Assessing the use of PIT Tags as a Tool to Monitor Adult Chinook Salmon Returns to Idaho

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Chinook PIT Tagging

- Since 2006, IDFG has been increasing PIT tagging numbers in an effort to have a representative group of tagged fish in each Chinook release

Hatchery	Release Site	BY 2009 # PIT Tagged Chinook
Clearwater	Clear Creek	17,100
	Crooked River	22,200
	Powell Pond	17,100
	Red River	12,000
	Selway River	17,100
McCall	SF Salmon River	52,000
Pahsimeroi	Pahsimeroi River	21,400
Rapid River	Rapid River	52,000
Sawtooth	Upper Salmon River	21,400
Total PITs		232,300

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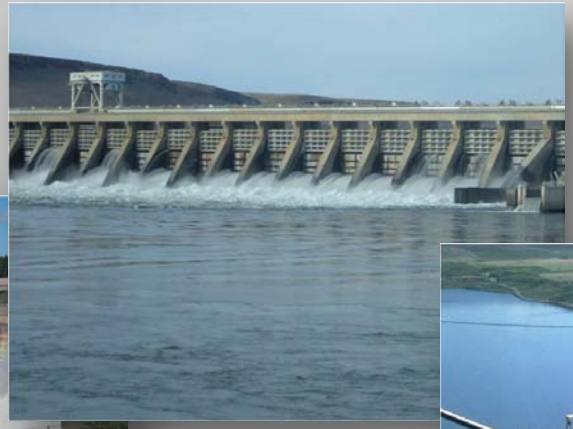
- The purpose of the increase in tags is to generate stock-specific SARs back to Lower Granite Dam
- **However, other benefits include the ability to generate stock and age specific:**
  - **In-season return estimates**
  - **Inter-dam conversion rates**
  - **Run timing over dams**
  - **Fallback / reascension rates**
  - **After – hours passage rates**

Tag Monitoring

- Since 2009, PIT detections have been monitored throughout the adult return at Bonneville, McNary, Ice Harbor, and Lower Granite dams



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- **Detections of Run-At-Large (monitor mode) tags in returning fish are used to generate in- and post-season return estimates, by hatchery, release site, and age**

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- Detections of Run-At-Large (monitor mode) tags in returning fish are used to generate in- and post-season return estimates, by hatchery, release site, and age
- **These expanded return estimates are then combined, by brood year, to generate stock specific SARs**

Other Benefits - In Season Return Estimates

Release Group	2010 Granite Pre-Season Adult Forecast	Final Lower Granite Adult Estimate
Dworshak	8,729	3,735
Kooskia	1,691	3,666
Selway	2,496	1,632
Powell	2,496	729
SF Clearwater	3,726	3,758
Total Clearwater R.	19,138	13,520
Rapid River	76,153	22,038
Sawtooth	1,644	762
Pahsimeroi	9,775	5,196
McCall SFSR	31,755	10,275
Total Salmon R.	119,327	38,271
TOTAL	138,465	51,791

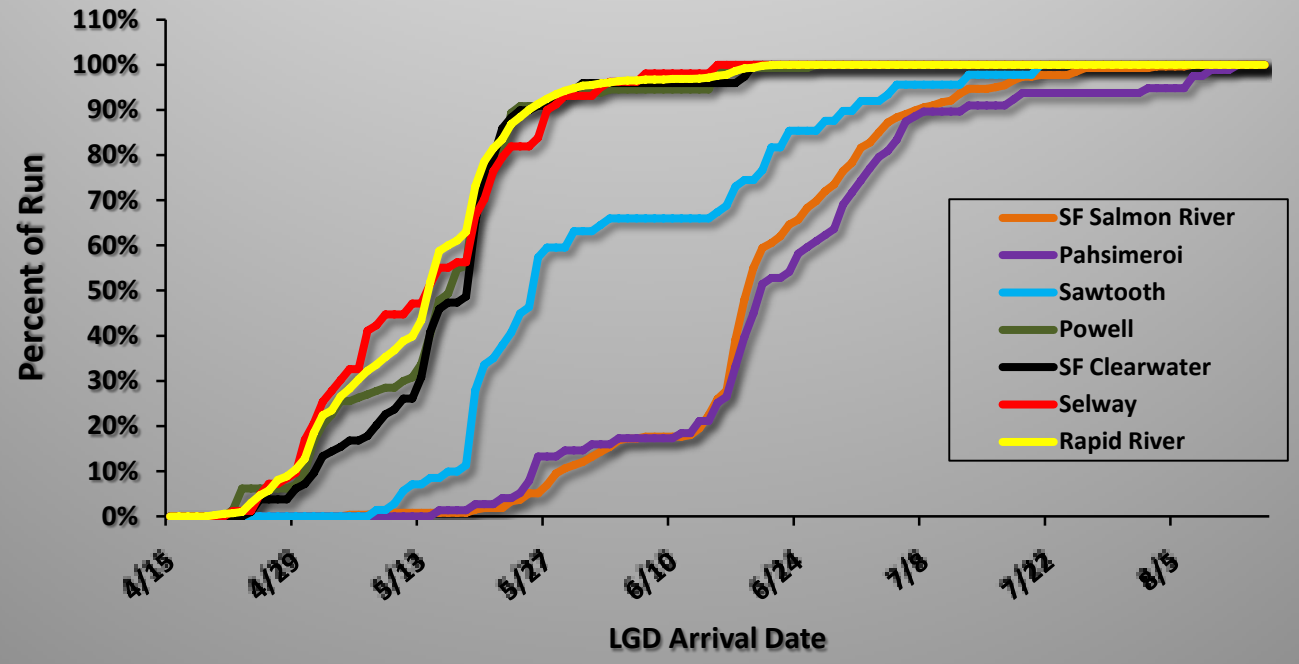
Other Benefits – Inter-Dam Conversion Rates

- This monitoring also provides more robust stock and age specific data for:
  - Inter-dam conversion rates

Hatchery	Release Site	Adults From Bonneville To:		Jacks From Bonneville To:	
		McNary	Lower Granite	McNary	Lower Granite
Clearwater	SF Clearwater River	75.0%	74.5%	100.0%	83.3%
Clearwater	Powell Pond	74.1%	71.6%	87.5%	71.2%
Clearwater	Selway River	75.0%	68.1%	100.0%	100.0%
McCall	SF Salmon River	75.7%	72.5%	96.6%	94.8%
Pahsimeroi	Pahsimeroi Hatchery	82.0%	79.7%	100.0%	91.7%
Rapid River	Rapid River Hatchery	73.8%	67.9%	100.0%	90.0%
Sawtooth	Sawtooth Hatchery	88.9%	88.3%	100.0%	100.0%
AVERAGE		77.8%	74.7%	97.7%	90.1%

Other Benefits – Run Timing

- This monitoring also provides more robust stock and age specific data for:
  - Run timing and vulnerability to / availability for downriver fisheries



Other Benefits – Fallback/Reascension

- This monitoring also provides more robust stock and age specific data for:
  - Fallback / reascension rates at each dam

Lower Granite Dam	ADULTS (2- and 3-Ocean)			JACKS (1-Ocean)		
Release Location	PITs at LGD	Fallback / Reascension	Percent	PITs at LGD	Fallback / Reascension	Percent
Clear Creek	NA	NA	NA	25	2	8.0%
Crooked River	37	4	10.8%	6	0	0.0%
Powell Pond	26	2	7.7%	6	0	0.0%
Selway River	72	3	4.2%	13	1	7.7%
Pahsimeori Ponds	70	3	4.3%	13	1	7.7%
Sawtooth Hatchery	47	0	0.0%	11	0	0.0%
Knox Bridge	287	20	7.0%	71	7	9.9%
Rapid River	463	27	5.8%	44	3	6.8%
TOTAL	1,002	59	5.9%	189	14	7.4%

Other Benefits - After-Hours Passage

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Crooked River	37	1	2.7%	6	1	16.7%
Powell Pond	26	2	7.7%	6	0	0.0%
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- Issues such as post-release tag shedding and differential survival result in lower representation of tagged fish in the returning population
- There is evidence that expanding PIT tagged adults by juvenile tagging rates underestimates the return
- **Historically, rates of tagged fish in adult returns have been difficult to determine because hand scanning at hatchery racks in not 100% efficient**

How are we Addressing Issues?

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Estimates of Actual Tags in the Release

- At some facilities, we have started experimenting with a fish pump array system to provide a true PIT tag number as fish are loaded onto trucks prior to release
- Hope to get a better idea of true on station shedding / survival

How are we Addressing Issues?

Estimates of Actual Tags in the Release

PIT tagged Chinook salmon smolts volitionally outmigrating from Rapid River ponds

Year	Fish Tagged (minus observed on-station mortality)	Exit Array Detection Efficiency	No. PIT Tags Detected	Corrected PIT Tag Detections	No. PIT Tags Not Detected	% PIT Tags Retained	% PIT Tags Lost
2000	47,748	0.917	43,353	47,277	471	0.990	0.010
2001	55,091	0.968	52,795	54,540	551	0.990	0.010
2002	183,923	0.940	172,092	183,077	846	0.995	0.005
2003	184,473	0.974	177,488	182,226	2,247	0.988	0.012
2004	51,969	0.997	51,076	51,230	739	0.986	0.014
2005	51,975	0.979	50,360	51,440	535	0.990	0.010
2006	96,975	0.996	95,514	95,898	1,077	0.989	0.011
2007	104,675	0.995	102,181	102,694	1,981	0.981	0.019
2008	51,689	0.908	46,117	50,790	899	0.983	0.017
AVE	**92,058**	**0.964**	**87,886**	**91,019**	**1,039**	**0.988**	**0.012**

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True PIT Tag Expansions of Adult Returns

- **To get at true tag expansions in adult returns, we have installed in-ladder detection arrays at both the SF Salmon River and Sawtooth traps**

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- **We have found that in-ladder array systems were 98 – 100% efficient for the two years they have been operated**

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True PIT Tag Expansions of Adult Returns

- **We have also found that conventional hand scanning for PIT Tags, as fish are worked up out of the trap, only detects 70 – 90% of the tags in returning fish**

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True PIT Tag Expansions of Adult Returns

- **In addition, we have found the rate of PIT tagged fish in adult returns is highly variable from the rate at which fish are tagged as juveniles**

			Corrected Expansions		
Trap	Brood Year	Juvenile Expansion Rate	1-Ocean	2-Ocean	3-Ocean
Sawtooth	2005	73.8			77.0
Sawtooth	2006	12.8		14.4	/
Sawtooth	2007	20.0	23.6	/	/
SF Salmon River	2004	31.2			44.4
SF Salmon River	2005	31.0		37.0	158.0
SF Salmon River	2006	28.8	33.5	46.2	/
SF Salmon River	2007	30.2	35.5	/	/

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Sawtooth	2007	20.0	23.6	/	/
SF Salmon River	2004	31.2			44.4
SF Salmon River	2005	31.0		37.0	158.0
SF Salmon River	2006	28.8	33.5	46.2	/
SF Salmon River	2007	30.2	35.5	/	/

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- **We have found that PIT Tag expansions rates in adult returns range from 12 – 60% higher than the expansions at juvenile tagging**

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- In addition, we have found the rate of PIT tagged fish in adult returns is highly variable from the rate at which fish are tagged as juveniles
- We have found that PIT Tag expansions rates in adult returns range from 12 – 60% higher than the expansions at juvenile tagging
- **The level of underestimation appears to vary across years, locations, and between age-classes**

How are we Addressing Issues?

True PIT Tag Expansions of Adult Returns

- **Having true tag proportions in adult returns allows us to correct expansion rates and adjust our estimates at the dams**
  - **However these adjustments are post-season**

SF SALMON RIVER TRAP		Raw PIT Tag Detections				
Brood Year	Original Expansion	RAL @ STR	R2R STR	Estimated Number	Actual Rack	Corrected Exp.
2005	31.0	1	1	32	159	158.0
2006	28.8	107	30	3,112	4,974	46.2
2007	30.2	35	11	1,068	1,255	35.5
				4,212	**6,388**	

LOWER GRANITE DAM		Corrected Detections**			
Brood Year	Expansion*	RAL @ LGD	R2R LGD	Corrected Estimate	Original Est. from Juv. Tag Rate
2005	158.0	2	0	316	62
2006	46.2	214	71	9,959	6,234
2007	35.5	55	16	1,969	1,677
				12,244	**7,973**

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True PIT Tag Expansions of Adult Returns

- **Having true tag proportions in adult returns allows us to correct expansion rates and adjust our estimates at the dams**
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- **This is the most extreme example we have seen**
  - **The same correction for 2010 Sawtooth Chinook increased the LDG estimate from 905 to 1,021 fish**

How are we Addressing Issues?

Tag Shedding and Differential Survival

- **Data from a double marking study of BY 2006 Chinook released in the Lochsa River in 2008 showed a tag shed rate of 11.1% in 1-Ocean jack returns and 30.5% in 2-Ocean adult returns**

Brood Year	Return Year	RAL PITs Needed to Meet Trap #	Actual RAL PITs Trapped	Estimate of Shed Tags	Remaining Missing Tags
2006	2009	25	16	2	7
2006	2010	93	50	28	15

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Tag Shedding and Differential Survival

- **However, there does not appear to be survival differences between the PIT and non-PIT tagged groups**

BY 2006 Returning in 2009 and 2010	# CWT's Released	# CWT's Returned 2009	# CWT's Returned 2010	Total CWT Returns	Total CWT Return Rate
Treatment	18,941	8	36	44	0.23%
Control	23,207	12	31	43	0.19%

How are we Addressing Issues?

Moving Forward

- It is our desire to conduct a larger scale double mark study for both Chinook and steelhead at multiple sites across multiple brood years
- We hope to add in-ladder PIT antenna systems to remaining Chinook salmon traps

Summary

- **PIT tags provide a tool to get stock-specific run timing, conversion, post- and in-season estimates, reascension and after-hours passage rates of adult returns at 4 of the 8 lower Columbia and Snake River dams**

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- While PIT estimates provide a better tool for estimating real-time returns, issues like tag shedding and mortality cause these estimates to be low
- **Through the use of in-trap and pump array systems, we are able to correct expansions by stock and age for certain return groups, post-season**

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- While PIT estimates provide a better tool for estimating real-time returns, issues like tag shedding and mortality cause these estimates to be low
- Through the use of in-trap and pump array systems, we are able to correct expansions by stock and age for certain return groups, post-season
- **We will continue to monitor the differential rates at which PIT tagged fish occur in adult returns and hope to further study shed and differential survival rates though a future large-scale double mark study**

Acknowledgements

- Lower Snake River Compensation Plan
- PSMFC Mark Crew
- Hatchery Staffs
- Comparative Survival Study
- Idaho Power Company
- Forrest Bohlen
- Paul Bunn
- Laurie Janssen
- Nez Perce Tribe
- ODFW
- WDFW
- Biomark

Questions?