

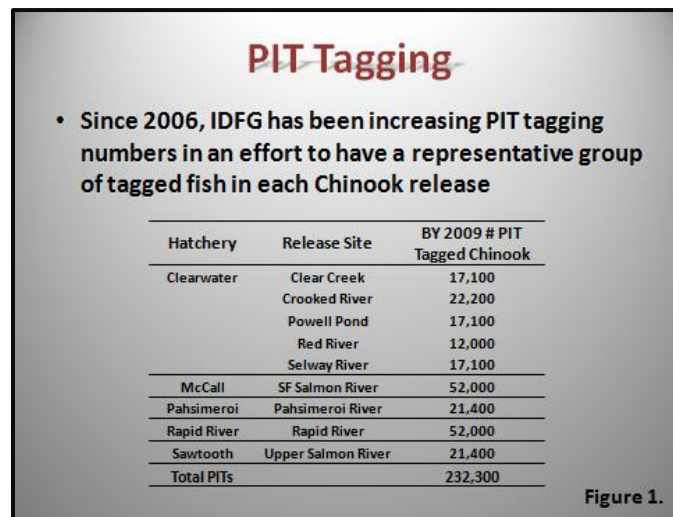
# The Use of Passive Integrated Transponder (PIT) Tags as a Tool to Monitor and Manage Adult Chinook Salmon Returns to Idaho

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## Background

In 2006, the Idaho Department of Fish and Game (IDFG) began increasing the number of Passive Integrated Transponder (PIT) tags injected into hatchery spring/summer Chinook salmon smolts to gain the ability to use the tags to monitor and quantify adult returns (for the purpose of this report, “adult” includes jacks). By release year 2008 (BY 2006), all hatchery Chinook salmon smolt releases from IDFG-operated hatcheries contained a representative group of PIT tags with the exception of off-site releases of Rapid River Chinook salmon into the Little Salmon River and in the Snake River at Hells Canyon Dam. Currently, over 230,000 PIT tags are implanted into Chinook salmon leaving IDFG hatcheries annually (Figure 1).



## Adult Monitoring

Starting in 2009, adult PIT tag detections have been monitored throughout the return at Bonneville, McNary, Ice Harbor, and Lower Granite dams. These PIT tag detections are expanded by the juvenile tagging rate for run-at-large (monitor mode) tags from the separation-by-code process. The expanded detections are used to generate daily in-season return estimates by hatchery, release site, and age at each dam. These daily updates are posted to a shared website (<https://research.idfg.idaho.gov/PublicDocuments/Forms/AllItems.aspx>) Monday through Friday throughout the adult run. Also throughout the run, weekly teleconference calls are held to discuss the updated run projections, run status, harvestable shares, hatchery operations and fishery status. Participation in these weekly calls typically includes, but is not limited to, IDFG, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Nez Perce Tribe, Shoshone Bannock Tribe, and Idaho Power Company. This coordinated process enables the most up to date in-season estimates to be available to all parties and for real time management decisions to be made.

## What We Gain

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	1,627
Powell	2,496	729
SF Clearwater	3,726	3,510
<b>Total Clearwater R.</b>	<b>19,138</b>	<b>13,267</b>
Rapid River	76,153	22,038
Sawtooth	1,644	689
Pahsimeroi	9,775	5,051
McCall SFSR	31,755	6,305
<b>Total Salmon R.</b>	<b>119,327</b>	<b>34,082</b>
<b>TOTAL</b>	<b>138,465</b>	<b>47,349</b>

Figure 2.

The use of PIT tags to monitor adult returns typically provides us with a more accurate return estimate than we get from pre-season forecasts that are based on simple sibling regression models. Figure 2 shows a comparison of two- and three-ocean adult return forecasts versus in-season return estimates from expanded PIT tags in 2010. As you can see, while the forecasts for the Clearwater River were close

## What We Gain

CLEARWATER HATCHERY SOUTH FORK ADULTS OVER BONN DAM  
Historic Timing, In-Season Estimate, and Projected Total Return  
Based on Historic PIT Tag Data

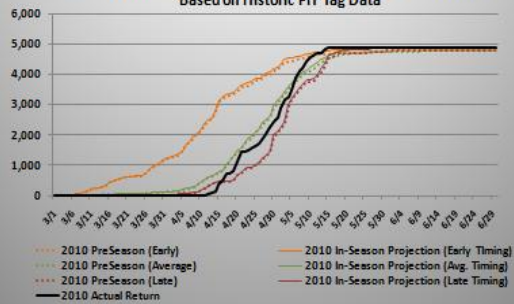


Figure 3.

## What We Gain

SFSR RIVER ADULTS OVER BONN DAM  
Historic Timing, In-Season Estimate, and Projected Total Return  
Based on Historic PIT Tag Data

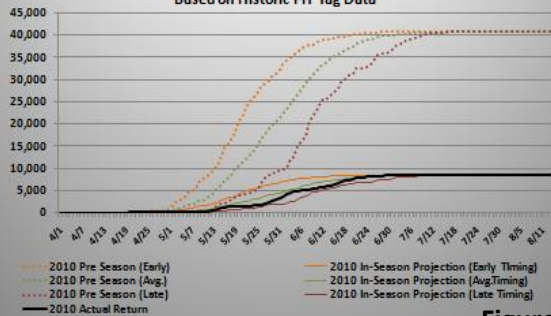


Figure 4.

to the PIT tag estimates, the Salmon River forecasts were much higher than the actual return based off of PIT tag estimates. Figures 3 and 4 compare an in-season estimate that is very close to a preseason forecast (Figure 3, South Fork Clearwater 2010) versus an in-season estimate that is a lot lower than the preseason forecast (Figure 4, South Fork Salmon River 2010). This emphasizes the value of having a tool that can be used to generate in-season stock and age specific return estimates as these more accurate numbers enable more precise management. In addition to in- and post-season return estimates, adult return monitoring also provides more robust stock and age specific data for inter-dam conversion rates, run timing, fallback with reascension rates, and after hour's passage rates at each dam. All of these are important monitoring and evaluation metrics that aid in run reconstruction.

## Addressing Issues

While PIT tag expansions provide valuable adult return data, there are some shortcomings associated with using PIT tags to estimate adult returns. In looking at historic adult return estimates, there was evidence that expanding PIT tagged adults by juvenile tagging rates was underestimating the return. This was likely due to issues such as unaccounted for tag shedding and differential survival post release. While evidence for this exists, historically it has been difficult to estimate rates of PIT tags in adult returns because hand scanning at hatchery racks is not 100 percent efficient. To get at the true tagged proportions within the adult returns, we had in-ladder detection arrays installed in both the South Fork Salmon River (Figure 5) and the Sawtooth Fish Hatchery adult traps. The South Fork array was installed



prior to trapping in 2009 and the Sawtooth array prior to trapping in 2010. These array systems have repeat antennas which allow us to get detection efficiencies which in turn, allow us to get at the true proportion of PIT tags in the adult return, by age class. We can then correct the expansions rates and use the corrected expansions to adjust our estimates downriver at in-stream arrays and at the dams. However, these adjustments can only be done post-season and cannot be used to adjust in-season return estimates. Figure 6 shows an example of these adjusted expansions for the South Fork Salmon River at Lower Granite Dam for the 2010 return. Using these corrected expansions, we have found in-season stock specific estimates range from 11 – 37 percent low and that the level of underestimation varies across years, locations, and between age classes. However, despite this level of underestimation, return estimates can still be corrected post-season for locations that we have in-ladder arrays and in-season numbers are still more accurate than relying on preseason forecasts.

LOWER GRANITE		Raw Detections		Corrected Detections**		Estimated Number	Original Est. from Juv. Tag Rate
Brood Year	Expansion*	RAL @ LGD	R2R LGD	RAL @ LGD	R2R LGD		
2005	199.0	2	0	2	0	398	62
2006	45.8	214	71	214	71	9,871	6,234
2007	35.7	55	16	55	16	1,977	1,677
						<b>12,246</b>	<b>7,973</b>

\* Corrected for Adult PIT tag ratio at Rack  
\*\* Corrected for 100% LGD detection efficiency

**Figure 6.**

In addition to monitoring adults at these array systems, we are midway through a double marking study at the Powell Satellite Facility. Brood Year 2006 Chinook salmon from Clearwater Fish Hatchery destined to be released at the Powell Satellite in 2008 were part of a double marking study designed to investigate shed rates of PIT tags from release to adult return and to estimate if PIT-tagged fish exhibit differential survival from non-PIT tagged fish. Prior to the release of these fish, the water intake for the pond froze over, resulting in a loss of water into the pond and the mortality of about half of the release group. The surviving fish from this study returned as one-ocean jacks in 2009 and two-ocean adults in 2010. All returning fish were thoroughly double scanned with both a CWT wand and handheld PIT tag reader to confirm the presence or absence of tags. Eight treatment fish and 12 control fish returned to Powell in 2009 as jacks. Of these eight treatment fish, one was missing a PIT tag (12.5% shed rate). In 2010, 36 treatment fish and 31 control fish returned. Of these 36 treatment fish 11 had lost their PIT tags (30.6%) shed rate. Also, at some facilities we have started experimenting with a pump array system to get at the true number of PIT tagged fish as they are loaded onto trucks for release to get a better idea of true on-station shedding/survival.

**Summary**

Having representative PIT tag groups in the majority of our releases provides a tool to get real time in-season estimates of adult returns at four of the eight lower Columbia and Snake River dams. These estimates are distributed and discussed through a shared website and weekly teleconference calls throughout the adult return which allows for more accurate and timely management and coordination. While these in-season estimates provide more accurate stock- and age-specific estimates than preseason forecasts, tag shedding and mortality cause these estimates to be low. However, in-ladder array systems allow us to correct these estimates at some of our facilities for run reconstruction purposes post-season. We will continue to monitor the rates at which PIT tagged adults return and continue to evaluate, and hopefully quantify, possible causes of these differential return rates.

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