Evaluating the Responses of Snake & Columbia River Basin Fall Chinook Salmon to Dam Passage Strategies & Experiences

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Background

- Hydrosystem operations and transportation strategies affect the behavior and survival of Fall Chinook salmon
- Disagreement between entities on what and how to study
- Multiyear effort to develop consensus approach
- U.S. v Oregon parties and COE agreed to a long-term (2008-2017) consensus study to evaluate SR FACH dam passage strategies in 2007

Scope of Study

- Would bypassing or transporting individuals collected in the bypass systems result in a higher SAR for the Snake River fall Chinook population?
- What is the relative performance of in-river fish (i.e. spilled and passed via surface bypass) versus transported fish?

- What are the corresponding SARs under various conditions, various FCRPS entry points, and various routes of passage?
- How do various juvenile migration life history approaches contribute to population level status and trends?

Study Design

- Tag several groups of juvenile fish each year (2008-2012):
  - Natural tag numbers too low: use of surrogates (special rearing protocol) to try and replicate natural fish size and migration timing
- Holdover strategy presents a potential analytical challenge
- PIT-tagged juveniles randomly assigned to be transported or bypassed if collected
- Adult returns expected through 2017

Nine Mark/Release Groups (5 years of marking)

1. Snake Basin Surrogate Subyearlings (328,000)
2. Snake Basin Production Subyearlings (250,000)
3. Snake Basin Production Yearlings (57,000)
4. Snake Basin Natural Subyearlings (20,000)
5. Hanford Reach natural Subyearlings (20,000)
6. Deschutes River Natural Subyearlings (10,000)
7. Little White Salmon Production Subyearlings (25,000)
8. Lyons Ferry Hatchery Yearlings (30,000)
9. Lyons Ferry Hatchery Subyearlings (45,000)

Analytical Approaches

1. Management Strategy Comparison
   - transportation with summer spill/surface bypass (TWS)
   - screen bypass with summer spill/surface bypass (BWS)
2. Passage Experience
   - transportation from a collector dam (“T0” group)
   - passage undetected through spillways and turbines but not through juvenile collection and bypass systems at all four collector dams (“C0” group)
   - collection and bypass back to the river at one or more juvenile fish bypass systems at collector dams (“C1” group)
3. Columbia vs Snake River Population Performance and Behavior Comparisons (Down River-Up River)

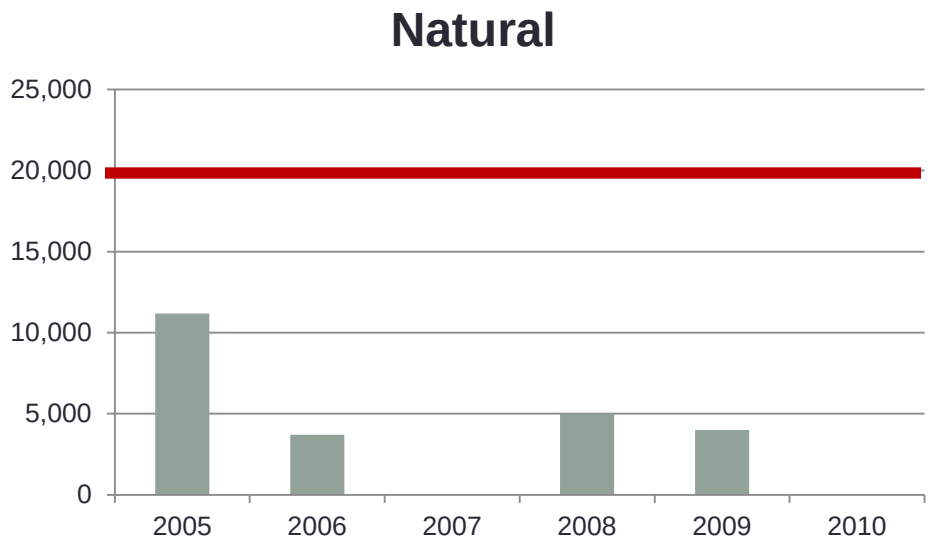
Evaluation Variables for Natural & Surrogate Fish

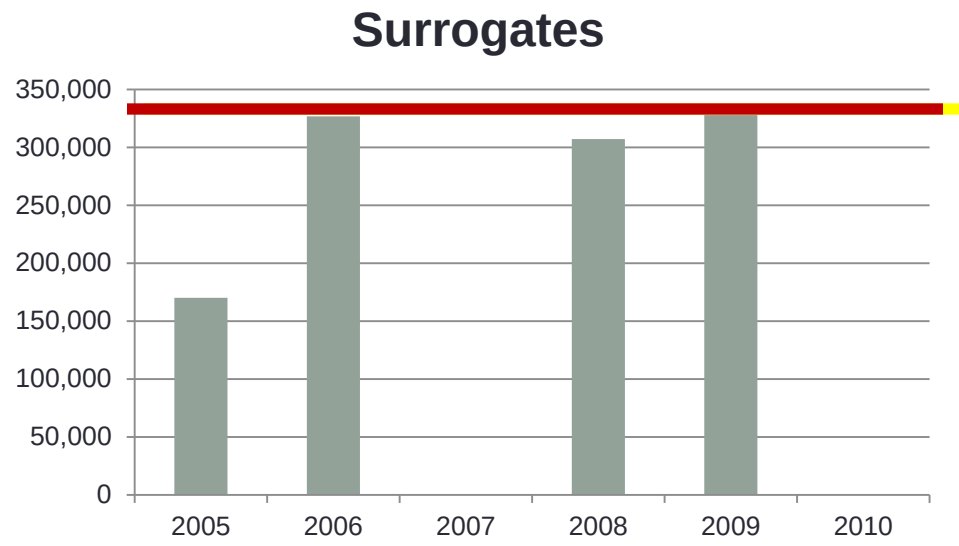
Variable Evaluated	Snake River Population		Snake River Subpopulation		Clearwater River Subpopulation	
	Surrogate	Natural	Surrogate	Natural	Surrogate	Natural
SARs for passage strategies and passage-experience groups (can also be analyzed by dam)						
TWS [a]	**X**	0	x	0	x	0
BWS	**X**	0	x	0	x	0
Transported (T_0)	**X**	0	x	0	x	0
Undetected (C_0)	A	0	a	0	a	0
Bypassed (C_1)	**X**	0	x	0	x	0
Jun to Aug (T_0,C_1)	x	0	x	0	x	0
Sep to Dec (T_0,C_1)	x	0	0	0	x	0
Ratios of SARs						
T/I	**X**	0	x	0	x	0
T_0/C_0	A	0	a	0	a	0
T_0/C_1	**X**	0	x	0	x	0
C_0/C_1	A	0	a	0	a	0
Post-release attributes						
Passage timing	**X**	**X**	**X**	**X**	**X**	**X**
Travel time	**X**	**X**	**X**	**X**	**X**	**X**
Reservoir overwintering	**X**	**X**	**X**	**X**	**X**	**X**
Exposure to spill	**X**	**X**	**X**	**X**	**X**	**X**
Migrant size	**X**	**X**	**X**	**X**	**X**	**X**
Migration and survival [b]	**X**	**X**	**X**	**X**	**X**	**X**
Survival	A	A	A	A	A	A

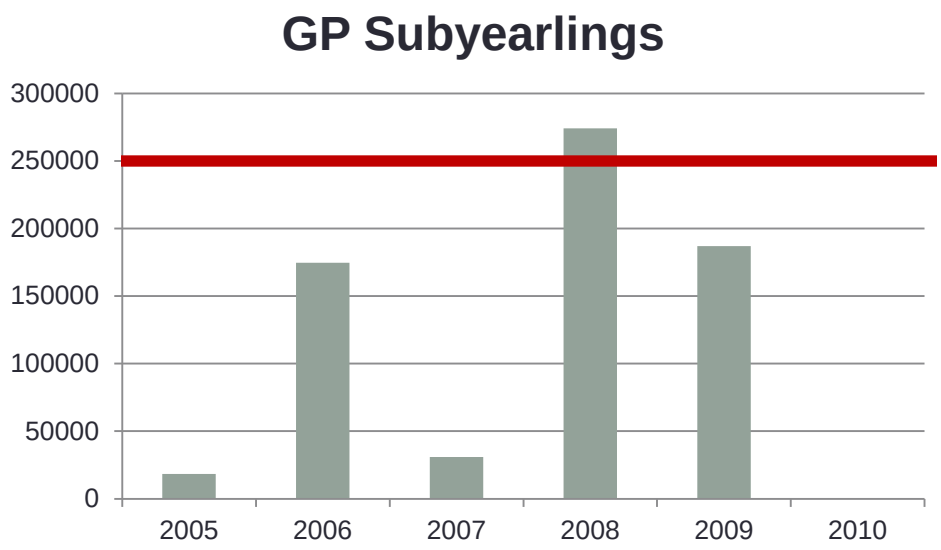
Evaluation Variables for Production Fish

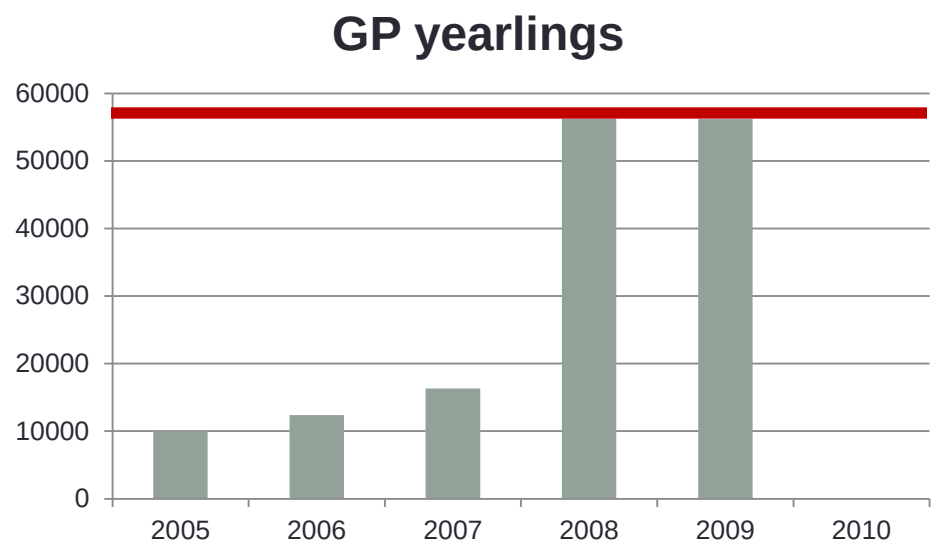
Variable Evaluated	Snake River Population		Snake River Subpopulation		Clearwater River Subpopulation	
	Age-1	Age-0	Age-1	Age-0	Age-1	Age-0
SARs for passage strategies and passage-experience groups (can also be analyzed by dam)						
TWS[a]	**X**	**X**	x	x	x	x
BWS	x	**X**	x	x	x	x
Transported (T_0)	**X**	**X**	x	x	x	x
Undetected (C_0)	**X**	**X**	x	x	x	x
Bypassed (C_1)	x	**X**	x	x	x	x
Jun to Aug (T_0,C_1)	x	x	x	x	x	x
Sep to Dec (T_0,C_1)	0	x	0	x	0	x
Ratios of SARs						
T/I	x	**X**	x	x	x	x
T_0/C_0	x	**X**	x	x	x	x
T_0/C_1	x	**X**	x	x	x	x
C_0/C_1	x	**X**	x	x	x	x
Post-release attributes						
Passage timing	**X**	**X**	**X**	**X**	**X**	**X**
Travel time	**X**	**X**	**X**	**X**	**X**	**X**
Reservoir overwintering	**X**	**X**	**X**	**X**	**X**	**X**
Exposure to spill	**X**	**X**	**X**	**X**	**X**	**X**
Migrant size	**X**	**X**	**X**	**X**	**X**	**X**
Survival	**X**	**X**	**X**	**X**	**X**	**X**

Release Numbers









Similarity Index (SI) Calculation

Attribute	Natural	Surrogates	SI	Natural	Production	SI
Lower Granite Dam						
Cumulative detection	36.8	48.2	1.3	18.4	54	2.9
Peak monthly detection	71.1	71.8	1.0	71.1	48.7	1.5
Summer spill detection	47.8	41.1	1.2	47.8	27.4	1.7
Travel time	24	22	1.1	24	14	1.7
2006 Detection	100	100	1.0	100	100	1.0
Migrant Size	94	91	1.0	94	103	1.1
Little Goose Dam						
Cumulative detection	35.4	45.4	1.3	12.3	69.6	5.7
Peak monthly detection	56.3	63	1.1	56.3	35.9	1.6
Summer spill detection	73.9	65.8	1.1	73.9	23.9	3.1
Travel time	33	31	1.1	33	18	1.8
Little Goose Dam						
Cumulative detection	11.7	6	1.9	14.9	85.2	5.7
Peak monthly detection	60.6	64.5	1.1	60.6	36.3	1.7
Summer spill detection	47.9	48.9	1.0	47.9	7.8	6.1
Travel time	34	31	1.1	34	21	1.6

Inter-Annual Mean Similarity Indices Across Dams

River	Comparison Groups	N	SI	SE
Snake	Natural & Surrogates	18	1.24	± 0.05
	Natural & Production	18	4.99	± 0.68
Clearwater	Natural & Surrogates	13	2.72	± 0.63
	Natural & Production	13	235.53	± 85.62

Reported Results

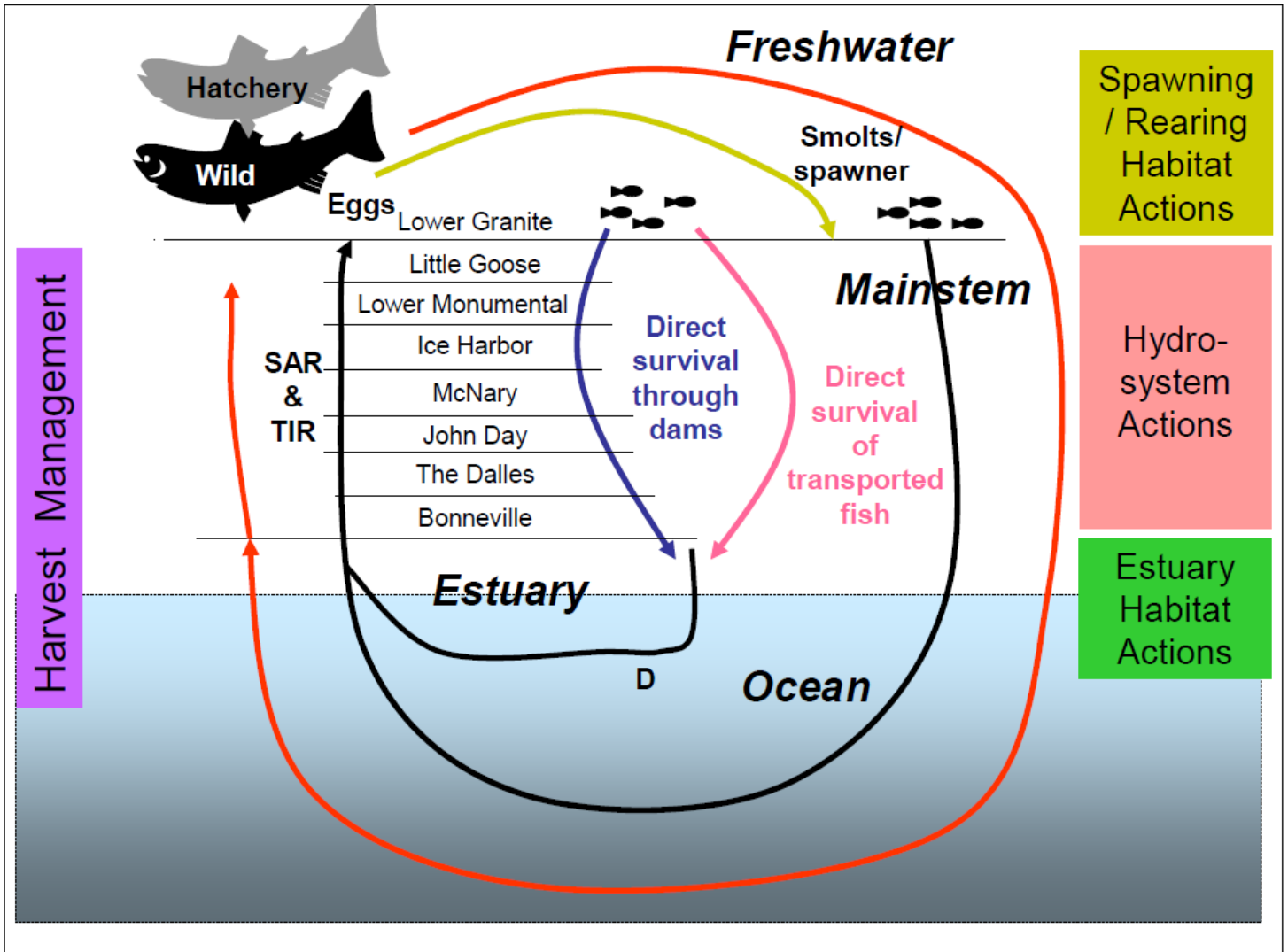
Metric	NOAA/USFWS	CSS
Transport: Bypass Ratios	✓	✓
Transport: ND Ratios	X	✓
Seasonality of SARs	✓	X
SARs by Hatchery Release	X	✓
Use of Surrogates	✓	X
Evaluations of holdover fish	✓	X

CSS Results

Analytical Methods

- Predicted holdover probability by release group using length and date at release
- Removed release groups that had high holdover probability to eliminate potential bias

CSS Estimates of TIR and D



CSS Results | 2006 Hatchery Releases SARs by Study Category

Table 5.11 Estimated LGR-to-GRA SAR (%) by study category without jacks for PIT-tagged hatchery subyearling Chinook by release site, tag site and coordinator ID from 2006 (with 90% confidence intervals).

Release Site, Tag Site, (PIT-tag coord-id)	SAR(T_x) %		SAR(C_0) %		SAR(C_1) %	
Big Canyon Creek, Lyons Ferry Hatchery, (DMM)	0.37	(0.30 - 0.45)	0.66	(0.57 - 0.75)	0.56	(0.44 - 0.69)
Couger Creek, Lyons Ferry Hatchery, (DMM)	0.31	(0.17 - 0.46)	0.11	(0.00 - 0.17)	0.05	(0.00 - 0.15)
Hells Canyon Dam, Umatilla Hatchery, (DMM)	0.22	(0.13 - 0.32)	0.20	(0.12 - 0.29)	0.16	(0.04 - 0.30)
Pittsburgh Landing, Umatilla Hatchery, (DMM)	0.08	(0.03 - 0.12)	0.15	(0.09 - 0.23)	0.18	(0.08 - 0.28)
Snake River, Dworshak Hatchery, (DMM)	0.27	(0.22 - 0.32)	0.21	(0.18 - 0.24)	0.24	(0.19 - 0.29)
Snake River, Lyons Ferry Hatchery, (DMM)	0.37	(0.22 - 0.53)	0.33	(0.24 - 0.45)	0.39	(0.20 - 0.64)

CSS Results | Wild Releases
SARs by Study Category

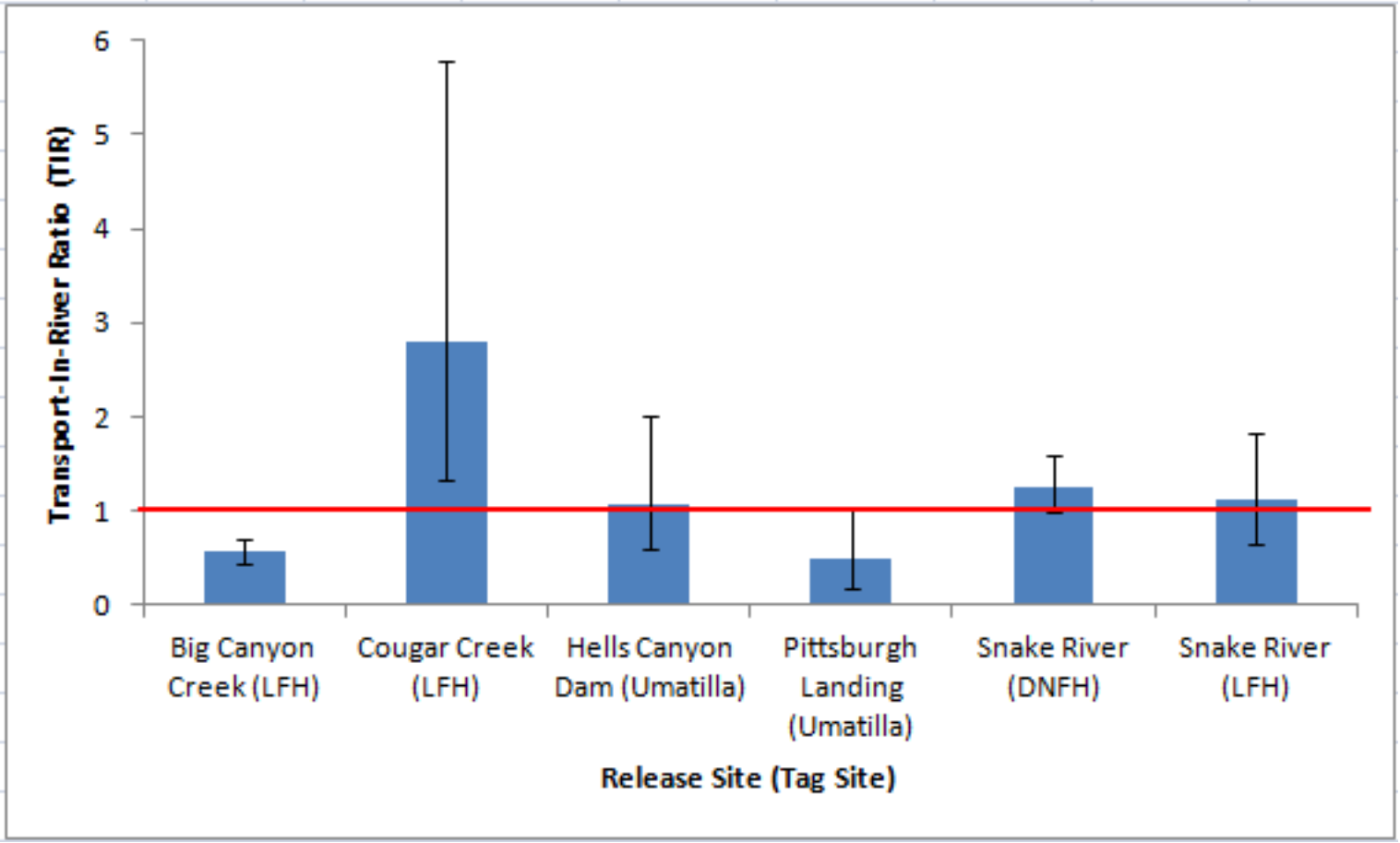
Table 5.14 Estimated LGR-to-GRA SAR (%) by study category without jacks for PIT-tagged wild subyearling Chinook marked and released in the Snake River by USFWS from 2006 to 2009 (with 90% confidence intervals).

Migration Year	SAR(T_x) %		SAR(C_0) %		SAR(C_1) %	
2006	0.56	(0.00 - 1.73)	0.96	(0.34 - 1.69)	0.53	(0.00 - 1.29)
2008	1.50	(0.00 - 3.48)	0.90	(0.56 - 1.27)	0.78	(0.37 - 1.25)
2009[a]	0.91	(0.00 - 2.03)	0.18	(0.00 - 0.37)	0.13	(0.00 - 0.37)

[a] Total of 6 adults for all three categories combined in 2009 so that SARs are not reliable.

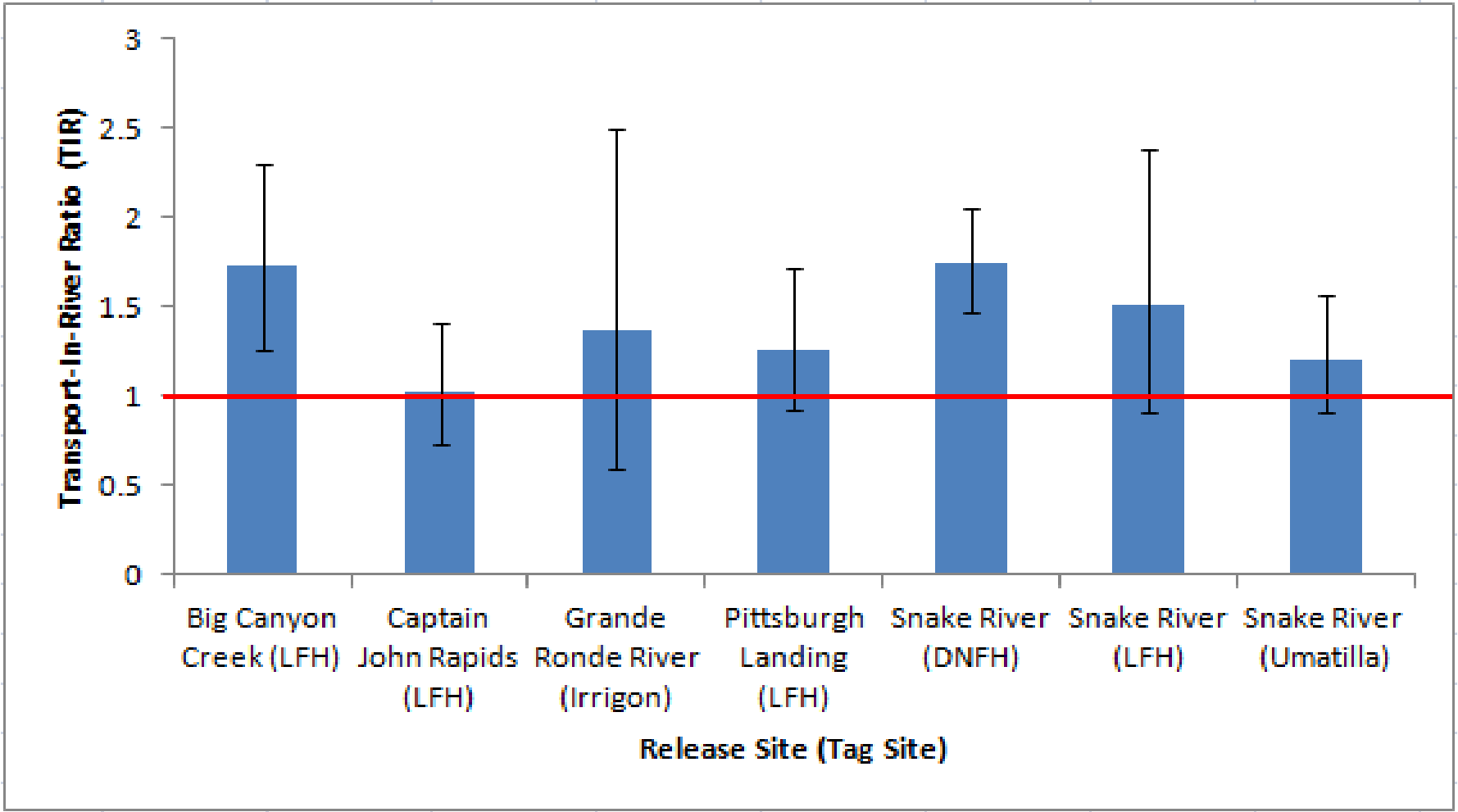
CSS Results | Results by Hatchery Release Group Transport to Non-Detected Ratios (TIR)

2006 TIR Results by release group



CSS Results

- 2008 TIR Results by release group

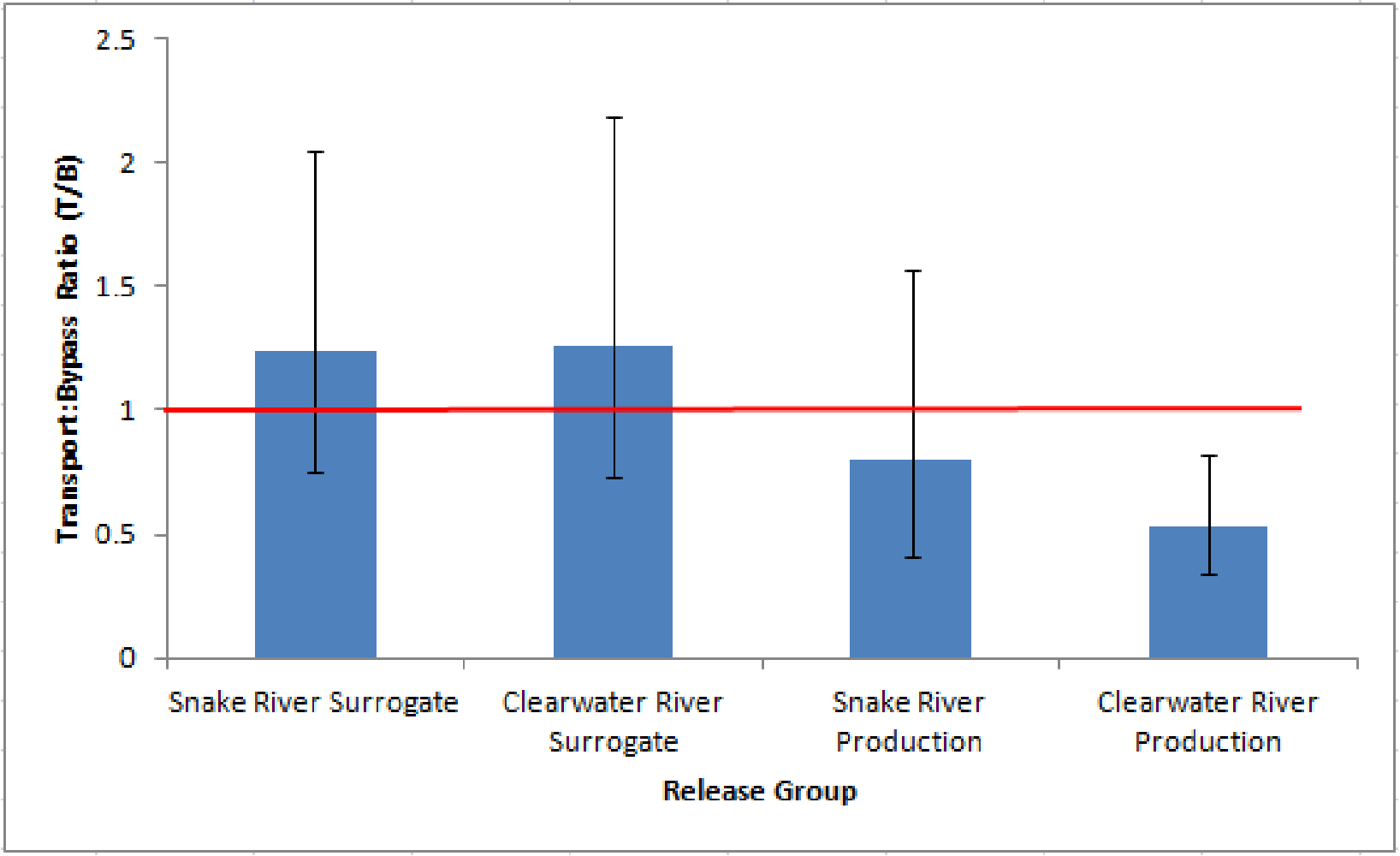


NMFS/USFWS Results

- Methods
  - Randomly assign PIT tags to transport if collected
  - Compare SARs of Transported fish to Bypassed Fish (T/B Ratios)
  - Provides information on what to do with a fish that is collected

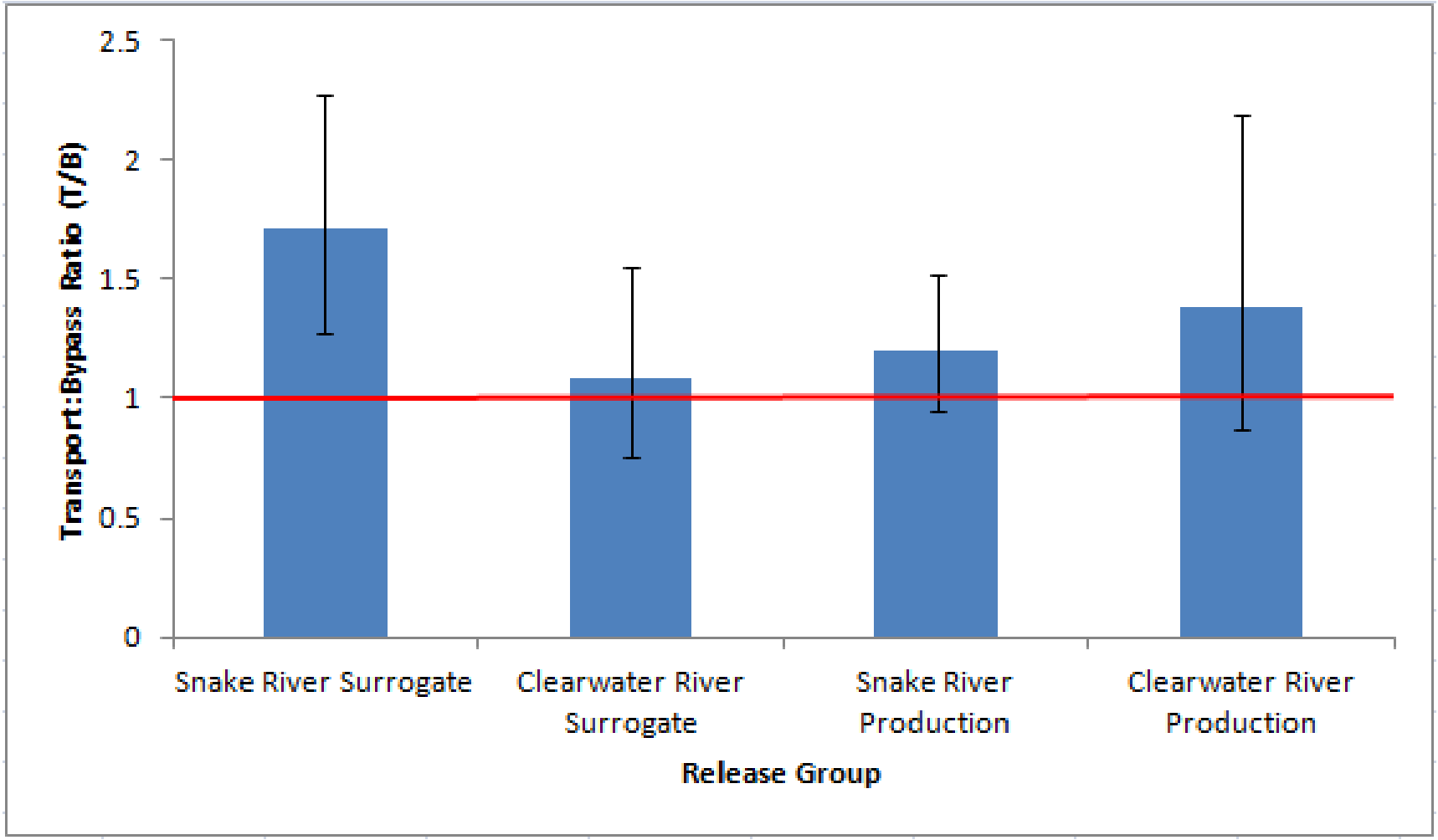
NMFS/USFWS Results

- 2006 T/B Results from LGR Dam



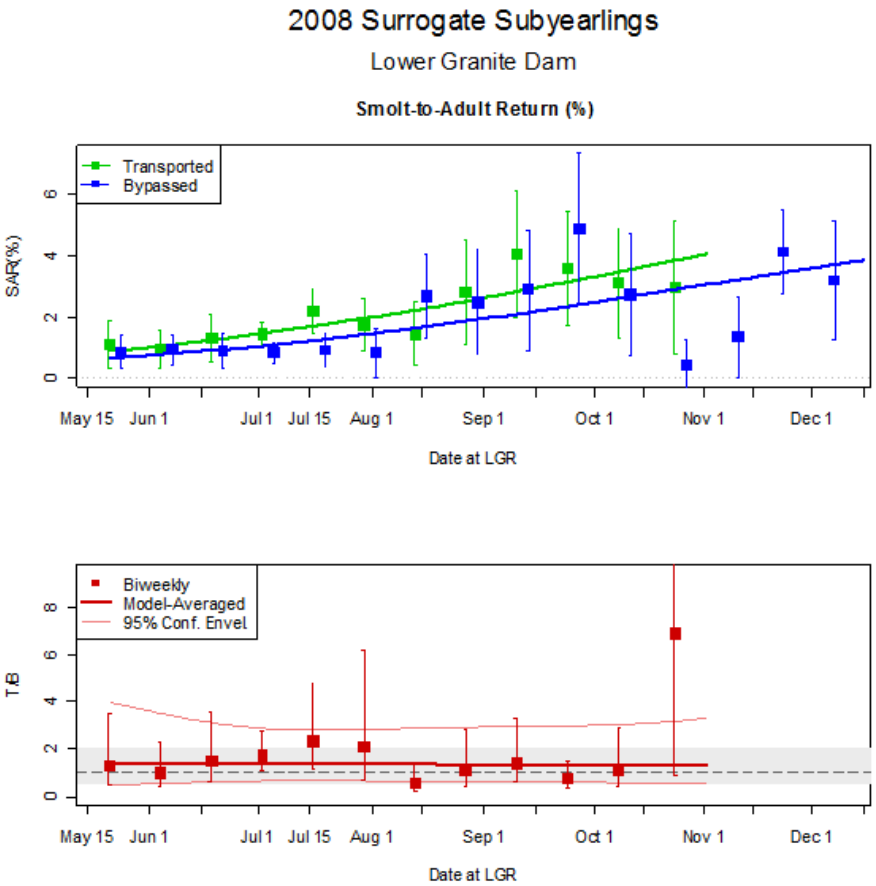
NMFS/USFWS Results

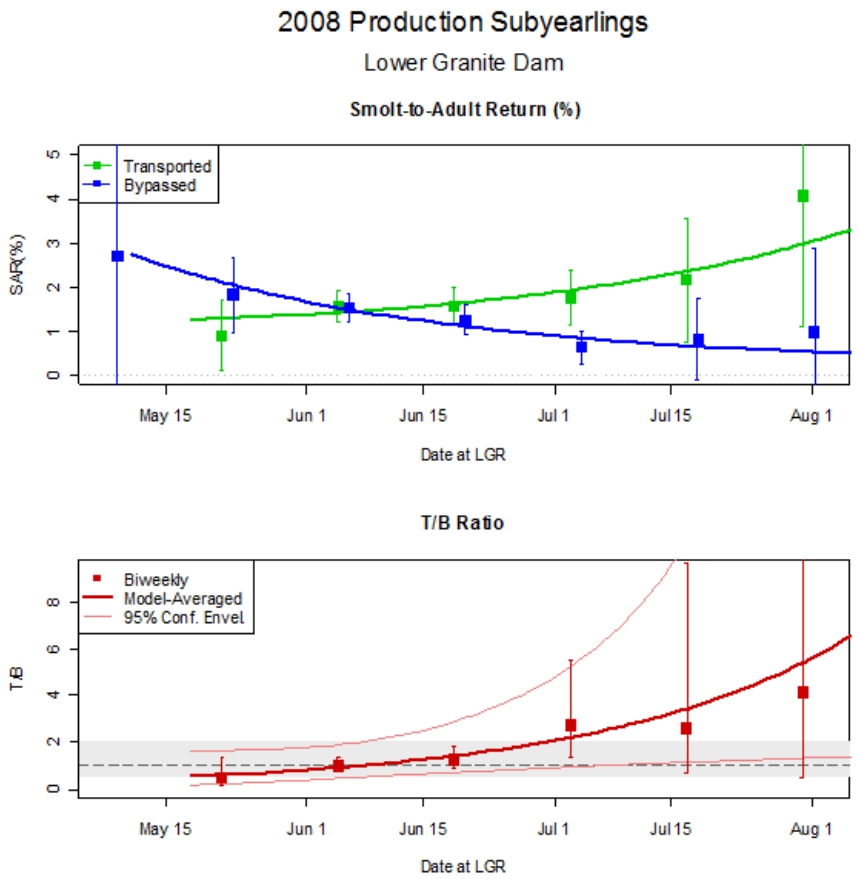
- 2008 T/B Results from LGR Dam



NMFS/USFWS Results

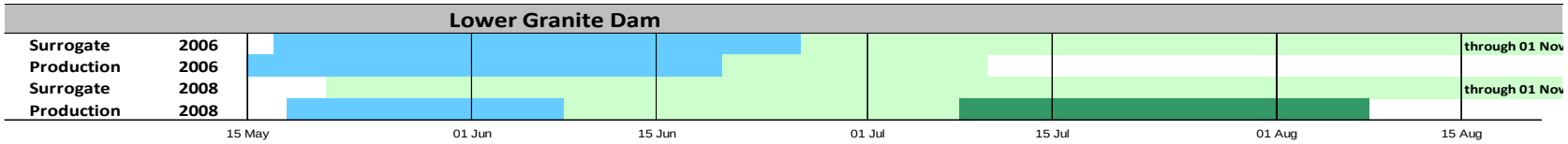
- Temporal evaluations

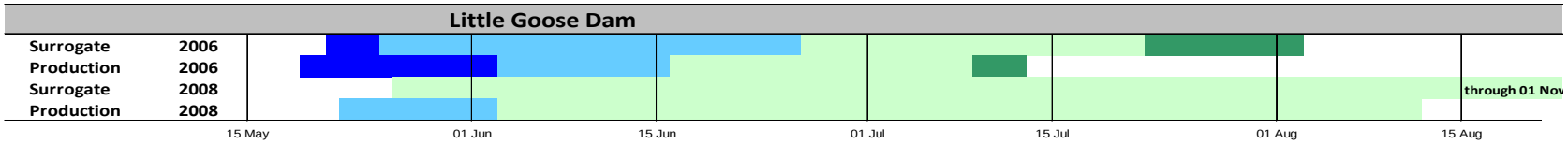


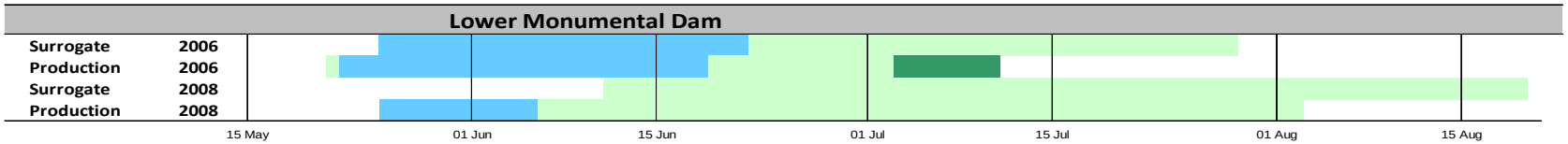


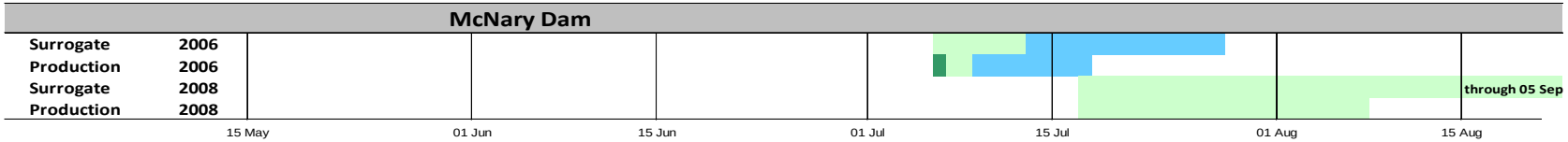
NMFS/USFWS Results

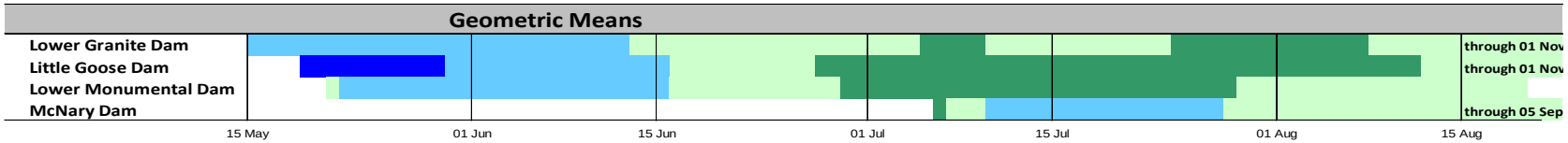
- Temporal Results by project, rearing type, and year
  - Blue = T/B < 1 Green = T/B > 1 (Dark color = statistical significance)











Conclusions

- Results will continue to be analyzed and updated through final adult returns in 2017
- Both analytical groups are providing useful management information
  - Temporal and spatial analyses are useful for hatchery managers, fishery managers, and hydro-system managers
- Where reported results overlap between the two analytical groups there is similarity

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