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MEMORANDUM

TO: Henry Franzoni

FROM: Michele DeHart

DATE: Apr 28, 2009

RE: Survival and detectability for 2008 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 8 groups of juvenile fall Chinook emigrating during 2008. 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. Although the data was sparse, we found no evidence that the coded wire tags (CWT) affected fish survival or detectability. However, there was evidence of a difference in detectability between the 8.5 and 12.5 mm PIT tags but not in survival. The size differential in smolts did affect survival but not detectability.

Data Description

You provided taglists of Hanford Reach juvenile fall Chinook that emigrated in 2008. Each of these groups had a combination of three treatments:

1) PIT tagged with Either 8.5 or 12.5 mm tags.
2) Tagged with CWT or not tagged with CWT.
3) Fish were “less than 60 mm” or “greater than or equal to 60mm” in total length.

Table 1. Group descriptions and sample size. CWT = coded wire tag.

Group name	CWT	PIT tag size (mm)	Fish size (mm)	Sample size
cwt125gte60	√	12.5	>=60	2741
ncwt125gte60		12.5	>=60	1153
cwt85gte60	√	8.5	>=60	3606
ncwt85gte60		8.5	>=60	1650
cwt125lt60	√	12.5	< 60	748
ncwt125lt60		12.5	< 60	143
cwt85lt60	√	8.5	< 60	5486
ncwt85lt60		8.5	< 60	1121

This resulted in 8 treatment groups. Here, we followed your naming scheme to describe the 8 groups (table 1) where "cwt125gte60" refers to fish with CWT tags, 12.5mm PIT tag, and a length >= 60. We censored 3, 1, and 8 individuals from groups ncwt125lt60, cwt85lt60, and ncwt85lt60 that were over the 60mm size limit before any analyses.

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
cwt125gte60				
Phi(1)	0.475952	0.084233	0.310854	0.641049
Phi(2)	0.45726	0.115058	0.231746	0.682774
Phi(3)	2.46802	2.405679	-2.24711	7.183151
p(2)	0.119578	0.022865	0.074762	0.164394
p(3)	0.177966	0.035211	0.108953	0.246979
p(4)	0.071429	0.06883	-0.063479	0.206336
Phi(4)p(5)	0.009524	0.009478	-0.009054	0.028101
ncwt125gte60				
Phi(1)	0.494363	0.11234	0.274176	0.714549
Phi(2)	0.520078	0.185978	0.155562	0.884594
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.147368	0.036368	0.076087	0.21865
p(3)	0.155172	0.047542	0.06199	0.248355
p(4)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
Phi(4)p(5)	0	0	0	0
cwt125lt60				
Phi(1)	0.190909	0.069475	0.054737	0.327081
Phi(2)	0.677083	0.40355	-0.113874	1.468041
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.168067	0.067528	0.035713	0.300421
p(3)	0.230769	0.116855	0.001734	0.459804
p(4)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
Phi(4)p(5)	0	0	0	0
ncwt125lt60				

Phi(1)	0.440559	0.386786	-0.317542	1.198661
Phi(2)	0.253968	0.297374	-0.328885	0.836822
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.142857	0.13226	-0.116372	0.402087
p(3)	0.25	0.216506	-0.174352	0.674352
p(4)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
Phi(4)p(5)	0	0	0	0
cwt85gte60				
Phi(1)	0.320577	0.047789	0.226911	0.414243
Phi(2)	0.7906	0.292868	0.216579	1.364621
Phi(3)	0.27597	0.266377	-0.246129	0.798069
p(2)	0.182526	0.029152	0.125388	0.239664
p(3)	0.148936	0.051932	0.04715	0.250722
p(4)	0.166667	0.152145	-0.131538	0.464871
Phi(4)p(5)	0.02381	0.023524	-0.022298	0.069917
ncwt85gte60				
Phi(1)	0.345051	0.067552	0.212649	0.477452
Phi(2)	0.655699	0.265387	0.135541	1.175857
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.198478	0.041761	0.116627	0.280329
p(3)	0.166667	0.062113	0.044925	0.288408
p(4)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
Phi(4)p(5)	0	0	0	0
ncwt85lt60				
Phi(1)	0.225564	0.071849	0.08474	0.366388
Phi(2)	0.500284	0.33202	-0.150475	1.151043
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.174011	0.059565	0.057265	0.290758
p(3)	0.285714	0.170747	-0.04895	0.620378
p(4)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
Phi(4)p(5)	0	0	0	0
cwt85lt60				
Phi(1)	0.290801	0.056241	0.180568	0.401034
Phi(2)	0.713448	0.407051	-0.084373	1.511268
Phi(3)	Unidentifiable	Unidentifiable	Unidentifiable	Unidentifiable
p(2)	0.138529	0.028001	0.083647	0.193412
p(3)	0.115385	0.062656	-0.007422	0.238191
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.

Because some data sets were sparse, containing less than 1000 fish, the CJS parameters were unstable or not able to be estimated. The farthest downstream reach estimable was the McNary to John Day dam reach, but this was not always possible. We were not able to estimate any parameters for the group with the fewest numbers (ncwt125lt60, n = 143; see table 1 and 2). There were no clear patterns between treatment groups from these direct comparisons.

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), and "CWT" = coded wire tagged or not.

Model	Delta AICc	AICc	Model Weight	Likelihood	Number of parameters
Size(S); PIT(p)	14448	0.0	**99.2%**	1	15
Size(S); PIT(p); PIT(S)	14457	9.7	0.8%	0.008	22
Size(S); Size(p); PIT(S); PIT(p)	14466	18.5	0.0%	0.0001	28
CWT(p); CWT(S); Size(S); Size(p); PIT(S); PIT(p)	14501	53.5	0.0%	0	56
Size(S)	14524	76.8	0.0%	0	11
Size(S); Size(p)	14529	81.4	0.0%	0	14
Size(p)	14529	81.6	0.0%	0	11
PIT(S)	14534	86.4	0.0%	0	11
CWT(S); Size(S); PIT(p)	14535	87.3	0.0%	0	22
PIT(S); PIT(p)	14536	88.8	0.0%	0	14
PIT(p)	14537	89.4	0.0%	0	11
CWT(p)	14666	218.3	0.0%	0	11
CWT(S)	14666	218.6	0.0%	0	11
No tag or size effects model	14681	233.2	0.0%	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. Each model name shown in table 3 represents a biologically meaningful hypothesis. For example, the second model name represents the hypothesis that fish size affected S (survival), PIT tag type affected p (detectability), and PIT tag type affected S. The second model does not assume any effects of CWT.

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 99.2 % of the model weight; this means this model was over 99 times as well supported as the next model which had a model weight of 0.8%. No other models had a model weight of over 0.05% and therefore all showed little evidence for being valid; these included any with CWT effects on survival or detectability.

So, 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.