FISH PASSAGE CENTER

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MEMORANDUM

TO: Data Request

FROM: Jerry McCann, Brandon Chockley

DATE: June 11, 2007

RE: Analysis of Jack Spring Chinook Returns at Bonneville Dam in 2007

In response to data requests, FPC staff examined information relating to jack spring Chinook returns at Bonneville Dam this year. Because of the relatively large number of jacks passing the project in 2007, many people were curious as to the origin of these fish. FPC examined PIT-tags to provide some information on the origin of jacks. Other information regarding the run-at-large out-migration was also summarized to provide a more complete understanding of what may have contributed to the return.

Caution should be used when interpreting jack counts, since the large return of jacks is usually but not always a good indication of the size of the returning adult population the following year. Based on a CRITFC analysis of historic age composition data, for the brood years 1985 to 2001, the mean proportion of the returning spring Chinook adults that were jacks was 5.8% with a minimum of 2.8% (BY 1993) and a maximum of 9.2% (BY 1990). Furthermore, PIT-tag data do not fully represent the run-at-large, because of differential marking in various sub-basins and tributaries, as well as proportions of hatchery origin fish compared to wild fish. However, PIT-tags are useful for making some inferences to the run-at-large about the origin and migration history (either transported or in-river migrants for example) of returning adults. FPC summarized PIT-tag detections of Chinook adults at Bonneville Dam for the time period April 1 through May 29, 2007. Jacks were identified based on their year of out-migration; in this case, 2006 migration year fish were considered jacks and are included in this summary. A summary of migration conditions and information related to the run-at-large (e.g., reach survivals, proportion transported, hatchery releases) is provided for spring Chinook that out-migrated in 2006. Our conclusions are summarized below:

- The 2006 juvenile migration year clearly showed the effects of flow and spill on downstream juvenile migrants. The high in-river survivals resulting from the relatively high flow and spill provide support for flow and spill measures to enhance in-river survival.
- It is too early to determine the combined effect of the 2006 out-migration conditions, ocean conditions and delayed transportation on listed and unlisted stocks of salmon and steelhead. However, a review of past data shows that the highest smolt to adult return rates for both in-river migrants and transported migrants occurs from out-migration years with higher flow and spill levels.
- The complete result of the passage strategy implemented in 2006 will not be determined until all of the adult return data is available.
- At this point, the 2006 implemented passage strategy, of delayed transportation of smolts, as it relates to recovery of listed stocks cannot be determined. However, indications from PIT-tag data suggests early migrants that were returned to river prior to the initiation of transportation returned at rates similar to later bypassed fish from CSS study groups.

The number of out-migrating juvenile fish was similar to other recent years based on the number of hatchery spring Chinook releases above Bonneville Dam in 2006 (Figure 1). However, reach survivals in 2006 were relatively high for spring Chinook originating in the Snake River (Table 4), based on estimates by NOAA technical staff memo from August of 2006. Furthermore, from our analysis of PIT-tag survival data, we estimated the proportion of transported fish in the Snake River in 2006 at approximately 60%. This estimate was lower than recent years, although comparable to 2003 (Table 5). This lower proportion transported was due, in part, to the delayed start to transportation at Snake River projects in 2006 compared to recent years. The combination of high in-river survival, coupled with a higher proportion of in-river migrants, likely produced the highest population of untagged in-river migrant spring Chinook surviving to below Bonneville Dam that we've had in recent years from the Snake River. Transported fish likely benefited from good in-river conditions as well, since SAR's of both in-river and transported spring Chinook tend to improve during higher flow years. It is likely that the increased jack counts seen in 2007 are a result of higher return rates from both in-river and transported fish from 2006. However, a more thorough analysis of PIT-tag adult returns, in 2007 and 2008 will be needed to determine the effects of 2006 operations on overall returns.

Our initial review of PIT-tagged returning jacks provided a clear answer to the question of what groups might be contributing to the higher numbers seen in 2007. The PIT-tag jacks appeared to return in relative proportion to the number released in each river zone (Table 1). For example, 85% of the PIT-tags released in 2006 were released from the Snake River and 85% of the jacks returning to Bonneville Dam in 2007 were of Snake River origin. The majority of PIT-tagged returning jacks were from the Snake River, with 361 total detected at Bonneville adult ladders. However, this is due to the larger number of tags released in the Snake River compared to other river zones.

PIT-tag counts don't shed a great deal of light on what river-zone the run-at-large jacks are from, since numbers of PIT-tags only represent the numbers of PIT-tags released in each basin. A comparison of jack counts at Ice Harbor and Priest Rapids dams was considered as a way to determine the relative proportion of the upriver groups (Snake River versus Mid Columbia). However, the jack count at Priest Rapids Dam as of May 29 was only 221, while the

number from Ice Harbor Dam was 5,891. The count at Priest Rapids is likely under-representing the total jacks passing the project, since the jack count at Rock Island Dam was 1,004. Therefore, the origin of the large return of jacks seen at Bonneville is difficult to determine based on available information.

PIT-tags do provide some insight into the route of passage as juveniles of the returning jacks. Of the 361 Snake River origin fish, 228 were in-river migrants in 2006, 108 were transported, and 25 were released below Ice Harbor Dam (presumably transported and then released below IHR). The PIT-tag data from two study groups, NOAA transportation studies and the CSS studies, are summarized in Tables 2 and 3 below. The information in Table 3 was summarized for releases from which the majority of jacks returned. In addition to the 124 jacks summarized in Table 2 and the 141 jacks summarized in Table 3, 94 jacks returned from various other releases above Lower Granite Dam.

As can be seen from Tables 2 and 3, transported and in-river fish appeared to return in relative proportion to the number of fish in that mark category. It is important to note that the data summarized in Tables 2 and 3 are not equivalent to SAR's of jacks, since numbers of tags in each category is simply a summary of total detected fish and are not adjusted to LGR equivalents. Furthermore, estimates of undetected in-river fish were not included. There were an additional 25 undetected jacks that returned from CSS groups shown in Table 3, but the starting number of undetected fish at Lower Granite Dam, which would make the PIT-tag starting groups equivalent, was not calculated.

Based on Smolt Monitoring Program estimates there were approximately 5.7 million yearling Chinook transported at Snake River collector projects in 2006, which is about average compared to other recent years (Table 6). This would indicate that transport returns likely make up a significant proportion of returning jacks, if transport returns benefit from good in-river conditions.

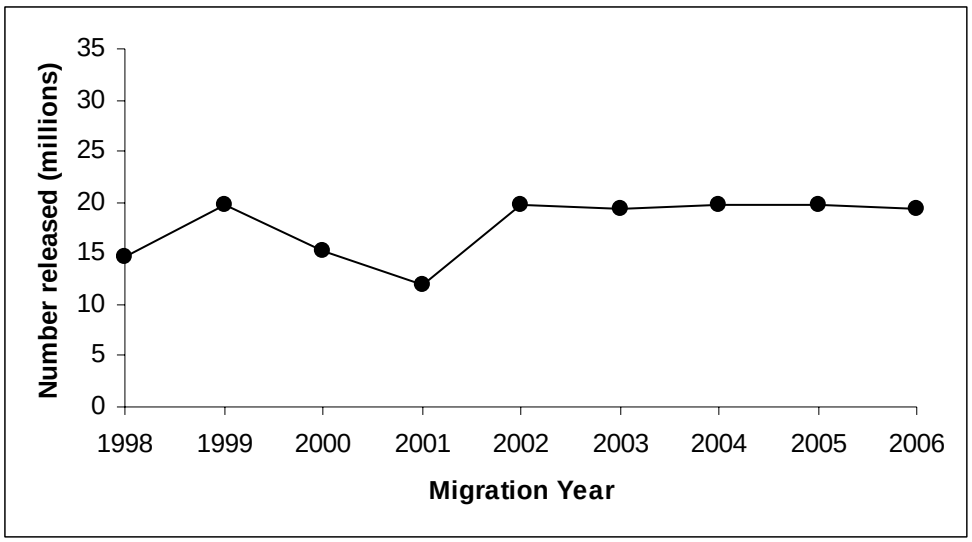

Figure 1. Number of juvenile spring-summer Chinook released above Bonneville Dam for the years 1998 to 2006.

Table 1. Total PIT-tag releases from releases sites with returning jacks in 2006, grouped by river zone where released; Lower Columbia (below Snake River), Snake River, Mid Columbia (above Snake River).

Release River Zone	Number of Tags released	Percent of total releases	Number of Jacks detected at BON	Percent of total Jacks detected
Lower Columbia	22,076	3%	8	2%
Snake River	644,675	85%	361	85%
Mid Columbia	94,890	12%	57	13%
Total	761,641		426	

Table 2. Summary of PIT-tag releases in 2006 and 2007 jack returns related to NOAA transport studies.

Release Site	Number released[a]	Percent of total PIT-tag releases	Number of PIT jacks at BON	Percent of total jacks
LGR Barge	53,093	21%	26	21%
LGR InRiver	161,915	63%	73	59%
Below IHR Dam	40,132	16%	25	20%
Total	255,140		124	

[a] Includes fish released prior to May 25, 2006.

Table 3. Summary of PIT-tags detected in-river or transported in 2006 and subsequent jack returns in 2007 from CSS and related releases.

Release Site	Number Detected	Percent of total tags detected (both categories)	Number of PIT jacks at BON	Percent of total jacks (both categories)
In-River PIT Summary				
CATHEP	2,158	2%	3	2%
DWOR	2,768	2%	2	1%
DWORNF	38,569	32%	40	28%
RAPH	39,405	33%	47	33%
Total In River	**82,900**	**69%**	**92**	**65%**
Transport PIT Summary				
CATHEP	2,846	2%	3	2%
DWOR	118	0%	1	1%
DWORNF	14,528	12%	21	15%

RAPH	19,484	16%	24	17%
Total Transport	**36,976**	**31%**	**49**	**35%**
Total both categories	**119,876**		**141**	

Table 4. Reach survival (see.) of yearling Chinook from Snake River in 2006 compared to other recent years from NOAA Tech Memo August 30, 2006.

	Migration Year					
Reach	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
LGR-MCN	0.556 (0.009)	0.757 (0.009)	0.731 (0.01)	0.666 (0.011)	0.732 (0.009)	0.758 (0.007)
MCN-BON	0.501 (0.027)	0.763 (0.079)	0.728 (0.03)	0.594 (0.074)	0.788 (0.092)	0.806 (0.022)
LGR-BON	0.279 (0.016)	0.578 (0.06)	0.532 (0.023)	0.395 (0.05)	0.577 (0.069)	0.611 (0.018)

Table 5. Comparison of the 2006 estimate of the proportion of Snake River Basin smolt population in Lower Granite Dam fore bay that were "destined for transportation" and the corresponding estimates from 1999 to 2005. The results exclude transport at McNairy Dam.

Species-age group	**Transport Proportion**						
	2006	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**
Yearling Chinook	0.611 (H) 0.579 (W)	0.92	0.870	0.629	0.683	0.980	0.71

Table 6. Estimated number of yearling Chinook at transported at Lower Granite, Little Goose and Lower Monumental dams from 1998 to 2006.

Migration Year	**Transport total**
1998	2,867,411
1999	7,275,653
2000	4,266,176
2001	3,157,045
2002	5,543,226
2003	5,552,257
2004	8,079,714
2005	7,727,186
2006	5,771,726
Average	5,582,266