FISH PASSAGE CENTER

1827 NE 44th Ave., Suite 240, Portland, OR 97213
Phone: (503) 230-4099 Fax: (503) 230-7559
http://www.fpc.org/
e-mail us at fpcstaff@fpc.org

MEMORANDUM

TO: Bob Heinith CRITFC

FROM: Michele DeHart

DATE: March 2, 2011

RE: Data Request

In response to your request the FPC staff reviewed 2010 PIT-tag reach survival data in relation to flows and spill levels experienced by out-migrating juvenile salmon.

- Based on our review it appears that high survivals for spring migrants in the Snake River were likely due in large part to relatively high spill levels during April and May.
- Spill in combination with relatively high flows in June also contributed to high survivals for hatchery subyearling Chinook during that later passage period.
- These analyses indicate that spill for fish passage help downstream migrating salmon and steelhead cope with low migration flows.

We compared reach survival cohorts for 2010 to those from the years 1998 to 2009 (see Figures 1 through 5). In the Snake River reach, steelhead survivals were well above the average of 0.59 for past years with 2010 survivals ranging from 0.71 to 0.92 (see Figure 1). Hatchery yearling spring/summer Chinook survivals were also above the average in the Snake River in 2010 (Figure 2), while wild yearling Chinook survivals were near average (Figure 3). Sockeye survival in 2010 of 0.72 was also above the 1998 to 2009 average of 0.62 (Figure 4). Finally, hatchery subyearling Chinook survivals in 2010 ranged between 0.75 and 0.79 which were much higher than the average of 0.59 (Figure 5).

Flows in the Snake River during the spring BiOp target period from April 3 to June 20 averaged 78.6 kcfs at Lower Granite Dam. Compared to other years in our multiyear analysis (1998 to 2009) the Spring 2010 average flow was in the middle of the range (Table 1). However, yearling

Chinook and steelhead passage timing in 2010, and historically, shows that nearly all (over 95% of steelhead and 99% of spring/summer Chinook) of those species pass prior to June 1. Based on the timing of yearling Chinook and steelhead passage at Lower Granite Dam, a comparison of average flows in April and May was considered more indicative of conditions that fish experienced during passage in the Snake River. Comparing average flows during the period April 3 to May 31 shows that for spring migrants in the Snake River flows in 2010 were nearly as poor as 2001 (Table 1).

Given the poorer than average flows (and conversely longer water transit times) other factors were more likely responsible for explaining the relatively high survivals. Plots of the water transit time--survival relations (Figures 11 through 14) showed that for steelhead, wild yearling Chinook and sockeye survivals were all above the bivariate regression line indicating that some other variable or variables were improving survival beyond what would have been predicted based on water transit time alone. In contrast to flows, spill proportions in April and May were relatively high in 2010 and temperatures were near average (See figures 6 to 10). Figures 6 through 10 show environmental conditions in the Lower Granite Dam to McNary Dam reach during the passage of the survival cohorts represented in Figures 1 to 5 and the survival discussion above. For analysis of survival versus flow we converted flows to water transit times (reservoir volume/discharge at dams) to estimate the average transit time through the reach of a water particle. High flows mean shorter water transit times. As shown in the figures for spring migrants (Figures 6A,7A, 8A and 9A) water transit times were longer than average for the 2010 cohorts. With the higher than average spill proportions these out-migrants experienced in 2010, it is likely that spill during this relatively low flow period was the primary contributor, for the relatively high survivals of yearling Chinook and steelhead.

For subyearling Chinook cohorts that passed during the period late May to the end of June flows were high (and conversely water transit times were shorter than average) and that combined with high spill and cooler than average temperatures likely all contributed to the high survivals seen in 2010.

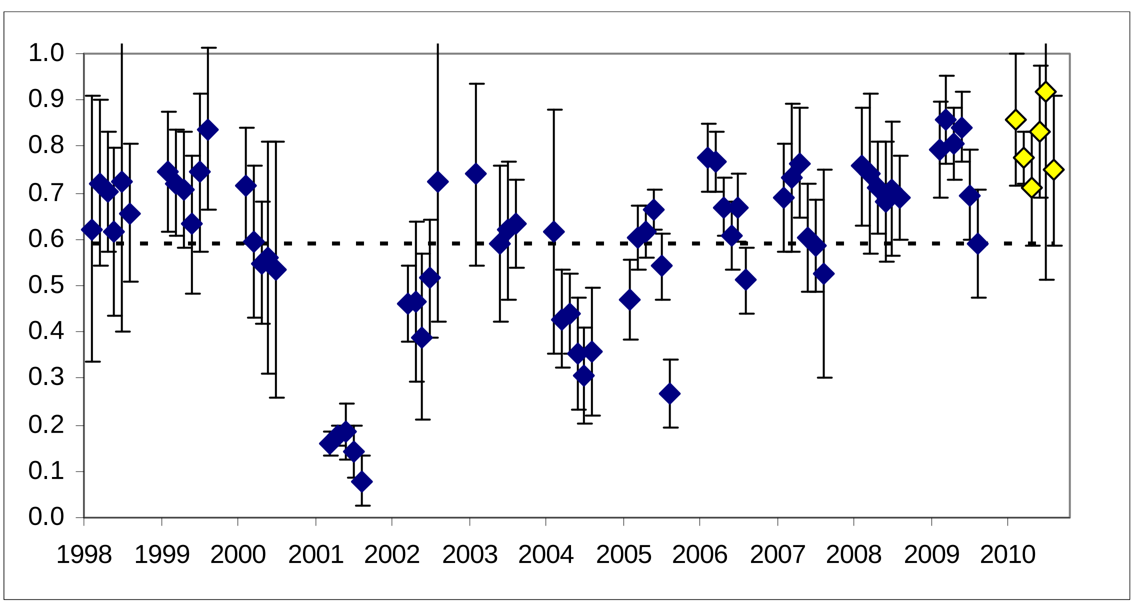

Figure 1. Weekly blocks of steelhead survival in the reach Lower Granite Dam to McNary Dam for the years 1998 to 2010. The dashed line represents the simple average survival for all blocks prior to 2010.

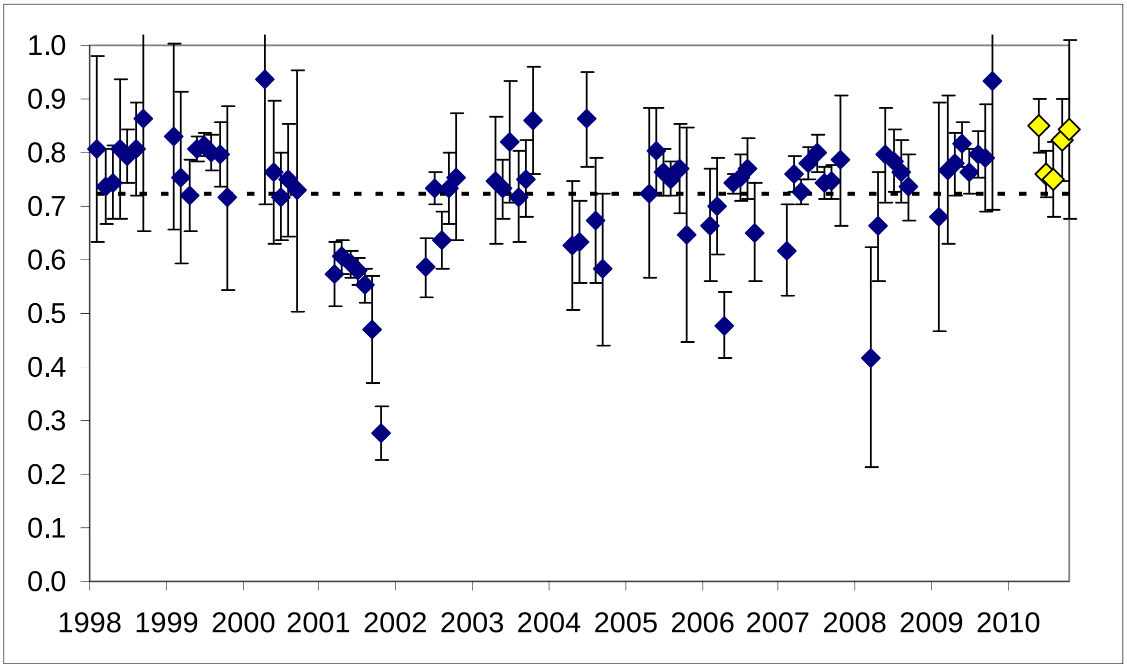

Figure 2. Weekly blocks of hatchery yearling spring/summer Chinook survival in the reach Lower Granite Dam to McNary Dam for the years 1998 to 2010. The dashed line represents the simple average survival for all blocks prior to 2010.

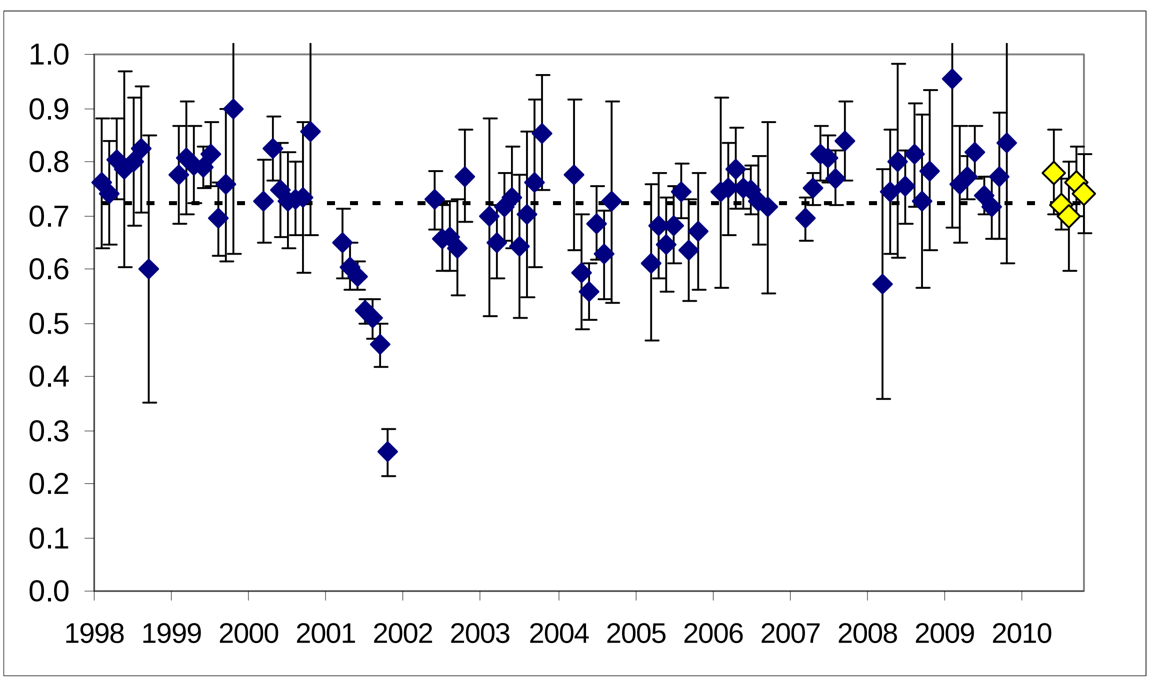

Figure 3. Weekly blocks of wild yearling spring/summer Chinook survival in the reach Lower Granite Dam to McNary Dam for the years 1998 to 2010. The dashed line represents the simple average survival for all blocks prior to 2010.

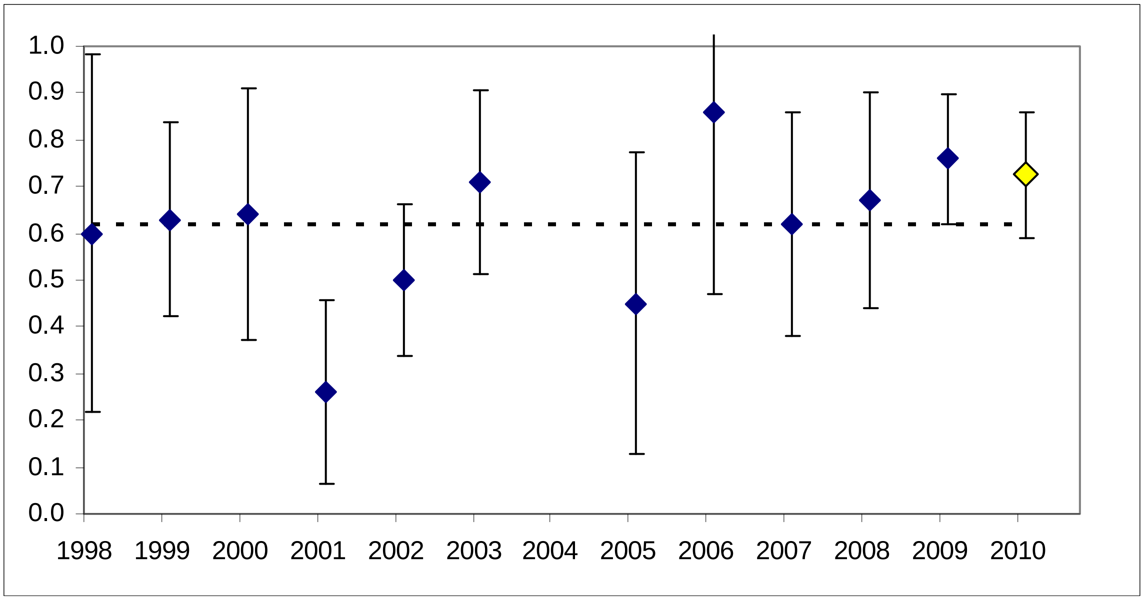

Figure 4. Annual sockeye survivals in the reach Lower Granite Dam to McNary Dam for the years 1998 to 2010. The dashed line represents the simple average survival for all blocks prior to 2010.

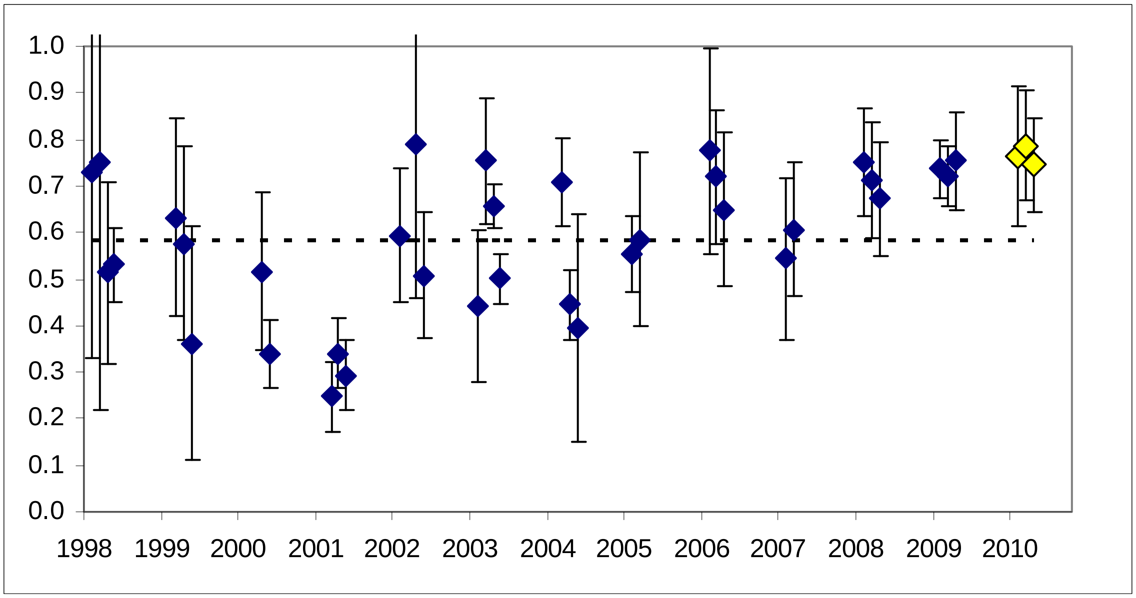

Figure 5. Bi-weekly blocks of hatchery subyearling fall Chinook survival in the reach Lower Granite Dam to McNary Dam for the years 1998 to 2010. The dashed line represents the simple average survival for all blocks prior to 2010.

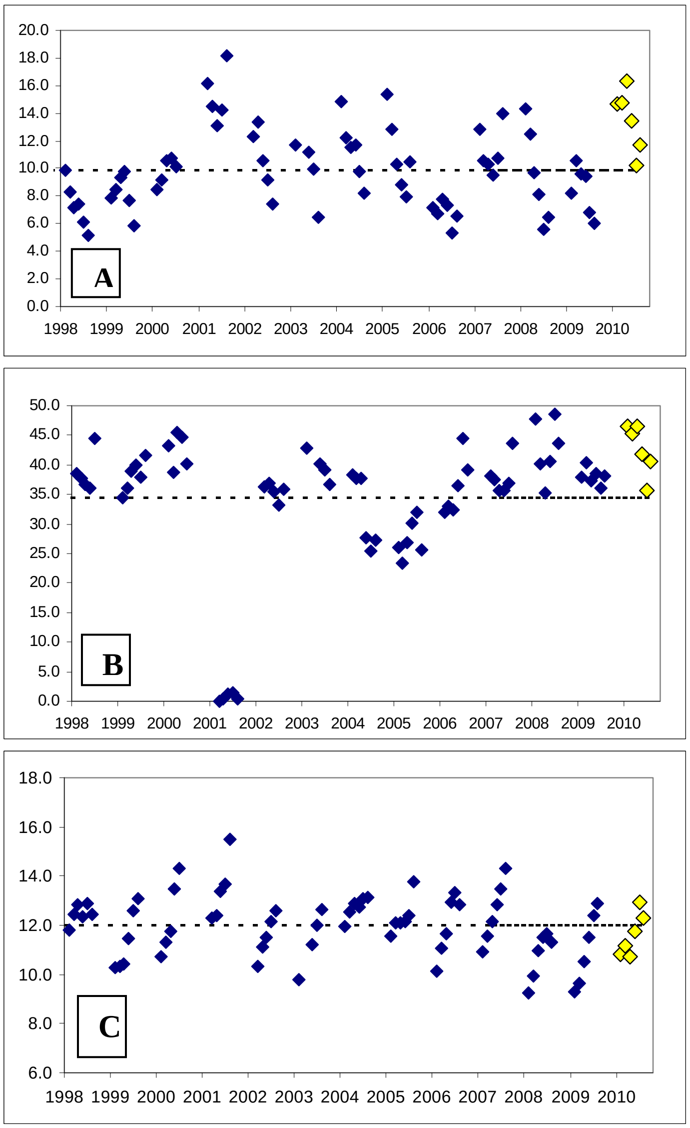

Figure 6. Environmental variables estimated for reach survival cohorts of hatchery and wild steelhead in the Lower Granite Dam to McNary Dam reach. A. Water transit times (LGR tailwater to McNary Dam) for cohorts in survival analysis. B. Average spill percentages for survival cohorts. C. Average Temp C as measured at tailwater tdgs monitors for survival cohorts.

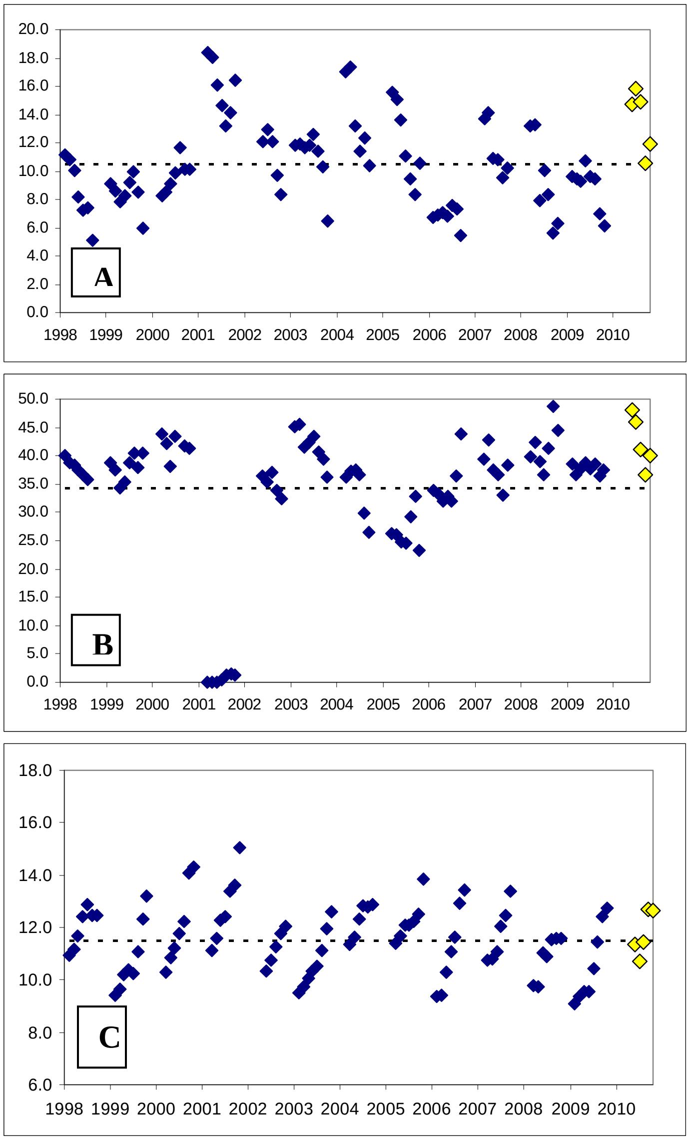

Figure 7. Environmental variables estimated for reach survival cohorts of wild yearling spring/summer Chinook in the Lower Granite Dam to McNary Dam reach. A. Water transit times (LGR tailwater to McNary Dam) for cohorts in survival analysis. B. Average spill percentages for survival cohorts. C. Average Temp C as measured at tailwater tdgs monitors for survival cohorts.

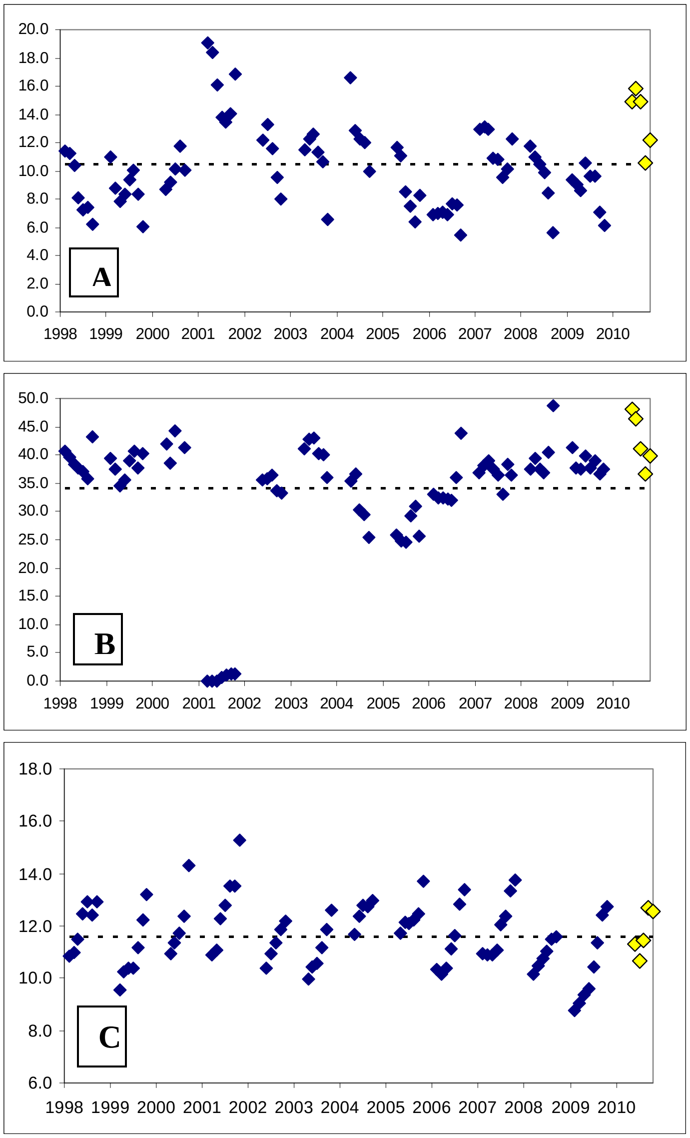

Figure 8. Environmental variables estimated for reach survival cohorts of hatchery yearling spring/summer Chinook in the Lower Granite Dam to McNary Dam reach. A. Water transit times (LGR tailwater to McNary Dam) for cohorts in survival analysis. B. Average spill percentages for survival cohorts. C. Average Temp C as measured at tailwater tdgs monitors for survival cohorts.

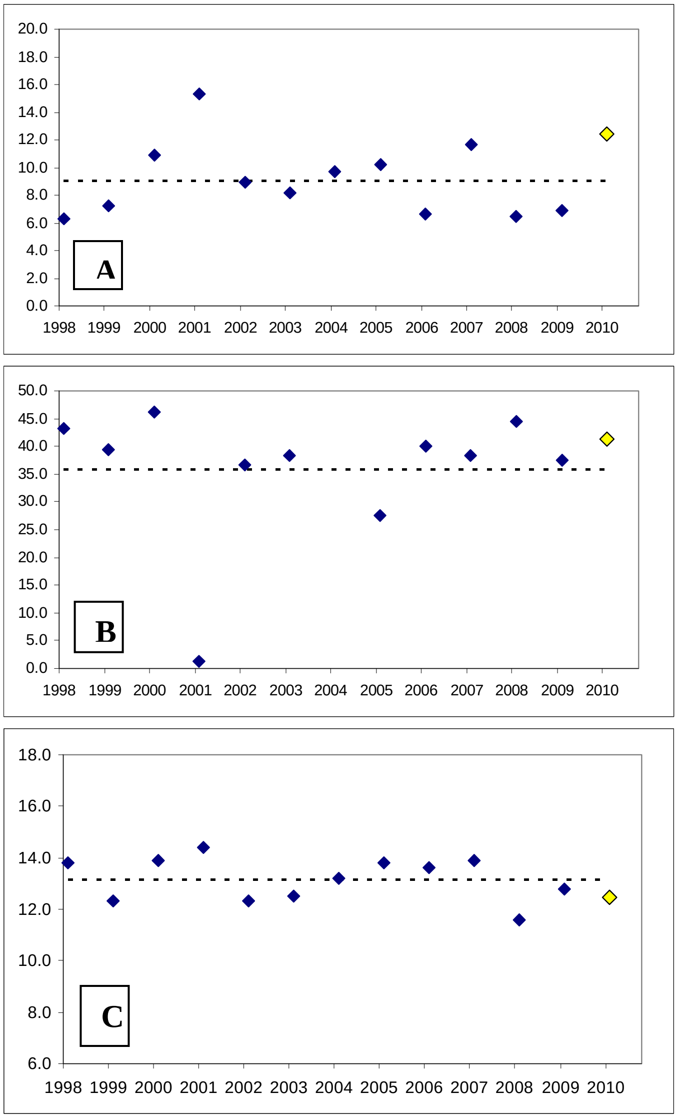

Figure 9. Environmental variables estimated for reach survival cohorts of sockeye in the Lower Granite Dam to McNary Dam reach. A. Water transit times (LGR tailwater to McNary Dam) for cohorts in survival analysis. B. Average spill percentages for survival cohorts. C. Average Temp C as measured at tailwater tdgs monitors for survival cohorts.

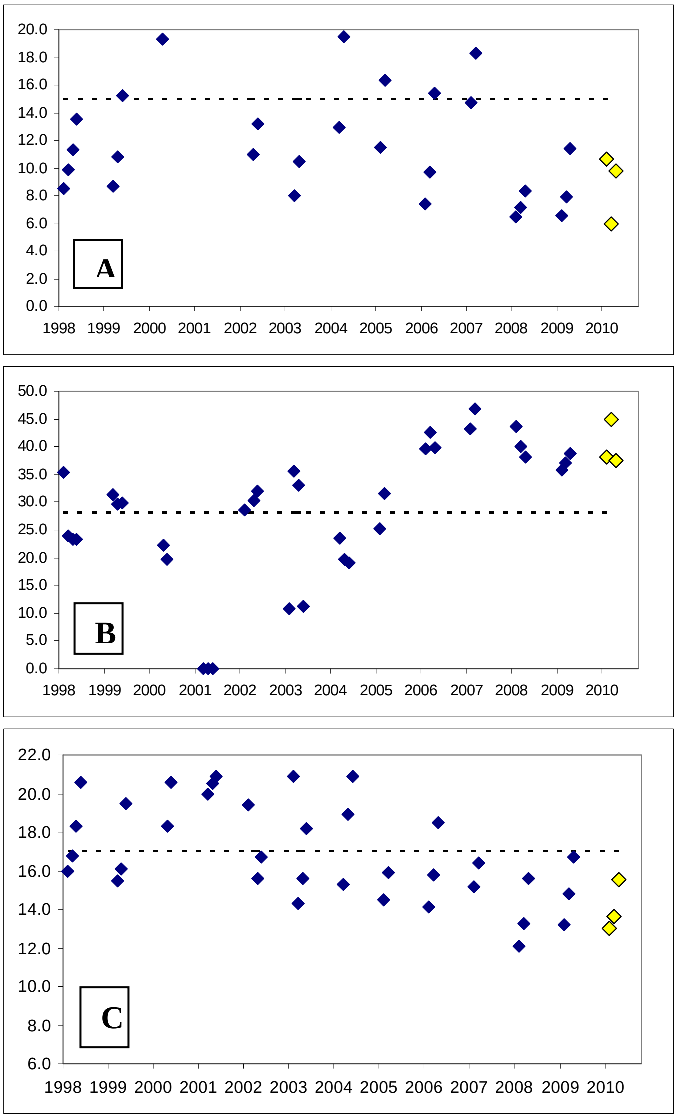

Figure 10. Environmental variables estimated for reach survival cohorts of hatchery subyearling fall Chinook in the Lower Granite Dam to McNary Dam reach. A. Water transit times (LGR tailwater to McNary Dam) for cohorts in survival analysis. B. Average spill percentages for survival cohorts. C. Average Temp C as measured at tailwater tdgs monitors for survival cohorts.

Table 1. Summary of Average flows at Lower Grantite Dam by month and two different aggregations for comparison among the years in cohort survival analysis (1998 to 2010).

Year	**Average Flows at Lower Granite Dam (kcfs)**				
	April 3 to April 30	**May**	**June (1 to 20)**	**BiOp Spring 4/3 to 6/20**	**April 3 to May 31**
1998	67.1	141.0	125.5	111.5	106.6
1999	94.7	112.5	142.2	114.0	104.2
2000	93.7	84.1	72.4	84.4	88.6
2001	35.0	63.2	40.3	47.6	50.1
2002	74.4	82.1	98.9	83.7	78.5
2003	71.4	94.4	109.0	90.2	83.7
2004	49.4	79.4	85.3	70.5	65.4
2005	42.8	90.6	62.0	66.7	68.3
2006	128.1	137.3	105.6	126.0	133.0
2007	47.7	79.6	51.9	61.5	64.7
2008	55.0	116.1	133.6	99.4	87.6
2009	90.1	118.5	127.1	110.9	105.3
2010	42.2	66.9	145.8	78.6	55.4

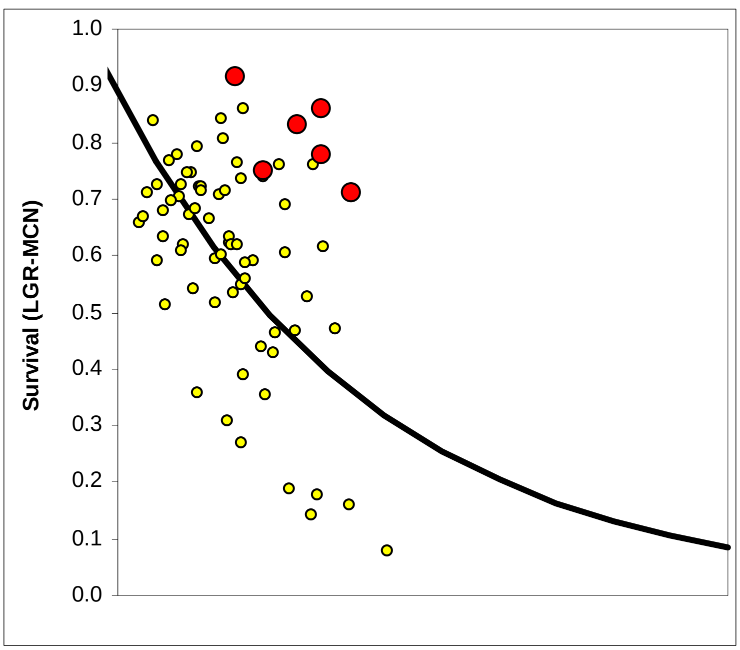

Figure 11. Bivariate plot of steelhead survival and water transit time in the reach LGR to McNary Dam. Data points in red are for 2010. Black line is regression of ln(survival) and WTT.

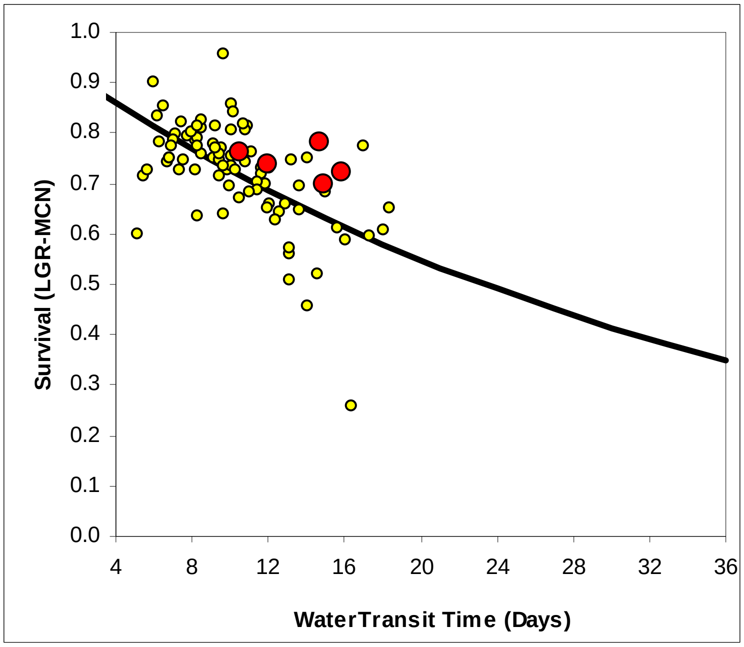

Figure 12. Bivariate plot of wild yearling Chinook survival and water transit time in the reach LGR to McNary Dam. Data points in red are for 2010. Black line is regression of ln(survival) and WTT.

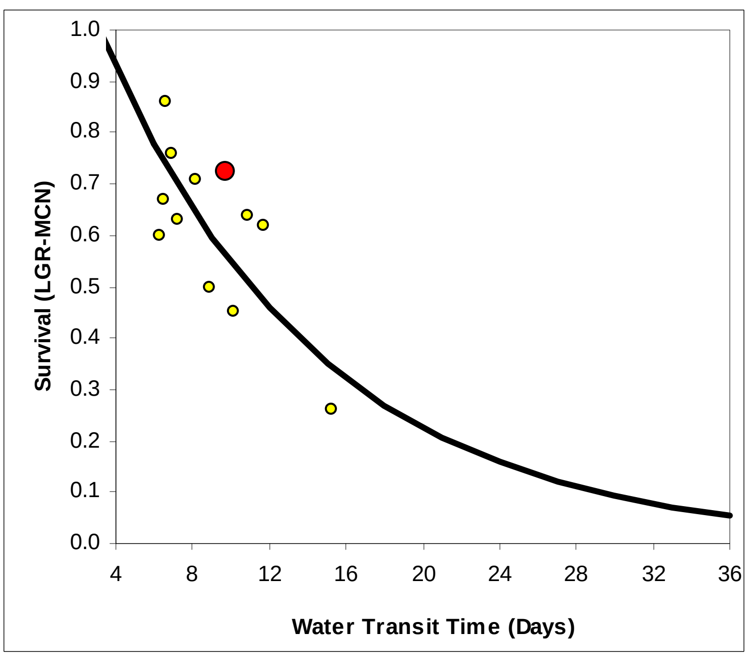

Figure 13. Bivariate plot of sockeye survival and water transit time in the reach LGR to McNary Dam. Data points in red are for 2010. Black line is regression of ln(survival) and WTT.

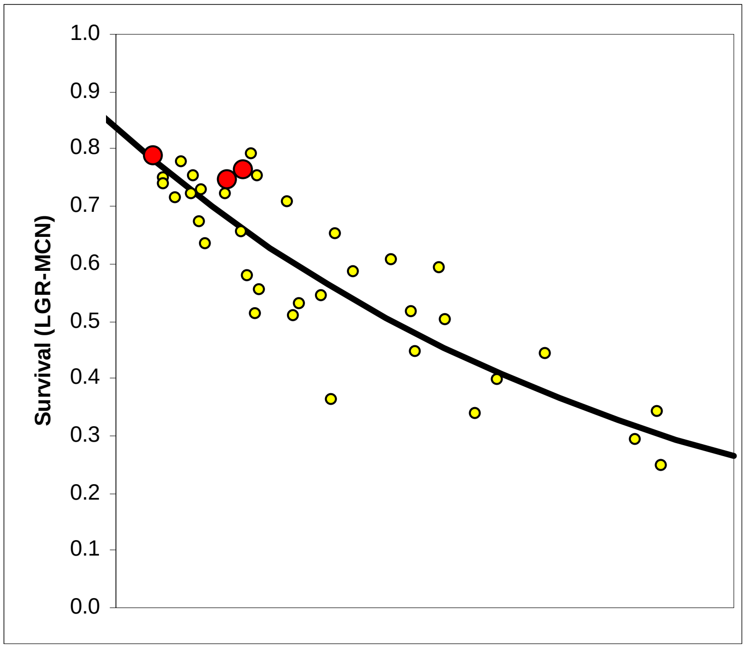

Figure 14. Bivariate plot of subyearling Chinook survival and water transit time in the reach LGR to McNary Dam. Data points in red are for 2010. Black line is regression of ln(survival) and WTT.

FISH PASSAGE CENTER
1827 NE 44th Ave, Suite 240, Portland, OR 97213
Phone: (503) 230-4099 Fax: (503) 230-7559
http://www.fpc.org
e-mail us at fpcstaff@fpc.org

DATA REQUEST FORM

Request Taken By: Jerry McCann **Date:** 2/25/2011

Data Requested By:
Name: BOB HEINITH **Phone:**
Address: CRITFC **Fax:**
Email:

Data Requested:
HIGH SURVIVAL IN 2010 ... ANALYSIS OF THE EFFECTS OF FLOW AND SPILL

Data Format: Hardcopy ☐ Text ☐ Excel ☐ WORD ☒

Delivery: Mail ☐ Email ☒ Fax ☐ Phone ☐

Comments:

Data Compiled By: Jerry McCann **Date:** 3/2/2011

Request # 20

G:\STAFF\DOCUMENT\FORMS\Templates\data request form template.doc