FISH PASSAGE CENTER

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MEMORANDUM

TO: Henry Franzoni

FROM: Michele Dehart

DATE: May 21, 2009

RE: Survival and detectability for 2007 Hanford Reach juvenile fall Chinook

In response to your request the FPC staff analyzed the tag groups you provided. We estimated survival and detection probability for 4 groups of juvenile fall Chinook emigrating during 2007.

The sample sizes for some groups were low enough that we were unable to estimate these parameters in many cases. We also performed a modeling exercise to compare groups in program Mark. There was evidence of a difference in detectability between the 8.5 and 12.5 mm PIT tags and in survival. However, the survival difference may have been confounded by fish size. In general, the 8mm tags were placed in smaller fish than the 12mm tags and these smaller fish may have had a lower survival than the larger fish with the 12mm tags.

Data Description

You provided taglists of Hanford Reach juvenile fall Chinook that emigrated in 2007. Each of these groups had a combination of 2 treatments:

1) PIT tagged with Either 8.5 or 12.5 mm tags.
2) Fish were “less than 60 mm” or “greater than 60mm” in total length.

This resulted in 4 treatment groups. We followed the naming scheme described in table 1 for these 4 groups.

Table 1. Group descriptions and sample size.

Group name	PIT tag size (mm)	Fish size (mm)	Sample size
12GT60	12.5	>60	9124
8GT60	8.5	>60	4986
12LT60	12.5	<60	806
8LT60	8.5	<60	4931

Individual reach survivals and project detectabilities

Table 2. Reach survival and detection probabilities from program Release. Greyed boxes contain estimates that were "unidentifiable", had confidence intervals below 0 or above 1, or equaled zero (due to a lack of fish). Many of these of these are probably due to small sample sizes.

Parameter	Estimate	Standard Error	Lower	Upper
		12GT60		
Phi(1)	0.402548	0.020526	0.362318	0.442778
Phi(2)	0.778269	0.08672	0.608297	0.948241
Phi(3)	0.846328	0.358692	0.143293	1.549364
p(2)	0.270907	0.015253	0.241012	0.300802
p(3)	0.19346	0.020619	0.153046	0.233875
p(4)	0.138889	0.057638	0.025918	0.25186
Phi(4)p(5)	0.014881	0.006605	0.001935	0.027827
		12LT60		
Phi(1)	0.445941	0.097224	0.255382	0.636501
Phi(2)	1.702703	1.191025	-0.63171	4.037112
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.205882	0.049034	0.109776	0.301989
p(3)	0.058824	0.040353	-0.02027	0.137915
p(4)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
Phi(4)p(5)	0	0	0	0
		8GT60		
Phi(1)	0.41929	0.039228	0.342403	0.496176
Phi(2)	0.513016	0.125081	0.267858	0.758174
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.242038	0.024171	0.194662	0.289414
p(3)	0.254545	0.058737	0.139421	0.36967
p(4)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
Phi(4)p(5)	0	0	0	0
		8LT60		
Phi(1)	0.263473	0.026266	0.211993	0.314954
Phi(2)	0.878791	0.306386	0.278274	1.479308
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.260163	0.027972	0.205338	0.314988
p(3)	0.189189	0.064388	0.062988	0.31539
p(4)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
Phi(4)p(5)	0	0	0	0

We used program Release (provided as a component of program Mark) to estimate reach survivals and detection probabilities for each group through the lower hydrosystem. The first reach identified for each group (Phi(1)) is the release to McNary Dam reach. The first detection probability identified for each group (p(2)) is for McNary Dam. Note the last detection probability and reach survival are shown together as these are confounded. This represents the trawl detection probability and the reach survival from Bonneville Dam to the trawl.

The CJS parameters were unstable or not able to be estimated in many cases. The 12GT60 group had the largest sample size by far and we were able to estimate to Bonneville Dam. It was difficult to denote any clear patterns between treatment groups from these direct comparisons because many estimates were not possible. It is worth noting that the 8LT60 fish which were of the lowest size of the four groups (figure 1) had the lowest survival in the first reach.

Model selection

Table 3. Results from model selection exercise in Mark. 'S' and 'p' refer to survival and detectability respectively. "Size" = fish size (greater than or less than 60mm), "PIT" = PIT tag type (8.5mm or 12.5mm).

Model	Delta AICc	AICc	Model Weight	Likelihood	#Par
{PIT(p).Size(S)}	25208.52	0	0.636	1	15
{PIT(S).Size(S)}	25211.11	2.6	0.17375	0.2732	19
{PIT(p).Size(S).PIT(S)}	25212.33	3.82	0.09437	0.1484	22
{PIT(S).Size(S).Size(p)}	25214.27	5.75	0.03585	0.0564	22
{PIT(S).Size(p)}	25214.46	5.95	0.03253	0.0511	15
{PIT(p).Size(p).Size(S)}	25216.2	7.68	0.01366	0.0215	22
{Size(S).Size(p).PIT(S).PIT(p)}	25217.86	9.34	0.00595	0.0094	28
{PIT(p).Size(p)}	25218.33	9.82	0.0047	0.0074	19
{PIT(p).Size(p).PIT(S)}	25219.11	10.59	0.00318	0.005	22
{PIT(S)}	25246.3	37.78	0	0	11
{PIT(S).PIT(p)}	25248.25	39.74	0	0	14
{PIT(p)}	25249.21	40.69	0	0	11
{Size(S)}	25362.34	153.83	0	0	11
{Size(p).Size(S)}	25365.18	156.67	0	0	14
{Size(p)}	25368.97	160.45	0	0	11
{No Difference in groups)	25474.4	265.89	0	0	7

We used program Mark to perform a simple modeling exercise to evaluate the effects of each treatment on survival and detectability. Program Mark works within the linear model paradigm to provide a framework for these types of tests. We ran each of the 16 candidate model and named each accordingly. For example, the first model name represents the hypothesis that fish size affected S (survival), PIT tag type affected p (detectability).

The most parsimonious model of the 16 ran contained an effect of fish size on survival and an effect of PIT tag type on detectability. This model contained 64 % of the model weight; this

means this model was about 3 times as well supported as the next model which had a model weight of 17%. Five of the top six models show an effect of PIT tag type on survival suggesting an effect here. However fish size and tag type were confounded in the groups.

The length of 8mm PIT tagged fish was smaller than for 12mm PIT tagged fish. Boxplots of the fish size for the four treatment groups are shown in figure 1. When performing a t-test between the two PIT tag types for fish less than 60 mm, greater than 60 mm, or the combined 12mm fish vs. combined 8mm fish, there is a statistical difference in fish size between the two types of PIT tag. When log transforming the length data (to account for the lack of normality) these differences still exist. So, any effect of PIT tag type on survival is confounded by fish size and probably not a valid result.

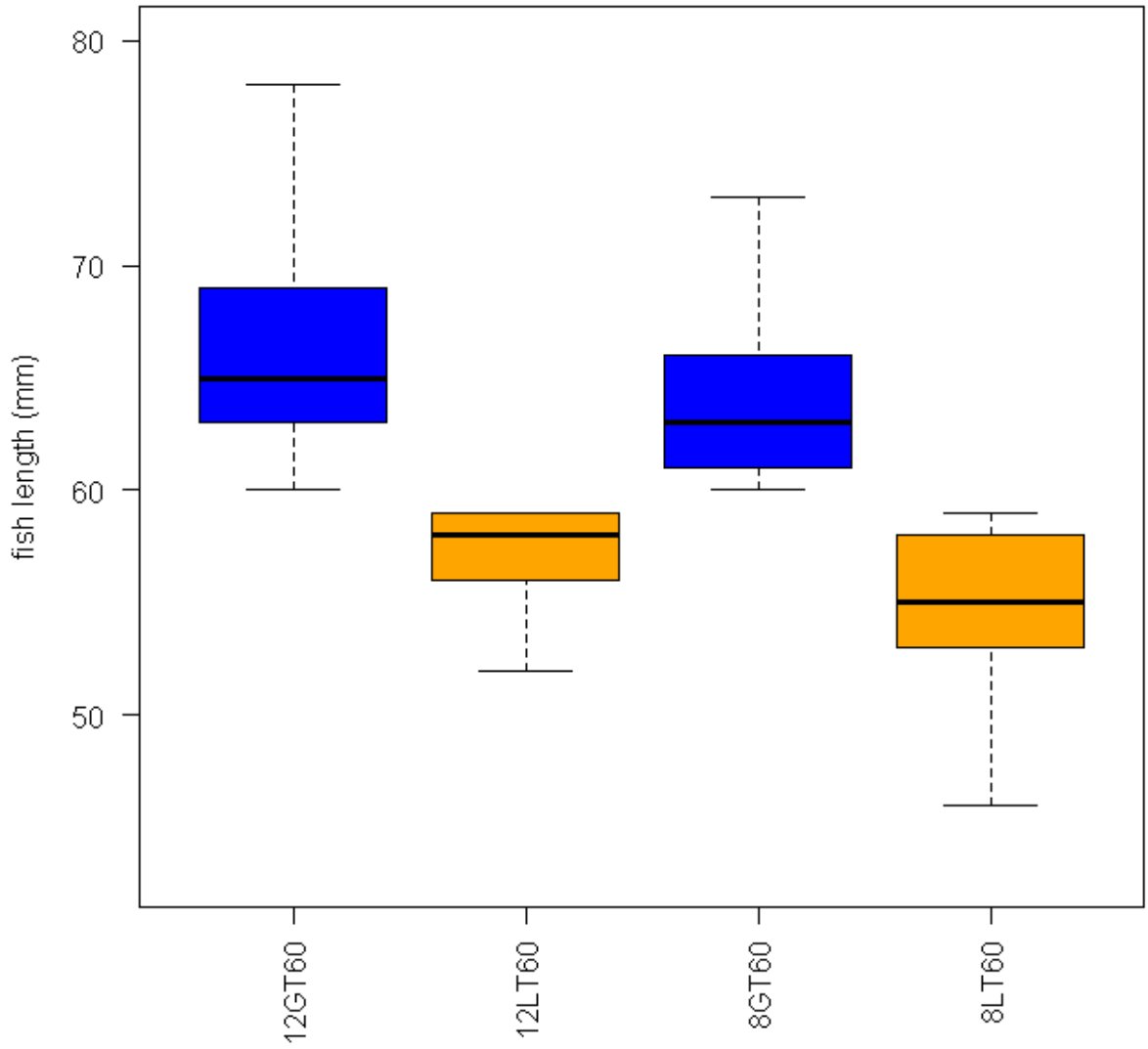

Figure 1. Size for all four treatment groups. Fish with 12mm PIT tag and > 60mm were significantly larger than fish with 8mm PIT tag and > 60 mm. The same was true for the < 60 mm size class.

Summary

Individual reaches and site probabilities of detections were only possible through the McNary to John Day reach in some cases. No clear pattern arose from the individual reach estimates. However, the modeling exercise did show support for an effect of size differential on survival and an effect on detectability by PIT tag type used.