study, 4 June to 6 July 2013. The black dashed line represents 30% spill.



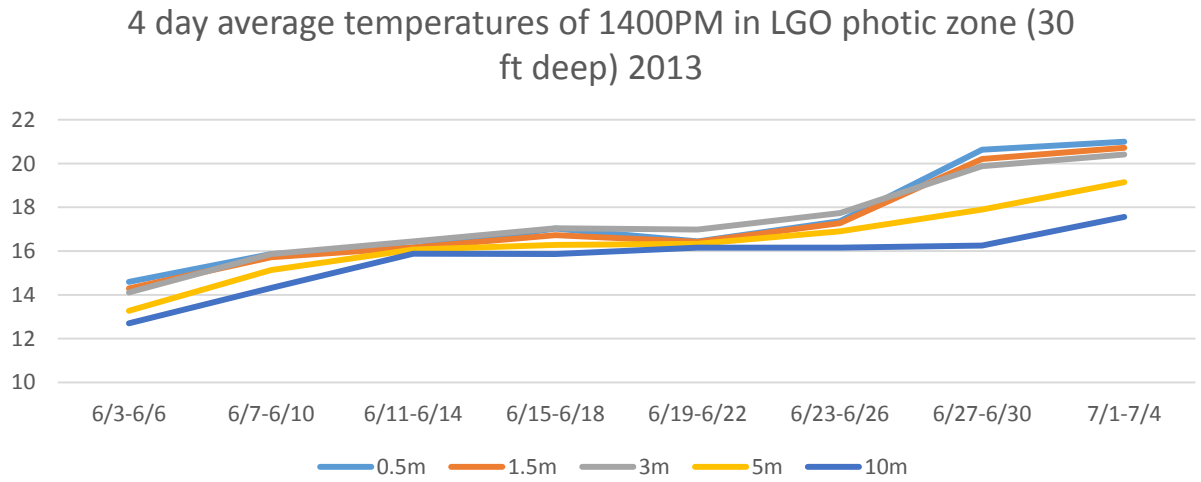
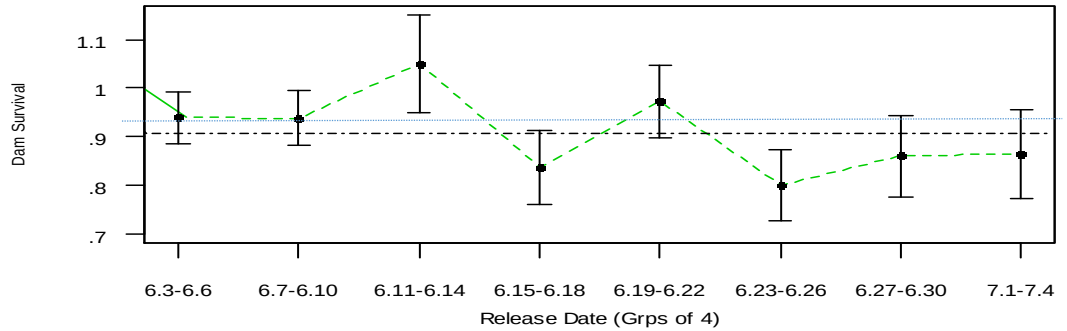
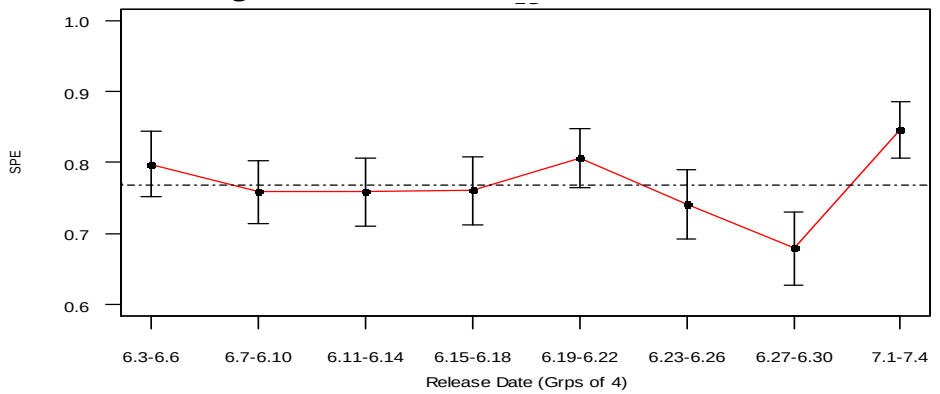


Figure 3-3. Seasonal Trends in Estimates of Dam Passage Survival (S_{Dam}) at Little Goose Dam for Subyearling Chinook Salmon (Summer 2013)*



*Data pooled on a 4-day basis across the study, with 95% CI, are illustrated. The horizontal line is the season-wide estimate.

Figure 3-4. Seasonal Trends in SPE at Little Goose Dam for Subyearling Chinook Salmon during Summer 2013



Route Surv Metrics	2009		2012		2013	
	Prop	Surv	Prop	Surv	Prop	Surv
Spill	0.714 (0.010)	0.963 (0.015)	0.7249 (0.0086)	0.9554 (0.0097)	0.7683 (0.0083)	0.9137 (0.0144)
TSW	0.646 (0.010)	0.975 (0.015)	0.4765 (0.0096)	0.9623 (0.0105)	0.6470 (0.0094)	0.9143 (0.0148)
Deep Training	0.068 (0.005)	0.852 (0.044)	0.2484 (0.0083)	0.9421 (0.0134)	0.1213 (0.0064)	0.9106 (0.0236)
Bypass	0.244 (0.009)	0.908 (0.024)	0.2258 (0.0081)	0.9807 (0.0119)	0.1816 (0.0076)	0.8978 (0.0215)
Turbine	0.042 (0.004)	0.828 (0.096)	0.0493 (0.0042)	0.8128 (0.0370)	0.0502 (0.0043)	0.8402 (0.0388)
Inflow	93.6 (43.7-164.8)		80.9		52.2	

Table A.11. Bivariate logistic regression models explaining the relationship between survival from passage to the array located 33 km downstream and environmental, temporal, operational, and individual variables for tagged subyearling Chinook salmon smolts at Little Goose Dam in 2013. Results (χ^2 and P) of likelihood ratio tests are also shown. * indicates a significant effect at $\alpha = 0.05$.

Parameter	Intercept	SE	Estimate	SE	χ^2	P
PassDay	11.149	1.179	-0.054	0.007	68.787	<0.001*
TRtemp	8.537	0.857	-0.406	0.051	67.058	<0.001*
Hazing	-2.195	0.085	0.613	0.085	65.752	<0.001*
Discharge	-0.002	0.271	0.036	0.005	50.839	<0.001*
TRTDG	27.064	5.996	-0.225	0.053	17.855	<0.001*
ln(TR egress)	1.723	0.193	-0.164	0.062	6.729	0.010*
TagBurden	2.165	0.276	-0.090	0.074	1.492	0.222
FL	0.770	0.891	0.010	0.008	1.457	0.228
%Spill	2.182	0.328	-0.011	0.010	1.080	0.299
PassDiel	-1.813	0.070	0.040	0.070	0.314	0.575
RelativeCond	1.899	1.548	-0.001	0.016	0.002	0.968

During the low flow year of 2013, less than 25% of the acoustic-tagged subyearling Chinook salmon passed Little Goose Dam when discharge was >70 kcfs, less than 50% passed when discharge was >50 kcfs, and the majority passed when discharge was <50 kcfs (and tailrace temperatures were ≥16°C). The single-release survival estimate to the detection array located 33 km downstream of Little Goose Dam was 0.8635 for subyearling Chinook salmon in 2013 (Skalski et al. 2014). Adjusting this estimate by the quotient of the survival estimates of the paired-release groups (0.8297/0.8720 = 0.9514) to account for the additional mortality that occurred between the tailrace and the detection array located 33 km downstream resulted in a dam survival estimate of 0.9076, which was below the BiOp standard. Given a paired-release quotient of 0.9514, a single-release survival probability of 0.885 would have been required to reach the BiOp dam survival standard of 0.93 in 2013. Acoustic-tagged subyearling Chinook salmon that passed Little Goose Dam in 2013 when discharge was >50 kcfs had a single-release survival probability of 0.92 to the array located 33 km downstream, and those that passed when discharge was <50 kcfs had a single-release survival probability of 0.84. Assuming the quotient remained constant over time (which was verified by estimating the single-release survival probabilities for each of 32 blocks of paired releases that occurred throughout the season, calculating the quotient for each block, and fitting a generalized linear model of quotient versus block; $\chi^2 = 0.13$; $P = 0.72$), it can be inferred that the low survival of subyearling Chinook salmon that passed Little Goose Dam during low flow and high temperature (<50 kcfs, ≥16°C) periods was primarily responsible for the low dam survival estimate in 2013.

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We observed high tailrace egress times associated with passage through traditional deep spill routes, particularly at lower discharges (Table 3.8 and Table 3.9). However, long egress times through these routes did not always result in low survival. For example, in 2013, 25 subyearling Chinook salmon passed via traditional deep spill bays during operation 8 with a median tailrace egress time of 202 minutes. However, the group had a 0.96 probability of survival to the detection array located 33 km downstream of Little Goose Dam.

4.3.1 Spillway Weir

The proportion of fish passing via the spillway weir was negatively correlated with variables that were associated with a greater volume of spill and discharge. Deep spill routes are adjacent to and at elevations only a few meters deeper than the spillway weir, so it makes sense that a higher proportion of discharge through those routes could draw passage away from the weir. Higher discharge would also result in more discharge through the turbines, but fewer fish were found at those deeper elevations, so their influence is less obvious. The proportion of fish passing via the spillway weir was positively correlated with variables associated with shallower depths of approach, horizontal (cross-channel) searching behavior, and passage during daylight. In general terms, the variables that were negatively correlated with spillway weir passage were those associated with greater discharge and, therefore, spill, whereas those that were positively correlated with spillway weir passage were more reflective of fish behavior.

4.3.2 Traditional Spill

The proportion of fish passing through traditional (deep) spill openings was positively correlated with variables associated with greater spill discharge and approach near the north (spillway) end of the dam. Horizontal (cross-channel) searching behavior was negatively correlated with the proportion of fish passing through traditional spill. For traditional spill, we found that increasing spill discharge increased the proportion of fish passing via this route, but fish that did more horizontal searching across the river channel were less likely to pass through these bays.

Table 3-5. Juvenile Subyearling Fall Chinook Salmon Dam Survival Metrics, Including Operational and Environmental Co-Variant Metrics, for the Three Summer-Run Migrant Juvenile Salmon Dam Survival Performance Studies in 2009, 2012, and 2013

Dam Survival Metrics	2009	2012	2013
Study period inflow kcfs/% spill	Mean 93.6 (43.7 to 164.8)/mean 29.4% spill day, 29.6% spill night	Mean 80.9 (49.1 to 123.7)/mean 38.5% (29.8% to 61.0%)	Mean 52.2 (36.3 to 74.2)/ mean 30.4% (29.5% to 38.1%)
TSW position	low crest	high crest	high crest
TDG% (tailrace)	Mean 109.4% (105 to 115.7%)	Mean 114.4% (111.4 to 120.2%)	Mean 112.1% (109.9% to 114.0%)
Temperature	13.2°C to 19.3°C	Mean 11.1°C (8.9°C to 12.5°C)	Mean 16.2°C (13.2°C to 19.4°C)
Season-wide summer survival	0.9502 (0.013)	0.9508 (0.0097)	0.9076 (0.0139)
Forebay-to-tailrace survival	0.936 (0.013)	0.9454 (0.0098)	0.9007 (0.0139)
Forebay residence time	Only median reported: Day 4.5 hours (5.03 to 5.79) Night 6.3 hours (5.09 to 7.47) TSW 2.8 hours Spill 3.3 hours Bypass 3.3 hours Turbines 2.7 hours	Mean 7.86 hours (0.56)/median 2.80 hours	Mean 12.27 hours (0.67)/median 3.66 hours)
Tailrace egress time	Mean TSW 0.719 hours (0.042) Spill 1.6 hours (0.23) Turbine 2.1 hours (1.57) Overall 0.67 hours (0.092) Bypass not reported: Median TSW 0.926 hours (0.29 to 0.51) Spill 0.644 (0.56 to 0.74) Turbines 0.478 (0.35 to 0.53) Overall 0.303 (0.29 to 0.32) Bypass not reported	Mean 1.41 hours (0.05)/median 0.78 hours	Mean 3.37 hours (0.55)/median 1.23 hours)
SPE	0.714 (0.010)	0.7249 (0.0086)	0.7683 (0.0083)
FPE	0.958 (0.004)	0.9507 (0.0042)	0.9498 (0.0043)

LGO 2007 Pre-TSW Test- Uniform w/o SB1

Summary Table 3. — Passage and survival estimates of subyearling Chinook salmon at Little Goose Dam by diel period and overall, summer 2007. Probabilities, standard errors (SE) and 95% profile likelihood confidence intervals (95% PCI) are presented. Parameter definitions are listed in Table 1 of the report text.

	Dam operations					
	Overall		Day		Night	
Parameters	Probability(SE)	95% PCI	Probability(SE)	95% PCI	Probability(SE)	95% PCI
S pool	0.865(0.012)	0.841,0.887	0.859(0.013)	0.832,0.884	0.894(0.025)	0.842,0.939
S forebay	0.921(0.011)	0.898,0.942	0.913(0.013)	0.886,0.937	0.956(0.021)	0.906,0.991
S concrete	0.905(0.023)	0.861,0.951	0.891(0.024)	0.843,0.939	1.106(0.135)	0.904,1.474
S dam	0.834(0.023)	0.789,0.880	0.813(0.025)	0.765,0.862	1.058(0.130)	0.861,1.141
S spill	0.918(0.026)	0.868,0.969	0.910(0.026)	0.859,0.962	1.148(0.169)	0.852,1.572
S turbine	0.877(0.087)	0.695,1.029	0.984(0.141)	0.646,1.171	0.972(0.165)	0.681,1.370
S bypass	0.874(0.038)	0.799,0.947	0.793(0.051)	0.690,0.891	1.130(0.141)	0.914,1.510
λ	0.827(0.014)	0.799,0.852	0.831(0.014)	0.803,0.857	0.710(0.082)	0.538,0.848
Pr spill	0.698(0.015)	0.667,0.727	0.810(0.014)	0.780,0.837	0.202(0.032)	0.145,0.269
Pr turbine	0.044(0.007)	0.032,0.058	0.015(0.002)	0.008,0.025	0.172(0.063)	0.120,0.234
Pr bypass	0.258(0.014)	0.231,0.287	0.176(0.013)	0.150,0.204	0.626(0.065)	0.551,0.697
FPE	0.956(0.007)	0.942,0.968	0.985(0.002)	0.975,0.992	0.828(0.063)	0.766,0.880
FGE	0.855(0.021)	0.810,0.893	0.923(0.022)	0.872,0.959	0.784(0.035)	0.710,0.848
SPY [a]	2.278		2.633		0.662	

[a] No standard error or confidence interval presented.

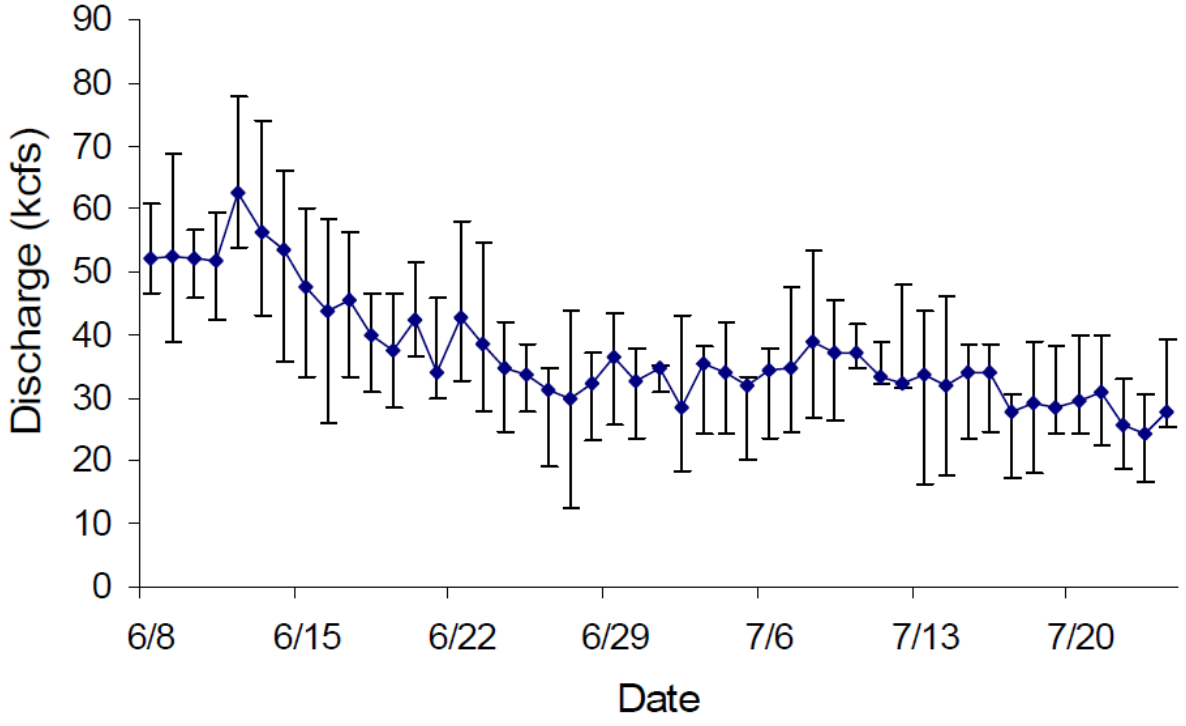

Figure 33. — Mean daily discharge through Little Goose Dam, summer 2007. Whisker bars represent the daily minimum and maximum discharge.

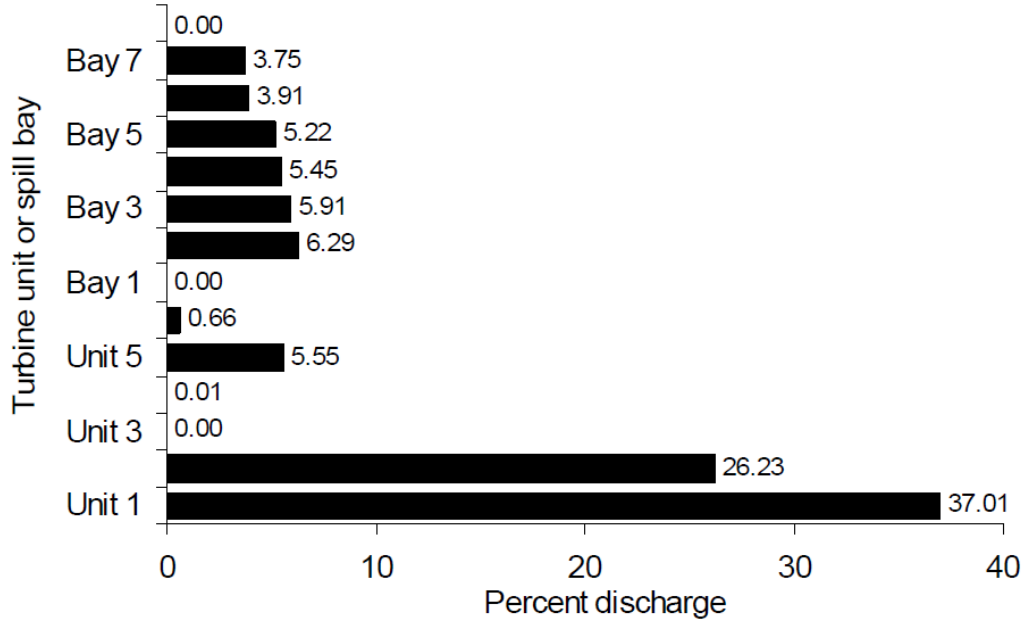

Figure 34. — Percent of total discharge through each turbine unit or spill bay during the Uniform spill pattern at Little Goose Dam, summer 2007.

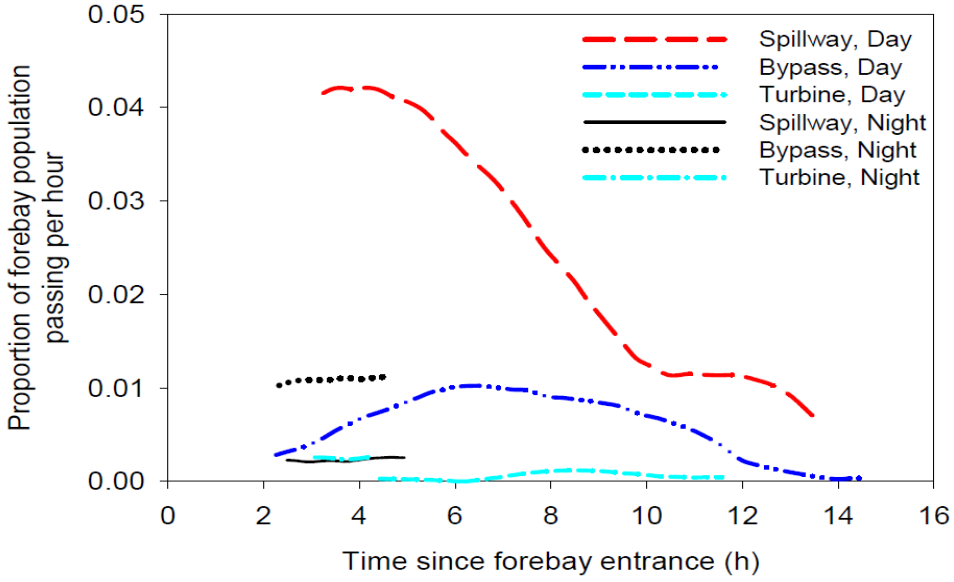

Figure 43. — Rates of dam passage of subyearling Chinook salmon entering the Little Goose Dam forebay during the day (approximately 0430- 2115) and night during 2007.

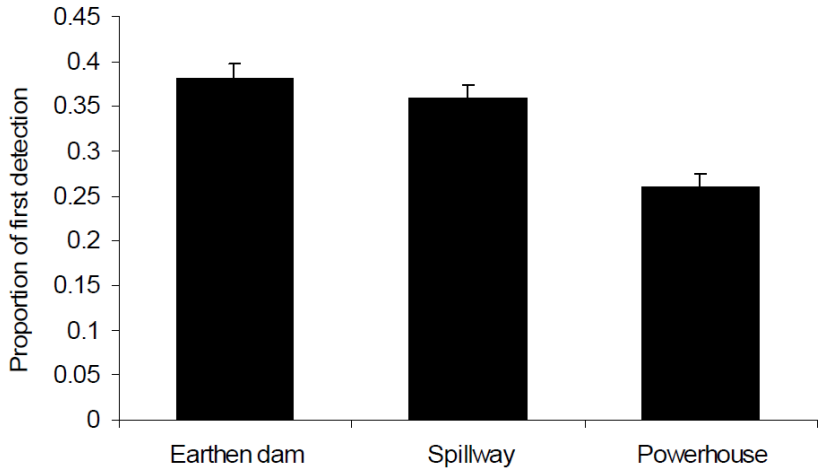

Figure 37. — Areas of first detections of the 876 subyearling Chinook salmon detected within about 100 m of the dam (aerial antennas) during Uniform spill operation, summer 2007.

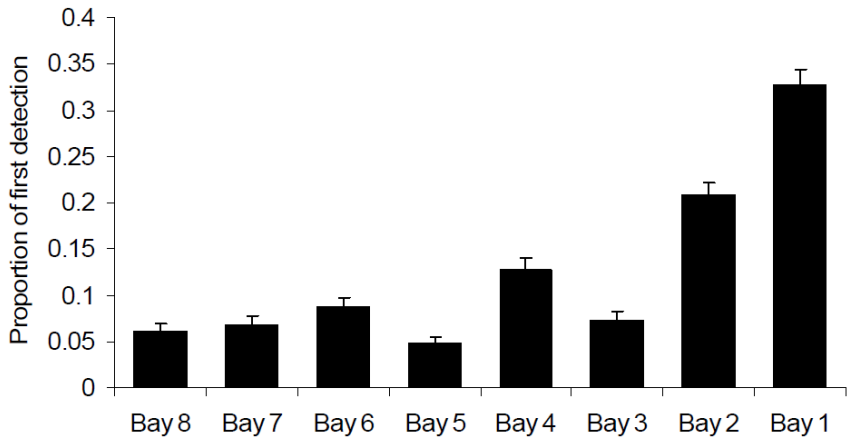

Figure 38. — Areas of first detections of the 810 subyearling Chinook salmon detected within about 6 m of the spillway (underwater antennas located at 178 m and 178.5 m elevation at mean sea level) at Little Goose Dam by spill bay during Uniform spill operation, summer 2007.

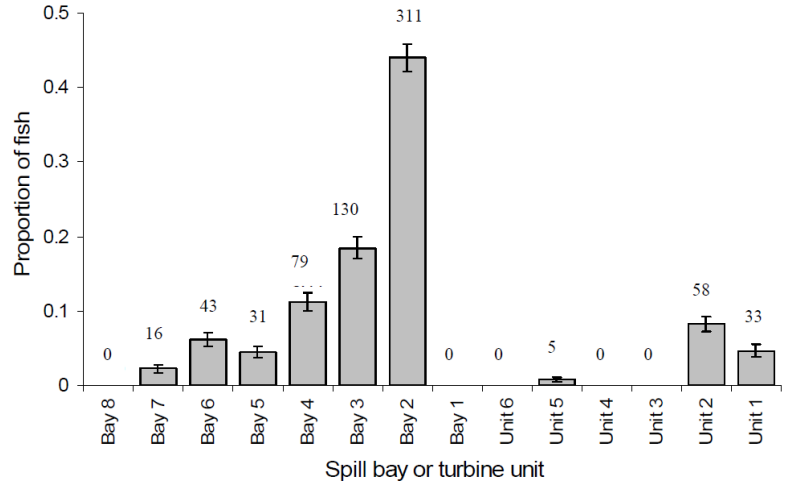

Figure 44. — Proportion of subyearling Chinook salmon passing through each spill bay or turbine unit at Little Goose Dam, summer 2007. Whisker bars represent the standard error of a proportion and numbers above bars are sample sizes.

LGO Day vs Night 2012-2013 – Higher proportion daytime, not nighttime

Table 3.2. Numbers, percentages, and passage rates (fish/h) of acoustic-tagged subyearling Chinook salmon that passed each route at Little Goose Dam in 2012 and 2013 overall and by diel period.

	2012						2013					
	Day		Night		Day+Night		Day		Night		Day+Night	
Route	*N* (%)	Fish /h	*N* (%)	Fish /h	*N* (%)	Fish /h	*N* (%)	Fish /h	*N* (%)	Fish/h	*N* (%)	Fish /h
TSW	1083 (61)	2.00	203 (23)	0.92	1286 (48)	1.69	1474 (75)	2.67	190 (34)	0.83	1664 (66)	2.13
Traditional spill	454 (26)	0.84	215 (24)	0.97	669 (25)	0.88	264 (13)	0.48	48 (9)	0.21	312 (12)	0.40
Powerhouse	238 (13)	0.44	484 (54)	2.18	722 (27)	0.95	232 (12)	0.42	326 (58)	1.42	558 (22)	0.72
All routes	1775 (66)	3.28	902 (34)	4.07	2677	3.51	1970 (78)	3.57	564 (22)	2.46	2534	3.25

Table 3.3. Numbers and percentages of acoustic-tagged subyearling Chinook salmon that passed via each powerhouse route at Little Goose Dam in 2012 and 2013 overall and by diel period.

	2012			2013		
Route	Day	Night	Day+Night	Day	Night	Day+Night
JBS	205 (86%)	384 (79%)	589 (82%)	206 (89%)	223 (68%)	429 (77%)
Turbine	33 (14%)	100 (21%)	133 (18%)	26 (11%)	103 (32%)	129 (23%)
Total	238	484	722	232	326	558

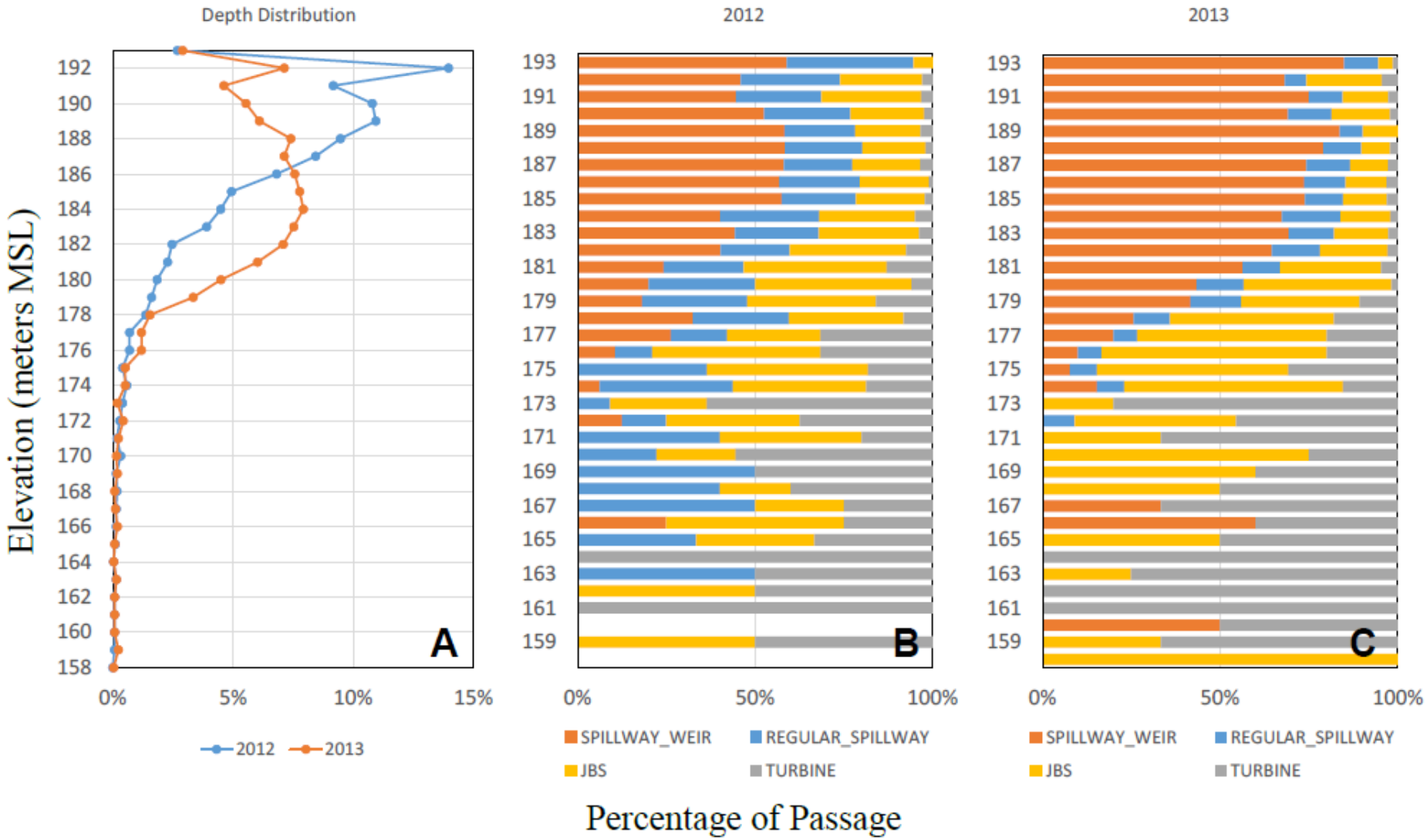

Figure 3.1. Vertical distributions of acoustic-tagged subyearling Chinook salmon that passed Little Goose Dam in 2012 and 2013 (A), 2012 routes of passage (B), and 2013 routes of passage (C).

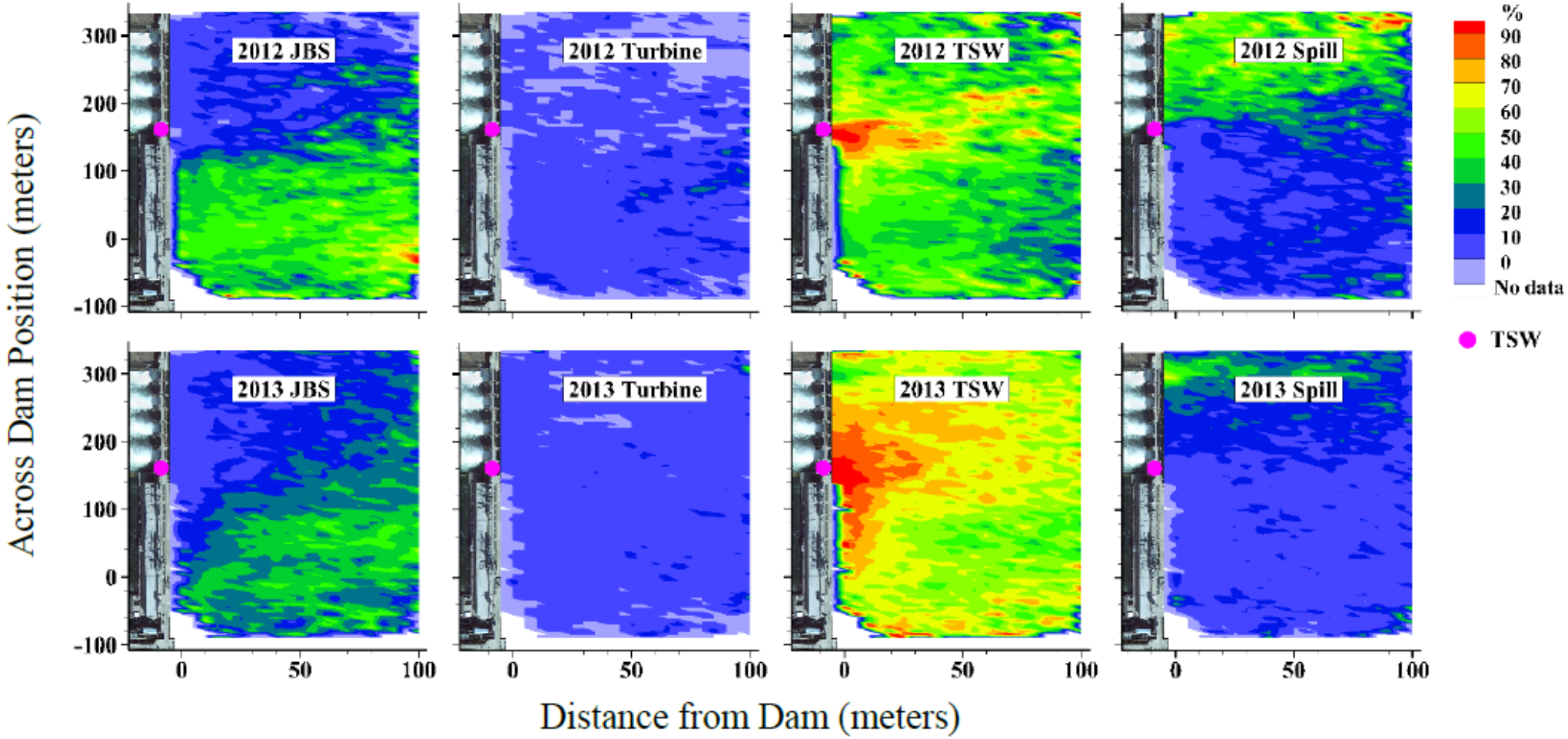

Figure 3.2. Passage probabilities by forebay location and route for acoustic-tagged subyearling Chinook salmon detected at depths between 7.5 m and 12.5 m from the water surface at Little Goose Dam in 2012 (top) and 2013 (bottom). The aerial photo incorporated on the left side of each plot illustrates the location of the spillway near the top of the axis and the powerhouse at the bottom of the axis. The temporary spillway weir is located at the first spill bay nearest the powerhouse and is marked with a pink dot overlaid onto the aerial photo.