A Study To Compare Return Rates of Snake River Fall Chinook Salmon Under Alternative Transport and Dam Operational Strategies

Migration Years 2005-2008

Anadromous Fish Evaluation Program
Annual Review
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- Background - 2001-2004 Studies
  - Reservoir-Type Life History

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    Don't complete migration as subyearlings

    Some migrate while bypass systems are dewatered

    Still in the river in the fall

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  - Conventional Methods Biased Because Survival Estimate Is Compromised

New Study Design

Figure 3. NOAA Proposal (December 2004 Revision)

Single pool of PIT-tagged hatchery fish (n = 175,568)

Group TWI: Designated for transport (50.0%)

Group BWI: Designated for in-river (50.0 %)

At all collector dams: Transport every Group TWI fish collected; return to river every Group BWI fish collected

Primary Analysis
- **Return Rate Group TWI**
- **Return Rate Group BWI**
- **Compare Return Rates**

Secondary Analysis
- **Return rate transport LGR-LGR**
- **Return rate inriver LGR-LGR**
- **"Conventional" T:B**

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Table 1.2. Detection history categories, with abbreviated codes.

Code	Description
ND	Never Detected at any site following release.
ND-D	Not detected at any collector dam, but detected at at least one non-collector dam.
H	Detected in spring of year after release (holdover, or reservoir-type)
U	Detected in bypass system(s) but disposition cannot be determined.
I	Detected in bypass systems(s), with detection history that is illogical in some way.
BE	Detected in bypass system(s) before transportation began (therefore returned to river).
BL	Detected in bypass system(s) after transportation ended (therefore returned to river).
B	Detected in at least one bypass system during the period in which transportation was an option, not transported.
T	Detected in a bypass system during the period in which transportation was an option, transported.

New Study Design
"TWI vs. BWI"

TWI = "Transport With Inriver" Strategy

BWI = "Bypass With Inriver" Strategy

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- Hatchery Production Yearlings
- Run-of-River in September/October

Steps of Analysis

2006 Clearwater Surrogates

Release date	River	BWI Number	BWI Fork length	TWI Number	TWI Fork length
6/19/2006	ClwR	3,248	74.5	3,239	74.5
6/20/2006	ClwR	3,229	74.0	3,237	74.1
6/21/2006	ClwR	3,222	73.9	3,260	74.0
6/22/2006	ClwR	3,255	74.0	3,211	74.0
6/23/2006	ClwR	3,232	74.8	3,232	74.9
6/26/2006	ClwR	3,223	76.1	3,244	76.1
6/27/2006	ClwR	3,233	76.7	3,234	76.8
6/28/2006	ClwR	3,227	76.5	3,219	76.4
6/29/2006	ClwR	3,234	77.5	3,238	77.4
6/30/2006	ClwR	3,235	78.6	3,236	78.6
7/5/2006	ClwR	3,227	80.3	3,233	80.2
7/6/2006	ClwR	3,226	81.1	3,238	81.1
7/7/2006	ClwR	3,240	80.3	3,226	80.5
7/8/2006	ClwR	3,235	82.4	3,228	82.5
7/9/2006	ClwR	2,997	81.0	2,985	81.1
Total		48,263		48,260	

Steps of Analysis

2006 Clearwater Surrogates

- Check that common detection histories are proportional

	Never detected	Not Det. at Collector; Bypassed at Non-Collector	Reservoir Type (Det. in 2007)	Bypassed Before Transportation Began	Bypassed After Transportation Ended	In Collector Bypass During Transportation Program (Transported + Bypassed)
TWI	44,589	227	525	0	1,185	1,717
BWI	44,577	216	511	0	1,150	1,804

$\chi 2 = 3.14$ (4 d.f); $P = 0.54$

Steps of Analysis

2006 Clearwater Surrogates

- Check that common detection histories have equal return rates

Category	Group	Juveniles	Adults	% Return	χ^2-statistic	P value
Never Detected	TWI	44,589	36	0.081%	0.014	0.906
	BWI	44,577	34	0.076%		
Not Det. At Coll; Byp. at Non-Coll.	TWI	227	4	1.762%	1.482	0.223
	BWI	216	9	4.167%		
Reservoir Type	TWI	525	26	4.952%	0.423	0.516
	BWI	511	31	6.067%		
Bypassed Before Transport Began	TWI	0	0	-	NA	NA
	BWI	0	0	-		
Bypassed After Transport Ended	TWI	1,185	31	2.616%	1.329	0.249
	BWI	1,150	21	1.826%		
Bypassed During Transport	TWI	147	3	2.041%	NA – exact test used	0.434
	BWI	1,531	19	1.241%		
Transported	TWI	1,570	36	2.293%	0.607	0.436
	BWI	273	9	3.297%		

Steps of Analysis

2006 Clearwater Surrogates

- Adjust total adult count to correct for misdirected fish

  - If all had been routed correctly:

    - 39 TWI adults (36 transported and 3 bypassed from 147 juveniles) would have been 39.59

    - 28 BWI adults (19 bypassed and 9 transported from 273 juveniles) would have been 22.58

Steps of Analysis

2006 Clearwater Surrogates

- Total up adults, with correction, and calculate rates and ratio

Group	Rel	Adults									Percent Return	TWI:BWI	P
		ND	ND-D	H	U+I	BE	BL	T	B	Tot			
TWI	48,260	36	4	26	0	0	31	39.59	0	136.59	0.283%	1.162 (0.938, 1.431)	0.252
BWI	48,263	34	9	31	0	0	21	0	22.58	117.58	0.244%		

Summary of TWI:BWI Results

2006 and 2008 Releases

	Year	Return %		TWI:BWI	P	Holdover %	
		TWI	BWI			% of Rel	% of Det
Surrogates							
Snake	2006	0.21%	0.18%	1.175 (1.008, 1.369)	0.088	0.02%	0.07%
	2008	0.69%	0.57%	1.213 (1.107, 1.327)	<0.001	0.08%	0.31%
Clearwater	2006	0.28%	0.24%	1.162 (0.938, 1.431)	0.252	1.07%	14.08%
	2008	0.41%	0.35%	1.156 (0.982, 1.369)	0.154	1.75%	16.73%

Summary of TWI:BWI Results

2006 and 2008 Releases

	Year	Return % TWI	Return % BWI	TWI:BWI	P	Holdover % % of Rel	Holdover % % of Det
Production Subyearlings							
Snake	2006	0.25%	0.39%	0.627 (0.501, 0.803)	0.002	0.003%	0.005%
	2008	1.45%	1.40%	1.032 (0.965, 1.105)	0.404	0.01%	0.01%
Clearwater	2006	0.72%	0.79%	0.919 (0.778, 1.084)	0.380	0.01%	0.02%
	2008	1.45%	1.18%	1.226 (1.082, 1.386)	0.008	0.06%	0.15%
Production Yearlings							
Snake	2008	3.34%	3.19%	1.048 (0.940, 1.187)	0.438	0	0
Clearwater	2008	2.64%	2.15%	1.226 (1.026, 1.514)	0.058	0	0

Summary of TWI:BWI Results
2005 and 2007

- 2007
  - Didn't get fish for TWI:BWI releases
  - Did get fish for late releases

- 2005
  - Released fish intended as surrogates
  - Surrogate rearing protocol not possible
  - Not considered a valid test of transportation; not showing results here

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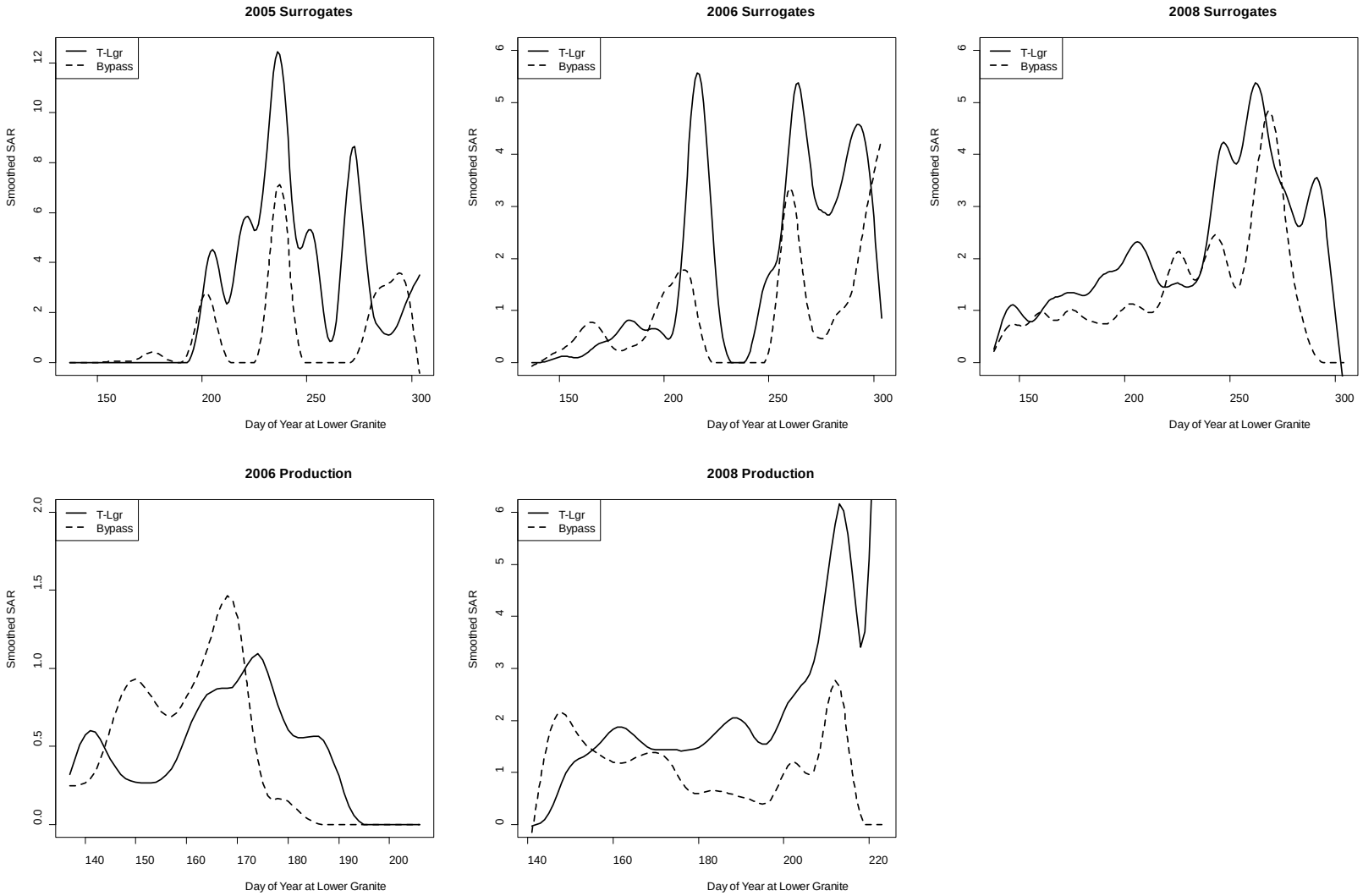
Preliminary Seasonal Analysis



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- Analyses of Age of Ocean Entry (Scale Analysis) and Age at Return
- Comparison of TWI:BWI Method vs. Other Approaches
  - Overwintering Model (Lowther et al); Comparative Survival Study; Other?
  - Data Sets Discussed Here
  - Simulated Data Sets
  - Investigate Different Rates of Reservoir Types, Different Rates of Unmonitored Winter Passage

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- TWI% > BWI% for surrogates in 2006 and 2008, significantly so for Snake River releases
- TWI% > BWI% for yearlings in 2008, significantly so for Clearwater River releases
- Results mixed for production subyearlings

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- Need to investigate relative power; degree to which reservoir-type biases other methods
  - Tools to do investigation have been built and are ready to go

Late-Season Releases

- Run-of-River Fish Tagged at LGR in September and October

		Number of fish released		
Yeat	Goal	Total	Transport	Inriver migrant
2005	2,500	2,550	2,550	na
2006	2,500	2,306	2,306	na
2007	10,000	8,717	4,357	4,360
2008	10,000	11,264	5,393	5,871

Late-Season Releases

Detection history	2007		2008	
	n	Percent	n	Percent
Total Released	4,360		5,871	
Subyearling Detection Only	326	7.5%	1,067	18.2%
Bypass	324		1,062	
Transport	2		5	
Holdover	1,249	28.6%	987	16.8%
Bypass	1,247		987	
Transport	2		0	
Not detected	2,785	63.9%	3,817	65.0%

Late-Season Releases

Table X3. Results for scale samples taken during the 2008-2010 return years from returning adults tagged in 2007 and 2008 at Lower Granite Dam. Adult age class is the difference between return year and brood year; AOE-0 and AOE-1 adults in the same age class spent different amounts of time in the ocean. Also shown are the total adult counts by age class ("Total Return"), based on PIT-tag detections at Lower Granite Dam.

			Returning fish						
Year	Group	Age of ocean entry	Total adults	Age-1	Age-2	Age-3	Age-4	Age-5
2007	Migrant	Total Return	244	54	62	93	35	0
		AOE-0	9%	3%	20%	12%	--	--
		AOE-1	91%	97%	80%	88%	--	--
	Transport	Total Return	250	69	90	72	19	0
		AOE-0	7%	2%	25%	11%	--	--
		AOE-1	93%	98%	75%	89%	--	--
2008	Migrant	Total Return	86	9	18	34	25	--
		AOE-0	14%	0%	15%	--	--	--
		AOE-1	86%	100%	85%	--	--	--
	Transport	Total Return	195	31	46	86	32	--
		AOE-0	79%	100%	79%	--	--	--
		AOE-1	21%	0%	21%	--	--	--

Late-Season Releases

Table 4.4. Juveniles, adult returns, and adult return rates for fish tagged at Lower Granite Dam in September and October, 2002-2008.

Study year	Group	Juveniles	Adults	Return %	T/M (90% CI)
2002	Transport	2,500	123	4.92	
2003	Transport	2,552	100	3.92	
2004	Transport	2,544	48	1.89	
2005	Transport	2,550	90	3.53	
2006	Transport	2,306	85	3.69	
2007	Transport	4,357	250	5.74	1.03 (0.89, 1.18)
	Migrant	4,360	244	5.60	
2008*	Transport	5,393	195	3.62	2.47 (2.01, 3.10)
	Migrant	5,871	86	1.46	

Late-Season Releases

Year	History	Juveniles	Adults	Return %
2007	Subyearling Detection Only	326	13	3.99%
	Holdover	1,249	112	8.97%
	Not Detected	2,785	119	4.27%
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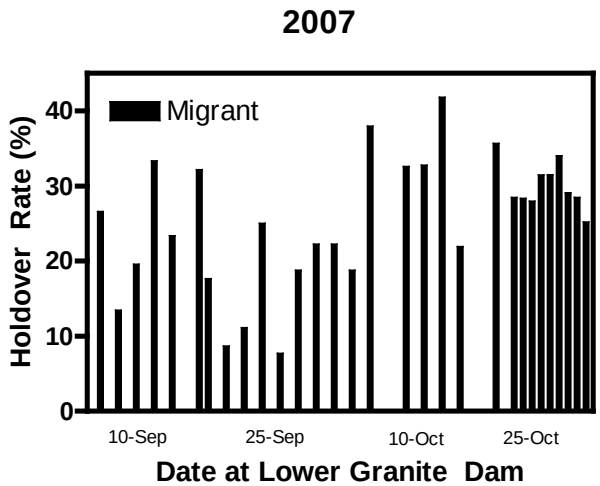
	Holdover	987	22	2.23%
	Not Detected	3,817	37	0.97%

Late-Season Releases



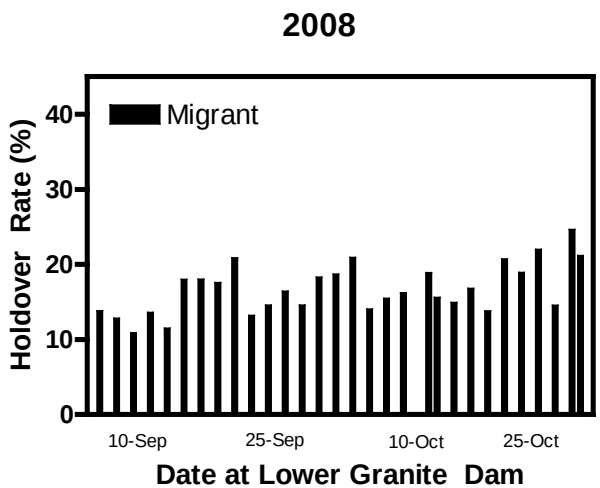
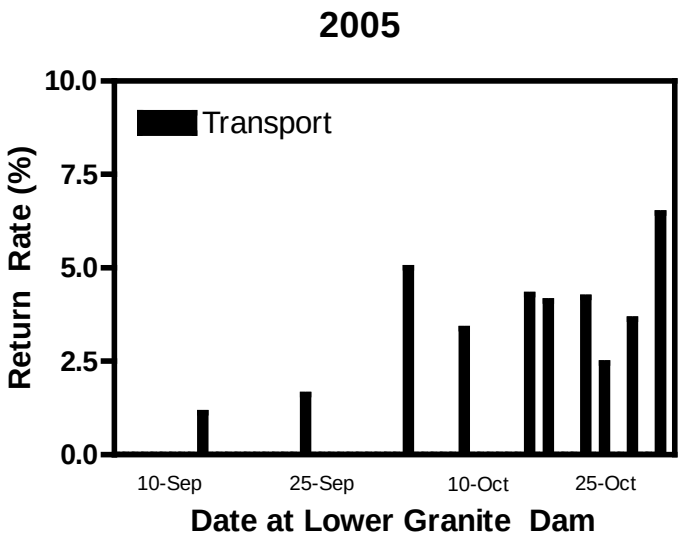
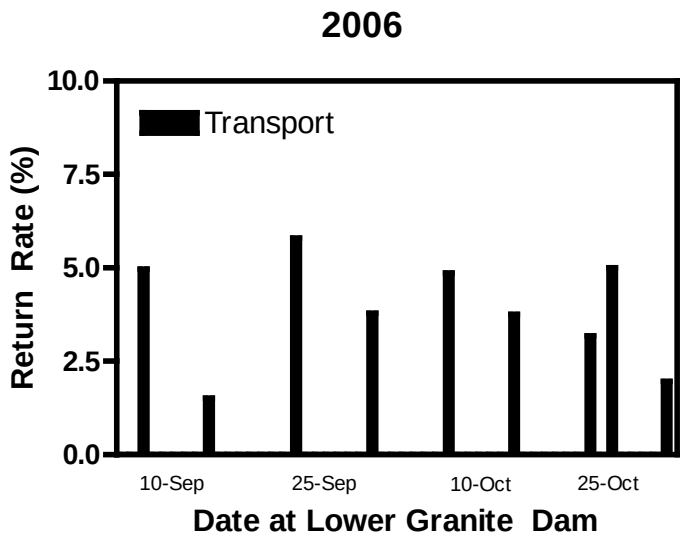
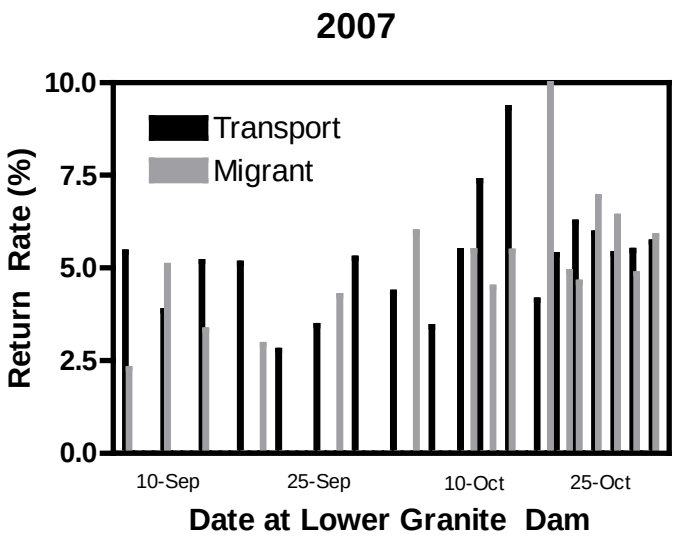


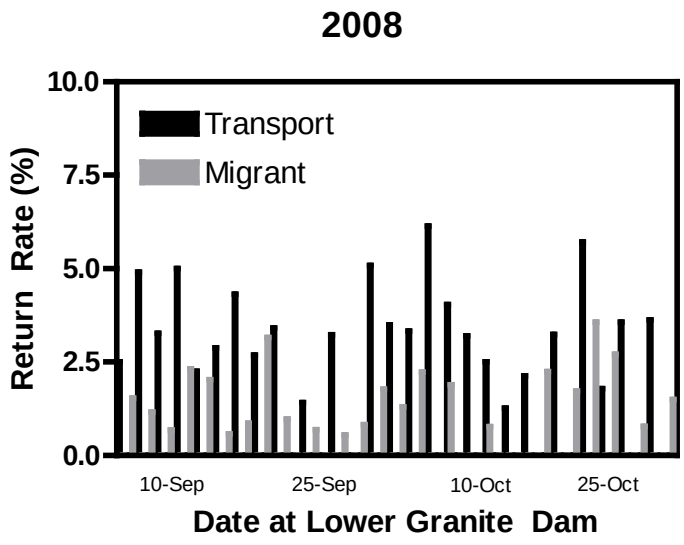
Figure X2. Percentage of fish from migrant release group that were detected in the spring after release (holdover rate) by date of release at Lower Granite Dam.

Late-Season Releases









Questions?