TURBINE OPERATIONAL EFFECTS ON SURVIVAL/CONDITION OF YEARLING CHINOOK SALMON, *Oncorhynchus tshawytscha*, AT ICE HARBOR DAM, MARCH 2007

Contract No. DACW68-02-D-0002
Task Order 29

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Prepared for

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EXECUTIVE SUMMARY

The experiment utilizing the HI-Z tag-recapture technique (HI-Z tag) was designed to estimate survival probabilities (1 and 48 h) within ≤ 0.03, 95% of the time, of yearling hatchery-reared chinook salmon, *Oncorhynchus tshawytscha,* (total lengths ranged from 121 to 196 mm in March 2007), in passage through turbine Unit 3 at Ice Harbor Dam at the following five operating conditions:

Condition 1: lower 1% (8.6 kcfs)
Condition 2: peak (9.8 kcfs)
Condition 3: intermediate (11.4 kcfs)
Condition 4: upper 1% (12.6 kcfs)
Condition 5: maximum (14.1 kcfs)

Although fish were released in each of the three intake slots (A, B, and C) and at five operational levels (15 test conditions), the primary objective was to obtain composite survival estimates for the five operational levels. However, statistical analysis was performed to assess the effects of slot releases on survival and fish condition. The fish were released just below the fish diversion screens in the intake (3.2 and 5 ft) and based on bead releases through a turbine model at the Engineer Research and Development Center, Vicksburg, Mississippi; they should have been broadly distributed within the turbine.

The survival and fish condition data were analyzed using three different metrics: (1) survival, (2) conditional malady-free estimate (free of visible injury, scale loss, or loss of equilibrium) given 48 h survival, and (3) the joint probability of passage survival and being malady-free. The latter metric was calculated to compare the observed bead blade strike data gathered from turbine models study conducted at the Engineer Research and Development Center.

Recapture rates (physical retrieval of alive and dead fish) ranged from 97 to 100% for treatment groups and 100% for controls. The actual percentage of fish recaptured dead ranged from 0 to 3%. The percentage of fish assigned dead or to unknown status was 1.7%. All controls were recaptured alive.

Retrieval times were similar within treatment and control groups. However, mean retrieval times for treatment groups (7.3 to 13.2 min) were somewhat higher than the 5.6 min control average.

The 48 h survival estimates for each of the 15 test conditions were as follows: (standard errors, SE, in parentheses).

	Lower 1% (8.6 kcfs)	**Peak (9.8 kcfs)**	**Intermediate (11.4 kcfs)**	**Upper 1% (12.6 kcfs)**	**Maximum (14.1 kcfs)**
Slot A	0.929 (0.026)	0.960 (0.028)	0.960 (0.020)	0.960 (0.020)	0.940 (0.024)
Slot B	0.960 (0.020)	0.980 (0.020)	0.980 (0.014)	0.970 (0.017)	0.950 (0.022)
Slot C	0.960 (0.020)	0.940 (0.034)	0.990 (0.010)	0.970 (0.017)	0.960 (0.020)

All survival probabilities equaled or exceeded 0.929 with the lowest survival (0.929, SE=0.026) occurring

for fish passed through Slot A at 8.6 kcfs (lower 1% operation level). The highest survival (0.990, SE=0.010) occurred when fish were passed through Slot C at 11.4 kcfs (intermediate operation level).

The lack of significant interaction (P = 0.9914) between slot and operational level permitted the pooling of survival for each treatment level across slots and for each slot to be pooled across treatment levels. With slots combined, the estimated 48 h survival probability of 0.977 at the intermediate operational level was higher than at the other four operating levels which ranged from 0.950 to 0.967 but it did not differ significantly (P > 0.10) from the other levels tested.

Estimated 1 and 48 h survival probabilities and standard errors (parentheses) for the five turbine operating efficiency (slots combined) are summarized as follows:

	Lower 1% (8.6 kcfs)	**Peak (9.8 kcfs)**	**Intermediate (11.4 kcfs)**	**Upper 1% (12.6 kcfs)**	**Maximum (14.1 kcfs)**
1 h	0.957 (0.012)	0.960 (0.0160)	0.980 (0.008)	0.970 (0.010)	0.950 (0.013)
48 h	0.950 (0.013)	0.960 (0.0160)	0.977 (0.009)	0.967 (0.010)	0.950 (0.013)

When operational levels are combined, Slots B and C 48 h survival probability of 0.967 was higher than survival probability in passage through Slot A (0.949), but not significantly (P > 0.10).

The malady rate for all examined fish at all operational conditions tested was 3.6%. The most common injury was operculum or gill damage (1.1%) followed by eye damage (1.0%), hemorrhages or bruises to the head or body (0.8%) and decapitation (0.8%) Only three fish examined (0.2%) exhibited loss of equilibrium exclusively and no fish exhibited scale loss exclusively. The probable cause of the majority (about 90%) of these injuries were sheer forces or mechanical (physical contact with a structure). The overall visible injury rate (3.4%), which combines the number of fish with visible injuries and excludes those with only loss of equilibrium or scale loss, was slightly lower than the 3.6% overall malady rate.

The conditional malady-free estimate (CMFE), given 48 h survival, (includes all examined fish without injuries or maladies surviving to 48 h) was calculated for each treatment scenario. As with the survival analysis, the lack of interaction effect allowed CMFE, to be averaged across slots and for each slot to be averaged across treatment levels. Average CMFE probabilities and standard errors (parentheses) for the five turbine operating levels (slots combined) are summarized as follows: The CMFE's were not significantly different (P=0.9263) and differed by less than 0.017.

Lower 1% (8.6 kcfs)	**Peak (9.8 kcfs)**	**Intermediate (11.4 kcfs)**	**Upper 1% (12.6 kcfs)**	**Maximum (14.1 kcfs)**
0.986 (0.007)	0.993 (0.007)	0.986 (0.007)	0.979 (0.008)	0.990 (0.006)

The joint probability of surviving turbine passage without malady and associated standard errors (SE) were similar to turbine passage survival alone. The joint probability estimates of surviving turbine

passage without malady along with their associated standard errors for the five turbine operating efficiencies are summarized as follows:

Lower 1% (8.6 kcfs)	Peak (9.8 kcfs)	Intermediate (11.4 kcfs)	Upper 1% (12.6 kcfs)	Maximum (14.1 kcfs)
0.937 (0.014)	0.953 (0.017)	0.963 (0.011)	0.947 (0.013)	0.940 (0.014)

The intermediate operation level was the highest (0.963) and the lower 1% operation level was the lowest (0.937).

The hypothesis that the highest survival coincides with peak operating efficiency was not supported; instead, the highest survival (0.977) appears to coincide with the intermediate operating level, but this was not proven to be significantly better than the other levels. Further testing should be conducted to confirm that the intermediate operating level (11.4 kcfs) could provide safer fish passage conditions than the other operating levels tested. Because the probability of incurring a malady, given survival was fairly constant across levels, the joint probability of surviving passage without incurring a malady followed the same pattern as the estimates of survival only for tested operating levels.

Although there was a trend for higher survival and better fish conditions at the intermediate operating level this trend may be the result of natural and experimental variations.

This study was conducted with surface acclimated fish. Recent laboratory experiments by Pacific Northwest National Laboratory have indicated that surface acclimated fish are less susceptible to pressure-related injuries than depth acclimated fish. Thus, there is a need to gather mortality and pressure-induced injury data on depth acclimated fish upon turbine passage.

Survival Study Summary Framework

Year: March 2007
Study site(s) Ice Harbor Dam
Objective(s) of study Release an adequate number of fish through Slots A, B, and C of Turbine Unit 3 at five operational levels Ice Harbor Dam such that the resulting 48 h survival and fish condition estimates would have a precision ( ) of $\leq\pm$ 0.03, 95% of the time.
State hypothesis, Survival is equal at all five operating levels and at each of three intake slots. Survival without malady is equal at all five operating levels and at each of three intake slots.
Fish Species-race: Chinook salmon Source: White Salmon National Fish Hatchery, WA
Size (range & mean) Weight: Not taken Length: 121-196 mm total range (mean 140 mm)
Tag Type/model: HI-Z Balloon Tags Weight (gm): 1.9 g
Implant procedure Surgical: Externally attached and then detached upon fish recapture Gastric: N/A Injected: N/A
Survival estimate (per species or objective) Type (project, etc.): Ice Harbor Dam Turbine Unit 3 48 h value (SE): Lower 1% 0.950 (0.013); Peak0.960 (0.016); Intermediate 0.977 (0.009); Upper 1% 0.967 (0.010), and Maximum 0.950 Sample size/replicate: Lower 1%(N = 299), Peak (N = 150); Intermediate (N = 300), Upper 1% (N = 300); Maximum (N=300) and 330 control # replicates: 2 Analytical model: Joint likelihood model (Normandeau Associates, Inc. and Skalski 2006a,b) Survival without malady estimate 48 h value (SE): Lower 1% 0.937 (0.014); Peak0.953 (0.017); Intermediate 0.963 (0.011); Upper 1% 0.947 (0.013), and Maximum 0.940 Sample size/replicate: Lower 1%(N = 299), Peak (N = 150); Intermediate (N = 300), Upper 1% (N = 300); Maximum (N=300) and 330 control # replicates: 2 Analytical model: Joint likelihood model (Normandeau Associates, Inc. and Skalski 2006a,b)
Hypothesis test and results (if applicable) H_o: Lower 1% survival without malady= Peak, Intermediate, Upper 1% or Maximum survival without malady. H_a: Survival without malady $\neq$ among the five operation levels tested Conclusion: Mortality and injury not significantly higher for any of the five operating levels and slots tested.

Characteristics of estimate Effects reflected (direct, total, etc.): Direct Absolute or relative: Absolute (relative to control)
Environmental/operating conditions Relevant discharge indices: Approximate volume (kcfs) of each operational level tested, Lower 1% (8.6), Peak (9.8), Intermediate (11.4), Upper (13.6), and Maximum (14.1). Project discharge, variable Temperature: 5.0 to 7.2° C (41.0 to 45.0° F) TDG: N/A Treatment(s): 15
Unique study characteristics:

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1.0 INTRODUCTION AND BACKGROUND

Efforts at maximizing survival of outmigrating salmonid smolts, particularly at several hydroelectric dams in the U.S. Pacific Northwest, have included constraining turbine operation within ± 1% peak efficiency. While yearling salmonid survival is assumed to be greatest within this peak efficiency range, greater survival levels may be achieved by operating turbines at other operational levels. Recent studies at some hydroelectric dams and statistical analyses of historical turbine passage survival data have indicated that the highest fish survival does not necessarily coincide with peak turbine operating efficiency (Normandeau Associates *et al.* 2000; Skalski *et al.* 2002). In fact, at some sites the highest survival coincided with turbines operating beyond the peak efficiency (Normandeau Associates *et al.* 1996; Mathur *et al.* 2000). Because the internal hydraulics and geometry of each turbine may differ resulting in variable fish passage survival (Normandeau Associates and Skalski 1996) it is unknown whether a generalization can be broadly applied. Thus, a better understanding of the relationship of turbine operating efficiency and fish condition/survival can provide a baseline with which to compare or quantify improvements in fish survival where turbine modifications (structural or operational) are planned or being made (Normandeau Associates *et al.* 1996).

The Corps provided an opportunity to evaluate the effects of various turbine operations on fish condition/survival at the Ice Harbor Dam (IHR) on the Snake River. The IHR turbines have a wide range of discharges, approximately 8.6 to 12.7 kcfs (61.8 to 91.3 MW), when operating within the prescribed 1% of peak efficiency at a 96 ft operating head (Figure 1-1). Because observations of the IHR 1:25 scale physical turbine model indicated that the quality of flow through the turbine environment is quite variable over this wide operating range the Corps proposed the following prototype study to ascertain if fish condition/survival could be improved by optimizing turbine operations. The Corps requested Normandeau Associates to use the HI-Z Turb'N Tag (HI-Z) fish recapture technique to test this hypothesis.

The primary objective of this investigation was to determine the effect of five operating points on direct survival and injury of yearling Chinook salmon passing through turbine Unit 3 at Ice Harbor Dam. Three metrics were estimated for each operating point:

Direct turbine passage survival (1 and 48 h),
Conditional probability of being malady-free given survival,
Joint probability of survival (48 h) and being malady-free.

The respective operating levels and corresponding discharges were: the lower end of the 1% operating level (approximately 8.6 kcfs), peak (9.8 kcfs), intermediate (11.4 kcfs), upper 1% (12.6 kcfs), and maximum (14.1 kcfs). The conditional malady-free estimate, given survival (MFE) differs slightly from the clean fish (CFE) metric used in previous studies since the CFE was not conditional on survival and was based only on fish physically recaptured. The product of the MFE and the 48 h survival estimate gives the joint probability of surviving passage and being malady-free.

The primary hypothesis of interest was whether the survival rate without malady at one operating level was equal to the survival rate without malady at another operating point (H_o) versus the alternative that the survival without malady rate is not equal (H_A). Sufficient fish were to be released to detect at least a ± 3% difference between treatment groups 95% of the time (P=0.05).

A secondary objective of this study was to examine the types of passage related injuries sustained by test fish and if possible to assign a probable cause or mechanism to each.

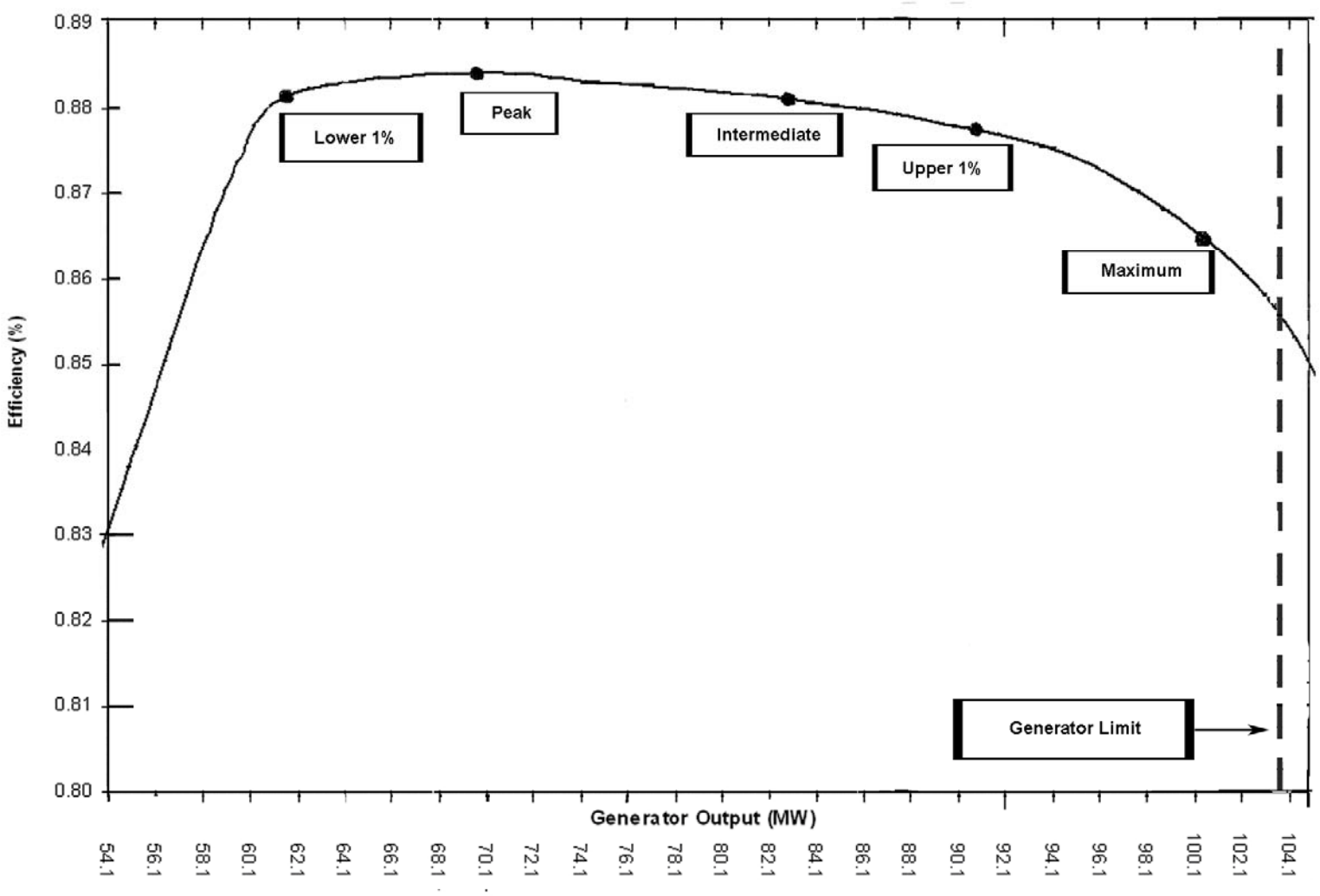


Figure 1-1 Ice Harbor Unit 3 generator output for 96 ft head at five operational levels: lower 1%, peak, intermediate, upper 1%, and maximum during survival /condition study with yearling Chinook salmon, March 2007.

Table 1-1 Physical parameters (mean values for each scenario) measured during the survival/condition trials conducted with yearling Chinook salmon passed through Slots A, B, and C of, Unit 3 at 5 operation levels: lower 1% (8.6 kcfs), peak (9.8 kcfs), intermediate (11.4 kcfs), upper 1% (12.6 kcfs) and maximum (14.1 kcfs) outputs, Ice Harbor Dam, March 2007.

Unit 3 Operation Level	Slot	Power Generation (MW)	Unit 3 Discharge (kcfs)	Station Discharge (kcfs)	Forebay Elevation (ft)	Tailwater Elevation (ft)	Head (ft)	Blade Angle (degrees)	Wicket Gate Opening (%)
	A	62.3	8.7	60.2	439.0	343.4	95.6	17.1	49.5
Lower 1%	B	61.8	8.6	60.9	439.1	343.5	95.5	16.9	49.3
	C	61.9	8.6	60.3	438.9	343.5	95.4	16.9	49.2
	A	70.0	9.7	58.0	439.0	343.5	95.6	19.5	53.2
Peak	B	71.0	9.8	57.7	439.1	343.3	95.7	19.8	53.6
	C	70.8	9.7	57.7	439.1	343.3	95.7	19.7	53.5
	A	83.5	11.4	48.2	438.8	342.3	96.5	23.0	59.9
Intermediate	B	83.0	11.4	49.2	438.8	342.5	96.3	23.0	59.9
	C	83.2	11.4	49.5	438.9	342.5	96.3	23.0	59.9
	A	90.8	12.6	54.0	438.5	342.8	95.7	25.3	64.9
Upper 1%	B	91.0	12.6	53.7	438.6	342.7	95.8	25.3	64.8
	C	91.3	12.7	54.0	438.7	342.7	96.0	25.2	64.8
	A	101.1	14.1	70.1	439.7	344.3	95.4	28.1	70.4
Maximum	B	100.7	14.1	63.8	439.0	343.7	95.3	28.1	70.4
	C	100.7	14.1	64.7	439.1	343.9	95.2	28.1	70.4

1.1 Study Site

Ice Harbor is the first dam on the Snake River upstream of the confluence with the Columbia River (Figure 1-2). It has six Kaplan type turbine units and 10 spillway bays, along with a navigation lock and an earth-fill section. Standard-length submersible traveling screens (STSs) are present in all turbine intake bays. Turbines are numbered 1-6 from south to north. Each unit is divided into three intakes, identified as Slots A, B, and C, south to north. The present investigation was conducted at turbine Unit 3. Turbine Unit 3 has 6 adjustable blades, a runner speed of 90 revolutions per minutes (rpm), and a runner diameter of 280 inches (Table 1-2).

The Ice Harbor tailwater elevation is directly dependent upon river flow (project discharge). At low discharge (less than 50 kcfs), the tailwater is generally below 341 ft. The tailwater is generally above 345 ft at discharges greater than 100 kcfs. The normal operating range of the tailrace elevation is 339.5 to 345 ft. Although the rated generator output is 94.7 MW at an operational head of approximately 89 ft, the output ranged from 61.3 to 101.8 MW (Appendix Table A). The study was conducted at an average head of 95.2 to 96.5 ft. Average forebay and tailrace elevation for each scenario ranged from 438.1 to 440.2 ft and 342.3 to 344.3 ft, respectively (Table 1-1).

Fish passage tests were conducted from March 17 to March 25, 2007. Ambient water temperature during the study ranged from 5.0 to 7.2° C (41.0 to 45.0° F).

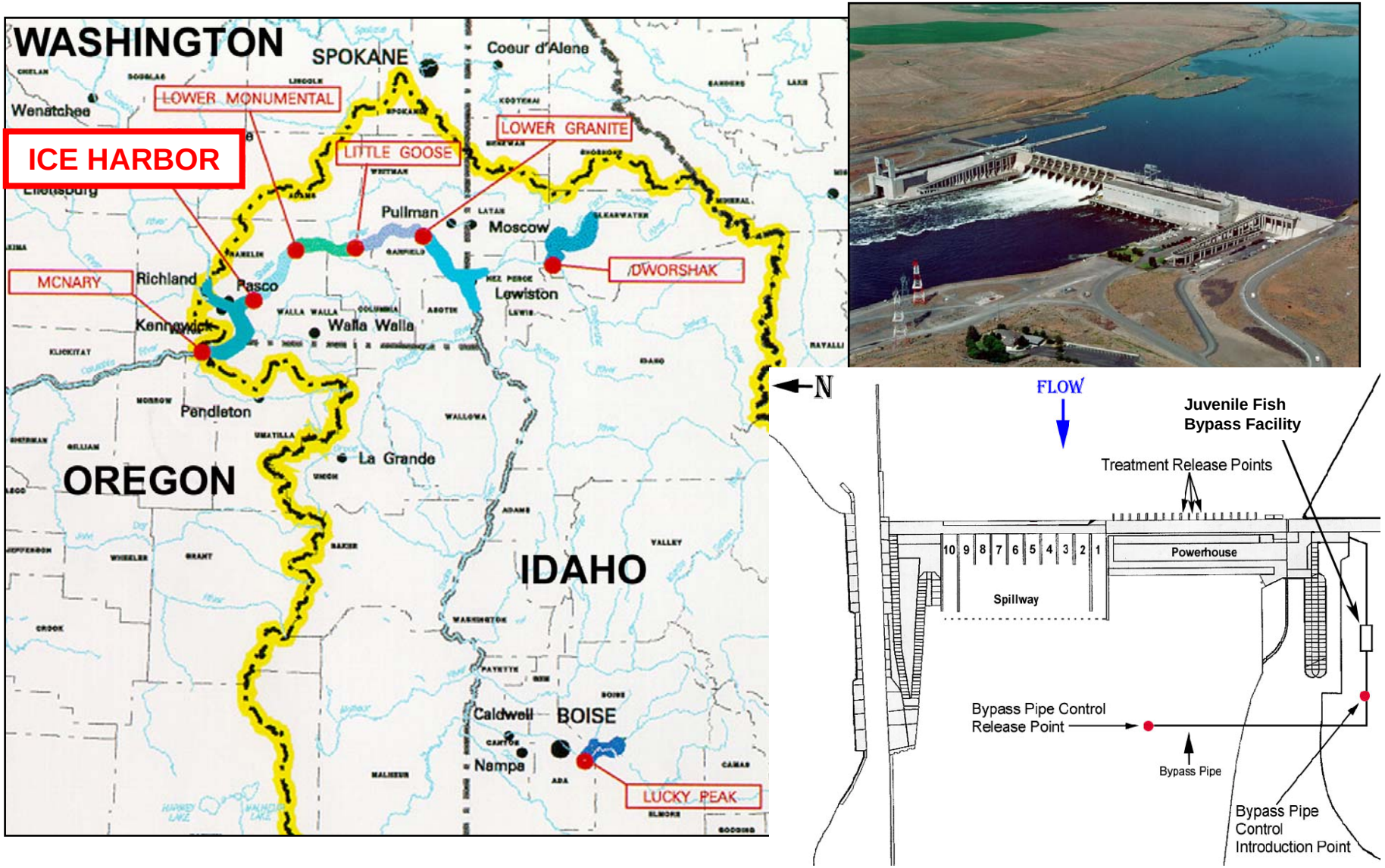


Figure 1-2 Location map of Ice Harbor Dam, showing orientation and general layout of the powerhouse and spillway. Fish release locations are also indicated.

Table 1-2 Physical and hydraulic characteristics of turbine Unit 3 at Ice Harbor Dam. Data provided by US Army Corps of Engineers.

	Unit 3
Manufacturer	Allis Chalmers
Type	Kaplan
Hydraulic capacity (cfs) at 96' head*	145,000
Rated Output (Total MW)	106.64
No. of Blades	6
No. of wicket gates	20
Maximum wicket gate opening (inches)	35
RPM	90
Runner diameter (inches)	280

*Average head during test with STS installed.

2.0 STUDY DESIGN

The present study obtained absolute estimates of direct survival rates at five turbine operating levels of Unit 3, using the HI-Z tag recapture methodology (Heisey *et al*. 1992) to estimate fish passage survival (Mathur *et al*. 1996; Normandeau Associates and Skalski 1997). The experimental design for the turbine passage survival study is a split-plot design with operation levels as whole-plot treatments, and slots, split-plot treatments.

Three metrics were computed to assess the condition of the fish, including (1) the percentage of recaptured fish with passage related maladies, (2) Conditional Malady-Free Estimate (CMFE); fish free of maladies that survived 48 h, and (3) joint probability of fish surviving 48 h and being malady-free. The survival and fish condition metrics were obtained for each operating point and intake slot location. The survival and condition was obtained relative to that of control fish released via the Juvenile Fish Bypass Facility.

2.1 Sample Size

There were two main considerations of the study. The first was to release an adequate number of fish such that the resulting 48 h survival and Fish condition (CMFE) estimates would have a precision ( ) of $\leq \pm$ 0.03, 95% of the time. The second was to test the hypothesis of differences among the 48 h survival and MFE rates at the five operating points. The sample size requirements for these two scenarios are presented separately in Tables 2-1 and 2-2. In general, the sample size is a function of the recapture rate (P_A), expected passage survival ($\hat{\tau}$) or malady-free rate; the survival/malady-free rate of control fish (S), and the desired precision ( ) or a difference ( ) to be detected at a given probability of significance ( ). Sample size requirements decrease with an increase in survival/malady-free and recapture rates, lower precision ( ) desired or detection of a larger difference ( ) (Mathur *et al.* 2000). Only precision ( ), , and a difference ( ) to be detected with a given power ( ) level can strictly be controlled by an investigator.

Based on the results of several turbine passage experiments (direct effects) from other sites on the Columbia River Basin, initially a sample size of approximately 450 fish per treatment release (at each of the five discharge rates with slots combined) was considered sufficient to attain a pre-specified precision level ( ) of $\leq \pm$ 0.03%, 95% of the time on (Table 2-1). This assumes a control survival/malady-free rate of $\geq$ 98%, recapture rate of 98%, and expected passage CMFE or survival rate of 95%.

For detecting differences between two operating points the sample sizes required are presented in Table 2-2. Sample sizes were calculated for detecting a difference ( ) in CMFE or survival rates between two treatments of 0.05 at = 0.05 with a power ( ) of 0.2. Assuming a control survival or a malady-free rate of 0.99 and recapture rate of 0.98 to detect a difference of 0.05 ($_1$ = 0.96 and $_2$ = 0.91), a sample size of 480 fish per treatment is needed.

Upon initiation of this study, approximately 1,680 (1,349 treatment and 330 control) fish were found to be sufficient to obtain the desired precision (ε) on the resulting CMFE or survival estimates and detect differences between operating points (Table 2-3 and Appendix Tables B-1 and B-2). Approximately 300 HI-Z tagged smolts were released (approximately 100 per slot) at each operating point except peak (150 fish) to assess the effects of discharge, turbine slot, and their interactions (Table 2-3). The sample size for peak was adjusted (decreased) to permit testing of an additional operational level, "maximum".

Table 2-1 Required sample sizes (R) if control survival (S)=0.99, 0.98, or 0.95, recapture rate (P_A) is 0.99, 0.98, or 0.95, and expected passage survival[1] probability ($\hat{\tau}$) is 0.95, 0.97, or 0.99 to achieve a precision level ( ) of ≤ 0.03, 95% of the time. Values in bold are discussed in the text.

	Expected Passage Survival ($\hat{\tau}$)		
Control Survival (S)	**0.95**	**0.97**	**0.99**
	Recapture Rate=0.99		
0.99	283	207	128
0.98	364	290	213
0.95	446	375	301
	Recapture Rate=0.98		
0.99	365	291	214
0.98	**446**	375	301
0.95	529	461	389
	Recapture Rate=0.95		
0.99	619	554	485
0.98	703	641	575
0.95	789	729	666

[1] Table values also applicable for malady-free values

Table 2-2 Required sample sizes ($R_C=R_T=R$) for control and treatment fish releases to detect turbine passage survival[1] difference (Δ) between two treatments (τ) at $\alpha = 0.05$.

Control Survival	Zα=1.654, Zβ=0.842, 1-tailed	Passage 1	Passage 2		Recapture Rate		
(S_c)	1-α	Survival ($_1$)	Survival ($_2$)	= $_1$- $_2$	0.95	0.98	0.99
0.98	0.95	0.95	0.90	0.05	680	529	481
	0.95	0.97	0.92	0.05	601	447	398
	0.95	0.99	0.94	0.05	518	361	311
0.99	0.95	**0.95**	**0.90**	**0.05**	630	**481**	434
	0.95	0.97	0.92	0.05	550	398	350
	0.95	0.99	0.94	0.05	467	311	261
1.0	0.95	0.95	0.90	0.05	582	434	387
	0.95	0.97	0.92	0.05	501	350	302
	0.95	0.99	0.94	0.05	416	262	213

[1] Table values also applicable for detecting differences between malady-free estimates.

Table 2-3 Daily schedule of releases of yearling Chinook salmon into turbine Unit 3, 3.2 ft below the fish diversion screen (Slots A and B) or 5 ft below the diversion screen (Slot C) at five operational levels: lower 1% (8.6 kcfs), peak (9.8 kcfs), intermediate (11.4 kcfs), upper 1% (12.6 kcfs), and maximum (14.1 kcfs). Control fish released via the Juvenile Fish Bypass Facility at Ice Harbor Dam, March 2007.

	River Temp.		*Operating Level*					*Control*
Date	**(°C)**	**Slot**	**Lower 1%**	**Peak**	**Intermediate**	**Upper 1%**	**Maximum**	**Bypass**
17-Mar	5.0	A	29					20
		B	30					
		C	30					
18-Mar	7.2	A			50			40
		B			50			
		C			50			
19-Mar	6.0	A		50				40
		B		50				
		C		50				
20-Mar	6.0	A				50		40
		B				50		
		C				50		
21-Mar	6.0	A					45	30
		B					45	
		C					45	
22-Mar	6.5	A	70					40
		B	70					
		C	70					
23-Mar	6.0	A					55	40
		B					55	
		C					55	
24-Mar	7.0	A				50		40
		B				50		
		C				50		
25-Mar	6.0	A			50			40
		B			50			
		C			50			
Total			**299**	**150**	**300**	**300**	**300**	**330**

2.2 Source of Fish

Hatchery-reared yearling chinook salmon were utilized this study. Fish were transported from the Little White Salmon NFH near Stevenson, Washington in a truck-mounted tank to the project site in lots of approximately 750 fish. Transport time from the hatchery to Ice Harbor Dam was about 3 h. The transport truck was equipped with a recirculation system and supplemental oxygen supply. At the project site, fish were held in holding pools (200 to 600 gal capacity) continuously supplied with ambient river water. Fish were held a minimum of 24 h prior to tagging to acclimate them to ambient conditions. Fish for the different test and control releases were drawn from the same group of fish assuring similar size and condition. Figure 2-1 shows the length frequency distribution of the treatment and control groups. The average total length for the different treatment and control groups was near 140 mm. Treatment and control fish ranged from 121-196 mm and 123-182 mm, respectively.

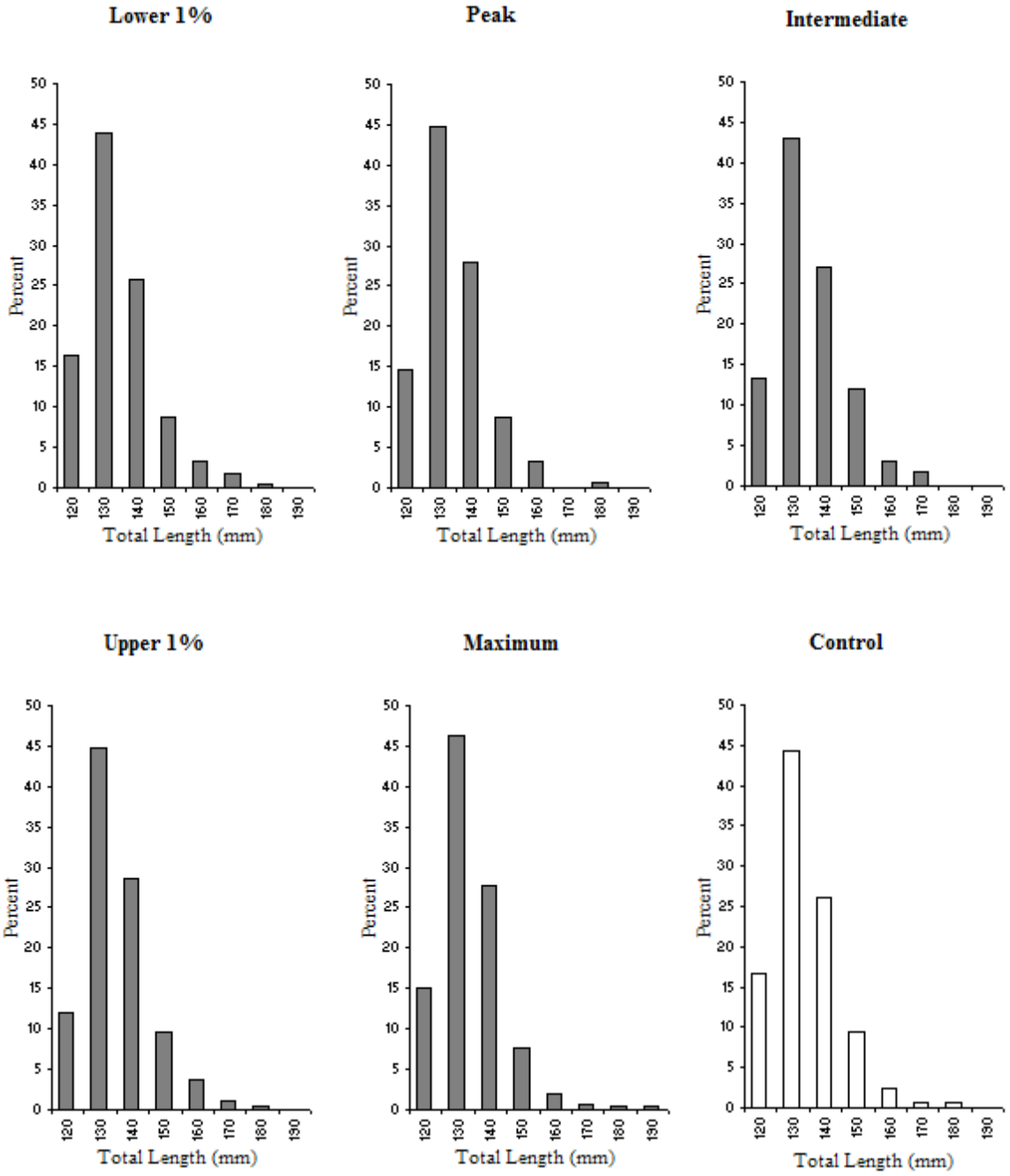


Figure 2-1 Total length (mm) frequency distribution of treatment and control for yearling chinook salmon released into turbine Unit 3 at five operational levels: lower 1%, peak, intermediate, upper 1%, and maximum. Ice Harbor Dam, March 2007. Controls released via the Juvenile Fish Bypass Facility.

2.3 Tagging and Release

Fish handling and tagging techniques followed those used in earlier turbine passage survival investigations (Normandeau Associates *et al.* 1995, 1996, 2000, 2006, Normandeau Associates and

Skalski 2007). Lots of 5 to 10 fish were randomly taken from a holding tank to the adjacent tagging site with a water sanctuary equipped net. Fish displaying abnormal behavior, severe injury, fungal infection, or descaling (≥ 20% per side) were not used. The same fish selection criteria was applied to all treatment and control groups. While anaesthetized, fish were equipped with two deflated HI-Z tags (Heisey *et al.* 1992) and a miniature radio tag. Tags were attached by a stainless steel pin inserted through the musculature beneath the dorsal and adipose fins. The radio tag was attached in combination with the dorsal HI-Z tag. A uniquely numbered VI tag (Visual Implant), Northwest Marine Technology, Inc., Shaw Island, Washington, was inserted in the postocular tissue for use in tracking 48 h survival of individually recaptured fish. Additionally, a fin was partially clipped or hole punched (pelvic or caudal) to permit identification of fish in the event that any VI tags were dislodged.

Prior to release through the induction apparatus fish were allowed to recover from anesthesia in a tub continuously supplied with ambient river water. Fish were individually placed into the induction system holding tub (Figure 2-2), tags were activated, and the fish released in the mid-region of each intake bay (Figure 2-2). The inflation time of the HI-Z tags after injecting water was approximately 2-4 minutes which was adequate time for the turbine passage, actual time was less than one minute. The procedures used in handling, tagging, and recapturing of fish for both treatment and control groups were identical.

Test fish were released equally into each of the IHR Unit 3 turbine intakes. The fish release pipes were fitted 30-inch off-center (toward the north) of the intake fish screen frames positioned into the gate well slots of each bay. Fish were released into the A, B intake slots at elevation 327.5 fmsl and the C intake slot (1.8 ft lower) at elevation 325.7 fmsl. The elevations were determined through model investigations conducted by the Corp's Engineer Research and Development Center (ERDC) using a 1:25 scale physical hydraulic model of the IHR turbine. The elevation is representative of the flow path the unguided fish are most likely to follow, assuming all the unguided fish would pass near the screen tip.

Control fish were released into the exit flume of the Juvenile Fish Bypass Facility (Figure 2-2).Control fish were released primarily to evaluate the effects of handling, tagging, releasing, and recapturing, as well as to provide additional data on recapture probabilities.

All treatment fish were released via coupling of smooth walled rigid steel and flexible 4-inch diameter plastic pipes that directed the fish to the three treatment release points within the three intake slots (Figures 2-2 and 2-3). The pipes were deployed and flushed with water so that the water velocity at the terminus of each pipe was similar to the water velocity passing by the outside of the pipe. This minimized the chance of tagged fish encountering potential injurious hydraulic conditions at the exit point.

Post-passage dispersal of the fish was determined from the radio signals received on a 5-element Yagi or loop antenna coupled to an Advanced Telemetry receiver (Insanti, Minnesota). Fish were tracked and recaptured by three to four boats when the HI-Z tags buoyed them to the surface. Recaptured fish were placed into an on-board holding facility and the tag(s) were removed by a pin puller (Heisey *et al.* 1992). Each fish was examined for descaling and injuries and assigned codes relative to descriptions presented in Table 2-4. Recaptured fish were transferred in 5 gal pails to one of four on-shore pools for estimating 48 h direct survival. These 6 ft diameter circular pools were located in a shaded area near the south shore Ice Harbor fish ladder. A flow-through system maintained approximately 400 gal of water in each pool.

Injuries were evaluated immediately following recapture and later during a detailed examination after expiration of the 48 h holding period. This procedure allowed assessment of some injuries, such as bleeding, which may no longer be evident at 48 h, and detection of other injuries, which may not have been apparent or were overlooked during the evaluation immediately following fish recapture. Injury and

descaling were categorized by type, extent, and area of body. A fish was classified descaled if ≥ 20% of the scales were missing on a side. Fish without any visible injuries that were not actively swimming were classified as "loss of equilibrium". This condition has been noted in past studies and often disappears within 10 to 15 minutes after recapture if the fish has no other apparent injuries.

For ease of understanding,, injured fish were divided into two basic groups: fish with visible cuts and bruises (missing eyes, decapitation, severed bodies, hemorrhaging, lacerations, etc.) and those with descaling or loss of equilibrium. The malady category was established to combines these two basic groups and it includes fish with visible injuries, and those with scale loss only (≥ 20% on either side or with loss of equilibrium only.

Figure 2-2 Release pipe attached to traveling fish screen frame (top left photo) 30-inch off-center toward North. Release pipes extended 3.2 ft below the screen frame in Slots A and B and 5 ft below frame in Slot C. Exit end of release pipes curved (top right photo) and oriented in a downstream direction when installed. Induction system (bottom left photo) carried test fish via a flexible hose to the release pipe. Induction system for control fish (bottom right photo) released fish directly into the exit flume of the Juvenile Fish Bypass Facility, Ice Harbor Dam, March 2007.

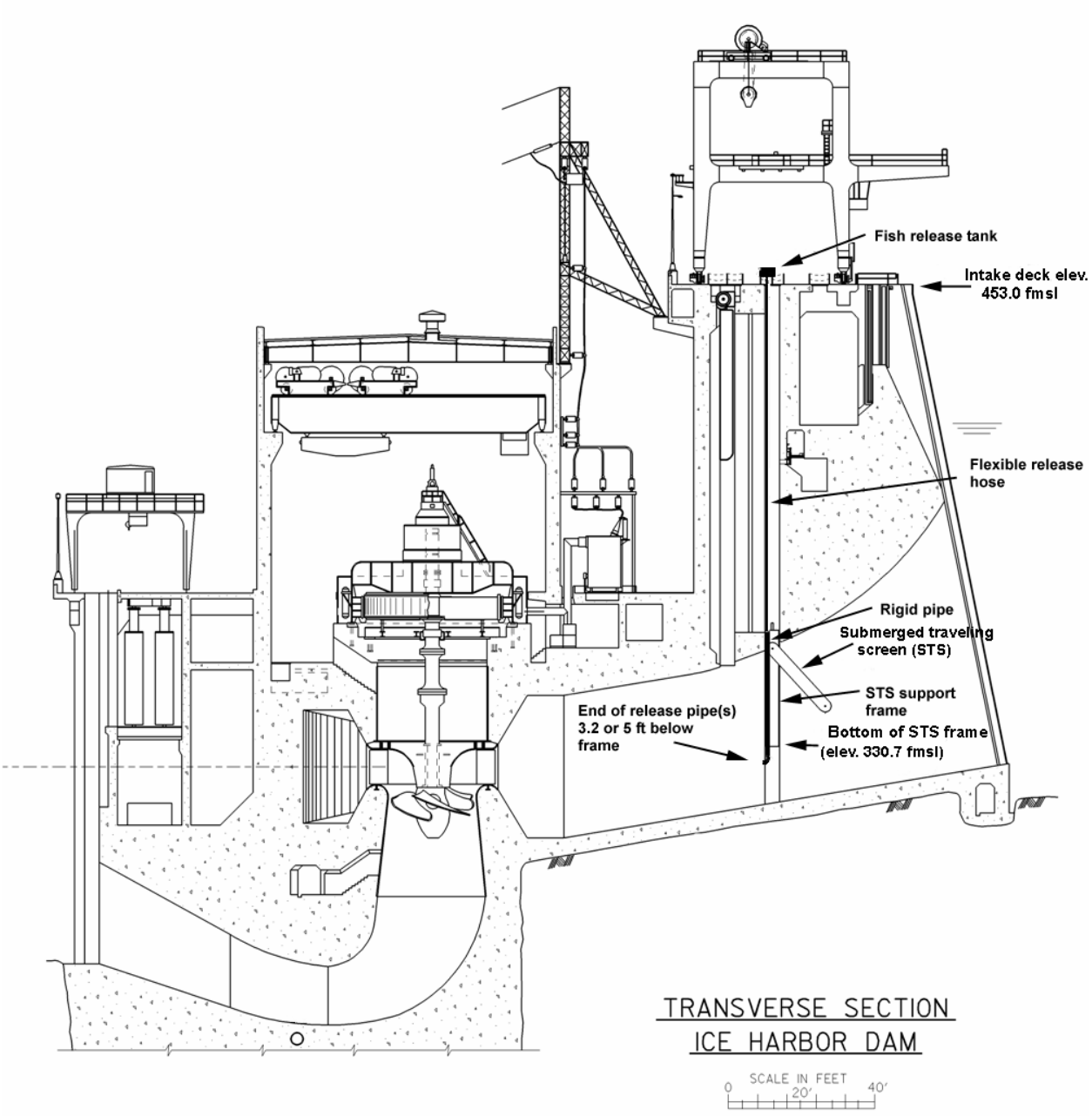


Figure 2-3 Cross-section of powerhouse and turbine Unit 3, showing release location for yearling Chinook salmon passed through Unit 3 at Ice Harbor Dam, March 2007. Source: U.S. Army Corps of Engineers.

Photographs of expired injured fish and injuries were taken with a digital camera. Alive fish with visible injuries were photographed after the 48 h holding period.

Mortalities of recaptured fish occurring after 1 h post-passage were considered 48 h mortalities. However, fish condition was evaluated at intervals of approximately 12 h. Dead fish were identified by the numbered VI tag or fin clip (if the VI tag was missing), examined for descaling and injury, and necropsied to determine the probable cause of mortality.

2.4 Classification of Recaptured Fish

The immediate post passage status of recaptured fish or retrieval of dislodged inflated tags was designated as described in Normandeau Associates *et al.* (1995, 1996, 1999, 2006). Immediate direct passage effects on each fish were designated as alive, dead, predation, recapture of dislodged balloons, or unknown. The following criteria have been established to define these designations: (1) alive--recaptured alive and remained so for 1 h; (2) alive--when the fish does not surface but radio signals indicate movement patterns typical of emigrating yearling; (3) dead--recaptured dead or dead within 1 h of release; (4) dead--when only dislodged inflated tag(s) without fish are recovered; telemetric tracking indicates a stationary signal, or the manner in which inflated tags surfaced is not indicative of predation; (5) unknown--when neither tags nor fish are recovered or radio signals are received only briefly and the subsequent status cannot be ascertained; and (6) predation--when fish are either visually observed being preyed upon, the predator is buoyed to the surface, distinctive bite marks are present on a recaptured fish, or subsequent radio telemetric tracking and/or tag dislodgment indicates predation (*i.e.*, rapid movements of tagged fish in and out of turbulent waters or sudden appearance of fully inflated tags). Un-recovered preyed upon fish are assumed dead in survival calculations; alive recaptured fish suspected of predator attack are included with the alive category. Fish with injuries attributed to gull or fish attacks, if any, were not included when ascribing injury rates to injury mechanisms induced by the turbine environment. Only a small proportion of fish was categorized as unknown.

Table 2-4 Codes assigned to recaptured or non-recaptured fish in the fish passage survival study at Ice Harbor Dam, March 2007.

SURVIVAL CODES	Description
1	Recovered - Alive
2	Recovered - Dead
3	Unrecovered - Tag and Pin only – assigned dead
4	Unrecovered – Unknown - no information or brief radio signal
5	Unrecovered – Unknown with trackable radio signal and/or other information
STATUS CODES	
*	Denotes (turbine or spillbay) passage-related malady
4	Damaged gill(s): hemorrhaged, torn or inverted
5	Major scale loss, ≥ 20%
6	Severed body or nearly severed
7	Decapitated or nearly decapitated
8	Damaged eye(s): hemorrhaged, bulged, ruptured or missing
9	Damaged operculum: torn, bent
A	No visible marks on fish
B	Flesh tear at tag site(s)
C	Minor scale loss, < 20%
E	Laceration(s): tear(s) on body or head (not severed)
F	Torn isthmus
G	Hemorrhaged, bruised head or body
H	LOE
K	Failed to enter system
L	Fish likely preyed on (telemetry, circumstances relative to recapture)
M	Substantial bleeding at tag site
P	Predator marks
Q	Other information
R	Replaced due to unrecoverable conditions
T	Trapped inside tunnel/gate well
V	Fins displaced, or hemorrhaged (ripped, torn, or pulled) from origin
W	Abrasion / Scrape

2.5 Injury Classification

Limited controlled experiments (Neitzel *et al.* 2000; PNNL *et al.* 2001) to replicate and correlate each injury type/characteristic to a specific causative mechanism provides some indication of the cause of observed injuries in the field. Probable causes of injury (*e.g.*, mechanical, shear, or pressure-related) were ascribed to each injured fish depending upon the observed injury characteristics. In the case of some injuries, probable causes could best be narrowed to only two sources (Neitzel *et al.* 2000). However, in other instances the unique characteristics of the observed wounds were used to delineate specific causes of injury. As an example, in the case of complete or partial decapitation, if the isthmus remained attached to the body the causative mechanism was likely shear-related (Neitzel *et al.* 2000).

Injuries likely to be associated with direct contact with turbine runner blades or structural components are classified as mechanical and include: bruise, laceration, and severance of the fish body (Eicher Associates 1987; Normandeau Associates *et al.* 1995, 1996, 1999, 2000; Normandeau and Skalski 2007). Passage through gaps between the runner blades and the hub or at the distal end between the blade tip and discharge ring may result in pinched bodies (Normandeau Associates *et al.* 1995). Contact with the turbine structural components may also result in swaths of scale loss. Injuries likely to be attributed to shear forces are decapitation (with the isthmus attached to the body and a slanted wound), torn or flared opercula, and inverted or broken gill arches. The probable pressure related effects are manifested as bloody eyes, ruptured/bulging eyes, air bladder rupture, hemorrhaged internal organs, and embolism; however, shear forces can also inflict hemorrhaged/ruptured eyes.

Injuries were also categorized as minor or major, following procedures established in laboratory studies at PNNL, Richland, Washington (PNNL *et al.* 2001) and Normandeau's field observations. These are as follows:

A fish with only LOE is classified as major if the fish dies within 1 h; if it survives or dies beyond 1 h, it is classified as minor.
A fish with no visible internal or external maladies is classified as a passage-related major injury if the fish dies within 1 h; if it dies beyond 1 h, it is classified as a non-passage-related minor injury.
Any minor injury that leads to death within 1 h is classified as a major injury; if it lives or dies after 1 h, it remains a minor injury.
Hemorrhaged eye: minor if less than 50%; major if 50% or more.
Deformed pupil(s): major.
Bruises (size-dependent): major if 10% or more of fish body per side; otherwise minor.
Inverted or bleeding gills or gill arches: major.
Operculum tear at dorsal insertion: major if 5 mm or greater; otherwise minor.
Operculum folded under or torn off: major.
Scale loss: major if 20% or more of fish per side; otherwise minor.
Scraping (damage to epidermis): major if 10% or more per side of fish; otherwise minor.
Cuts and lacerations: generally classified as major. Small flaps of skin or skinned snouts: minor.
Internal hemorrhage or rupture of kidney, heart or other internal organs and/or damaged spinal column resulting in death at 1 to 48 h: major.
Multiple injuries: use worst injury.

Description of injuries observed on each fish are given in Appendix Table C.

3.0 STATISTICAL ANALYSIS

3.1 Data Analysis

Statistical analyses were performed by Drs. John R. Skalski and Richard Townsend, University of Washington, Seattle, Washington. The basic tag-recapture data given in Appendix Tables B-1 and B-2 and malady data given in Appendix Table C form the basis for all of the statistical analyses reported herein. Only the summarized results are presented in the main body of the report. Individual fish release, recapture, and trial data are presented in Appendix Table D. Three different metrics were estimated from these data: (1) direct survival, (2) conditional probability of being malady-free given survival (herein called the Conditional Malady-Free Estimate or CMFE), and (3) the joint probability of survival (48 h) and being malady-free.

Because a goal of the study was to assess interaction which may exist between the three intake slots and the five operational levels, analysis of deviance (ANODEV) was used to compare the 12 turbine passage survival, 12 MFE estimates, and 12 survival and being malady-free estimates. The peak operating level was not included in this analysis because at the Corps' request, only one replicate was completed at that operating level. The ANODEV was used to test the main effects of discharge, the main effects of turbine slot, and their interactions (Table 3-1).

3.1.1 Survival Without Injury

The survival without injury metric was selected as a possible means to find a performance measure for the HI-Z studies that might be comparable with the observed bead strike data from physical turbine models. The bead data are unconditional in nature. In other words, observations are available from all beads regardless of their fates. Mortality data are inferred from the mark-recapture data of HI-Z tag studies. Injury observations are made only from fish in hand. Thus, the physical model and HI-Z tag data are inherently different. The purpose of this report is to provide a metric from the HI-Z tag data that may be comparable to the unconditional bead strike data.

Bead strike data rank strikes from severe to nonexistent. It is assumed some of the bead strike severity rankings include levels comparable to fish death and injury. Therefore, a HI-Z tag metric is sought that incorporates both of these biological responses to turbine passage. The desire is to have a measure that expresses the probability of death or injury. The complement of this measure is the probability that a fish is alive and uninjured after passage through a turbine. Figure 3-1 presents a Venn diagram illustrating these potential fates.

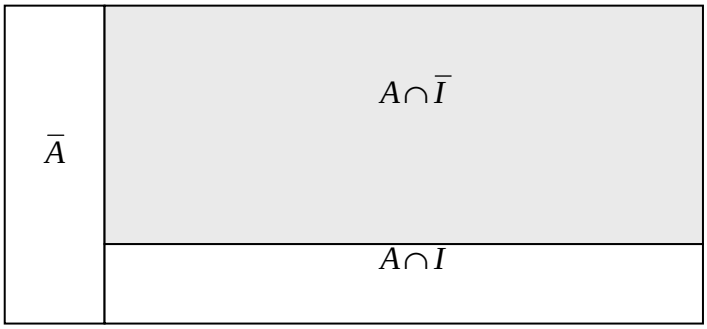


Figure 3-1 Venn diagram illustrating the states of mortality (i.e., not alive, $\bar{A}$), alive (A), and if alive, injured $(A \cap I)$ or not injured $(A \cap \bar{I})$. The metric being measured (i.e., the shaded area) is the probability of a fish being alive and uninjured through a turbine $(A \cap \bar{I})$.

The conduct of the experimental design at Unit 3 at Ice Harbor Dam is summarized in Table 3-1. On any one day, yearling Chinook salmon releases through the three intake slots (i.e., A, B, or C) were conducted at a single operation level. At four operation levels (lower 1%, intermediate, upper 1%, and maximum), releases were replicated on two different days. One set of trials (i.e., Block 1) occurred from 17 March to 21 March 2007; the other set of trials, (i.e., Block 2) occurred from 22 March to 25 March 2007. For the peak operation level, only one day of trials was performed during Block 1 at the request of the U.S. Army Corps of Engineers (ACOE).

Table 3-1 Schematic of the split-plot Ice Harbor turbine Unit 3 passage survival study indicating blocks, whole-plot treatments (operation levels) and split-plot treatments (slots), March 2007.

			Slots		
Block	Date	Operation level	A	B	C
1	March 17	Lower 1%	x	x	x
	March 18	Intermediate	x	x	x
	March 19	Peak	x	x	x
	March 20	Upper 1%	x	x	x
	March 21	Maximum	x	x	x
2	March 22	Lower 1%	x	x	x
	March 23	Intermediate	x	x	x
	March 24	Upper 1%	x	x	x
	March 25	Maximum	x	x	x

As indexed in Section 2.0 (study design) the experiment was a split-plot design with turbine operational levels as whole-plot treatments and intake slots split-plot treatments. Because the peak operation trial was halted at the request of ACOE before the second block of replication, it was omitted from the tests of hypotheses and the analysis of deviance (ANODEV) (Table 3-2). Instead, only point estimates of passage survival and associated standard errors (SE) were computed for that treatment combination.

Table 3-2 Degree-of-freedom table for the split-plot analysis of operation level, whole-plot treatments and slot, split-plot treatments (peak operation level releases omitted), turbine Unit 3, Ice Harbor Dam, March 2007.

Source	DF	F-test
TotalCor	23	
Block	1	
Whole plot (operation)	3	F3,3
Error	3	
Split plot (slots)	2	F2,8
Operation x slot interaction	6	F6,8
Error	8	

3.2 Estimation of Passage Survival

A joint likelihood model was used to estimate both 1 and 48 h passage survival for the two test blocks, four operation levels, three slots, and the common control group. Chi-square tests of homogeneity was used to compare control releases over the course of the study to guide pooling of the release-recapture data. The joint likelihood can be written as

$$L = \binom{R_c}{a_c, d_c} (Sp_a)^{a_c} \left((1-S)\,p_d\right)^{d_c} \left(1 - Sp_a - (1-S)\,p_d\right)^{R_c - a_c - d_c}$$

$$\cdot \prod_{i=1}^{2} \prod_{j=1}^{4} \prod_{k=1}^{3} \left[\binom{R_{ijk}}{a_{ijk}, d_{ijk}} (\tau_{ijk} Sp_a)^{a_{ijk}} \left(\left(1-\tau_{ijk}S\right)p_d\right)^{d_{ijk}} \right.$$

$$\left. \cdot \left(1 - \tau_{ijk} Sp_a - \left(1-\tau_{ijk}S\right)p_d\right)^{R_{ijk} - a_{ijk} - d_{ijk}} \right], \tag{1}$$

where

S = survival from tailrace to recovery location for all fish;

p_a = probability an alive fish is recovered;

p_d = probability a dead fish is recovered;

R_c = number of control fish released;

a_c = number of control fish recovered alive;

d_c = number of control fish recovered dead;

R_{ijk} = number of fish released for the *i*th block $(i = 1,2)$, *j*th operation level $(j = 1,\ldots,4)$, and *k*th slot $(k = 1,\ldots,3)$;

a_{ijk} = number of fish recovered alive for the *i*th block $(i = 1,2)$, *j*th operation level $(j = 1,\ldots,4)$, and *k*th slot $(k = 1,\ldots,3)$;

d_{ijk} = number of fish recovered dead for the *i*th block $(i = 1,2)$, *j*th operation level $(j = 1,\ldots,4)$, and *k*th slot $(k = 1,\ldots,3)$.

The maximum likelihood estimates will be calculated based on a numerical maximization/minimization algorithm in R software.

In the case where all control yearling Chinook salmon are recovered alive, Sp_a is set to 1 in likelihood (1), and the joint likelihood can be reduced to

$$L = \prod_{i=1}^{2} \prod_{j=1}^{4} \prod_{k=1}^{3} \left[\binom{R_{ijk}}{a_{ijk}} \tau_{ijk}^{a_{ijk}} \left(1 - \tau_{ijk}\right)^{R_{ijk} - a_{ijk}} \right]. \tag{2}$$

Maximum likelihood estimates are

$$\hat{\tau}_{ijk} = \frac{a_{ijk}}{R_{ijk}} \tag{3}$$

with associated variances

$$\widehat{\mathrm{Var}}\left(\hat{\tau}_{ijk}\right) = \frac{\hat{\tau}_{ijk}\left(1-\hat{\tau}_{ijk}\right)}{R_{ijk}}. \tag{4}$$

3.3 Estimation of Conditional Probability of Malady-Free, Given Alive at 48 H

The conditional probability a yearling Chinook salmon being malady-free (i.e., no injury, scale loss ≥ 20% per side or loss of equilibrium), given it passed through the turbine alive, i.e.

$$\hat{\Psi} = 1 - \hat{P}\left(I \mid A\right) \tag{5}$$

was also compared among treatments.

3.4 Estimation of Joint Probability of 48 H Survival and Being Malady-Free

In addition to the comparison of 48 h turbine passage survival (τ), the probabilities yearling Chinook salmon passed through the turbine being malady-free and alive were compared among the test conditions. The probability a yearling Chinook salmon passed through the turbine malady-free and alive was estimated by

$$\hat{\theta} = \hat{\tau}\left(1-\hat{P}\left(I \mid A\right)\right), \tag{6}$$

where $P\left(I \mid A\right)$ = probability of malady, given a fish is alive. The variance of $\hat{\theta}$ is estimated by

$$\widehat{\mathrm{Var}}\left(\hat{\theta}\right) = \left(1-\hat{P}\left(I \mid A\right)\right)^2 \cdot \widehat{\mathrm{Var}}\left(\hat{\tau}\right) + \hat{\tau}^2 \cdot \widehat{\mathrm{Var}}\left(\hat{P}\left(I \mid A\right)\right) - \widehat{\mathrm{Var}}\left(\hat{\tau}\right) \cdot \widehat{\mathrm{Var}}\left(\hat{P}\left(I \mid A\right)\right), \tag{7}$$

where

$$\widehat{\mathrm{Var}}\left(\hat{P}\left(I \mid A\right)\right) = \frac{\hat{P}\left(I \mid A\right)\left(1-\hat{P}\left(I \mid A\right)\right)}{k} \tag{8}$$

and where k = number of fish alive at 48 h.

3.5 Tests of Operation Level and Slot Effects

Analysis of deviance (ANODEV) was used to test the effects of operation level (i.e., lower 1%, intermediate, upper 1%, maximum), slot location (A, B, C), and their interaction based on a split-plot design (Table 3-1) using general linear models (GLMs). Based on likelihood (2), a binomial error structure and a logit-link was used to test the effects of operation level, slot location, and their interaction at α = 0.05 (Table 3-2). The single replicate at peak operation was not tested as part of the split-plot design. The ANODEV was used to analyze passage survival, conditional malady-free, and the joint probabilities of survival and malady-free.

Plots of survival profiles and the two malady metrics were constructed across operation levels for each slot location. The best summaries of the response variables were guided by the results of the ANODEV.

4.0 RESULTS

4.1 Recapture Rates

Recapture (physical retrieval of alive and dead fish) proportions of individual treatment groups equaled or exceeded 0.97 (97%) and 1.0 (100%) of the control fish were recovered (Table 4-1).

4.2 Retrieval Times

Average retrieval times for individual operation levels ranged from 7.4 minutes for the upper 1% to 11.1 minutes at the lower 1% (Figure 4-1). Control retrieval time averaged 5.6 minutes.

4.3 Estimation of Passage Survival

The recoveries and 1 and 48 h alive/dead status for each operation level and slot release are shown in Table 4-1. All control yearling Chinook salmon were recaptured and were alive at 48 h. The estimated 1 h survival ($\hat{S}$) (Table 4-2 and Figure 4-2) ranged from 0.9394 ($\widehat{SE}$ = 0.0240) for (lower 1%, slot A) to 1.0000 ($\widehat{SE}$ < 0.0001) for the intermediate, Slot C. The estimated 48 h survival ($\hat{S}$) (Table 4-3 and Figure 4-3) differed only slightly from the 1 h survivals, as only an additional four fish had died. These estimates ranged from 0.9294 ($\widehat{SE}$ = 0.0257) for the (lower 1%, Slot A) to 0.9900 ($\widehat{SE}$ = 0.0098) for the intermediate, Slot C.

Table 4-1 Counts of yearling Chinook salmon released by slot for each operation level and the numbers recovered alive and dead at 1 and 48 h or unknown for turbine Unit 3, at Ice Harbor Dam, March 2007.

Operation Level	Slot	Date	Number Released	Status at 1 h			Status at 48 h		
				Alive	Dead	Unknown	Alive	Dead	Unknown
Lower 1%	A	17-Mar	29	28	1	0	28	1	0
	A	22-Mar	70	65	4	1	64	5	1
	B	17-Mar	30	29	1	0	29	1	0
	B	22-Mar	70	68	2	0	67	3	0
	C	17-Mar	30	28	2	0	28	2	0
	C	22-Mar	70	68	1	1	68	1	1
Peak	A	19-Mar	50	48	2	0	48	2	0
	B	19-Mar	50	49	1	0	49	1	0
	C	19-Mar	50	47	3	0	47	3	0
Intermediate	A	18-Mar	50	49	1	0	49	1	0
	A	25-Mar	50	47	3	0	47	3	0
	B	18-Mar	50	48	2	0	48	2	0
	B	25-Mar	50	50	0	0	50	0	0
	C	18-Mar	50	50	0	0	50	0	0
	C	25-Mar	50	50	0	0	49	1	0
Upper 1%	A	20-Mar	50	49	1	0	48	2	0
	A	24-Mar	50	48	2	0	48	2	0
	B	20-Mar	50	48	2	0	48	2	0
	B	24-Mar	50	49	1	0	49	1	0
	C	20-Mar	50	48	2	0	48	2	0
	C	24-Mar	50	49	1	0	49	1	0
Maximum	A	21-Mar	45	43	2	0	43	2	0
	A	23-Mar	55	51	2	2	51	2	2
	B	21-Mar	45	45	0	0	45	0	0
	B	23-Mar	55	50	3	2	50	3	2
	C	21-Mar	45	43	2	0	43	2	0
	C	23-Mar	55	53	1	1	53	1	1

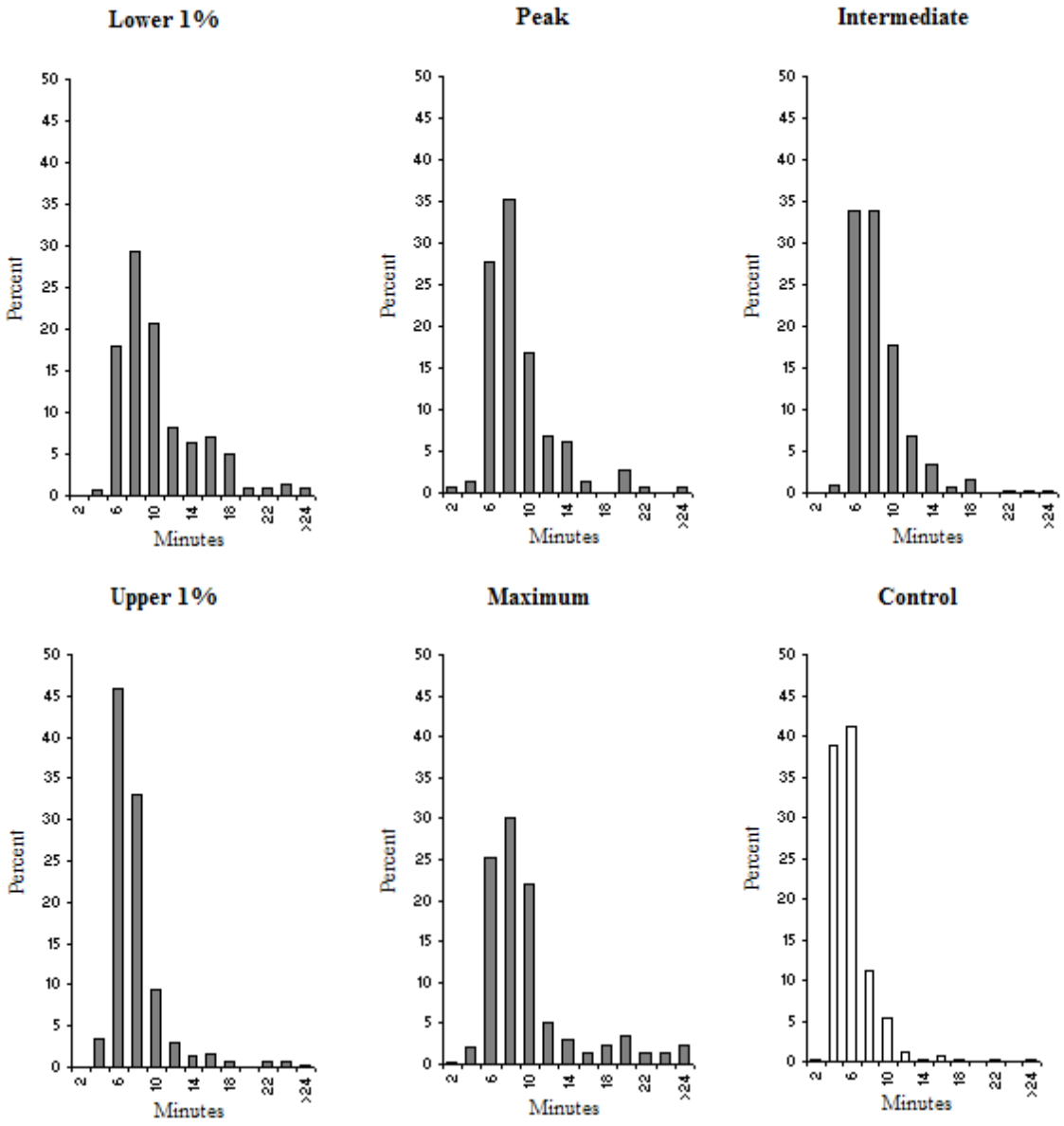


Figure 4-1 Frequency of recapture times (minutes) of treatment and control Chinook salmon smolts released through turbine Unit 3 at five operational levels: lower 1%, Peak, intermediate, upper 1%, and maximum at Ice Harbor Dam, March 2007. Controls released via the Juvenile Fish Bypass Facility.

Table 4-2 Estimated 1 h survivals and probability of yearling Chinook salmon recovered for the 5 operation levels and 3 turbine intake slots, Ice Harbor Dam, March 2007. The peak operation level had only 1 release trial. Standard errors are in parentheses.

		Slot			Probability of recapture	
Operation Level	MW	A	B	C	Alive	Dead
Lower 1%	62	0.9394 (0.0240)	0.9700 (0.0170)	0.9600 (0.0196)	1.0000 (NA)	0.8573 (0.0500)
Peak	70	0.9600 (0.0277)	0.9800 (0.0197)	0.9400 (0.0336)		
Intermediate	83	0.9600 (0.0196)	0.9800 (0.0140)	1.0000 (NA)		
Upper 1%	91	0.9700 (0.0170)	0.9700 (0.0170)	0.9700 (0.0170)		
Maximum	101	0.9400 (0.0238)	0.9500 (0.0218)	0.9600 (0.0196)		

Table 4-3 Estimated 48 h survivals and probability of yearling Chinook salmon recovered for the 5 operation levels and 3 turbine intake slots, Ice Harbor Dam, March 2007. The peak operation level had only 1 release trial. Standard errors are in parentheses.

		Slot			Probability of recapture	
Operation Level	MW	A	B	C	Alive	Dead
Lower 1%	62	0.9294 (0.0257)	0.9600 (0.0196)	0.9600 (0.0196)	1.0000 (NA)	0.8680 (0.0465)
Peak	70	0.9600 (0.0277)	0.9800 (0.0198)	0.9400 (0.0336)		
Intermediate	83	0.9600 (0.0196)	0.9800 (0.0140)	0.9900 (0.0098)		
Upper 1%	91	0.9600 (0.0196)	0.9700 (0.0170)	0.9700 (0.0170)		
Maximum	101	0.9401 (0.0237)	0.9501 (0.0218)	0.9600 (0.0196)		

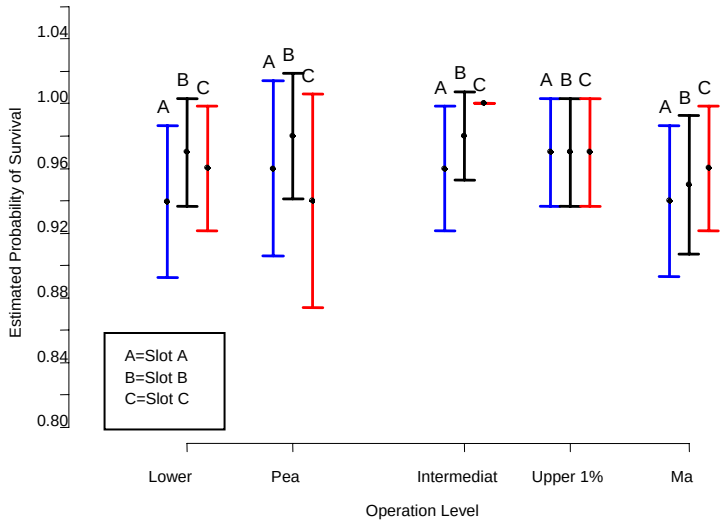


Figure 4-2 Estimated 1 h passage survival and 95% confidence intervals yearling Chinook salmon for each operation level and slot (A, B, or C), Ice Harbor Dam, March 2007.

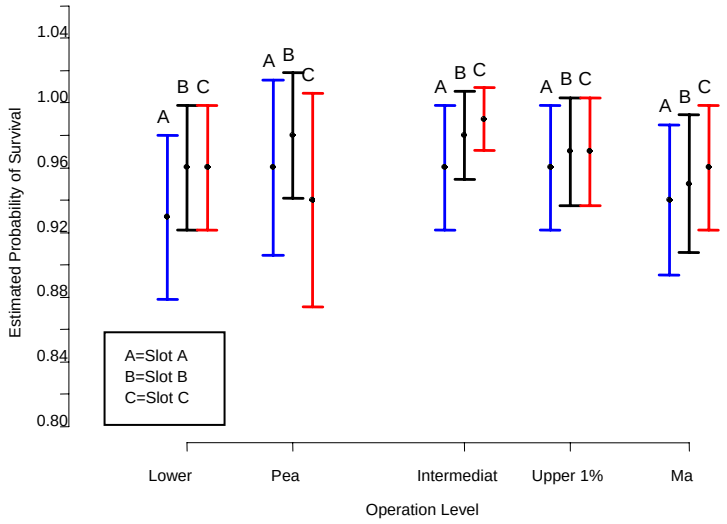


Figure 4-3 Estimated 48 h passage survival and 95% confidence intervals for yearling Chinook salmon for each operation level and slot (A, B, or C), Ice Harbor Dam, March 2007.

Statistical tests (Table 4-4) on the 1 h survival results indicated that the effects of slot ($P = 0.4262$) and operation level ($P = 0.2435$) were not significantly different, nor was there a significant interaction ($P = 0.7245$) present between slot and operation level. The test results were similar for the 48 h survival (Table 4-5), as neither the effect of slot ($P = 0.4016$), operation level ($P = 0.3218$), nor their interaction ($P = 0.9914$) were significant.

Table 4-4 Split-plot 1 h survival analysis of operation level, whole-plot treatments and slot, split-plot treatments (peak operation release omitted due to non-replication), Ice Harbor Dam, March 2007.

Source	DF	Deviance	Mean deviance	F-test	P-value
TotalCor	23	24.9537			
Block	1	0.7749	0.7749	1.2192	0.3501
Whole plot (operation)	3	4.6133	1.5378	2.4194	0.2435
Error	3	1.9068	0.6356		
Split plot (slots)	2	2.4858	1.2429	0.9505	0.4262
Operation x slot interaction	6	4.7120	0.7853	0.6006	0.7245
Error	8	10.4609	1.3076		

Table 4-5 Split-plot 48 h survival analysis of operation level, whole-plot treatments and slot, split-plot treatments (peak operation release omitted due to non-replication), Ice Harbor Dam, March 2007.

Source	DF	Deviance	Mean deviance	F-test	P-value
TotalCor	23	22.5848			
Block	1	1.1468	1.1468	1.5748	0.2984
Whole plot (operation)	3	3.9161	1.3054	1.7926	0.3218
Error	3	2.1846	0.7282		
Split plot (slots)	2	2.9243	1.4622	1.0246	0.4016
Operation x slot interaction	6	0.9962	0.1660	0.1163	0.9914
Error	8	11.4168	1.4271		

Though the analyses of deviance indicated that the slot effect was not significant, further comparisons of the 1 and 48 h survivals by slot (Figures 4-4 and 4-5) show that Slot A appears to have lower survival than either Slot B or C for most of the operation levels tested, but that confidence intervals on the estimates overlap considerably. Survival estimates for the main effects of operation level and slot are summarized in Table 4-6. Figure 4-6 shows a quadratic regression of both 1 and 48 h survival, weighted inversely proportional to the estimated variances, versus operation level (1 h: $P = 0.1016$, $R^2 = 0.8984$; 48 h: $P = 0.0461$, adjusted $R^2 = 0.9077$). The highest probability of passage survival occurs at the intermediate operation level (81 MW). The fitted regression models on 1 and 48 h survival after passage were:

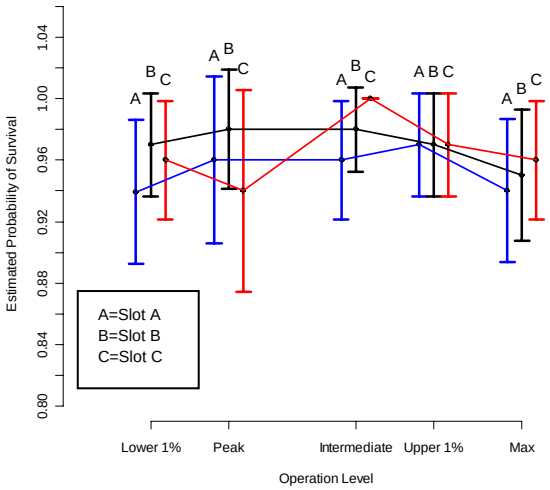
$$\hat{S}_{1-hr} = \underset{(\widehat{SE}=0.1094)}{0.5098} + \underset{(\widehat{SE}=0.0028)}{0.0116}x - \underset{(\widehat{SE}=0.00002)}{0.00007}x^2 \qquad (8a)$$

and

$$\hat{S}_{48-hr} = \underset{(\widehat{SE}=0.0720)}{0.5010} + \underset{(\widehat{SE}=0.0018)}{0.0116}x - \underset{(\widehat{SE}=0.00001)}{0.00007}x^2 \qquad (8b)$$

where x = the operation level in MW.

a. 1 h survival



b. 48 h survival

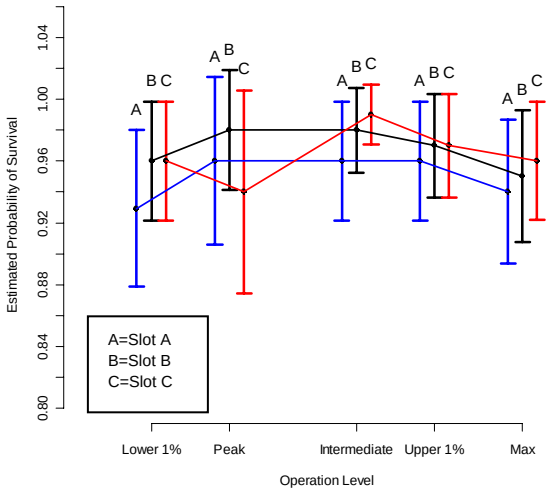
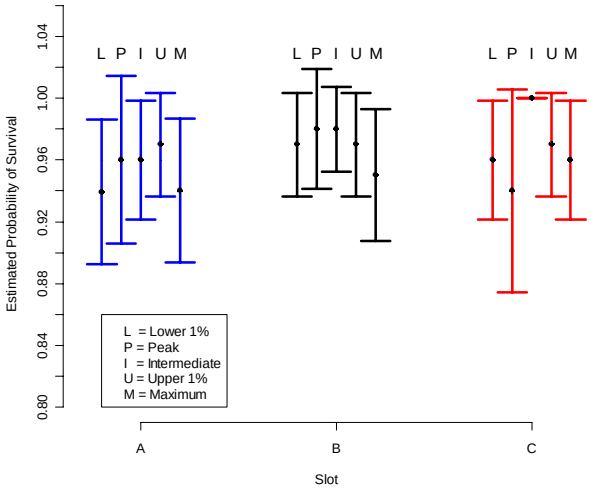


Figure 4-4 Estimated 1 and 48 h passage survivals and 95% confidence intervals for releases by operation level and slot location, Ice Harbor Dam, March 2007. Lines connect the point estimates for each slot across operation levels.

a. 1 h survival



b. 48 h survival

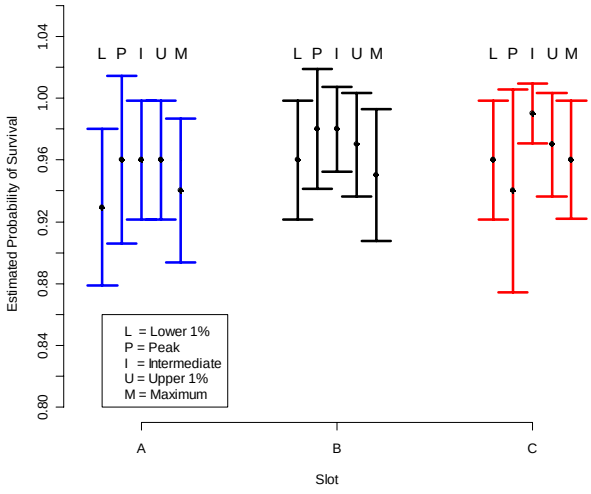


Figure 4-5 Estimated 1 and 48 h passage survivals and 95% confidence intervals grouped by slot location, turbine Unit 3, Ice Harbor Dam, March 2007.

Table 4-6 Pooled 1 and 48 h survivals of juvenile Chinook salmon for each slot and operation level, turbine Unit 3, Ice Harbor Dam, March 2007. Standard errors are in parentheses.

	$\hat{S}$ $(\widehat{SE})$		95% Confidence intervals	
	1 h	48 h	1 h	48 h
Slots				
A	0.9532 (0.0081)	0.9488 (0.0104)	(0.9373, 0.9691)	(0.9284, 0.9692)
B	0.9689 (0.0118)	0.9667 (0.0085)	(0.9458, 0.9920)	(0.9500, 0.9834)
C	0.9689 (0.0126)	0.9667 (0.0085)	(0.9442, 0.9936)	(0.9500, 0.9834)
Operation Level				
Lower 1%	0.9565 (0.0118)	0.9498 (0.0126)	(0.9334, 0.9796)	(0. 9251, 0.9745)
Peak	0.9600 (0.0160)	0.9600 (0.0160)	(0.9286, 0.9914)	(0.9286, 0.9914)
Intermediate	0.9800 (0.0081)	0.9767 (0.0087)	(0.9641, 0.9959)	(0.9596, 0.9938)
Upper 1%	0.9700 (0.0098)	0.9667 (0.0104)	(0.9508, 0.9892)	(0.9463, 0.9871)
Maximum	0.9500 (0.0126)	0.9500 (0.0126)	0.9253, 0.9747)	(0.9253, 0.9747)

a. 1 h survival

b. 48 h survival

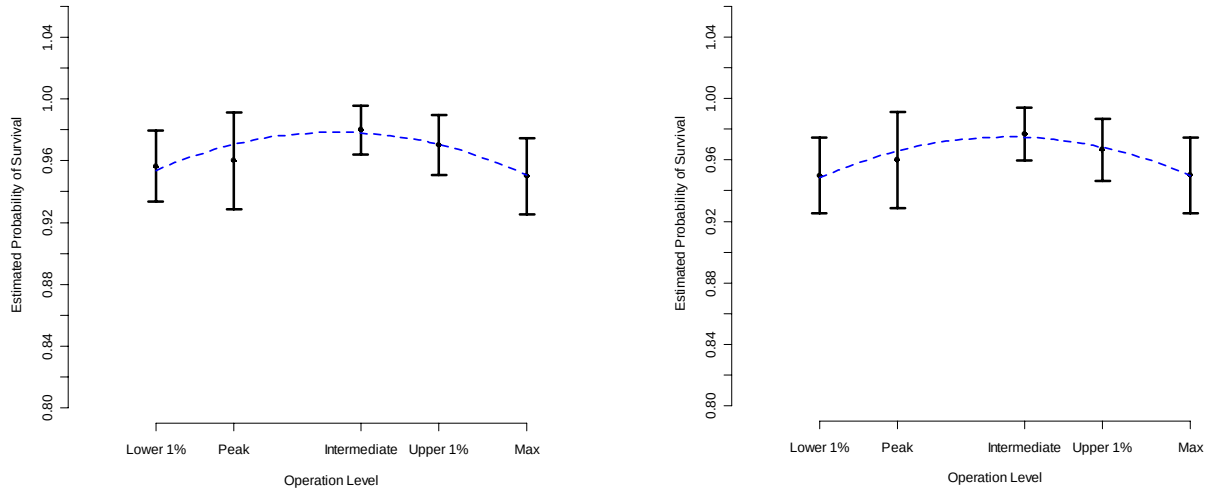


Figure 4-6 Estimated 1 and 48 h survivals pooled across slots versus turbine operation levels. The dashed line is a quadratic fit of the probabilities, inversely weighted by estimated variance, Ice Harbor Dam, March 2007.

4.4 Conditional Probability of Being Malady-Free, Given Alive at 48 H

All Chinook salmon recovered and alive after 48 h were examined for maladies (Table 4-7). All control fish were recovered alive and malady-free. The conditional probability that a fish would be malady-free (CMFE) for the various release conditions (Table 4-7) ranged from 0.9688 ($\widehat{SE}$ = 0.0178) for Upper 1%, Slot A to 1.0000 ($\widehat{SE}$ = NA) for Intermediate, Slot C and Peak, Slots B and C. No pattern was apparent (Figure 4-7), suggesting that the risk of incurring a malady is the same across slots and operation levels. The analysis of deviance (Table 4-8) found no significant effect of operation level (P = 0.9263), slot location (P = 0.4576), or their interaction (P = 0.7990). Table 4-9 summarizes the conditional probabilities of malady-free passage, given survival, by slot and operation level.

Table 4-7 Counts of yearling Chinook salmon alive at 48 h and examined for maladies for each operation level and slot, Ice Harbor Dam , March 2007. The estimated conditional probability of being malady-free, given passage survival at 48 h is in last column. Standard errors are in parentheses.

Operation Level	Slot	Alive at 48 h and examined	Malady		Probability of no malady given alive
			Absent	Present	
Lower 1%	A	92	90	2	0.9783 (0.0152)
	B	96	95	1	0.9896 (0.0104)
	C	96	95	1	0.9896 (0.0104)
Peak	A	48	47	1	0.9792 (0.0206)
	B	49	49	0	1.0000 (NA)
	C	47	47	0	1.0000 (NA)
Intermediate	A	96	95	1	0.9896 (0.0104)
	B	98	95	3	0.9694 (0.0174)
	C	99	99	0	1.0000 (NA)
Upper 1%	A	96	93	3	0.9688 (0.0178)
	B	97	95	2	0.9794 (0.0144)
	C	97	96	1	0.9897 (0.0103)
Maximum	A	94	93	1	0.9894 (0.0106)
	B	95	94	1	0.9895 (0.0105)
	C	96	95	1	0.9896 (0.0104)

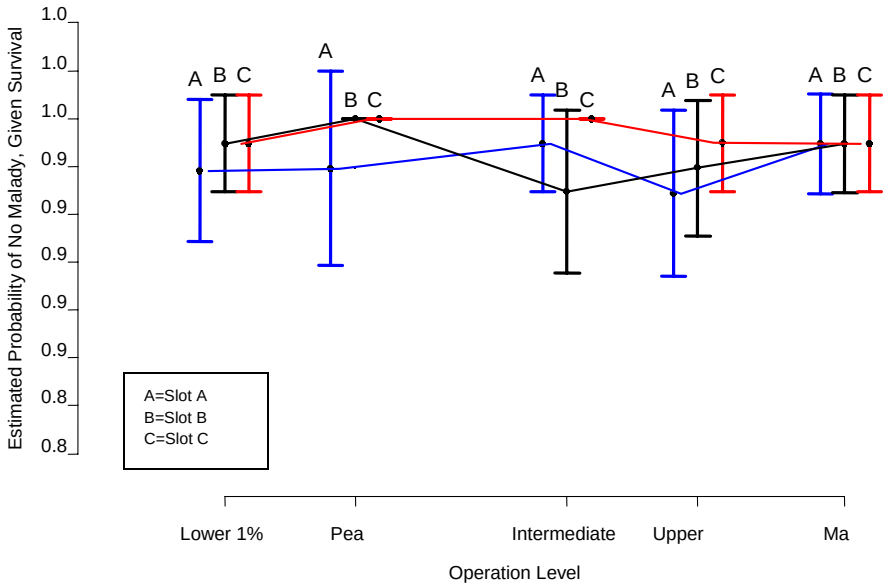


Figure 4-7 Estimated conditional probability with 95% confidence intervals of a yearling Chinook salmon being malady-free, given 48 h survival at each operation level and slot, Ice Harbor Dam, March 2007. Lines connect the point estimates for each slot across operation levels.

Table 4-8 Split-plot ANODEV for conditional malady-free, given alive at 48 h survival, analysis of the operation level, whole-plot treatments and slot, split-plot treatments (peak operation releases omitted due to non-replication), Ice Harbor Dam, March 2007.

Source	DF	Deviance	Mean deviance	F-test	P-value
TotalCor	23	27.2816			
Block	1	2.9863	2.9863	1.3010	0.3368
Whole plot (operation level)	3	1.0000	0.3333	0.1452	0.9263
Error	3	6.8863	2.2954		
Split plot (slots)	2	2.2355	1.1178	0.8634	0.4576
Operation level x slot interaction	6	3.8163	0.6361	0.4913	0.7990
Error	8	10.3573	1.2947		

Table 4-9 Pooled conditional probabilities for yearling Chinook salmon of being malady-free, given alive at 48 h, for each slot and operation level, Ice Harbor Dam, March 2007. Standard errors are in parentheses.

	P(No malady, given survival)	95% confidence interval
Slots		
A	0.9812 (0.0066)	(0.9683, 0.9941)
B	0.9839 (0.0060)	(0.9721, 0.9957)
C	0.9931 (0.0040)	(0.9853, 1.0009)
Operation Level		
Lower 1%	0.9859 (0.0070)	(0.9722, 0.9996)
Peak	0.9931 (0.0069)	(0.9796, 1.0066)
Intermediate	0.9863 (0.0068)	(0.9730, 0.9996)
Upper 1%	0.9793 (0.0084)	(0.9628, 0.9958)
Maximum	0.9895 (0.0060)	(0.9777, 1.0013)

4.5 Estimation of Joint Probability of 48 H Survival and Being Malady-Free

In Section 4.1, the estimated probability of recovering an alive yearling Chinook salmon was 1.0 and a dead yearling Chinook salmon was 0.868. In effect, the model suggests that all yearling Chinook salmon not recovered were dead. Assuming this to be true, the joint probabilities of surviving passage under each of the treatment conditions without incurring a malady are estimated as a simple binomial proportion and are estimated by multiplying the probability of surviving (48 h) passage (Section 4.1) by being malady-free given 48 h survival (Section 4.2). Table 4-10 has the resulting counts by category for each trial.

The split-plot analysis of deviance (Table 4-11) shows that neither the main effects of slot (P = 0.4192) and operation level (P = 0.7703) nor their interaction (P = 0.9725) were significant. Joint probabilities of malady-free passage and survival ranged from 0.9365 ($\widehat{SE}$ = 0.0141) (Lower 1%) to 0.9633 ($\widehat{SE}$ = 0.0108) (Intermediate) for the 5 operation levels tested, and 0.9310 ($\widehat{SE}$ = 0.0120) (Slot A) to 0.9600 ($\widehat{SE}$ = 0.0092) (Slot C) for the 3 slots. Figure 4-8 shows a quadratic regression between operation level and the joint probability of being alive and malady-free (P = 0.1467, adjusted R^2 = 0.7065). The highest joint probability of passage survival and malady-free occurs at the intermediate operation level (81 MW). The joint probability of survival and malady-free is estimated by:

$$\hat{S}_{noMalady} = \underset{(\widehat{SE}=0.1193)}{0.5445} + \underset{(\widehat{SE}=0.0030)}{0.0103}\,x - \underset{(\widehat{SE}=0.00002)}{0.00006}x^2 \qquad (9)$$

where x = the operation level in MW.

Table 4-10 Counts of yearling Chinook salmon and/or with a malady released for each operation level and slot at turbine Unit 3 the numbers of alive and malady-free at 48 h, or dead (or assumed dead) Ice Harbor Dam, March 2007.

			Status at 48 h	
Operation Level	Slot	Number Released	Alive malady-free	Dead, assumed dead and/or with malady
Lower 1%	A	29	27	2
	A	70	63	7
	B	30	29	1
	B	70	66	4
	C	30	28	2
	C	70	67	3
Peak	A	50	47	3
	B	50	49	1
	C	50	47	3
Intermediate	A	50	49	1
	A	50	46	4
	B	50	45	5
	B	50	50	0
	C	50	50	0
	C	50	49	1
Upper 1%	A	50	45	5
	A	50	48	2
	B	50	46	4
	B	50	49	1
	C	50	47	3
	C	50	49	1
Maximum	A	45	43	2
	A	55	50	5
	B	45	45	0
	B	55	49	6
	C	45	42	3
	C	55	53	2

Table 4-11 Split-plot ANODEV for the joint probability of 48 h survival and being malady-free (peak operation releases omitted due to non-replication)for yearling Chinook salmon, Ice Harbor Dam, March 2007.

Source	DF	Deviance	Mean deviance	F-test	P-value
TotalCor	23	34.1575			
Block	1	0.0001	0.0001	< 0.0001	0.9952
Whole plot (operation)	3	2.7206	0.9069	0.3897	0.7703
Error	3	6.9814	2.3271		
Split plot (slots)	2	4.2955	2.1478	0.9711	0.4192
Operation x slot interaction	6	2.4664	0.4111	0.1859	0.9725
Error	8	17.6936	2.2117		

Table 4-12 Estimated joint probabilities of 48 h survival and being malady-free for each operation level and slot for yearling Chinook salmon, Ice Harbor Dam, March 2007. Standard errors are in parentheses.

	P(survival without incurring a malady)	95% confidence interval
Slots		
A	0.9310 (0.0120)	(0.9075, 0.9545)
B	0.9511 (0.0102)	(0.9311, 0.9711)
C	0.9600 (0.0092)	(0.9420, 0.9780)
Operation Level		
Lower 1%	0.9365 (0.0141)	(0.9089, 0.9641)
Peak	0.9533 (0.0172)	(0.9196, 0.9870)
Intermediate	0.9633 (0.0108)	(0.9421, 0.9845)
Upper 1%	0.9467 (0.0130)	(0.9212, 0.9722)
Maximum	0.9400 (0.0137)	(0.9131, 0.9669)

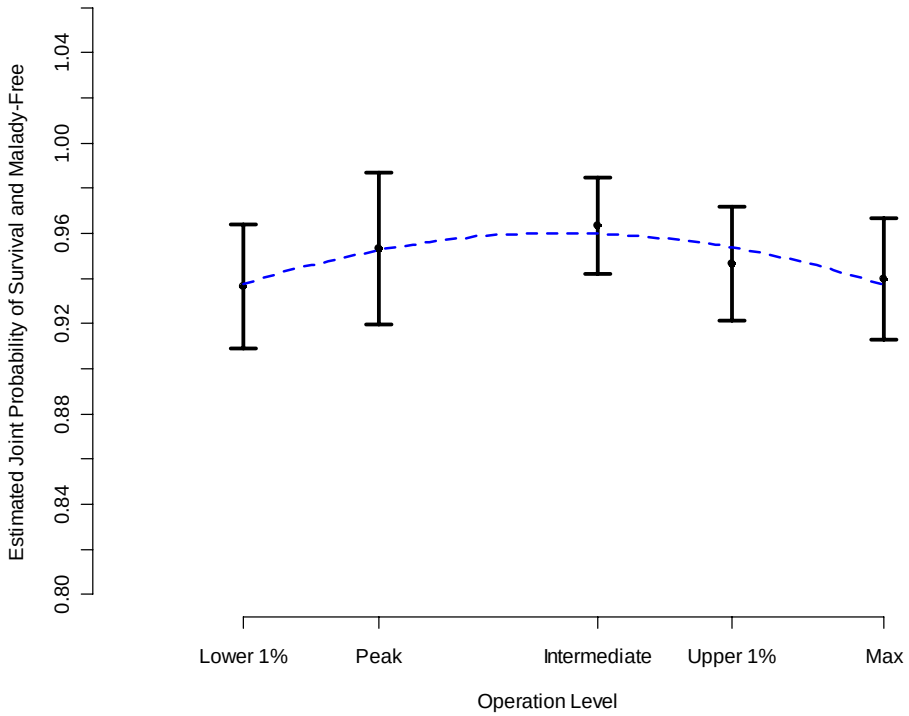


Figure 4-8 Estimated joint probabilities of 48 h survival and being malady-free and 95% confidence intervals on yearling Chinook salmon for each operation level, Ice Harbor Dam, March 2007. The dashed line is a quadratic fit of the probabilities, weighted inversely proportional to variances.

4.6 Visible Injuries

Of the 1,329 recovered test fish a total of 45 (3.4%) exhibited visible injuries (Table 4-13). This total count was not conditional on survival and represents both major injuries (some of which resulted in death) as well as minor scrapes and hemorrhages. Almost half (20) of these injuries were attributed to releases in Slot A, and the remainder were equally distributed between Slots B and C.

When injuries among slots are combined, the lower 1% and upper 1%, operation levels resulted in the highest proportions (0.044, 0.040) of visibly injured fish. The lowest proportions of visibly injured fish resulted from releases made under intermediate (0.017) operating level. None of the control fish released through the Juvenile Fish Bypass Facility directly into the tailrace were visibly injured.

The most common visible injuries observed were damage to the operculum, gills or eyes (Table 4-13). Other injuries (in decreasing order of occurrence) included bruises to the head or body, severed body or decapitation, cuts or tears on the head or body and internal injury.

4.7 Maladies

Passage related maladies (Table 4-14) includes recovered fish with visible injuries or that exhibit major scale loss ($\geq$ 20% scale loss on either side of the body) or loss of equilibrium. The total number of maladies enumerated in Table 4-14 is 48 and consisted primarily of the 45 visible injuries discussed above plus three fish that only exhibited loss of equilibrium. With slots combined, only 11 of the 48 fish with maladies (23%) were attributed to the peak and intermediate operation levels. The remaining 36 fish with maladies (77%) were attributed to the lower 1%, upper 1%, and maximum operation levels. The proportion of examined fish with maladies (2%) at the intermediate operational level was lower than at the other operating levels (3.3-4.7%).

Based on the severity classifications of maladies presented in Section 2.5, 40 of the 47 passage related maladies were classified as major. Twenty eight of the 47 fish with major passage related maladies died within the 48 h assessment period. The remainder survived. Test fish released during the intermediate turbine operating level had the lowest incidence (2) of major maladies. The highest number of major maladies were recorded during the lower 1% (12) and upper 1% (12) operation levels.

4.8 Probable Cause of Injuries

Shear forces were responsible for the greatest number (21) of visibly injured fish followed closely (19) by mechanically caused injuries (Table 4-15). Hemorrhaged eyes and torn opercula are generally attributed to shear forces. Mechanical injuries include bruises or cuts to the head or body and pinched body. Injuries on three additional fish were probably caused by a combination of shear and mechanical contact. Only two injured fish exhibited pressure related injuries such as bulged eyes or a ruptured air bladder.

Table 4-13 Summary of visible injury types (passage induced) and injury rates observed on recaptured yearling Chinook salmon released into turbine Unit 3, 3.2 ft below the fish diversion screen (Slots A and B) or 5 ft below the diversion screen (Slot C) at five operational levels: lower 1%, peak, intermediate, upper 1%,and maximum. Control fish released via the Juvenile Fish Bypass Facility at Ice Harbor Dam, March 2007.

				Injury Type					
Operation Level	**No. Released**	**No. Examined**	**No Visibly Injured**	**Severed or Decapitated**	**Hemorrhaged, Bulged, Ruptured Eye(s)**	**Torn, Scraped Operculum, Hemorrhaged Gills**	**Body/Head Cut, Torn, Scraped**	**Body/Head Hemorrhaged Bruised**	**Internal Injury**
					Slot A				
Lower 1%	99	98 (98.4%)	7 (7.1%)	3 (3.1%)	1 (1.0%)	2 (2.0%)	3 (3.1%)	2 (2.0%)	1 (1.0%)
Peak	50	49 (98.0%)	2 (4.1%)	0 (0.0%)	1 (2.0%)	1 (2.0%)	0 (0.0%)	1 (2.0%)	0 (0.0%)
Intermediate	100	100 (100 %)	2 (2.0%)	0 (0.0%)	1 (1.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Upper 1%	100	100 (100 %)	6 (6.0%)	1 (1.0%)	1 (1.0%)	2 (2.0%)	0 (0.0%)	2 (2.0%)	2 (2.0%)
Maximum	100	96 (96.0%)	3 (3.1%)	2 (2.1%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
					Slot B				
Lower 1%	100	98 (98.0%)	3 (3.1%)	0 (0.0%)	2 (2.0%)	1 (1.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)
Peak	50	50 (100%)	1 (2.0%)	0 (0.0%)	1 (2.0%)	1 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Intermediate	100	98 (98.0%)	3 (3.1%)	0 (0.0%)	1 (1.0%)	1 (1.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)
Upper 1%	100	98 (98.0%)	3 (3.1%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	3 (3.1%)	1 (1.0%)
Maximum	100	97 (97.0%)	3 (3.1%)	1 (1.0%)	1 (1.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	1 (1.0%)
					Slot C				
Lower 1%	100	98 (98.0%)	3 (3.1%)	0 (0.0%)	1 (1.0%)	1 (1.0%)	1 (1.0%)	1 (1.0%)	1 (1.0%)
Peak	50	49 (98.0%)	2 (4.1%)	0 (0.0%)	0 (0.0%)	1 (2.0%)	0 (0.0%)	0 (0.0%)	1 (2.0%)
Intermediate	100	100 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Upper 1%	100	99 (99.0%)	3 (3.0%)	0 (0.0%)	1 (1.0%)	2 (2.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)
Maximum	100	99 (99.0%)	4 (4.0%)	3 (3.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Combined	1,349	1,329 (98.5%)	45 (3.4%)	10 (0.8%)	13 (1.0)	14 (1.1%)	7 (0.5%)	10 (0.8%)	7 (0.5%)
					Control				
Control	330	330	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 4-14 Summary of passage related maladies, including visible injury, loss of equilibrium, and scale loss (≥ 20% per side) observed on recaptured yearling Chinook salmon released into turbine Unit 3, 3.2 ft below the fish diversion screen (Slots A and B) or 5 ft below the diversion screen (Slot C) at five operational levels: lower 1%, peak, intermediate, upper 1% and maximum. Control fish released via the Juvenile Fish Bypass Facility at Ice Harbor Dam, March 2007.

			With Maladies				
Operation Level	**No. Released**	**No. Examined**	**Total With Maladies**	**No. Dead at 48 h**	**Exclusively LOE**	**Exclusively Major Scale Loss**	**Visibly Injured**
				Slot A			
Lower 1%	99	98 (98.4%)	8 (8.2%)	6	1 (1.0%)	0 (0.0%)	7 (7.1%)
Peak	50	49 (98.0%)	2 (4.1%)	1	0 (0.0%)	0 (0.0%)	2 (4.1%)
Intermediate	100	100 (100 %)	2 (2.0%)	1	0 (0.0%)	0 (0.0%)	2 (2.0%)
Upper 1%	100	100 (100 %)	7 (7.0%)	4	1 (1.0%)	0 (0.0%)	6 (6.0%)
Maximum	100	96 (96.0%)	3 (3.1%)	2	0 (0.0%)	0 (0.0%)	3 (3.1%)
				Slot B			
Lower 1%	100	98 (98.0%)	3 (3.1%)	2	0 (0.0%)	0 (0.0%)	3 (3.1%)
Peak	50	50 (100%)	1 (2.0%)	1	0 (0.0%)	0 (0.0%)	1 (2.0%)
Intermediate	100	98 (98.0%)	3 (3.1%)	0	0 (0.0%)	0 (0.0%)	3 (3.1%)
Upper 1%	100	98 (98.0%)	3 (3.1%)	1	0 (0.0%)	0 (0.0%)	3 (3.1%)
Maximum	100	97 (97.0%)	3 (3.1%)	2	0 (0.0%)	0 (0.0%)	3 (3.1%)
				Slot C			
Lower 1%	100	98 (98.0%)	3 (3.1%)	2	0 (0.0%)	0 (0.0%)	3 (3.1%)
Peak	50	49 (98.0%)	2 (4.1%)	2	0 (0.0%)	0 (0.0%)	2 (4.1%)
Intermediate	100	100 (100%)	1 (1.0%)	1	1 (1.0%)	0 (0.0%)	0 (0.0%)
Upper 1%	100	99 (99.0%)	3 (3.0%)	2	0 (0.0%)	0 (0.0%)	3 (3.0%)
Maximum	100	99 (99.0%)	4 (4.0%)	3	0 (0.0%)	0 (0.0%)	4 (4.0%)
Combined	1,349	1,329 (98.5%)	48 (3.6%)	30	3 (0.2%)	0 (0.0%)	45 (3.4%)
				Control			
Control	330	330 (100%)	0 (0.0%)	0	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 4-15 Probable sources of visibly observed injuries, and scale loss (≥ 20% per side) on recaptured yearling Chinook salmon released into turbine Unit 3, 3.2 ft below the fish diversion screen (Slots A and B) and 5 ft below the diversion screen in Slot C at five operational levels: lower 1%, peak, intermediate, upper 1%, and maximum. Control fish released via the Juvenile Fish Bypass Facility at Ice Harbor Dam, March 2007.

		Probable Injury Source						
Operation Level	No. of Fish Examined	Mechanical	Shear	Pressure	Shear/ Mechanical*	Mechanical/ Pressure	Injury Mechanism Undetermined	Total
				Slot A				
Lower 1%	98	4 (4.1%)	2 (2.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	7 (7.1%)
Peak	49	1 (2.0%)	1 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (4.1%)
Intermediate	100	1 (1.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (2.0%)
Upper 1%	100	4 (4.0%)	1 (1.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (6.0%)
Maximum	96	0 (0.0%)	3 (3.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (3.1%)
				Slot B				
Lower 1%	98	0 (0.0%)	2 (2.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	3 (3.1%)
Peak	50	0 (0.0%)	1 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (2.0%)
Intermediate	98	3 (3.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (3.1%)
Upper 1%	98	2 (2.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (3.1%)
Maximum	97	2 (2.1%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	0 (0.0%)	3 (3.1%)
				Slot C				
Lower 1%	98	1 (1.0%)	2 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (3.1%)
Peak	49	0 (0.0%)	1 (2.0%)	1 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (4.1%)
Intermediate	100	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Upper 1%	99	1 (1.0%)	2 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (3.0%)
Maximum	99	0 (0.0%)	4 (4.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (4.0%)
Combined	1,329	19 (1.4%)	21 (1.6%)	2 (0.2%)	3 (0.2%)	0 (0.0%)	0 (0.0%)	45 (3.4%)

Mechanical, shear, or pressure injuries may have been due to multiple forces or one acting singularly.

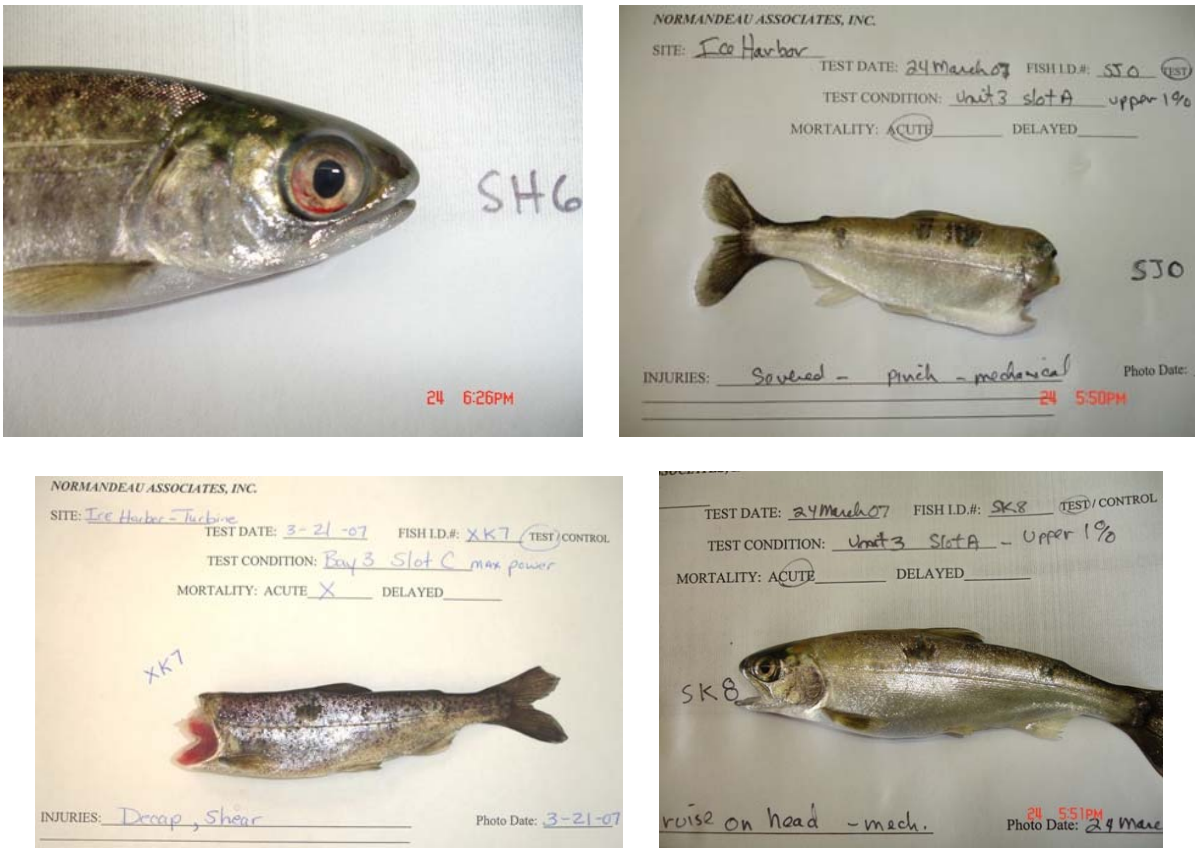


Figure 4-9 Examples of shear injuries (hemorrhaged eye: top left and decapitation forward of the gill arches: bottom left) and mechanical injuries (pinched body: top right and bruise behind head: bottom right) sustained by yearling Chinook salmon passed through turbine Unit 3 at Ice Harbor Dam, March 2007.

5.0 FINDINGS AND CONCLUSIONS

A release of 1,349 HI-Z tagged yearling Chinook salmon was sufficient to meet the primary statistical criterion established for the experiment. All the estimated survival (direct effects) estimates at the tested turbine operational levels (lower 1%, peak, intermediate, upper 1%, and maximum) through three intake slots (A, B and C) were within the prespecified criterion of ≤ 0.03, 95% of the time. The two other metrics were also used to assess turbine passage effects and these metrics integrated both survival and injury rates: (1) conditional probability a fish being malady-free and survived at 48 h, and (2) joint probability of 48 h survival and malady-free. Estimates of these metrics also had the precision (ε) of $\leq \pm$ 0.03, 95% of the time.

The highest survival (0.977, SE = 0.009) coincided with turbine operating at intermediate level; the survival at peak efficiency was 0.960. Survival estimates generated in the present study are within the range of those reported for similar sized Kaplan type turbines at hydroelectric dams on the Columbia River Basin.

Survival estimates showed relatively small variations among intake slots. Though not significantly different ($P = 0.4262$ (1 hr); $P = 0.4016$ (48 hr), the lowest 48 h survival (0.929, SE=0.026) occurred for fish passed through Slot A at 8.6 kcfs (lower 1%) and the most benign route (0.990, SE=0.010) occurred for fish passed through Slot C at 11.4 kcfs (intermediate). Pooled across operational levels, the 48 h survival probabilities of 0.967(SE=0.009) for Slots B and C were slightly higher than through Slot A (0.949,SE=0.010).

With operation levels pooled, the conditional probability a fish being malady-free (i.e., no injuries, scale loss $\geq$ 20% per side or loss of equilibrium) given it was alive at 48 h, were similar (0.981-0.993) among intake slots. With slots pooled, the conditional malady-free estimate given 48 h survival ranged from 0.979 (SE=0.008) at the upper 1% operational level to 0.993 (SE=0.007) at the peak level.

Estimates of the joint probability of 48 h survival and being malady-free followed the pattern of survival. With operation levels pooled, Slot A exhibited the lowest joint probability (0.931, SE=0.012) of 48 h survival and being malady-free. Slots B and C had higher (0.951 and 0.960, respectively) joint probabilities of surviving passage malady-free. With slots pooled, the joint probability of surviving turbine passage without malady was lowest for the lower 1% operation level (0.937, SE=0.014) and highest for the intermediate level (0.963, SE=0.011). The maximum operation level exhibited the second lowest joint probability (0.940, SE=0.014) of 48 h survival and being malady-free.

A predictive statistical relationship could not be established between any of the three metrics used in the analysis and turbine operational level.

Evidence is emerging that highest fish passage survival does not necessarily coincide with peak turbine operating efficiency. At Lower Granite, Wanapum, and McNary Dams, highest passage survival was not associated with the peak turbine operating efficiency (Normandeau Associates *et al.* 1996, 2003). At Ice Harbor, it appears that the highest survival (0.977, SE=0.009) was at intermediate operating efficiency; at the peak efficiency survival was about 0.017 less than that at the intermediate efficiency. It appears that each turbine has specific internal hydraulics and geometry that produce highest survival.

Because the other two metrics used in the analysis are newly developed ones, little data exist for examining trends in their relationship to various turbine operation levels. However, a recent study at the John Day Dam on the Columbia River (Normandeau Associates and J. R. Skalski 2007) reported that the highest values of these metrics coincided with upper 1% turbine efficiency (best geometry) and not at the peak efficiency.

There is a need to gather direct mortality and injury data on depth acclimated fish passed through operating turbines. Recent laboratory experiments indicate depth acclimated fish are more likely to suffer pressure induced injuries than surface acclimated fish when exposed to a simulated turbine environment. HI-Z tagged fish are presently not depth acclimated, but this should be considered.

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APPENDIX TABLE A

HYDRAULIC AND PHYSICAL CONDITIONS DURING TESTING

PARAMETER DATA

Appendix Table A Station parameters recorded during conduct of passage and condition investigation with yearling Chinnok salmon at Ice Harbor Dam,17-25 March 2007.

Date	Release Slot A, B, C	Start Release Time	End Release Time	Station Parameters Time	Power Generation (MW)	Forebay Elevation (ft)	Tailrace Elevation (ft)	Gross Head (ft)	Blade Angle (degrees)	Wicket Gate Opening (%)
					Lower 1%					
17-Mar	A	1557	1604	1554	61.92	438.44	342.52	95.92	16.71	49.96
17-Mar	A	1632	1637	1628	61.70	438.43	342.63	95.80	16.71	49.72
22-Mar	A	858	904	849	63.20	439.10	343.54	95.56	17.35	49.43
22-Mar	A	938	944	931	62.51	439.12	343.71	95.41	17.19	49.35
22-Mar	A	1023	1029	1007	62.16	439.29	343.89	95.40	17.22	49.51
22-Mar	A	1100	1107	1054	62.37	439.26	343.16	96.10	17.01	49.31
22-Mar	A	1137	1141	1133	62.48	439.37	344.21	95.16	17.19	49.53
Mean					**62.33**	**439.00**	**343.38**	**95.62**	**17.05**	**49.54**
17-Mar	B	1441	1447	1436	61.38	438.47	342.58	95.89	16.54	49.10
17-Mar	B	1517	1524	1513	61.59	438.44	342.48	95.96	16.68	49.66
22-Mar	B	1212	1219	1208	62.11	439.41	344.01	95.40	17.11	49.85
22-Mar	B	1256	1304	1252	62.13	439.32	343.90	95.42	16.93	48.94
22-Mar	B	1330	1337	1324	62.17	439.26	343.89	95.37	16.97	49.27
22-Mar	B	1408	1415	1404	61.34	439.24	343.99	95.25	16.81	49.11
22-Mar	B	1443	1447	1439	62.08	439.29	343.96	95.33	17.01	49.22
Mean					**61.83**	**439.06**	**343.54**	**95.52**	**16.86**	**49.31**
17-Mar	C	1322	1330	1317	61.64	438.51	342.36	96.15	16.54	49.20
17-Mar	C	1355	1402	1352	61.89	438.45	342.43	96.02	16.56	49.30
22-Mar	C	1524	1530	1520	62.06	439.17	344.04	95.13	16.97	49.00
22-Mar	C	1603	1610	1559	61.58	438.99	344.00	94.99	16.94	49.37
22-Mar	C	1633	1639	1629	61.84	438.97	343.86	95.11	16.87	49.12
22-Mar	C	1718	1725	1713	62.10	438.97	343.77	95.20	17.04	49.47

Appendix Table A

Continued.

Date	Release Slot A, B, C	Start Release Time	End Release Time	Station Parameters Time	Power Generation (MW)	Forebay Elevation (ft)	Tailrace Elevation (ft)	Gross Head (ft)	Blade Angle (degrees)	Wicket Gate Opening (%)
22-Mar	C	1746	1750	1742	62.10	438.94	343.76	95.18	17.06	48.96
Mean					**61.89**	**438.86**	**343.46**	**95.40**	**16.85**	**49.20**
					Peak					
19-Mar	A	831	838	826	69.76	439.07	343.47	95.60	19.58	53.11
19-Mar	A	906	913	856	69.34	439.04	343.47	95.57	19.28	53.03
19-Mar	A	938	948	929	70.89	439.02	343.41	95.61	19.74	53.51
Mean					**70.00**	**439.04**	**343.45**	**95.59**	**19.53**	**53.22**
19-Mar	B	1023	1031	1019	71.27	439.07	343.33	95.74	19.92	53.89
19-Mar	B	1101	1107	1056	70.81	439.05	343.30	95.75	19.77	53.30
19-Mar	B	1135	1144	1130	70.95	439.06	343.32	95.74	19.72	53.53
Mean					**71.01**	**439.06**	**343.32**	**95.74**	**19.80**	**53.57**
19-Mar	C	1326	1333	1322	70.96	439.08	343.32	95.76	19.74	53.72
19-Mar	C	1404	1411	1357	70.81	439.03	343.40	95.63	19.78	53.50
19-Mar	C	1436	1447	1432	70.64	439.06	343.30	95.76	19.61	53.31
Mean					**70.80**	**439.06**	**343.34**	**95.72**	**19.71**	**53.51**
					Intermediate					
18-Mar	A	840	847	833	83.58	438.81	342.19	96.62	22.93	59.78
18-Mar	A	916	922	909	83.46	438.84	342.13	96.71	23.06	59.78
18-Mar	A	946	952	938	83.39	438.78	342.15	96.63	23.00	59.60
18-Mar	A	1503	1506	1452	83.67	438.98	342.60	96.38	23.09	59.95
25-Mar	A	845	852	840	83.91	438.73	342.36	96.37	23.10	60.13
25-Mar	A	922	928	917	83.19	438.82	342.42	96.40	22.94	59.83

Appendix Table A

Continued.

Date	Release Slot A, B, C	Start Release Time	End Release Time	Station Parameters Time	Power Generation (MW)	Forebay Elevation (ft)	Tailrace Elevation (ft)	Gross Head (ft)	Blade Angle (degrees)	Wicket Gate Opening (%)
25-Mar	A	1002	1013	957	83.40	438.92	342.40	96.52	22.95	60.50
Mean					**83.51**	**438.84**	**342.32**	**96.52**	**23.01**	**59.94**
18-Mar	B	1121	1128	1112	82.99	438.74	342.12	96.62	23.29	60.21
18-Mar	B	1152	1159	1147	83.74	438.75	342.26	96.49	23.11	59.95
18-Mar	B	1223	1230	1217	83.22	438.78	342.25	96.53	22.89	59.55
18-Mar	B	1457	1459	1452	83.67	438.98	342.60	96.38	23.09	59.95
25-Mar	B	1048	1054	1044	82.51	438.78	342.64	96.14	22.75	59.78
25-Mar	B	1114	1120	1109	82.20	438.73	342.71	96.02	22.91	59.86
25-Mar	B	1146	1157	1141	82.43	438.76	342.69	96.07	22.80	59.87
Mean					**82.97**	**438.79**	**342.47**	**96.32**	**22.98**	**59.88**
18-Mar	C	1256	1304	1251	84.01	438.88	342.25	96.63	23.21	59.98
18-Mar	C	1331	1339	1327	83.88	438.92	342.26	96.66	23.14	60.20
18-Mar	C	1358	1403	1354	84.11	438.94	342.35	96.59	23.26	60.14
18-Mar	C	1427	1433	1423	83.49	438.98	342.61	96.37	23.06	59.98
25-Mar	C	1219	1225	1214	82.66	438.84	342.66	96.18	22.88	59.88
25-Mar	C	1243	1249	1239	82.31	438.75	342.73	96.02	22.72	59.85
25-Mar	C	1312	1326	1308	82.09	438.64	342.82	95.82	22.75	59.57
Mean					**83.22**	**438.85**	**342.53**	**96.32**	**23.00**	**59.94**
					Upper 1%					
20-Mar	A	943	955	937	91.34	439.01	343.12	95.89	25.54	65.00
20-Mar	A	1026	1039	1022	91.23	439.02	343.10	95.92	25.35	64.95
20-Mar	A	1113	1127	1058	91.25	438.88	343.11	95.77	25.42	64.61
24-Mar	A	843	848	833	90.31	438.11	342.56	95.55	25.16	65.03

Appendix Table A

Continued.

Date	Release Slot A, B, C	Start Release Time	End Release Time	Station Parameters Time	Power Generation (MW)	Forebay Elevation (ft)	Tailrace Elevation (ft)	Gross Head (ft)	Blade Angle (degrees)	Wicket Gate Opening (%)
24-Mar	A	909	916	905	90.19	437.91	342.55	95.36	25.15	65.10
24-Mar	A	933	944	928	90.34	437.99	342.56	95.43	25.05	64.69
Mean					**90.78**	**438.49**	**342.83**	**95.65**	**25.28**	**64.90**
20-Mar	B	1216	1226	1159	91.29	439.03	343.08	95.95	25.36	64.53
20-Mar	B	1259	1310	1253	91.96	439.07	342.97	96.10	25.52	65.25
20-Mar	B	1331	1346	1327	92.18	438.90	343.12	95.78	25.59	65.04
24-Mar	B	1006	1012	1001	90.11	438.08	342.47	95.61	25.02	64.46
24-Mar	B	1034	1039	1028	90.27	438.20	342.35	95.85	25.05	64.76
24-Mar	B	1110	1123	1105	90.00	438.16	342.48	95.68	24.96	64.72
Mean					**90.97**	**438.57**	**342.75**	**95.83**	**25.25**	**64.79**
20-Mar	C	1420	1432	1416	92.00	438.99	343.04	95.95	25.56	64.78
20-Mar	C	1510	1524	1504	91.56	439.08	342.95	96.13	25.16	64.58
20-Mar	C	1547	1603	1542	92.52	439.07	342.98	96.09	25.61	65.21
24-Mar	C	1149	1155	1144	89.95	438.28	342.41	95.87	24.88	64.42
24-Mar	C	1224	1230	1220	90.51	438.26	342.39	95.87	25.10	64.75
24-Mar	C	1410	1421	1403	91.34	438.32	342.38	95.94	25.14	65.02
Mean					**91.31**	**438.67**	**342.69**	**95.98**	**25.24**	**64.79**
					Maximum					
21-Mar	A	1031	1046	1027	101.78	440.19	344.27	95.92	28.12	70.50
21-Mar	A	1121	1127	1104	101.90	440.12	344.16	95.96	28.14	70.28
21-Mar	A	1157	1203	1151	101.28	440.03	344.46	95.57	28.16	70.68
21-Mar	A	1605	1605	1549	100.42	439.52	344.31	95.21	28.26	70.42
23-Mar	A	1525	1532*	1518	101.81	439.46	343.51	95.95	28.09	70.31

Appendix Table A

Continued.

Date	Release Slot A, B, C	Start Release Time	End Release Time	Station Parameters Time	Power Generation (MW)	Forebay Elevation (ft)	Tailrace Elevation (ft)	Gross Head (ft)	Blade Angle (degrees)	Wicket Gate Opening (%)
23-Mar	A	1608	1616	1602	101.31	439.30	343.93	95.37	28.06	70.43
23-Mar	A	1649	1657	1642	100.10	439.40	344.71	94.69	28.08	70.43
23-Mar	A	1721	1728	1722	99.86	439.60	344.76	94.84	27.94	70.17
Mean					**101.06**	**439.70**	**344.26**	**95.44**	**28.11**	**70.40**
21-Mar	B	1245	1252	1239	100.99	439.99	344.49	95.50	28.09	70.44
21-Mar	B	1321	1328	1315	100.33	439.96	344.43	95.53	27.85	70.14
21-Mar	B	1400	1406	1352	100.47	439.77	344.57	95.20	28.07	70.00
21-Mar	B	1417	1422	1352	100.47	439.77	344.57	95.20	28.07	70.00
23-Mar	B	830	844	824	100.09	438.10	342.98	95.12	28.11	70.84
23-Mar	B	901	907	856	99.96	438.17	342.91	95.26	27.91	70.19
23-Mar	B	951	957	943	100.97	438.38	343.47	94.91	28.18	70.49
23-Mar	B	1024	1028	1013	101.15	438.43	343.25	95.18	28.28	70.59
23-Mar	B	1103	1109	1057	100.93	438.55	343.14	95.41	28.04	70.55
23-Mar	B	1146	1152	1140	101.59	438.77	343.06	95.71	28.23	70.63
Mean					**100.70**	**438.99**	**343.69**	**95.30**	**28.08**	**70.39**
21-Mar	C	1448	1453	1442	100.22	439.65	344.49	95.16	28.09	70.19
21-Mar	C	1522	1529	1517	100.47	439.61	344.36	95.25	27.92	70.00
21-Mar	C	1554	1600	1549	100.42	439.52	344.31	95.21	28.26	70.42
23-Mar	C	750	752	740	98.37	437.89	343.95	93.94	27.94	70.36
23-Mar	C	1222	1229	1215	101.31	438.81	343.82	94.99	28.09	70.50
23-Mar	C	1317	1325	1310	101.13	438.89	343.45	95.44	28.13	70.52
23-Mar	C	1401	1410	1355	101.84	439.12	343.46	95.66	28.31	70.94
23-Mar	C	1442	1447	1438	101.55	439.54	343.44	96.10	28.03	70.02
Mean					**100.66**	**439.13**	**343.91**	**95.22**	**28.10**	**70.37**

APPENDIX TABLE B

SCHEDULE OF RELEASES AND INDIVIDUAL TRIAL DATA

Appendix Table B-1 Daily tag-recapture data for yearling Chinook salmon passed through turbine unit 3 at 5 operational levels with controls released via junenile fish facility bypass pipe at Ice Harbor Dam, March 2007.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Lower 1%, slot A										
Number released	29	--	--	--	--	70	--	--	--	**99**
Number alive	28	--	--	--	--	65	--	--	--	**93**
Number recovered dead	1	--	--	--	--	4	--	--	--	**5**
Assigned dead*	0	--	--	--	--	0	--	--	--	**0**
Dislodged tags	--	--	--	--	--	--	--	--	--	**0**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	0	--	--	--	--	1	--	--	--	**1**
Held	28	--	--	--	--	65	--	--	--	**93**
Alive 24 h	28	--	--	--	--	64	--	--	--	**92**
Alive 48 h	28	--	--	--	--	64	--	--	--	**92**
Lower 1%, slot B										
Number released	30	--	--	--	--	70	--	--	--	**100**
Number alive	29	--	--	--	--	68	--	--	--	**97**
Number recovered dead	0	--	--	--	--	1	--	--	--	**1**
Assigned dead*	1	--	--	--	--	1	--	--	--	**2**
Dislodged tags	1	--	--	--	--	1	--	--	--	**2**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	0	--	--	--	--	0	--	--	--	**0**
Held	29	--	--	--	--	68	--	--	--	**97**
Alive 24 h	29	--	--	--	--	68	--	--	--	**97**
Alive 48 h	29	--	--	--	--	67	--	--	--	**96**

Appendix Table B-1

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Lower 1%, slot C										
Number released	30	--	--	--	--	70	--	--	--	**100**
Number alive	28	--	--	--	--	68	--	--	--	**96**
Number recovered dead	2	--	--	--	--	0	--	--	--	**2**
Assigned dead*	0	--	--	--	--	1	--	--	--	**1**
Dislodged tags	--	--	--	--	--	1	--	--	--	**1**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	0	--	--	--	--	1	--	--	--	**1**
Held	28	--	--	--	--	68	--	--	--	**96**
Alive 24 h	28	--	--	--	--	68	--	--	--	**96**
Alive 48 h	28	--	--	--	--	68	--	--	--	**96**
Peak, slot A										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number alive	--	--	48	--	--	--	--	--	--	**48**
Number recovered dead	--	--	1	--	--	--	--	--	--	**1**
Assigned dead*	--	--	1	--	--	--	--	--	--	**1**
Dislodged tags	--	--	1	--	--	--	--	--	--	**1**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	0	--	--	--	--	--	--	**0**
Held	--	--	48	--	--	--	--	--	--	**48**
Alive 24 h	--	--	48	--	--	--	--	--	--	**48**
Alive 48 h	--	--	48	--	--	--	--	--	--	**48**

Appendix Table B-1

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Peak, slot B										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number alive	--	--	49	--	--	--	--	--	--	**49**
Number recovered dead	--	--	1	--	--	--	--	--	--	**1**
Assigned dead*	--	--	0	--	--	--	--	--	--	**0**
Dislodged tags	--	--	--	--	--	--	--	--	--	**0**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	0	--	--	--	--	--	--	**0**
Held	--	--	49	--	--	--	--	--	--	**49**
Alive 24 h	--	--	49	--	--	--	--	--	--	**49**
Alive 48 h	--	--	49	--	--	--	--	--	--	**49**
Peak, slot C										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number alive	--	--	47	--	--	--	--	--	--	**47**
Number recovered dead	--	--	2	--	--	--	--	--	--	**2**
Assigned dead*	--	--	1	--	--	--	--	--	--	**1**
Dislodged tags	--	--	1	--	--	--	--	--	--	**1**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	0	--	--	--	--	--	--	**0**
Held	--	--	47	--	--	--	--	--	--	**47**
Alive 24 h	--	--	47	--	--	--	--	--	--	**47**
Alive 48 h	--	--	47	--	--	--	--	--	--	**47**

Appendix Table B-1

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Intermediate, slot A										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number alive	--	49	--	--	--	--	--	--	47	**96**
Number recovered dead	--	1	--	--	--	--	--	--	0	**1**
Assigned dead*	--	0	--	--	--	--	--	--	3	**3**
Dislodged tags	--	--	--	--	--	--	--	--	3	**3**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	0	--	--	--	--	--	--	0	**0**
Held	--	49	--	--	--	--	--	--	47	**96**
Alive 24 h	--	49	--	--	--	--	--	--	47	**96**
Alive 48 h	--	49	--	--	--	--	--	--	47	**96**
Intermediate, slot B										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number alive	--	48	--	--	--	--	--	--	50	**98**
Number recovered dead	--	0	--	--	--	--	--	--	0	**0**
Assigned dead*	--	2	--	--	--	--	--	--	0	**2**
Dislodged tags	--	2	--	--	--	--	--	--	--	**2**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	0	--	--	--	--	--	--	0	**0**
Held	--	48	--	--	--	--	--	--	50	**98**
Alive 24 h	--	48	--	--	--	--	--	--	50	**98**
Alive 48 h	--	48	--	--	--	--	--	--	50	**98**

Appendix Table B-1

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Intermediate, slot C										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number alive	--	50	--	--	--	--	--	--	50	**100**
Number recovered dead	--	0	--	--	--	--	--	--	0	**0**
Assigned dead*	--	0	--	--	--	--	--	--	0	**0**
Dislodged tags	--	--	--	--	--	--	--	--	--	**0**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	0	--	--	--	--	--	--	0	**0**
Held	--	50	--	--	--	--	--	--	50	**100**
Alive 24 h	--	50	--	--	--	--	--	--	49	**99**
Alive 48 h	--	50	--	--	--	--	--	--	49	**99**
Upper 1%, slot A										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number alive	--	--	--	49	--	--	--	48	--	**97**
Number recovered dead	--	--	--	1	--	--	--	2	--	**3**
Assigned dead*	--	--	--	0	--	--	--	0	--	**0**
Dislodged tags	--	--	--	--	--	--	--	--	--	**0**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	--	0	--	--	--	0	--	**0**
Held	--	--	--	49	--	--	--	48	--	**97**
Alive 24 h	--	--	--	48	--	--	--	48	--	**96**
Alive 48 h	--	--	--	48	--	--	--	48	--	**96**

Appendix Table B-1

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Upper 1%, slot B										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number alive	--	--	--	48	--	--	--	49	--	**97**
Number recovered dead	--	--	--	0	--	--	--	1	--	**1**
Assigned dead*	--	--	--	2	--	--	--	0	--	**2**
Dislodged tags	--	--	--	2	--	--	--	--	--	**2**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	--	0	--	--	--	0	--	**0**
Held	--	--	--	48	--	--	--	49	--	**97**
Alive 24 h	--	--	--	48	--	--	--	49	--	**97**
Alive 48 h	--	--	--	48	--	--	--	49	--	**97**
Upper 1%, slot C										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number alive	--	--	--	48	--	--	--	49	--	**97**
Number recovered dead	--	--	--	1	--	--	--	1	--	**2**
Assigned dead*	--	--	--	1	--	--	--	0	--	**1**
Dislodged tags	--	--	--	1	--	--	--	--	--	**1**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	--	0	--	--	--	0	--	**0**
Held	--	--	--	48	--	--	--	49	--	**97**
Alive 24 h	--	--	--	48	--	--	--	49	--	**97**
Alive 48 h	--	--	--	48	--	--	--	49	--	**97**

Appendix Table B-1

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Maximum, slot A										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number alive	--	--	--	--	43	--	51	--	--	**94**
Number recovered dead	--	--	--	--	2	--	0	--	--	**2**
Assigned dead*	--	--	--	--	0	--	2	--	--	**2**
Dislodged tags	--	--	--	--	--	--	2	--	--	**2**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	--	--	0	--	2	--	--	**2**
Held	--	--	--	--	43	--	51	--	--	**94**
Alive 24 h	--	--	--	--	43	--	51	--	--	**94**
Alive 48 h	--	--	--	--	43	--	51	--	--	**94**
Maximum, slot B										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number alive	--	--	--	--	45	--	50	--	--	**95**
Number recovered dead	--	--	--	--	0	--	2	--	--	**2**
Assigned dead*	--	--	--	--	0	--	1	--	--	**1**
Dislodged tags	--	--	--	--	--	--	1	--	--	**1**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	--	--	0	--	2	--	--	**2**
Held	--	--	--	--	45	--	50	--	--	**95**
Alive 24 h	--	--	--	--	45	--	50	--	--	**95**
Alive 48 h	--	--	--	--	45	--	50	--	--	**95**

Appendix Table B-1

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Maximum, slot C										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number alive	--	--	--	--	43	--	53	--	--	**96**
Number recovered dead	--	--	--	--	2	--	1	--	--	**3**
Assigned dead*	--	--	--	--	0	--	0	--	--	**0**
Dislodged tags	--	--	--	--	--	--	--	--	--	**0**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	--	--	0	--	1	--	--	**1**
Held	--	--	--	--	43	--	53	--	--	**96**
Alive 24 h	--	--	--	--	43	--	53	--	--	**96**
Alive 48 h	--	--	--	--	43	--	53	--	--	**96**
Control										
Number released	20	40	40	40	30	40	40	40	40	**330**
Number alive	20	40	40	40	30	40	40	40	40	**330**
Number recovered dead	--	--	--	--	--	--	--	--	--	**0**
Assigned dead*	--	--	--	--	--	--	--	--	--	**0**
Dislodged tags	--	--	--	--	--	--	--	--	--	**0**
Stationary radio signals	--	--	--	--	--	--	--	--	--	**0**
Undetermined	--	--	--	--	--	--	--	--	--	**0**
Held	20	40	40	40	30	40	40	40	40	**330**
Alive 24 h	20	40	40	40	30	40	40	40	40	**330**
Alive 48 h	20	40	40	40	30	40	40	40	40	**330**

* Includes dislodged tags, and stationary signals.

Appendix Table B-2 Summary tag-recapture data for yearling Chinook salmon passed through turbine unit 3 at 5 operational levels with controls released via junenile fish facility bypass pipe at Ice Harbor Dam, March 2007.

Operation Level	Lower 1%			Peak			Intermediate		
Slot	A	B	C	A	B	C	A	B	C
Number released	99	100	100	50	50	50	100	100	100
Number alive	93	97	96	48	49	47	96	98	100
Number recovered dead	5	1	2	1	1	2	1	0	0
Assigned dead*	0	2	1	1	0	1	3	2	0
Dislodged tags	0	2	1	1	0	1	3	2	0
Stationary radio signals	0	0	0	0	0	0	0	0	0
Undetermined	1	0	1	0	0	0	0	0	0
Held	93	97	96	48	49	47	96	98	100
Alive 24 h	92	97	96	48	49	47	96	98	99
Alive 48 h	92	96	96	48	49	47	96	98	99

Operation Level	Upper 1%			Maximum			
Slot	A	B	C	A	B	C	Control
Number released	100	100	100	100	100	100	330
Number alive	97	97	97	94	95	96	330
Number recovered dead	3	1	2	2	2	3	0
Assigned dead*	0	2	1	2	1	0	0
Dislodged tags	0	2	1	2	1	0	0
Stationary radio signals	0	0	0	0	0	0	0
Undetermined	0	0	0	2	2	1	0
Held	97	97	97	94	95	96	330
Alive 24 h	96	97	97	94	95	96	330
Alive 48 h	96	97	97	94	95	96	330

APPENDIX TABLE C

FISH INJURY DATA

Appendix Table C-1 Incidence of injury, scale loss, and temporary loss of equilibrium (LOE) observed on recaptured yearling Chinook salmon passed through turbine unit 3 at 5 operational levels and controls released via junenile fish facility bypass pipe at Ice Harbor Dam,March 2007.

Date	Test Lot	Fish VI	Live / Dead		Maladies	Passage Induced Injury	Passage Induced Malady	Photo taken	Cause	Status
					Lower 1%, Slot A					
3/17/07	2	V59	alive	48h	LOE	No	Yes	No		Minor
3/17/07	2	V57	dead	1h	Decapitated	Yes	Yes	Yes	Shear	Major
3/22/07	7	SC5	alive	48h	Hemorrhaged, bruised head	Yes	Yes	No	Mechanical	Major
3/22/07	7	PX8	dead	1h	Severed body	Yes	Yes	Yes	Mechanical	Major
3/22/07	7	PY2	dead	1h	Laceration: tear right side body below gill cover; Damaged operculum; torn; Bruised on top of head	Yes	Yes	Yes	Mechanical	Major
3/22/07	7	SC6	dead	1h	Decapitated; Laceration at right pelvic fin	Yes	Yes	Yes	Mechanical	Major
3/22/07	7	SC7	dead	1h	Laceration left side near caudal tag (not tag induced); Damaged right eye: missing	Yes	Yes	Yes	Mechanical/ Shear	Major
3/22/07	7	PX9	dead	24h	Damaged left gills: hemorraghed; Damaged left operculum; hemorrhaged; Broken backbone	Yes	Yes	No	Shear	Major
					Lower 1%, Slot B					
3/22/07	7	SL7	dead	1h	Damaged right eye; missing; Tear on body	Yes	Yes	No	Mechanical/ Shear	Major
3/22/07	7	SH6	alive	48h	Damaged right eye; hemorrhaged < 50%	Yes	Yes	Yes	Shear	Minor
3/22/07	7	SL1	dead	48h	Damaged right operculum; slightly torn at attachment point; Damaged right gills: hemorraghed; LOE; Flesh tear at tag site	Yes	Yes	Yes	Shear	Major
					Lower 1%, Slot C					
3/17/07	2	P31	dead	1h	Damaged left eye: hemorrhaged and torn retina, LOE	Yes	Yes	Yes	Shear	Major
3/17/07	2	ZB1	dead	1h	Flesh tear at tag site(s; LOE; Laceration and bruise left side on body; Dent on head; Internal hemorrhage	Yes	Yes	Yes	Mechanical	Major
3/22/07	7	ZC2	alive	48h	Damaged right operculum; bruised; Damaged right gills: hemorraghed; Flesh tear at tag site	Yes	Yes	Yes	Shear	Major
					Peak, Slot A					
3/19/07	4	TY0	dead	1h	Damaged left gills:hemorraghed; Bruised behind head	Yes	Yes	Yes	Mechanical	Major
3/19/07	4	TW5	alive	48h	Damaged right eye; missing, LOE	Yes	Yes	Yes	Shear	Major

Appendix Table C-1

Continued.

Date	Test Lot	Fish VI	Live / Dead		Maladies	Passage Induced Injury	Passage Induced Malady	Photo taken	Cause	Status
					Peak, Slot B					
3/19/07	4	PA8	dead	1h	Damaged right eye; missing; Damaged right gills:hemorraghed	Yes	Yes	Yes	Shear	Major
					Peak, Slot C					
3/19/07	4	PK8	dead	1h	Flesh tear at tag site(s); Kidneys damaged: hemorrhaged	Yes	Yes	Yes	Pressure	Major
3/19/07	4	R14	dead	1h	Flesh tear at tag site(s), LOE; Damaged left gills: minor hemorraghed; Damaged left operculum: minor tear at attachment point	Yes	Yes	No	Shear	Minor
					Intermediate, Slot A					
3/18/07	3	TU3	dead	1h	Damaged left eye; missing; Flesh tear at tag site(s)	Yes	Yes	Yes	Shear	Major
3/25/07	10	ZX7	alive	48h	Damaged left operculum; bruised; Flesh tear at tag site, LOE	Yes	Yes	No	Mechanical	Major
					Intermediate, Slot B					
3/18/07	3	TM2	alive	48h	Damaged left operculum; bruised	Yes	Yes	No	Mechanical	Minor
3/18/07	3	Z80	alive	48h	Scrape on top of head	Yes	Yes	No	Mechanical	Minor
3/18/07	3	Z79	alive	48h	LOE, Small laceration left eye	Yes	Yes	No	Mechanical	Minor
					Intermediate, Slot C					
3/25/07	10	ZB4	dead	24h	LOE, No visible marks on fish	No	Yes	No		Major
					Upper 1%, Slot A					
3/20/07	5	Z05	alive	48h	LOE	No	Yes	No		Minor
3/20/07	5	R85	alive	48h	LOE, Inverted gills protruding from mouth	Yes	Yes	No	Shear	Major
3/20/07	5	Z18	dead	1h	Flesh tear at tag site(s); Bruised both sides of body; Broken backbone; Hemorrhaged Kidney	Yes	Yes	No	Mechanical	Major
3/20/07	5	Z07	dead	24h	Damaged Kidneys: hemorrhaged	Yes	Yes	No	Pressure	Major
3/20/07	5	Z10	alive	48h	Damaged right eye; hemorraghed; Damaged right gills: torn cover	Yes	Yes	Yes	Mechanical	Major
3/24/07	9	SJ0	dead	1h	Severed body - pinch wound	Yes	Yes	Yes	Mechanical	Major
3/24/07	9	SK8	dead	1h	Flesh tear at tag site(s); Bruised head	Yes	Yes	Yes	Mechanical	Major

Appendix Table C-1

Continued.

Date	Test Lot	Fish VI	Live / Dead		Maladies	Passage Induced Injury	Passage Induced Malady	Photo taken	Cause	Status
					Upper 1%, Slot B					
3/20/07	5	Z58	alive	48h	Bruised top of head; LOE; Major scale loss	Yes	Yes	Yes	Mechanical	Major
3/20/07	5	Z40	alive	48h	Bruised top of head	Yes	Yes	No	Mechanical	Major
3/24/07	9	ZE1	dead	1h	Flesh tear at tag site(s); Hemorrhaged gills; Damaged right operculum: bent; Bruised head; Kidneys damaged	Yes	Yes	Yes	Shear	Major
					Upper 1%, Slot C					
3/20/07	5	Z84	alive	48h	Damaged right eye: hemorrhaged & damaged pupil	Yes	Yes	Yes	Shear	Major
3/20/07	5	Z93	dead	1h	Damaged left gills: hemorrhaged and inverted; Tear at opercular insertion	Yes	Yes	Yes	Shear	Major
3/24/07	9	ZP9	dead	1h	Damaged both gills: hemorrhaged; Flesh tear at tag site(s); Bruised on head	Yes	Yes	Yes	Mechanical	Major
					Maximum, Slot A					
3/21/07	6	X41	dead	1h	Decapitated	Yes	Yes	Yes	Shear	Major
3/21/07	6	X46	dead	1h	Flesh tear at tag site(s); Partial decapitated	Yes	Yes	Yes	Shear	Major
3/23/07	8	ZZ3	alive	48h	Damaged left eye: bulged	Yes	Yes	No	Shear	Major
					Maximum, Slot B					
3/23/07	8	ZM7	dead	1h	Severed body - pinch wound	Yes	Yes	Yes	Mechanical	Major
3/23/07	8	ZP1	dead	1h	Flesh tear at tag site(s); Laceration on body near caudal tag site (not tag induced)	Yes	Yes	Yes	Mechanical	Major
3/23/07	8	ZJ7	alive	48h	LOE, Damaged left eye: bulged; Damaged spine	Yes	Yes	No	Mechanical/ Shear	Major
					Maximum, Slot C					
3/21/07	6	XK7	dead	1h	Decapitated	Yes	Yes	Yes	Shear	Major
3/21/07	6	XL9	dead	1h	Decapitated	Yes	Yes	Yes	Shear	Major
3/21/07	6	PM7	alive	48h	Damaged left eye: hemorrhaged	Yes	Yes	Yes	Shear	Major
3/23/07	8	ZS7	dead	1h	Decapitated	Yes	Yes	Yes	Shear	Major

Appendix Table C-2 Daily, alive at 48 h and malady free data for yearling Chinook salmon passed through turbine unit 3 at 5 operational levels with controls released via junenile fish facility bypass pipe at Ice Harbor Dam, March 2007.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Lower 1%, slot A										
Number released	29	--	--	--	--	70	--	--	--	**99**
Number alive and malady free	27	--	--	--	--	63	--	--	--	**90**
With maladies, or died	2	--	--	--	--	6	--	--	--	**8**
Number assigned dead	0	--	--	--	--	0	--	--	--	**0**
Undetermined	0	--	--	--	--	1	--	--	--	**1**
Lower 1%, slot B										
Number released	30	--	--	--	--	70	--	--	--	**100**
Number alive and malady free	29	--	--	--	--	66	--	--	--	**95**
With maladies, or died	0	--	--	--	--	3	--	--	--	**3**
Number assigned dead	1	--	--	--	--	1	--	--	--	**2**
Undetermined	0	--	--	--	--	0	--	--	--	**0**
Lower 1%, slot C										
Number released	30	--	--	--	--	70	--	--	--	**100**
Number alive and malady free	28	--	--	--	--	67	--	--	--	**95**
With maladies, or died	2	--	--	--	--	1	--	--	--	**3**
Number assigned dead	0	--	--	--	--	1	--	--	--	**1**
Undetermined	0	--	--	--	--	1	--	--	--	**1**
Peak, slot A										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number alive and malady free	--	--	47	--	--	--	--	--	--	**47**
With maladies, or died	--	--	2	--	--	--	--	--	--	**2**
Number assigned dead	--	--	1	--	--	--	--	--	--	**1**
Undetermined	--	--	0	--	--	--	--	--	--	**0**

Appendix Table C-2

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Peak, slot B										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number alive and malady free	--	--	49	--	--	--	--	--	--	**49**
With maladies, or died	--	--	1	--	--	--	--	--	--	**1**
Number assigned dead	--	--	0	--	--	--	--	--	--	**0**
Undetermined	--	--	0	--	--	--	--	--	--	**0**
Peak, slot C										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number alive and malady free	--	--	47	--	--	--	--	--	--	**47**
With maladies, or died	--	--	2	--	--	--	--	--	--	**2**
Number assigned dead	--	--	1	--	--	--	--	--	--	**1**
Undetermined	--	--	0	--	--	--	--	--	--	**0**
Intermediate, slot A										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number alive and malady free	--	49	--	--	--	--	--	--	46	**95**
With maladies, or died	--	1	--	--	--	--	--	--	1	**2**
Number assigned dead	--	0	--	--	--	--	--	--	3	**3**
Undetermined	--	0	--	--	--	--	--	--	0	**0**
Intermediate, slot B										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number alive and malady free	--	45	--	--	--	--	--	--	50	**95**
With maladies, or died	--	3	--	--	--	--	--	--	0	**3**
Number assigned dead	--	2	--	--	--	--	--	--	0	**2**
Undetermined	--	0	--	--	--	--	--	--	0	**0**

Appendix Table C-2

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Intermediate, slot C										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number alive and malady free	--	50	--	--	--	--	--	--	49	**99**
With maladies, or died	--	0	--	--	--	--	--	--	1	**1**
Number assigned dead	--	0	--	--	--	--	--	--	0	**0**
Undetermined	--	0	--	--	--	--	--	--	0	**0**
Upper 1%, slot A										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number alive and malady free	--	--	--	45	--	--	--	48	--	**93**
With maladies, or died	--	--	--	5	--	--	--	2	--	**7**
Number assigned dead	--	--	--	0	--	--	--	0	--	**0**
Undetermined	--	--	--	0	--	--	--	0	--	**0**
Upper 1%, slot B										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number alive and malady free	--	--	--	46	--	--	--	49	--	**95**
With maladies, or died	--	--	--	2	--	--	--	1	--	**3**
Number assigned dead	--	--	--	2	--	--	--	0	--	**2**
Undetermined	--	--	--	0	--	--	--	0	--	**0**
Upper 1%, slot C										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number alive and malady free	--	--	--	47	--	--	--	49	--	**96**
With maladies, or died	--	--	--	2	--	--	--	1	--	**3**
Number assigned dead	--	--	--	1	--	--	--	0	--	**1**
Undetermined	--	--	--	0	--	--	--	0	--	**0**

Appendix Table C-2

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Maximum, slot A										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number alive and malady free	--	--	--	--	43	--	50	--	--	**93**
With maladies, or died	--	--	--	--	2	--	1	--	--	**3**
Number assigned dead	--	--	--	--	0	--	2	--	--	**2**
Undetermined	--	--	--	--	0	--	2	--	--	**2**
Maximum, slot B										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number alive and malady free	--	--	--	--	45	--	49	--	--	**94**
With maladies, or died	--	--	--	--	0	--	3	--	--	**3**
Number assigned dead	--	--	--	--	0	--	1	--	--	**1**
Undetermined	--	--	--	--	0	--	2	--	--	**2**
Maximum, slot C										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number alive and malady free	--	--	--	--	42	--	53	--	--	**95**
With maladies, or died	--	--	--	--	3	--	1	--	--	**4**
Number assigned dead	--	--	--	--	0	--	0	--	--	**0**
Undetermined	--	--	--	--	0	--	1	--	--	**1**
Control										
Number released	20	40	40	40	30	40	40	40	40	**330**
Number alive and malady free	20	40	40	40	30	40	40	40	40	**330**
With maladies, or died	0	0	0	0	0	0	0	0	0	**0**
Number assigned dead	0	0	0	0	0	0	0	0	0	**0**
Undetermined	0	0	0	0	0	0	0	0	0	**0**

Appendix Table C-3 Summary of alive at 48 h and malady-free data for yearling Chinook salmon passed through turbine Unit 3 at 5 operational levels with controls released via junenile fish facility bypass pipe at Ice Harbor Dam, March 2007.

Operation Level	Lower 1%			Peak			Intermediate		
Slot	A	B	C	A	B	C	A	B	C
Number released	99	100	100	50	50	50	100	100	100
Alive and malady free	90	95	95	47	49	47	95	95	99
With maladies, or died	8	3	3	2	1	2	2	3	1
Number assigned dead	0	2	1	1	0	1	3	2	0
Undetermined*	1	0	1	0	0	0	0	0	0

Operation Level	Upper 1%			Maximum			
Slot	A	B	C	A	B	C	Control
Number released	100	100	100	100	100	100	330
Alive and malady free	93	95	96	93	94	95	330
With maladies, or died	7	3	3	3	3	4	0
Number assigned dead	0	2	1	2	1	0	0
Undetermined*	0	0	0	2	2	1	0

*Since all controls were recovered alive the full joint likelihood model classifies all undetermined fish as dead

Appendix Table C-4 Daily malady data for yearling Chinook salmon passed through turbine unit 3 at 5 operational levels with controls released via junenile fish facility bypass pipe at Ice Harbor Dam, March 2007.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Lower 1%, slot A										
Number released	29	--	--	--	--	70	--	--	--	**99**
Number examined	29	--	--	--	--	69	--	--	--	**98**
Passage related maladies	2	--	--	--	--	6	--	--	--	**8**
Visible injuries	1	--	--	--	--	6	--	--	--	**7**
Loss of equilibrium only	1	--	--	--	--	0	--	--	--	**1**
Scale loss only	0	--	--	--	--	0	--	--	--	**0**
Without maladies	27	--	--	--	--	63	--	--	--	**90**
Without maladies that died	0	--	--	--	--	0	--	--	--	**0**
Lower 1%, slot B										
Number released	30	--	--	--	--	70	--	--	--	**100**
Number examined	29	--	--	--	--	69	--	--	--	**98**
Passage related maladies	0	--	--	--	--	3	--	--	--	**3**
Visible injuries	0	--	--	--	--	3	--	--	--	**3**
Loss of equilibrium only	0	--	--	--	--	0	--	--	--	**0**
Scale loss only	0	--	--	--	--	0	--	--	--	**0**
Without maladies	29	--	--	--	--	66	--	--	--	**95**
Without maladies that died	0	--	--	--	--	0	--	--	--	**0**
Lower 1%, slot C										
Number released	30	--	--	--	--	70	--	--	--	**100**
Number examined	30	--	--	--	--	68	--	--	--	**98**
Passage related maladies	2	--	--	--	--	1	--	--	--	**3**
Visible injuries	2	--	--	--	--	1	--	--	--	**3**
Loss of equilibrium only	0	--	--	--	--	0	--	--	--	**0**
Scale loss only	0	--	--	--	--	0	--	--	--	**0**
Without maladies	28	--	--	--	--	67	--	--	--	**95**
Without maladies that died	0	--	--	--	--	0	--	--	--	**0**

Appendix Table C-4

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Peak, slot A										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number examined	--	--	49	--	--	--	--	--	--	**49**
Passage related maladies	--	--	2	--	--	--	--	--	--	**2**
Visible injuries	--	--	2	--	--	--	--	--	--	**2**
Loss of equilibrium only	--	--	0	--	--	--	--	--	--	**0**
Scale loss only	--	--	0	--	--	--	--	--	--	**0**
Without maladies	--	--	47	--	--	--	--	--	--	**47**
Without maladies that died	--	--	0	--	--	--	--	--	--	**0**
Peak, slot B										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number examined	--	--	50	--	--	--	--	--	--	**50**
Passage related maladies	--	--	1	--	--	--	--	--	--	**1**
Visible injuries	--	--	1	--	--	--	--	--	--	**1**
Loss of equilibrium only	--	--	0	--	--	--	--	--	--	**0**
Scale loss only	--	--	0	--	--	--	--	--	--	**0**
Without maladies	--	--	49	--	--	--	--	--	--	**49**
Without maladies that died	--	--	0	--	--	--	--	--	--	**0**
Peak, slot C										
Number released	--	--	50	--	--	--	--	--	--	**50**
Number examined	--	--	49	--	--	--	--	--	--	**49**
Passage related maladies	--	--	2	--	--	--	--	--	--	**2**
Visible injuries	--	--	2	--	--	--	--	--	--	**2**
Loss of equilibrium only	--	--	0	--	--	--	--	--	--	**0**
Scale loss only	--	--	0	--	--	--	--	--	--	**0**
Without maladies	--	--	47	--	--	--	--	--	--	**47**
Without maladies that died	--	--	0	--	--	--	--	--	--	**0**

Appendix Table C-4

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Intermediate, slot A										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number examined	--	50	--	--	--	--	--	--	47	**97**
Passage related maladies	--	1	--	--	--	--	--	--	1	**2**
Visible injuries	--	1	--	--	--	--	--	--	1	**2**
Loss of equilibrium only	--	0	--	--	--	--	--	--	0	**0**
Scale loss only	--	0	--	--	--	--	--	--	0	**0**
Without maladies	--	49	--	--	--	--	--	--	46	**95**
Without maladies that died	--	0	--	--	--	--	--	--	0	**0**
Imtermediate, slot B										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number examined	--	48	--	--	--	--	--	--	50	**98**
Passage related maladies	--	3	--	--	--	--	--	--	0	**3**
Visible injuries	--	3	--	--	--	--	--	--	0	**3**
Loss of equilibrium only	--	0	--	--	--	--	--	--	0	**0**
Scale loss only	--	0	--	--	--	--	--	--	0	**0**
Without maladies	--	45	--	--	--	--	--	--	50	**95**
Without maladies that died	--	0	--	--	--	--	--	--	0	**0**
Intermediate, slot C										
Number released	--	50	--	--	--	--	--	--	50	**100**
Number examined	--	50	--	--	--	--	--	--	50	**100**
Passage related maladies	--	0	--	--	--	--	--	--	1	**1**
Visible injuries	--	0	--	--	--	--	--	--	0	**0**
Loss of equilibrium only	--	0	--	--	--	--	--	--	1	**1**
Scale loss only	--	0	--	--	--	--	--	--	0	**0**
Without maladies	--	50	--	--	--	--	--	--	49	**99**
Without maladies that died	--	0	--	--	--	--	--	--	0	**0**

Appendix Table C-4

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Upper 1%, slot A										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number examined	--	--	--	50	--	--	--	50	--	**100**
Passage related maladies	--	--	--	5	--	--	--	2	--	**7**
Visible injuries	--	--	--	4	--	--	--	2	--	**6**
Loss of equilibrium only	--	--	--	1	--	--	--	0	--	**1**
Scale loss only	--	--	--	0	--	--	--	0	--	**0**
Without maladies	--	--	--	45	--	--	--	48	--	**93**
Without maladies that died	--	--	--	0	--	--	--	0	--	**0**
Upper 1%, slot B										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number examined	--	--	--	48	--	--	--	50	--	**98**
Passage related maladies	--	--	--	2	--	--	--	1	--	**3**
Visible injuries	--	--	--	2	--	--	--	1	--	**3**
Loss of equilibrium only	--	--	--	0	--	--	--	0	--	**0**
Scale loss only	--	--	--	0	--	--	--	0	--	**0**
Without maladies	--	--	--	46	--	--	--	49	--	**95**
Without maladies that died	--	--	--	0	--	--	--	0	--	**0**
Upper 1%, slot C										
Number released	--	--	--	50	--	--	--	50	--	**100**
Number examined	--	--	--	49	--	--	--	50	--	**99**
Passage related maladies	--	--	--	2	--	--	--	1	--	**3**
Visible injuries	--	--	--	2	--	--	--	1	--	**3**
Loss of equilibrium only	--	--	--	0	--	--	--	0	--	**0**
Scale loss only	--	--	--	0	--	--	--	0	--	**0**
Without maladies	--	--	--	47	--	--	--	49	--	**96**
Without maladies that died	--	--	--	0	--	--	--	0	--	**0**

Appendix Table C-4

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Maximum, slot A										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number examined	--	--	--	--	45	--	51	--	--	**96**
Passage related maladies	--	--	--	--	2	--	1	--	--	**3**
Visible injuries	--	--	--	--	2	--	1	--	--	**3**
Loss of equilibrium only	--	--	--	--	0	--	0	--	--	**0**
Scale loss only	--	--	--	--	0	--	0	--	--	**0**
Without maladies	--	--	--	--	43	--	50	--	--	**93**
Without maladies that died	--	--	--	--	0	--	0	--	--	**0**
Maximum, slot B										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number examined	--	--	--	--	45	--	52	--	--	**97**
Passage related maladies	--	--	--	--	0	--	3	--	--	**3**
Visible injuries	--	--	--	--	0	--	3	--	--	**3**
Loss of equilibrium only	--	--	--	--	0	--	0	--	--	**0**
Scale loss only	--	--	--	--	0	--	0	--	--	**0**
Without maladies	--	--	--	--	45	--	49	--	--	**94**
Without maladies that died	--	--	--	--	0	--	0	--	--	**0**
Maximum, slot C										
Number released	--	--	--	--	45	--	55	--	--	**100**
Number examined	--	--	--	--	45	--	54	--	--	**99**
Passage related maladies	--	--	--	--	3	--	1	--	--	**4**
Visible injuries	--	--	--	--	3	--	1	--	--	**4**
Loss of equilibrium only	--	--	--	--	0	--	0	--	--	**0**
Scale loss only	--	--	--	--	0	--	0	--	--	**0**
Without maladies	--	--	--	--	42	--	53	--	--	**95**
Without maladies that died	--	--	--	--	0	--	0	--	--	**0**

Appendix Table C-4

Continued.

	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24	3/25	Totals
Control										
Number released	20	40	40	40	30	40	40	40	40	**330**
Number examined	20	40	40	40	30	40	40	40	40	**330**
Passage related maladies	--	--	--	--	--	--	--	--	--	**0**
Visible injuries	--	--	--	--	--	--	--	--	--	**0**
Loss of equilibrium only	--	--	--	--	--	--	--	--	--	**0**
Scale loss only	--	--	--	--	--	--	--	--	--	**0**
Without maladies	20	40	40	40	30	40	40	40	40	**330**
Without maladies that died	0	0	0	0	0	0	0	0	0	**0**

Appendix Table C-5 Summary malady data for yearling Chinook salmon passed through turbine unit 3 at 5 operational levels with controls released via juvenile fish facility bypass pipe at Ice Harbor Dam, March 2007.

Operation Level	Lower 1%			Peak			Intermediate		
Slot	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Number released	99	100	100	50	50	50	100	100	100
Number examined	98	98	98	49	50	49	97	98	100
Passage related maladies	8	3	3	2	1	2	2	3	1
Visible injuries	7	3	3	2	1	2	2	3	0
Loss of equilibrium only	1	0	0	0	0	0	0	0	1
Scale loss only	0	0	0	0	0	0	0	0	0
Without maladies	90	95	95	47	49	47	95	95	99
Without maladies that died	0	0	0	0	0	0	0	0	0

Operation Level	Upper 1%			Maximum			
Slot	**A**	**B**	**C**	**A**	**B**	**C**	**Control**
Number released	100	100	100	100	100	100	330
Number examined	100	98	99	96	97	99	330
Passage related maladies	7	3	3	3	3	4	0
Visible injuries	6	3	3	3	3	4	0
Loss of equilibrium only	1	0	0	0	0	0	0
Scale loss only	0	0	0	0	0	0	0
Without maladies	93	95	96	93	94	95	330
Without maladies that died	0	0	0	0	0	0	0

APPENDIX TABLE D

INDIVIDUAL FISH DISPOSITION DATA

Appendix Table D Short term passage survival data on individual yearling chinook salmon passed through turbine unit 3 at at 5 operational levels and controls released via junenile fish facility bypass pipe at Ice Harbor Dam, March 2007. Description of survival and status codes are presented in Table 2-4 and details on injured fish are presented in Appendix Table C-1.

Fish ID	Total Length (mm)	Time			No. HI-Z tags recovered	Survival Code	Status Codes			
		Re-leased	Re-covered	Minutes at large			1	2	3	4
17-Mar-07		**Testlot 2**	**Lower 1% power, Slot A**		**Water temp = 5.0°C**					
P86	146	15:58	16:04	*6*	2	1	A			
P87	133	15:57	16:05	*8*	2	1	A			
P88	141	15:58	16:06	*8*	2	1	A			
P89	146	15:59	16:10	*11*	2	1	A			
P90	138	15:57	16:14	*17*	2	1	A			
P91	147	16:00	16:18	*18*	2	1	A			
P92	121	15:59	16:09	*10*	2	1	A			
P93	125	16:00	16:04	*4*	2	1	A			
P94	131	16:01	16:09	*8*	2	1	A			
P95	153	16:01	16:16	*15*	2	1	A			
P96	136	16:02	16:07	*5*	2	1	A			
P97	143	16:03	16:21	*18*	2	1	A			
P98	137	16:04	16:17	*13*	2	1	A			
P99	130	16:03	16:09	*6*	2	1	A			
V50	130	16:02	16:09	*7*	2	1	A			
V51	154	16:32	16:39	*7*	2	1	A			
V52	128	16:33	16:39	*6*	2	1	A			
V53	148	16:32	16:39	*7*	2	1	A			
V54	137	16:33	16:38	*5*	2	1	A			
V55	126	16:33	16:54	*21*	2	1	A			
V56	124	16:34	16:41	*7*	2	1	A			
V57	147	16:35	16:48	*13*	2	2	7			*
V58	136	16:35				4	Q	R		
V59	147	16:35	16:46	*11*	2	1	H			*
V60	136	16:34	16:40	*6*	2	1	A			
V61	129	16:36	16:44	*8*	2	1	A			
V62	126	16:37	16:42	*5*	2	1	A			
V63	132	16:37	16:43	*6*	2	1	A			
V64	132	16:36	16:54	*18*	2	1	A			
V65	129	16:37	16:45	*8*	2	1	A			
17-Mar-07		**Testlot 2**	**Lower 1% power, Slot B**		**Water temp = 5.0°C**					
P56	140	14:41	14:47	*6*	2	1	A			
P57	129	14:41	14:55	*14*	2	1	A			
P58	145	14:42	14:48	*6*	2	1	A			
P59	143	14:42	14:53	*11*	2	1	A			
P60	143	14:42	14:55	*13*	2	1	A			
P61	136	14:44	14:51	*7*	2	1	A			
P62	145	14:45	14:55	*10*	2	1	A			
P63	165	14:43	14:53	*10*	2	1	A			
P64	155	14:45	14:59	*14*	2	1	A			
P65	138	14:44	14:50	*6*	2	1	A			
P66	140	14:45	14:54	*9*	2	1	A			
P67	144	14:46	14:54	*8*	2	1	A			
P68	155	14:47	14:55	*8*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
P69	130	14:46	14:55	*9*	2	1	A			
P70	125	14:47	14:56	*9*	2	1	A			
P71	135	15:19				3	Q			
MZ0	134	15:17	15:27	*10*	2	1	A			
P73	135	15:18	15:24	*6*	2	1	A			
P74	136	15:18	15:31	*13*	2	1	A			
P75	135	15:19	15:25	*6*	2	1	A			
P76	137	15:21	15:30	*9*	2	1	A			
P77	128	15:20	15:27	*7*	2	1	A			
P78	133	15:21	15:29	*8*	2	1	A			
P79	138	15:21	15:35	*14*	2	1	A			
P80	134	15:20	15:31	*11*	2	1	A			
P81	135	15:23	15:34	*11*	2	1	A			
P82	135	15:22	15:28	*6*	2	1	A			
P83	130	15:24	15:32	*8*	2	1	A			
P84	132	15:22	15:31	*9*	2	1	A			
P85	124	15:23	15:32	*9*	2	1	A			
17-Mar-07		**Testlot 2**	**Lower 1% power, Slot C**		**Water temp = 5.0°C**					
P26	153	13:27	13:35	*8*	2	1	A			
P27	127	13:26	13:34	*8*	2	1	A			
P28	123	13:26	13:33	*7*	2	1	A			
P29	133	13:27	13:34	*7*	2	1	A			
P30	142	13:25	13:34	*9*	2	1	A			
P31	149	13:28	13:38	*10*	2	2	H	*		
P32	147	13:29	13:36	*7*	2	1	A			
P33	130	13:28	13:37	*9*	2	1	A			
P34	151	13:29	13:36	*7*	2	1	A			
P35	140	13:28	13:38	*10*	2	1	A			
P36	147	13:31	13:43	*12*	2	1	A			
P37	144	13:30	13:39	*9*	2	1	A			
P38	135	13:31	13:37	*6*	2	1	A			
ZB0	147	13:31	13:39	*8*	2	1	A			
ZB1	142	13:32	13:41	*9*	2	2	H	B	E	*
P41	144	13:56	14:03	*7*	2	1	A			
P42	141	13:56	14:03	*7*	2	1	A			
P43	127	13:55	14:02	*7*	2	1	A			
P44	138	13:56	14:06	*10*	2	1	A			
P45	137	13:57	14:08	*11*	2	1	A			
P46	143	13:59	14:07	*8*	2	1	A			
P47	150	13:58	14:20	*22*	2	1	A			
P48	133	13:59	14:25	*26*	2	1	A			
P49	141	13:59	14:05	*6*	2	1	A			
ZB2	152	13:58	14:05	*7*	2	1	A			
P51	125	14:00	14:10	*10*	2	1	A			
P52	142	14:00	14:08	*8*	2	1	A			
P53	136	14:02	14:15	*13*	2	1	A			
P54	130	14:01	14:08	*7*	2	1	A			
P55	130	14:01	14:10	*9*	2	1	A			
17-Mar-07		**Testlot 2**	**Control**		**Water temp = 5.0°C**					

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
V66	132	17:15	17:20	*5*	2	1	A			
V67	153	17:16	17:21	*5*	2	1	A			
V68	144	17:17	17:22	*5*	2	1	A			
V69	159	17:14	17:18	*4*	2	1	A			
V70	145	17:14	17:18	*4*	2	1	A			
V71	145	17:16	17:22	*6*	2	1	A			
V72	142	17:17	17:22	*5*	2	1	A			
V73	126	17:15	17:19	*4*	2	1	A			
V74	135	17:18	17:21	*3*	2	1	A			
V75	135	17:13	17:18	*5*	2	1	A			
V76	140	17:19	17:24	*5*	2	1	A			
V77	137	17:23	17:26	*3*	2	1	A			
V78	140	17:22	17:27	*5*	2	1	A			
V79	137	17:21	17:26	*5*	2	1	A			
V80	132	17:23	17:27	*4*	2	1	A			
V81	133	17:21	17:24	*3*	2	1	A			
V82	144	17:20	17:24	*4*	2	1	A			
V83	133	17:19	17:24	*5*	2	1	A			
V84	144	17:20	17:25	*5*	2	1	A			
V85	161	17:24	17:28	*4*	2	1	A			
18-Mar-07		**Testlot 3**	**Intermediate power, Slot C**		**Water temp = 5.0°C**					
TM5	146	12:56	13:02	*6*	2	1	A			
TM6	125	12:56	13:03	*7*	2	1	A			
TM7	126	12:57	13:05	*8*	2	1	A			
TM8	140	12:58	13:05	*7*	2	1	A			
TM9	143	12:57	13:05	*8*	2	1	A			
TN0	158	13:04	13:10	*6*	2	1	A			
TN1	145	13:02	13:11	*9*	2	1	A			
TN2	132	13:03	13:09	*6*	2	1	A			
TN3	148	13:04	13:09	*5*	2	1	A			
TN4	144	13:03	13:09	*6*	2	1	A			
TN5	158	13:02	13:09	*7*	2	1	A			
TN6	137	13:00	13:09	*9*	2	1	A			
TN7	143	12:59	13:12	*13*	2	1	A			
TN8	126	12:59	13:06	*7*	2	1	A			
TN9	132	13:01	13:07	*6*	2	1	A			
TP0	167	13:01	13:07	*6*	2	1	A			
TP1	137	13:32	13:37	*5*	2	1	A			
TP2	142	13:32	13:39	*7*	2	1	A			
TP3	127	13:31	13:38	*7*	2	1	A			
TP4	153	13:33	13:40	*7*	2	1	A			
TP5	143	13:34	13:39	*5*	2	1	A			
TP6	143	13:35	13:41	*6*	2	1	A			
TP7	133	13:35	13:44	*9*	2	1	A			
TP8	135	13:36	13:42	*6*	2	1	A			
TP9	133	13:33	13:40	*7*	2	1	A			
TR0	130	13:38	13:44	*6*	2	1	A			
TR1	143	13:37	13:48	*11*	2	1	A			
TR2	147	13:39	13:46	*7*	2	1	A			
TR3	132	13:37	13:43	*6*	2	1	A			

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Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
TR4	163	13:37	13:42	*5*	2	1	A			
TR5	135	13:59	14:04	*5*	2	1	A			
TR6	147	13:58	14:10	*12*	2	1	A			
TR7	136	14:00	14:08	*8*	2	1	A			
TR8	158	14:00	14:09	*9*	2	1	A			
TR9	146	13:59	14:06	*7*	2	1	A			
TS0	128	14:02	14:08	*6*	2	1	A			
TS1	134	14:02	14:08	*6*	2	1	A			
TS2	138	14:03	14:09	*6*	2	1	A			
TS3	153	14:01	14:07	*6*	2	1	A			
TS4	139	14:01	14:10	*9*	2	1	A			
TS5	133	14:28	14:38	*10*	2	1	A			
TS6	133	14:29	14:40	*11*	2	1	A			
TS7	135	14:27	14:32	*5*	2	1	A			
TS8	137	14:28	14:38	*10*	2	1	A			
TS9	143	14:29	14:47	*18*	2	1	A			
TT0	131	14:32	14:37	*5*	2	1	A			
TT1	151	14:30	14:38	*8*	2	1	A			
TT2	146	14:33	14:44	*11*	2	1	A			
TT3	141	14:32	14:43	*11*	2	1	A			
TT4	172	14:31	14:40	*9*	2	1	A			
18-Mar-07		**Testlot 3**	**Intermediate power, Slot A**		**Water temp = 5.0°C**					
V86	137	8:42	8:49	*7*	2	1	A			
V87	130	8:40	8:49	*9*	2	1	A			
V88	130	8:40	8:47	*7*	2	1	A			
V89	138	8:41	8:51	*10*	2	1	A			
V90	134	8:41	8:47	*6*	2	1	A			
V91	133	8:44	8:51	*7*	2	1	A			
V92	136	8:44	8:53	*9*	2	1	A			
V93	143	8:43	9:04	*21*	2	1	A			
V94	133	8:43	8:53	*10*	2	1	A			
V95	136	8:43	8:55	*12*	2	1	A			
V96	134	8:46	8:52	*6*	2	1	A			
V97	135	8:45	8:55	*10*	2	1	A			
V98	126	8:47	9:04	*17*	2	1	A			
ZH2	123	8:46	8:54	*8*	2	1	A			
ZH3	138	8:47	8:56	*9*	2	1	A			
Z00	133	9:16	9:25	*9*	2	1	A			
Z01	146	9:17	9:27	*10*	2	1	A			
Z02	142	9:17	9:24	*7*	2	1	A			
Z03	140	9:16	9:26	*10*	2	1	A			
Z04	143	9:16	9:22	*6*	2	1	A			
Z05	134	9:19	9:25	*6*	2	1	A			
Z06	126	9:19	9:28	*9*	2	1	A			
Z07	126	9:18	9:25	*7*	2	1	A			
Z08	134	9:19	9:26	*7*	2	1	A			
Z09	144	9:20	9:26	*6*	2	1	A			
Z10	138	9:22	9:31	*9*	2	1	A			
Z11	132	9:21	9:35	*14*	2	1	A			
Z12	136	9:22	9:30	*8*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
Z13	137	9:21	9:29	*8*	1	1	A			
Z14	136	9:20	9:28	*8*	2	1	A			
Z15	127	9:46	9:59	*13*	2	1	A			
Z16	144	9:47	9:52	*5*	2	1	A			
Z17	127	9:47	9:57	*10*	2	1	A			
Z18	125	9:46	10:00	*14*	2	1	A			
Z19	142	9:46	9:51	*5*	2	1	A			
Z20	137	9:49	9:58	*9*	2	1	A			
Z21	138	9:48	9:59	*11*	2	1	A			
Z22	123	9:48	9:57	*9*	2	1	A			
Z23	151	9:49	9:55	*6*	2	1	A			
Z24	142	9:50	9:55	*5*	2	1	A			
Z25	125	9:52	9:59	*7*	2	1	A			
Z26	143	9:51	9:57	*6*	2	1	A			
Z27	137	9:51	10:01	*10*	2	1	A			
Z28	137	9:52	9:58	*6*	2	1	A			
Z29	131	9:50	9:56	*6*	2	1	A			
TU0	136	15:03	15:13	*10*	2	1	A			
TU1	126	15:06	15:15	*9*	2	1	A			
TU2	132	15:05	15:15	*10*	2	1	A			
TU3	128	15:05	15:15	*10*	1	2	8	B		
TU4	125	15:04	15:10	*6*	2	1	A			
18-Mar-07		**Testlot 3**	**Intermediate power, Slot B**		**Water temp =**	**5.0°C**				
Z60	136	11:21	11:27	*6*	2	1	A			
Z61	142	11:21	11:26	*5*	2	1	A			
Z62	144	11:23	11:30	*7*	2	1	A			
Z63	154	11:22	11:29	*7*	2	1	A			
Z64	145	11:22	11:29	*7*	2	1	A			
Z65	136	11:24	11:32	*8*	2	1	A			
Z66	133	11:24	11:31	*7*	2	1	A			
Z67	148	11:25	11:30	*5*	2	1	A			
Z68	140	11:23	11:28	*5*	2	1	A			
Z69	128	11:25	11:33	*8*	2	1	A			
Z70	138	11:27			2	3				
Z71	138	11:26	11:36	*10*	2	1	A			
Z72	133	11:26	11:33	*7*	2	1	A			
Z73	144	11:28	11:37	*9*	2	1	A			
Z74	134	11:28	11:35	*7*	2	1	A			
Z75	132	11:53	12:02	*9*	2	1	A			
Z76	126	11:52	12:00	*8*	2	1	A			
Z77	133	11:53	12:01	*8*	2	1	A			
Z78	134	11:54	12:00	*6*	2	1	A			
Z79	135	11:53	12:03	*10*	2	1	H	E		*
Z80	126	11:55	12:05	*10*	2	1	W			*
Z81	153	11:56			2	3				
Z82	134	11:57	12:02	*5*	2	1	A			
Z83	137	11:55	12:03	*8*	2	1	A			
Z84	143	11:56	12:05	*9*	2	1	A			
Z85	126	11:59	12:06	*7*	2	1	A			
Z86	138	11:59	12:07	*8*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
Z87	131	11:58	12:03	*5*	2	1	A			
Z88	133	11:58	12:07	*9*	2	1	A			
Z89	133	11:59	12:06	*7*	2	1	A			
Z90	142	12:25	12:36	*11*	2	1	A			
Z91	128	12:24	12:31	*7*	2	1	A			
Z92	140	12:23	12:28	*5*	2	1	A			
Z93	147	12:23	12:29	*6*	2	1	A			
Z94	131	12:24	12:30	*6*	2	1	A			
Z95	147	12:26	12:33	*7*	2	1	A			
Z96	148	12:27	12:32	*5*	2	1	A			
Z97	133	12:26	12:34	*8*	2	1	A			
Z98	137	12:28	12:41	*13*	2	1	A			
Z99	143	12:28	12:35	*7*	2	1	A			
TM0	139	12:31	12:40	*9*	2	1	A			
TM1	131	12:30	12:36	*6*	2	1	A			
TM2	133	12:30	12:38	*8*	2	1	9	*		
TM3	146	12:29	12:37	*8*	2	1	A			
TM4	165	12:31	12:38	*7*	2	1	A			
TT5	145	14:57	15:05	*8*	2	1	A			
TT6	133	14:57	15:01	*4*	2	1	A			
TT7	141	14:58	15:08	*10*	2	1	A			
TT8	134	14:58	15:03	*5*	2	1	A			
TT9	137	14:59	15:04	*5*	2	1	A			
18-Mar-07		**Testlot 3**	**Control**		**Water temp = 5.0°C**					
Z30	133	10:24	10:30	*6*	2	1	A			
Z31	143	10:23	10:28	*5*	2	1	A			
Z32	136	10:21	10:24	*3*	2	1	A			
Z33	157	10:20	10:26	*6*	2	1	A			
Z34	137	10:21	10:25	*4*	2	1	A			
Z35	143	10:23	10:27	*4*	2	1	A			
Z36	123	10:24	10:29	*5*	2	1	A			
Z37	127	10:22	10:26	*4*	2	1	A			
Z38	128	10:22	10:26	*4*	2	1	A			
Z39	156	10:25	10:29	*4*	2	1	A			
Z40	134	10:29	10:34	*5*	2	1	A			
Z41	142	10:30	10:34	*4*	2	1	A			
Z42	138	10:26	10:30	*4*	2	1	A			
Z43	146	10:30	10:33	*3*	2	1	A			
Z44	143	10:28	10:32	*4*	2	1	A			
Z45	161	10:29	10:33	*4*	2	1	A			
Z46	142	10:26	10:30	*4*	2	1	A			
Z47	136	10:27	10:32	*5*	2	1	A			
Z48	143	10:27	10:31	*4*	2	1	A			
Z49	144	10:28	10:32	*4*	2	1	A			
Z50	126	10:52	11:07	*15*	2	1	A			
Z51	131	10:51	10:59	*8*	2	1	A			
Z52	148	10:55	10:58	*3*	2	1	A			
Z53	126	10:51	10:54	*3*	2	1	A			
Z54	137	10:54	11:00	*6*	2	1	A			
Z55	166	10:55	11:00	*5*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
Z56	144	10:52	10:56	*4*	2	1	A			
Z57	146	10:54	10:58	*4*	2	1	A			
Z58	155	10:51	10:55	*4*	2	1	A			
Z59	143	10:53	10:57	*4*	2	1	A			
ZS5	134	10:55	11:01	*6*	2	1	A			
ZS6	133	10:56	11:03	*7*	2	1	A			
ZS7	134	10:59	11:05	*6*	2	1	A			
ZS8	138	10:58	11:06	*8*	2	1	A			
ZS9	136	10:57	11:05	*8*	2	1	A			
ZT0	133	10:57	11:03	*6*	2	1	A			
ZT1	136	11:00	11:05	*5*	2	1	A			
ZT2	130	11:00	11:06	*6*	2	1	A			
ZT3	155	10:58	11:03	*5*	2	1	A			
ZT4	148	10:56	11:03	*7*	2	1	A			
19-Mar-07		**Testlot 4**	**Peak power, Slot A**		**Water temp = 6.0°C**					
TU5	153	8:33	8:44	*11*	2	1	A			
TU6	131	8:32	8:38	*6*	2	1	A			
TU7	130	8:31	8:37	*6*	2	1	A			
TU8	141	8:32	8:40	*8*	2	1	A			
TU9	140	8:33	8:47	*14*	2	1	A			
TV0	138	8:36	8:43	*7*	2	1	A			
TV1	148	8:34	8:53	*19*	2	1	A			
TV2	134	8:35	8:41	*6*	2	1	A			
TV3	135	8:34	8:41	*7*	2	1	A			
TV4	146	8:34	8:40	*6*	2	1	A			
TV5	130	8:38	8:46	*8*	2	1	A			
TV6	147	8:37	8:42	*5*	2	1	A			
TV7	143	8:37	8:51	*14*	2	1	A			
TV8	145	8:38	8:47	*9*	2	1	A			
TV9	147	8:38	8:46	*8*	2	1	A			
TW0	128	9:06	9:12	*6*	2	1	A			
TW1	158	9:08	9:15	*7*	2	1	A			
TW2	143	9:08	9:14	*6*	2	1	A			
TW3	128	9:07	9:14	*7*	2	1	A			
TW4	145	9:07	9:13	*6*	2	1	A			
TW5	136	9:09	9:18	*9*	2	1	8	H	*	
TW6	126	9:10	9:22	*12*	2	1	A			
TW7	140	9:11	9:16	*5*	2	1	A			
TW8	134	9:10	9:17	*7*	2	1	A			
TW9	135	9:09	9:19	*10*	2	1	A			
TX0	137	9:12	9:20	*8*	2	1	A			
TX1	137	9:12	9:20	*8*	2	1	A			
TX2	132	9:12	9:21	*9*	2	1	A			
TX3	140	9:13	9:23	*10*	2	1	A			
TX4	142	9:13	9:42	*29*	2	1	A			
TX5	124	9:39	9:46	*7*	2	1	A			
TX6	128	9:39	9:46	*7*	2	1	A			
TX7	128	9:39	9:46	*7*	2	1	A			
TX8	127	9:40	9:47	*7*	2	1	A			
TX9	133	9:38	9:44	*6*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
TY0	133	9:42	9:50	*8*	2	2	G		*	
TY1	135	9:42	9:47	*5*	2	1	A			
TY2	138	9:41	9:47	*6*	2	1	A			
TY3	142	9:43	9:54	*11*	2	1	A			
TY4	133	9:41			2	3				
TY5	134	9:45	10:05	*20*	2	1	A			
TY6	148	9:44	9:52	*8*	2	1	A			
TY7	132	9:45	9:56	*11*	2	1	A			
TY8	138	9:48	9:55	*7*	2	1	A			
TY9	133	9:44	9:50	*6*	2	1	A			
TZ0	146	9:46	9:56	*10*	2	1	A			
TZ1	143	9:47	9:52	*5*	2	1	A			
TZ2	152	9:46	9:54	*8*	2	1	A			
TZ3	132	9:48	9:55	*7*	2	1	A			
TZ4	160	9:46	9:53	*7*	2	1	A			
19-Mar-07		**Testlot 4**	**Peak power, Slot B**		**Water temp =**	**6.0°C**				
TZ5	129	10:23	10:30	*7*	2	1	A			
TZ6	133	10:24	10:35	*11*	2	1	A			
TZ7	136	10:25	10:32	*7*	2	1	A			
TZ8	143	10:25	10:32	*7*	1	1	A			
TZ9	138	10:25	10:32	*7*	2	1	A			
PA0	135	10:23	10:34	*11*	2	1	A			
PA1	145	10:26	10:36	*10*	2	1	A			
PA2	143	10:28	10:34	*6*	2	1	A			
PA3	157	10:28	10:33	*5*	2	1	A			
PA4	142	10:27	10:35	*8*	2	1	A			
PA5	162	10:31	10:39	*8*	2	1	A			
PA6	152	10:30	10:39	*9*	2	1	A			
PA7	129	10:30	10:38	*8*	2	1	A			
PA8	143	10:29	10:38	*9*	2	2	*	8	G	
PA9	129	10:29	10:34	*5*	2	1	A			
PB0	133	11:01	11:12	*11*	2	1	A			
PB1	125	11:02	11:16	*14*	2	1	A			
PB2	133	11:01	11:23	*22*	2	1	A			
PB3	133	11:02	11:10	*8*	2	1	A			
PB4	127	11:02	11:07	*5*	2	1	A			
PB5	144	11:03	11:10	*7*	2	1	A			
PB6	132	11:03	11:09	*6*	2	1	A			
PB7	147	11:04	11:11	*7*	2	1	A			
PB8	128	11:05	11:12	*7*	2	1	A			
PB9	158	11:04	11:10	*6*	2	1	A			
PC0	146	11:07	11:14	*7*	2	1	A			
PC1	134	11:06	11:15	*9*	2	1	A			
PC2	128	11:06	11:13	*7*	2	1	A			
PC3	131	11:07	11:14	*7*	2	1	A			
PC4	168	11:07	11:13	*6*	2	1	A			
PC5	153	11:37	11:42	*5*	2	1	A			
PC6	148	11:36	11:45	*9*	2	1	A			
PC7	136	11:37	11:43	*6*	2	1	A			
PC8	143	11:35	11:41	*6*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
PC9	135	11:36	11:44	*8*	2	1	A			
PD0	156	11:39	11:47	*8*	2	1	A			
PD1	147	11:38	11:51	*13*	2	1	A			
PD2	133	11:39	11:45	*6*	2	1	A			
PD3	145	11:38	11:42	*4*	2	1	A			
PD4	127	11:38	11:45	*7*	2	1	A			
PD5	127	11:43	11:53	*10*	2	1	A			
PD6	155	11:41	11:47	*6*	2	1	A			
PD7	138	11:41	11:48	*7*	2	1	A			
PD8	138	11:40	11:41	*1*	2	1	A			
PD9	124	11:40	11:49	*9*	2	1	A			
PE0	142	11:42	11:49	*7*	2	1	A			
PE1	188	11:44	11:52	*8*	2	1	A			
PE2	144	11:43	11:49	*6*	2	1	A			
PE3	146	11:40	11:46	*6*	2	1	A			
PE4	162	11:41	11:53	*12*	2	1	A			
19-Mar-07		**Testlot 4**	**Peak power, Slot C**		**Water temp =**	**6.0°C**				
PK5	130	13:26	13:45	*19*	2	1	A			
PK6	143	13:27	13:42	*15*	2	1	A			
PK7	138	13:28	13:34	*6*	2	1	A			
PK8	134	13:27	13:40	*13*	1	2	B			
PK9	130	13:28	13:35	*7*	2	1	A			
PL0	152	13:29	13:36	*7*	2	1	A			
PL1	133	13:30	13:41	*11*	2	1	A			
PL2	132	13:29			2	3				
PL3	148	13:31	13:51	*20*	2	1	A			
PL4	139	13:30	13:38	*8*	2	1	A			
PL5	142	13:32	13:41	*9*	2	1	A			
PL6	142	13:33	13:43	*10*	2	1	A			
PL7	158	13:33	13:42	*9*	2	1	A			
PL8	140	13:32	13:38	*6*	2	1	A			
PL9	147	13:32	13:41	*9*	2	1	A			
R00	131	14:05	14:10	*5*	2	1	A			
R01	127	14:05	14:14	*9*	2	1	A			
R02	137	14:04	14:12	*8*	2	1	A			
R03	135	14:06	14:21	*15*	2	1	A			
R04	137	14:06	14:19	*13*	2	1	A			
R05	136	14:08	14:14	*6*	2	1	A			
R06	131	14:07	14:17	*10*	2	1	A			
R07	128	14:09	14:19	*10*	2	1	A			
R08	128	14:07	14:15	*8*	2	1	A			
R09	138	14:08	14:22	*14*	2	1	A			
R10	143	14:11	14:16	*5*	2	1	A			
R11	137	14:11	14:18	*7*	2	1	A			
R12	136	14:11	14:19	*8*	2	1	A			
R13	133	14:10	14:17	*7*	2	1	A			
R14	166	14:09	14:22	*13*	1	2	B	H		*
R15	137	14:39	14:43	*4*	2	1	A			
R16	133	14:38	14:48	*10*	2	1	A			
R17	147	14:37	14:43	*6*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
R18	138	14:39	14:53	*14*	2	1	A			
R19	132	14:38	14:44	*6*	2	1	A			
R20	130	14:36	14:42	*6*	2	1	A			
R21	138	14:42	14:48	*6*	2	1	A			
R22	136	14:41	14:47	*6*	2	1	A			
R23	128	14:40	14:50	*10*	2	1	A			
R24	128	14:41	14:51	*10*	2	1	A			
R25	137	14:42	14:49	*7*	2	1	A			
R26	150	14:43	14:52	*9*	2	1	A			
R27	138	14:45	14:53	*8*	2	1	A			
R28	140	14:44	14:55	*11*	2	1	A			
R29	153	14:43	14:53	*10*	2	1	A			
R30	146	14:46	14:51	*5*	2	1	A			
R31	137	14:43	14:48	*5*	2	1	A			
R32	135	14:46	14:52	*6*	2	1	A			
R33	138	14:45	14:52	*7*	2	1	A			
R34	138	14:47	14:54	*7*	2	1	A			
19-Mar-07		**Testlot 4**	**Control**		**Water temp = 6.0°C**					
PE5	140	12:18	12:21	*3*	2	1	A			
PE6	137	12:14	12:17	*3*	2	1	A			
PE7	133	12:15	12:20	*5*	2	1	A			
PE8	135	12:14	12:35	*21*	2	1	A			
PE9	147	12:15	12:20	*5*	2	1	A			
PF0	127	12:22	12:25	*3*	2	1	A			
PF1	136	12:20	12:34	*14*	2	1	A			
PF2	151	12:20	12:24	*4*	2	1	A			
PF3	138	12:23	12:26	*3*	2	1	A			
PF4	158	12:19	12:23	*4*	2	1	A			
PF5	130	12:14	12:18	*4*	2	1	A			
PF6	152	12:16	12:19	*3*	2	1	A			
PF7	152	12:17	12:32	*15*	2	1	A			
PF8	153	12:16	12:19	*3*	2	1	A			
PF9	125	12:17	12:20	*3*	2	1	A			
PH0	133	12:21	12:25	*4*	2	1	A			
PH1	144	12:21	12:24	*3*	2	1	A			
PH2	135	12:21	12:24	*3*	2	1	A			
PH3	130	12:22	12:26	*4*	2	1	A			
PH4	132	12:19	12:22	*3*	2	1	A			
PH5	124	12:56	12:59	*3*	2	1	A			
PH6	132	12:55	13:00	*5*	2	1	A			
PH7	133	12:57	13:00	*3*	2	1	A			
PH8	148	12:53	12:57	*4*	2	1	A			
PH9	126	12:53	12:57	*4*	2	1	A			
PJ0	132	12:56	13:02	*6*	2	1	A			
PJ1	128	12:55	12:59	*4*	2	1	A			
PJ2	163	12:54	12:58	*4*	2	1	A			
PJ3	148	12:54	12:57	*3*	2	1	A			
PJ4	143	12:56	13:00	*4*	2	1	A			
PJ5	133	13:00	13:09	*9*	2	1	A			
PJ6	125	13:00	13:09	*9*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
PJ7	157	13:02	13:11	*9*	2	1	A			
PJ8	127	12:58	13:06	*8*	2	1	A			
PJ9	135	13:01	13:10	*9*	2	1	A			
PK0	128	12:58	13:06	*8*	2	1	A			
PK1	124	13:01	13:12	*11*	2	1	A			
PK2	133	13:00	13:09	*9*	2	1	A			
PK3	127	12:59	13:04	*5*	2	1	A			
PK4	143	12:59	13:06	*7*	2	1	A			
20-Mar-07		**Testlot 5**	**Upper 1% power, Slot A**		**Water temp = 6.0°C**					
R75	143	9:44	9:52	*8*	2	1	A			
R76	149	9:44	9:50	*6*	2	1	A			
R77	133	9:43	9:51	*8*	2	1	A			
R78	145	9:44	9:50	*6*	2	1	A			
R79	137	9:43	9:53	*10*	2	1	A			
R80	129	9:47	9:57	*10*	2	1	A			
R81	130	9:45	9:52	*7*	2	1	A			
R82	134	9:46	9:55	*9*	2	1	A			
R83	130	9:47	9:54	*7*	2	1	A			
R84	130	9:46	9:52	*6*	2	1	A			
R85	140	9:54	10:02	*8*	2	1	H	9		*
R86	137	9:53	10:01	*8*	2	1	A			
R87	128	9:53	9:59	*6*	2	1	A			
R88	131	9:54	10:02	*8*	2	1	A			
R89	125	9:55	10:03	*8*	2	1	A			
R90	140	10:29	10:37	*8*	2	1	A			
R91	141	10:29	10:35	*6*	2	1	A			
R92	128	10:26	10:33	*7*	2	1	A			
R93	128	10:28	10:34	*6*	2	1	A			
R94	127	10:27	10:40	*13*	2	1	A			
R95	126	10:31	10:38	*7*	2	1	A			
R96	132	10:32	10:39	*7*	2	1	A			
R97	138	10:30	10:37	*7*	2	1	A			
R98	155	10:31	10:40	*9*	2	1	A			
R99	142	10:30	10:35	*5*	2	1	A			
Z00	136	10:39	10:48	*9*	2	1	A			
Z01	127	10:39	10:45	*6*	2	1	A			
Z02	144	10:38	10:43	*5*	2	1	A			
Z03	146	10:37	10:44	*7*	2	1	A			
Z04	156	10:38	10:45	*7*	2	1	A			
Z05	133	11:15	11:24	*9*	2	1	H			*
Z06	141	11:13	11:17	*4*	2	1	A			
Z07	128	11:13	11:19	*6*	2	1	A			*
Z08	137	11:17	11:25	*8*	2	1	A			
Z09	138	11:14	11:20	*6*	2	1	A			
Z10	138	11:14	11:20	*6*	2	1	A			
Z11	134	11:16	11:23	*7*	2	1	A			
Z12	144	11:16	11:24	*8*	2	1	A			
Z13	142	11:15	11:22	*7*	2	1	A			
Z14	146	11:15	11:22	*7*	2	1	A			
Z15	131	11:26	11:34	*8*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
Z16	130	11:26	11:32	*6*	2	1	A			
Z17	146	11:25	12:06	*41*	2	1	A			
Z18	168	11:27	11:33	*6*	1	2	B	G	*	
Z19	132	11:23	11:30	*7*	2	1	A			
Z20	179	11:24	11:29	*5*	2	1	A			
Z21	130	11:25	11:30	*5*	2	1	A			
Z22	137	11:27	11:37	*10*	2	1	A			
Z23	145	11:24	11:30	*6*	2	1	A			
Z24	132	11:27	11:39	*12*	2	1	A			
20-Mar-07		**Testlot 5**	**Upper 1% power, Slot A**		**Water temp = 6.0°C**					
Z25	135	12:16	12:21	*5*	2	1	A			
Z26	137	12:18	12:25	*7*	2	1	A			
Z27	138	12:19	12:24	*5*	2	1	A			
Z28	157	12:18	12:23	*5*	2	1	A			
Z29	127	12:17	12:22	*5*	2	1	A			
Z30	135	12:21	12:32	*11*	2	1	A			
Z31	130	12:20	12:26	*6*	2	1	A			
Z32	145	12:21	12:28	*7*	2	1	A			
Z33	174	12:19	12:24	*5*	2	1	A			
Z34	138	12:20	12:28	*8*	2	1	A			
Z35	135	12:25	12:36	*11*	2	1	A			
Z36	137	12:26	12:33	*7*	2	1	A			
Z37	153	12:24	12:29	*5*	2	1	A			
Z38	137	12:26	12:31	*5*	2	1	A			
Z39	143	12:24	12:39	*15*	2	1	A			
Z40	128	13:00	13:06	*6*	2	1	G		*	
Z41	137	13:01	13:10	*9*	1	1	B			
Z42	135	13:00	13:08	*8*	2	1	A			
Z44	134	12:59	13:07	*8*	2	1	A			
Z45	127	13:02	13:06	*4*	2	1	A			
Z46	126	13:02	13:19	*17*	2	1	A			
Z47	137	13:03	13:09	*6*	2	1	A			
Z48	135	13:02	13:07	*5*	2	1	A			
Z49	132	13:03	13:10	*7*	2	1	A			
Z50	123	13:10	13:15	*5*	2	1	A			
Z51	129	13:08			2	3				
Z52	135	13:09	13:14	*5*	2	1	A			
Z53	132	13:09	13:16	*7*	2	1	A			
Z54	137	13:08	13:12	*4*	2	1	A			
Z43	148	12:59	13:04	*5*	2	1	A			
Z55	135	13:33	13:40	*7*	2	1	A			
Z56	153	13:34	13:43	*9*	2	1	A			
Z57	143	13:35	13:47	*12*	2	1	A			
Z58	143	13:32	13:39	*7*	2	1	G	H		*
Z59	167	13:32	13:38	*6*	2	1	A			
Z60	146	13:34	13:39	*5*	2	1	A			
Z61	143	13:35	13:40	*5*	2	1	A			
Z62	138	13:33	13:41	*8*	2	1	A			
Z63	145	13:31	13:36	*5*	2	1	A			
Z64	145	13:32	13:42	*10*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
Z65	144	13:42	13:48	*6*	2	1	A			
Z66	152	13:45	13:55	*10*	2	1	A			
Z67	132	13:44	13:53	*9*	2	1	A			
Z68	131	13:46	13:51	*5*	2	1	A			
Z69	130	13:45	13:52	*7*	2	1	A			
Z70	128	13:44	13:52	*8*	2	1	A			
Z71	136	13:43	13:50	*7*	2	1	A			
Z72	149	13:41	13:49	*8*	2	1	A			
Z73	137	13:42	13:47	*5*	2	1	A			
Z74	128	13:41			1	3				
20-Mar-07		**Testlot 5**	**Upper 1% power, Slot C**		**Water temp = 6.0°C**					
Z75	140	14:22	14:27	*5*	2	1	A			
Z76	136	14:21	14:37	*16*	2	1	A			
Z77	140	14:21	14:28	*7*	2	1	A			
Z78	127	14:20			1	3				
Z79	130	14:22	14:27	*5*	2	1	A			
Z80	128	14:23	14:30	*7*	2	1	A			
Z81	130	14:24	14:33	*9*	2	1	A			
Z82	134	14:24	14:31	*7*	2	1	A			
Z83	127	14:23	14:34	*11*	2	1	A			
Z84	136	14:24	14:32	*8*	2	1	8			*
Z85	154	14:31	14:36	*5*	2	1	A			
Z86	149	14:32	14:36	*4*	2	1	A			
Z87	133	14:31	14:38	*7*	2	1	A			
Z88	143	14:33	14:37	*4*	2	1	A			
Z89	146	14:32	14:47	*15*	2	1	A			
Z90	143	15:11	15:16	*5*	2	1	A			
Z91	146	15:12	15:17	*5*	2	1	A			
Z92	133	15:12	15:21	*9*	2	1	A			
Z93	140	15:12	15:20	*8*	1	2	*	G	8	9
Z94	140	15:10	15:16	*6*	2	1	A			
Z95	136	15:23	15:34	*11*	2	1	A			
Z96	138	15:23	15:27	*4*	2	1	A			
Z97	138	15:22	15:28	*6*	2	1	A			
Z98	137	15:24	15:34	*10*	2	1	A			
Z99	128	15:22	15:30	*8*	2	1	A			
X00	136	15:13	15:22	*9*	1	1	B	H		
X01	137	15:14	15:22	*8*	2	1	A			
X02	133	15:13	15:18	*5*	2	1	A			
X03	132	15:15	15:23	*8*	2	1	A			
X04	151	15:14	15:24	*10*	2	1	A			
X05	146	15:48	15:53	*5*	2	1	A			
X06	173	15:50	15:56	*6*	2	1	A			
X07	137	15:48	15:53	*5*	2	1	A			
X08	143	15:51	15:57	*6*	2	1	A			
X09	143	15:50	15:56	*6*	2	1	A			
X10	138	15:49	15:55	*6*	2	1	A			
X11	136	15:51	15:57	*6*	2	1	A			
X12	145	15:47	15:52	*5*	2	1	A			
X13	137	15:49	16:00	*11*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
X14	160	15:49	15:55	*6*	2	1	A			
X15	137	16:03	16:08	*5*	2	1	A			
X16	141	15:59	16:10	*11*	2	1	A			
X17	144	16:00	16:09	*9*	2	1	A			
X18	151	16:00	16:07	*7*	2	1	A			
X19	147	15:59	16:13	*14*	2	1	A			
X20	146	16:01	16:07	*6*	2	1	A			
X21	133	16:02	16:10	*8*	2	1	A			
X22	152	16:02	16:09	*7*	2	1	A			
X23	136	16:00	16:06	*6*	2	1	A			
X24	137	16:01	16:07	*6*	2	1	A			
20-Mar-07		**Testlot 5**	**Control**		**Water temp = 6.0°C**					
R35	149	8:25	8:28	*3*	2	1	A			
R36	138	8:27	8:31	*4*	2	1	A			
R37	138	8:27	8:33	*6*	2	1	A			
R38	135	8:22	8:26	*4*	2	1	A			
R39	136	8:24	8:29	*5*	2	1	A			
R40	127	8:26	8:30	*4*	2	1	A			
R41	144	8:24	8:27	*3*	2	1	A			
R42	147	8:24	8:28	*4*	2	1	A			
R43	124	8:23	8:27	*4*	2	1	A			
R44	137	8:26	8:30	*4*	2	1	A			
R45	136	8:31	8:36	*5*	2	1	A			
R46	128	8:32	8:41	*9*	2	1	A			
R47	141	8:30	8:37	*7*	2	1	A			
R48	124	8:29	8:33	*4*	2	1	A			
R49	143	8:31	8:36	*5*	2	1	A			
R50	125	8:29	8:35	*6*	2	1	A			
R51	138	8:32	8:41	*9*	2	1	A			
R52	154	8:30	8:37	*7*	2	1	A			
R53	127	8:28	8:32	*4*	2	1	A			
R54	127	8:29	8:34	*5*	2	1	A			
R55	138	8:56	9:02	*6*	2	1	A			
R56	153	8:57	9:01	*4*	2	1	A			
R57	133	8:52	8:56	*4*	2	1	A			
R58	132	8:52	8:57	*5*	2	1	A			
R59	147	8:55	8:59	*4*	2	1	A			
R60	141	8:53	8:57	*4*	2	1	A			
R61	124	8:55	9:00	*5*	2	1	A			
R62	133	8:57	9:01	*4*	2	1	A			
R63	142	8:54	8:58	*4*	2	1	A			
R64	136	8:54	8:59	*5*	2	1	A			
R65	146	8:59	9:07	*8*	2	1	A			
R66	145	9:02	9:10	*8*	2	1	A			
R67	147	9:00	9:05	*5*	2	1	A			
R68	135	9:01	9:07	*6*	2	1	A			
R69	137	8:59	9:09	*10*	2	1	A			
R70	145	9:00	9:06	*6*	2	1	A			
R71	134	9:02	9:10	*8*	2	1	A			
R72	160	9:02	9:08	*6*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
R73	136	9:03	9:12	*9*	2	1	A			
R74	147	8:58	9:04	*6*	2	1	A			
21-Mar-07		**Testlot 6**	**Max power, Slot A**		**Water temp = 6.0°C**					
X25	134	10:35	10:53	*18*	2	1	A			
X26	135	10:33	10:41	*8*	2	1	A			
X27	157	10:31	10:40	*9*	2	1	A			
X28	137	10:36	10:44	*8*	2	1	A			
X29	145	10:35	10:44	*9*	2	1	A			
X30	127	10:38	10:45	*7*	2	1	A			
X31	133	10:37	10:42	*5*	2	1	A			
X32	165	10:37	10:44	*7*	2	1	A			
X33	138	10:37	10:47	*10*	2	1	A			
X34	143	10:38	10:45	*7*	2	1	A			
X35	136	10:46	10:55	*9*	2	1	A			
X36	125	10:45	10:59	*14*	2	1	A			
X37	154	10:45	10:54	*9*	2	1	A			
X38	136	10:44	10:58	*14*	2	1	A			
X39	166	10:45	10:54	*9*	2	1	A			
X40	126	11:21	11:29	*8*	2	1	A			
X41	135	11:21	11:31	*10*	2	2	7			*
X42	132	11:22	11:34	*12*	2	1	A			
X43	143	11:22	11:30	*8*	2	1	A			
X44	133	11:21	11:34	*13*	2	1	A			
X45	137	11:24	11:34	*10*	2	1	A			
X46	144	11:24	11:34	*10*	1	2	F	B		*
X47	136	11:23	11:31	*8*	2	1	A			
X48	136	11:25	11:31	*6*	2	1	A			
X49	138	11:23	11:31	*8*	2	1	A			
X50	147	11:26	11:37	*11*	2	1	A			
X51	134	11:26	11:35	*9*	2	1	A			
X52	136	11:27	11:37	*10*	2	1	A			
X53	137	11:27	11:36	*9*	2	1	A			
X54	133	11:25	11:38	*13*	2	1	A			
X55	133	11:58	12:04	*6*	2	1	A			
X56	128	11:59	12:04	*5*	2	1	A			
X57	138	11:58	12:05	*7*	2	1	A			
X58	129	11:58	12:05	*7*	2	1	A			
X59	144	11:57	12:29	*32*	2	1	A			
X60	134	12:00	12:08	*8*	2	1	A			
X61	135	12:00	12:09	*9*	2	1	A			
X62	148	11:59	12:32	*33*	2	1	A			
X63	133	12:01	12:22	*21*	2	1	A			
X64	137	12:00	12:07	*7*	2	1	A			
X65	135	12:01	12:08	*7*	2	1	A			
X66	146	12:02	12:12	*10*	2	1	A			
X67	142	12:03	12:09	*6*	2	1	A			
X68	126	12:02	12:11	*9*	2	1	A			
X69	127	12:03	12:24	*21*	1	1	B			
21-Mar-07		**Testlot 6**	**Max power, Slot B**		**Water temp = 6.0°C**					
X70	135	12:47	12:52	*5*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
X71	149	12:45	12:51	*6*	2	1	A			
X72	142	12:47	12:54	*7*	2	1	A			
X73	143	12:46	12:52	*6*	2	1	A			
X74	130	12:46	12:53	*7*	2	1	A			
X75	127	12:49	12:58	*9*	2	1	A			
X76	143	12:47	12:56	*9*	2	1	A			
X77	138	12:49	12:59	*10*	2	1	A			
X78	143	12:48	13:03	*15*	2	1	A			
X79	148	12:48	12:56	*8*	2	1	A			
X80	136	12:51	12:59	*8*	2	1	A			
X81	143	12:50	12:57	*7*	2	1	A			
X82	137	12:51	12:57	*6*	2	1	A			
X83	140	12:50	13:01	*11*	1	1	B			
X84	143	12:52	12:59	*7*	2	1	A			
X85	133	13:22	13:29	*7*	2	1	A			
X86	128	13:23	13:29	*6*	2	1	A			
X87	134	13:21	13:27	*6*	2	1	A			
X88	143	13:21	13:26	*5*	2	1	A			
X89	133	13:22	13:41	*19*	2	1	A			
X90	134	13:23	13:28	*5*	2	1	A			
X91	130	13:24	13:30	*6*	2	1	A			
X92	126	13:25	13:33	*8*	2	1	A			
X93	128	13:24	13:31	*7*	2	1	A			
X94	128	13:24	13:33	*9*	2	1	A			
X95	152	13:28	13:33	*5*	2	1	A			
X96	133	13:26	13:34	*8*	2	1	A			
X97	133	13:27	13:33	*6*	2	1	A			
X98	132	13:26	13:32	*6*	2	1	A			
X99	158	13:27	13:36	*9*	2	1	A			
XF0	153	14:01	14:08	*7*	2	1	A			
XF1	139	14:01	14:08	*7*	2	1	A			
XF2	134	14:00	14:06	*6*	2	1	A			
XF3	128	14:00	14:20	*20*	2	1	A			
XF4	138	14:01	14:10	*9*	2	1	A			
XF5	142	14:03	14:10	*7*	2	1	A			
XF6	145	14:04	14:11	*7*	2	1	A			
XF7	138	14:02	14:09	*7*	2	1	A			
XF8	138	14:03	14:12	*9*	2	1	A			
XF9	129	14:03	14:11	*8*	2	1	A			
XH0	129	14:05	14:13	*8*	2	1	A			
XH1	128	14:05	14:13	*8*	2	1	A			
XH2	152	14:04	14:13	*9*	2	1	A			
XH3	147	14:06	14:12	*6*	2	1	A			
XH4	143	14:06	14:13	*7*	2	1	A			
21-Mar-07		**Testlot 6**	**Max power, Slot C**		**Water temp = 6.0°C**					
XH5	134	14:49	14:57	*8*	2	1	A			
XH6	136	14:49	14:56	*7*	2	1	A			
XH7	131	14:49	14:55	*6*	2	1	A			
XH8	144	14:48	15:06	*18*	2	1	A			
XH9	144	14:48	14:56	*8*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
XJ0	136	14:51	14:59	*8*	2	1	A			
XJ1	137	14:52	15:00	*8*	2	1	A			
XJ2	140	14:50	14:58	*8*	2	1	A			
XJ3	196	14:50	14:57	*7*	2	1	A			
XJ4	150	14:51	15:01	*10*	2	1	A			
XJ5	166	14:54	15:00	*6*	2	1	A			
XJ6	143	14:52	14:57	*5*	2	1	A			
XJ7	139	14:54	15:01	*7*	2	1	A			
XJ8	132	14:53	14:59	*6*	2	1	A			
XJ9	133	14:53	14:58	*5*	2	1	A			
XK0	147	15:23	15:31	*8*	2	1	A			
XK1	137	15:22	15:30	*8*	2	1	A			
XK2	144	15:23	15:43	*20*	2	1	A			
XK3	132	15:22	15:30	*8*	2	1	A			
XK4	135	15:22	15:27	*5*	2	1	A			
XK5	154	15:24	15:30	*6*	2	1	A			
XK7	138	15:24	15:33	*9*	2	2	*7*			
XK8	130	15:25	15:32	*7*	2	1	A			
XK9	145	15:25	15:30	*5*	2	1	A			
XL0	145	15:28	15:36	*8*	2	1	A			
XL1	149	15:27	15:35	*8*	2	1	A			
XL2	140	15:27	15:35	*8*	2	1	A			
XL3	148	15:26	15:33	*7*	2	1	A			
XL4	144	15:26	15:33	*7*	2	1	A			
XL5	137	15:54	16:13	*19*	2	1	A			
XL6	148	15:56	16:01	*5*	2	1	A			
XL7	146	15:55	16:02	*7*	2	1	A			
XL8	146	15:55	16:01	*6*	2	1	A			
XL9	136	15:55	16:03	*8*	2	2	*7*			*
PM0	133	15:56	16:02	*6*	2	1	A			
PM1	136	15:57	16:07	*10*	2	1	A			
PM2	135	15:57	16:06	*9*	2	1	A			
PM3	133	15:58	16:04	*6*	2	1	A			
PM4	134	15:57	16:07	*10*	2	1	A			
PM5	127	16:00	16:09	*9*	2	1	A			
PM6	132	15:59	16:09	*10*	2	1	A			
PM7	157	15:58	16:10	*12*	2	1	8			*
PM8	148	15:59	16:09	*10*	2	1	A			
PM9	136	16:00	16:05	*5*	2	1	A			
XK6	148	15:25	15:36	*11*	2	1	A			
21-Mar-07		**Testlot 6**	**Control**		**Water temp =**	**6.0°C**				
PN0	132	16:28	16:31	*3*	2	1	A			
PN1	144	16:29	16:34	*5*	2	1	A			
PN2	128	16:28	16:38	*10*	2	1	A			
PN3	135	16:27	16:31	*4*	2	1	A			
PN4	136	16:30	16:35	*5*	2	1	A			
PN5	135	16:29	16:33	*4*	2	1	A			
PN6	156	16:26	16:32	*6*	2	1	A			
PN7	128	16:30	16:37	*7*	2	1	A			
PN8	134	16:31	16:37	*6*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
PN9	131	16:29	16:35	*6*	2	1	A			
PP0	135	16:34	16:37	*3*	2	1	A			
PP1	136	16:33	16:38	*5*	2	1	A			
PP2	132	16:33	16:38	*5*	2	1	A			
PP3	135	16:32	16:34	*2*	2	1	A			
PP4	146	16:32	16:36	*4*	2	1	A			
PP5	138	16:51	16:58	*7*	2	1	A			
PP6	144	16:52	16:56	*4*	2	1	A			
PP7	147	16:48	16:54	*6*	2	1	A			
PP8	133	16:50	16:59	*9*	2	1	A			
PP9	170	16:50	16:59	*9*	2	1	A			
PR0	132	16:49	16:58	*9*	2	1	A			
PR1	156	16:49	16:59	*10*	2	1	A			
PR2	134	16:48	16:59	*11*	2	1	A			
PR3	132	16:47	16:58	*11*	2	1	A			
PR4	135	16:51	16:59	*8*	2	1	A			
PR5	147	16:53	16:56	*3*	2	1	A			
PR6	133	16:54	16:57	*3*	2	1	A			
PR7	138	16:53	16:57	*4*	2	1	A			
PR8	138	16:54	16:58	*4*	2	1	A			
PR9	132	16:53	16:57	*4*	2	1	A			
22-Mar-07		**Testlot 7**	**Lower 1% power, Slot A**		**Water temp = 6.5°C**					
PW0	130	8:58	9:05	*7*	2	1	A			
PW1	137	8:59	9:07	*8*	2	1	A			
PW2	152	8:59	9:14	*15*	2	1	A			
PW3	137	8:58				4				
PW4	140	8:58	9:04	*6*	2	1	A			
PW5	138	9:00	9:09	*9*	2	1	A			
PW6	138	9:02	9:10	*8*	2	1	A			
PW7	133	9:01	9:08	*7*	2	1	A			
PW8	135	9:02	9:18	*16*	2	1	A			
PW9	147	9:01	9:07	*6*	2	1	A			
PX0	138	9:03	9:11	*8*	2	1	A			
PX1	127	9:03	9:13	*10*	2	1	A			
PX2	131	9:04	9:11	*7*	2	1	A			
PX3	136	9:04	9:12	*8*	2	1	A			
PX4	134	9:03	9:09	*6*	2	1	A			
PX5	134	9:40	9:46	*6*	2	1	A			
PX6	147	9:39	9:47	*8*	2	1	A			
PX7	128	9:38	9:45	*7*	2	1	A			
PX8	135	9:39	9:53	*14*	1	2	B	7	*	
PX9	141	9:39	9:48	*9*	2	1	H	*		
PY0	137	9:41	9:53	*12*	2	1	A			
PY1	131	9:41	9:51	*10*	2	1	A			
PY2	143	9:40	9:57	*17*	2	2	9	G		*
PY3	126	9:42	9:53	*11*	2	1	A			
PY4	131	9:41	9:49	*8*	2	1	A			
PY5	131	9:44	9:54	*10*	2	1	A			
MZ1	136	9:44	9:56	*12*	2	1	A			
PY7	142	9:43	9:52	*9*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
PY8	134	9:42	9:53	*11*	2	1	A			
PY9	135	9:43	9:56	*13*	2	1	A			
PZ0	136	10:24	10:39	*15*	2	1	A			
PZ1	144	10:23	10:30	*7*	2	1	A			
PZ2	125	10:25	10:33	*8*	2	1	A			
PZ3	137	10:24	10:33	*9*	2	1	A			
PZ4	145	10:24	10:36	*12*	2	1	A			
PZ5	147	10:26	10:32	*6*	2	1	A			
PZ6	133	10:27	10:45	*18*	2	1	A			
PZ7	175	10:26	10:32	*6*	2	1	A			
PZ8	172	10:26	10:50	*24*	2	1	A			
PZ9	125	10:25	10:34	*9*	2	1	A			
SA0	143	10:28	10:37	*9*	2	1	A			
SA1	156	10:29	10:38	*9*	2	1	A			
SA2	125	10:28	10:45	*17*	2	1	A			
SA3	137	10:28	10:38	*10*	2	1	A			
SA4	144	10:29	10:37	*8*	2	1	A			
SA5	151	11:00	11:07	*7*	2	1	A			
SA6	142	11:01	11:10	*9*	2	1	A			
SA7	140	11:01	11:08	*7*	2	1	A			
SA8	138	11:02	11:15	*13*	2	1	A			
SA9	145	11:02	11:11	*9*	2	1	A			
SB0	132	11:03	11:18	*15*	2	1	A			
SB1	135	11:04	11:22	*18*	2	1	A			
SB2	135	11:04	11:21	*17*	1	1	B			
SB3	134	11:03	11:11	*8*	2	1	A			
SB4	135	11:04	11:10	*6*	2	1	A			
SB5	130	11:06	11:16	*10*	2	1	A			
SB6	131	11:07	11:17	*10*	2	1	A			
SB7	131	11:06	11:13	*7*	2	1	A			
SB8	151	11:05	11:14	*9*	2	1	A			
SB9	130	11:06	11:21	*15*	2	1	A			
SC0	155	11:38	11:46	*8*	2	1	A			
SC1	127	11:38	11:49	*11*	2	1	A			
SC2	143	11:37	11:49	*12*	2	1	A			
SC3	133	11:37	11:46	*9*	2	1	A			
SC4	147	11:39	11:49	*10*	2	1	A			
SC5	135	11:41	11:48	*7*	2	1	G	*		
SC6	137	11:41	11:57	*16*	2	2	7	*		
SC7	138	11:40	11:53	*13*	1	2	8	E	*	
SC8	135	11:40	11:58	*18*	2	1	A			
SC9	141	11:39	11:45	*6*	2	1	A			
22-Mar-07		**Testlot 7**	**Lower 1% power, Slot B**		**Water temp = 6.5°C**					
SD0	146	12:14	12:21	*7*	2	1	A			
SD1	160	12:12	12:30	*18*	2	1	A			
SD2	137	12:13	12:18	*5*	2	1	A			
SD3	125	12:14	12:27	*13*	2	1	A			
SD4	145	12:12	12:20	*8*	2	1	A			
SD5	125	12:16	12:22	*6*	2	1	A			
SD6	133	12:16	12:26	*10*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time			No. HI-Z tags recovered	Survival Code	Status Codes			
		Re-leased	Re-covered	Minutes at large			1	2	3	4
SD7	127	12:15	12:24	*9*	2	1	A			
SD8	141	12:17	12:26	*9*	2	1	A			
SD9	138	12:15	12:25	*10*	2	1	A			
SE0	126	12:17	12:34	*17*	2	1	A			
SE1	133	12:18	12:23	*5*	2	1	A			
SE2	137	12:18	12:25	*7*	2	1	A			
SE3	146	12:19	12:25	*6*	2	1	A			
SE4	125	12:19	17:53	*334*	2	1	A			
SE5	138	12:56	13:01	*5*	2	1	A			
SE6	138	12:56	13:06	*10*	2	1	A			
SE7	142	12:57	13:08	*11*	2	1	A			
SE8	177	12:57	13:07	*10*	2	1	A			
SE9	143	12:58	13:05	*7*	2	1	A			
SF5	146	13:03	13:09	*6*	2	1	A			
SF6	151	13:02	13:13	*11*	2	1	A			
SF7	135	13:04	13:13	*9*	2	1	A			
SF8	148	13:02	13:11	*9*	2	1	A			
SF9	137	13:03	13:12	*9*	2	1	A			
SF0	149	12:59	13:05	*6*	2	1	A			
SF1	135	13:00	13:15	*15*	2	1	A			
SF2	188	12:59	13:08	*9*	2	1	A			
SF3	137	13:01	13:07	*6*	2	1	A			
SF4	134	13:00			0	3				
SH0	141	13:31	13:39	*8*	2	1	A			
SH1	141	13:32	13:42	*10*	2	1	A			
SH2	135	13:32	13:45	*13*	2	1	A			
SH3	131	13:30	13:50	*20*	2	1	A			
SH4	135	13:31	13:39	*8*	2	1	A			
SH5	153	13:35	13:43	*8*	2	1	A			
SH6	137	13:34	13:43	*9*	2	1	A			
SH7	133	13:33	13:50	*17*	2	1	A			
SH8	140	13:33	13:43	*10*	2	1	A			
SH9	135	13:34	13:40	*6*	2	1	A			
SJ0	139	13:37	13:46	*9*	2	1	A			
SJ1	141	13:37	13:44	*7*	2	1	A			
SJ2	142	13:36	13:41	*5*	2	1	A			
SJ3	123	13:35	13:42	*7*	2	1	A			
SJ4	142	13:37	13:45	*8*	2	1	A			
SJ5	139	14:09	14:18	*9*	2	1	A			
SJ6	126	14:09	14:20	*11*	2	1	A			
SJ7	159	14:08	14:15	*7*	2	1	A			
SJ8	152	14:08	14:31	*23*	2	1	A			
SJ9	132	14:08	14:20	*12*	2	1	A			
SK0	137	14:11	14:17	*6*	2	1	A			
SK1	131	14:12	14:20	*8*	2	1	A			
SK2	128	14:10	14:18	*8*	2	1	A			
SK3	128	14:11	14:29	*18*	2	1	A			
SK4	140	14:12	14:18	*6*	2	1	A			
SK5	143	14:15	14:21	*6*	2	1	A			
SK6	165	14:13	14:23	*10*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
SK7	158	14:15	14:21	*6*	2	1	A			
SK8	153	14:13	14:29	*16*	2	1	A			
SK9	136	14:14	14:26	*12*	2	1	A			
SL0	134	14:44	14:53	*9*	2	1	A			
SL1	127	14:45	14:53	*8*	1	1	B	H		*
SL2	128	14:44	15:02	*18*	2	1	A			
SL3	143	14:43	14:58	*15*	2	1	A			
SL4	133	14:43	14:49	*6*	2	1	A			
SL5	136	14:46	14:59	*13*	2	1	A			
SL6	128	14:46	14:53	*7*	1	1	B			
SL7	125	14:47	15:10	*23*	2	2	8	E	G	*
SL8	135	14:47	15:02	*15*	2	1	A			
SL9	128	14:46	15:10	*24*	2	1	A			
22-Mar-07		**Testlot 7**	**Lower 1% power, Slot C**		**Water temp = 6.5°C**					
ZA0	146	15:25	15:40	*15*	2	1	A			
ZA1	158	15:24	15:52	*28*	2	1	A			
ZA2	160	15:25	15:40	*15*	2	1	A			
ZA3	132	15:24	15:45	*21*	2	1	A			
ZA4	170	15:26	15:32	*6*	2	1	A			
ZA5	128	15:28	15:35	*7*	2	1	A			
ZA6	137	15:26	15:38	*12*	2	1	A			
ZA7	137	15:27	15:34	*7*	2	1	A			
ZA8	133	15:27	15:34	*7*	2	1	A			
ZA9	136	15:27	15:34	*7*	2	1	A			
ZB0	124	15:29	15:42	*13*	2	1	A			
ZB1	136	15:29	15:43	*14*	2	1	A			
ZB2	137	15:29	15:37	*8*	2	1	A			
ZB3	138	15:30	15:43	*13*	2	1	A			
ZB4	134	15:30	15:36	*6*	2	1	A			
ZB5	162	16:04	16:12	*8*	2	1	A			
ZB6	140	16:03	16:09	*6*	2	1	A			
ZB7	148	16:04	16:10	*6*	2	1	A			
ZB8	126	16:05	16:11	*6*	2	1	A			
ZB9	125	16:04	16:20	*16*	2	1	A			
ZC0	138	16:10	16:17	*7*	2	1	A			
ZC1	143	16:09	16:19	*10*	2	1	A			
ZC2	172	16:08	16:15	*7*	1	1	B	9	*	
ZC3	135	16:10	16:18	*8*	2	1	A			
ZC4	132	16:09	16:17	*8*	2	1	A			
ZC5	169	16:05	16:17	*12*	2	1	A			
ZC6	134	16:08	16:14	*6*	2	1	A			
ZC7	148	16:07	16:13	*6*	2	1	A			
ZC8	149	16:06	16:14	*8*	2	1	A			
ZC9	137	16:16	16:20	*4*	2	1	A			
ZD0	133	16:34	16:40	*6*	2	1	A			
ZD1	137	16:34	16:41	*7*	2	1	A			
ZD2	133	16:34	16:48	*14*	2	1	A			
ZD3	163	16:33	16:39	*6*	2	1	A			
ZD4	137	16:35			0	3				
ZD5	133	16:36	16:55	*19*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZD6	143	16:37	16:52	*15*	2	1	A			
ZD7	137	16:35	16:46	*11*	2	1	A			
ZD8	127	16:35	16:46	*11*	2	1	A			
ZD9	140	16:36	16:42	*6*	2	1	A			
ZE0	138	16:38	16:47	*9*	2	1	A			
ZE1	153	16:37	16:42	*5*	2	1	A			
ZE2	138	16:39	16:55	*16*	2	1	A			
ZE3	138	16:39			0	4				
ZE4	151	16:38	16:45	*7*	2	1	A			
ZE5	144	17:18	17:28	*10*	2	1	A			
ZE6	146	17:20	17:35	*15*	2	1	A			
ZE7	153	17:18	17:25	*7*	2	1	A			
ZE8	168	17:19	17:35	*16*	2	1	A			
ZE9	127	17:20	17:27	*7*	2	1	A			
ZF5	128	17:24	17:31	*7*	2	1	A			
ZF6	157	17:24	17:33	*9*	2	1	A			
ZF7	137	17:23	17:38	*15*	2	1	A			
ZF8	162	17:25	17:33	*8*	2	1	A			
ZF9	128	17:25	17:32	*7*	2	1	A			
ZF0	133	17:23	17:31	*8*	2	1	A			
ZF1	143	17:22	17:29	*7*	2	1	A			
ZF2	133	17:22	17:37	*15*	2	1	A			
ZF3	125	17:21	17:27	*6*	2	1	A			
ZF4	143	17:21	17:41	*20*	2	1	A			
ZH0	127	17:46	17:53	*7*	2	1	A			
ZH1	143	17:48	17:53	*5*	2	1	A			
ZH2	127	17:46	17:55	*9*	2	1	A			
ZH3	136	17:46	17:56	*10*	2	1	A			
ZH4	136	17:47	17:55	*8*	2	1	A			
ZH5	142	17:49	17:57	*8*	2	1	A			
ZH6	128	17:48	18:03	*15*	2	1	A			
ZH7	150	17:49	17:59	*10*	2	1	A			
ZH8	163	17:49	18:01	*12*	2	1	A			
ZH9	152	17:50	17:56	*6*	2	1	A			
22-Mar-07		**Testlot 7**	**Control**		**Water temp = 6.5°C**					
PS0	136	7:48	8:51	*63*	2	1	A			
PS1	158	7:49	7:53	*4*	2	1	A			
PS2	160	7:47	7:52	*5*	2	1	A			
PS3	133	7:49	7:56	*7*	2	1	A			
PS4	146	7:46	7:54	*8*	2	1	A			
PS5	133	7:46	7:56	*10*	2	1	A			
PS6	141	7:47	7:55	*8*	2	1	A			
PS7	128	7:47	7:53	*6*	2	1	A			
PS8	127	7:48	7:55	*7*	2	1	A			
PS9	141	7:49	7:53	*4*	2	1	A			
PT0	131	7:52	7:59	*7*	2	1	A			
PT1	140	7:53	7:58	*5*	2	1	A			
PT2	143	7:50	8:01	*11*	2	1	A			
PT3	137	7:53	7:59	*6*	2	1	A			
PT4	153	7:54	7:59	*5*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time			No. HI-Z tags recovered	Survival Code	Status Codes			
		Released	Recovered	Minutes at large			1	2	3	4
PT5	144	7:51	7:57	*6*	2	1	A			
PT6	131	7:52	7:58	*6*	2	1	A			
PT7	128	7:54	8:00	*6*	2	1	A			
PT8	146	7:50	7:54	*4*	2	1	A			
PT9	158	7:52	8:00	*8*	2	1	A			
PU0	131	8:14	8:19	*5*	2	1	A			
PU1	138	8:12	8:17	*5*	2	1	A			
PU2	124	8:13	8:19	*6*	2	1	A			
PU3	130	8:12	8:19	*7*	2	1	A			
PU4	135	8:11	8:16	*5*	2	1	A			
PU5	138	8:13	8:18	*5*	2	1	A			
PU6	133	8:11	8:16	*5*	2	1	A			
PU7	127	8:10	8:14	*4*	2	1	A			
PU8	126	8:12	8:17	*5*	2	1	A			
PU9	128	8:10	8:15	*5*	2	1	A			
PV0	136	8:15	8:21	*6*	2	1	A			
PV1	127	8:20	8:27	*7*	2	1	A			
PV2	132	8:22	8:28	*6*	2	1	A			
PV3	138	8:21	8:27	*6*	2	1	A			
PV4	133	8:16	8:22	*6*	2	1	A			
PV5	137	8:21	8:27	*6*	2	1	A			
PV6	134	8:15	8:20	*5*	2	1	A			
PV7	133	8:15	8:21	*6*	2	1	A			
PV8	150	8:21	8:28	*7*	2	1	A			
PV9	137	8:22	8:29	*7*	2	1	A			
23-Mar-07		**Testlot 8**	**Max power, Slot A**		**Water temp = 6.0°C**					
ZW0	138	15:26	15:33	*7*	2	1	A			
ZW1	128	15:25	15:30	*5*	2	1	A			
ZW2	143	15:27	15:36	*9*	2	1	A			
ZW3	143	15:26	15:35	*9*	2	1	A			
ZW4	126	15:25	15:28	*3*	2	1	A			
ZW5	136	15:27				4				
ZW6	140	15:28				3				
ZW7	136	15:28				4				
ZW8	132	15:29	15:39	*10*	2	1	A			
ZW9	127	15:29	15:46	*17*	2	1	A			
ZX0	144	15:30	15:37	*7*	2	1	A			
ZX1	145	15:30	15:35	*5*	2	1	A			
ZX2	142	15:32	15:40	*8*	2	1	A			
ZX3	135	15:31	15:37	*6*	2	1	A			
ZX4	127	15:31	15:40	*9*	2	1	A			
ZX5	144	16:08	16:14	*6*	2	1	A			
ZX6	133	16:10	16:20	*10*	2	1	A			
ZX7	127	16:09	16:19	*10*	2	1	A			
ZX8	132	16:09	16:37	*28*	1	1	B			
ZX9	148	16:10	16:33	*23*	2	1	A			
ZY0	161	16:13	16:23	*10*	2	1	A			
ZY1	148	16:12	16:20	*8*	2	1	A			
ZY2	141	16:11	16:14	*3*	2	1	A			
ZY3	143	16:13	16:23	*10*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZY4	152	16:12	16:32	*20*	2	1	A			
ZY5	143	16:16	16:25	*9*	2	1	A			
ZY6	136	16:14	16:24	*10*	2	1	A			
ZY7	140	16:16	16:22	*6*	2	1	A			
ZY8	138	16:15	16:21	*6*	2	1	A			
ZY9	133	16:15	16:25	*10*	2	1	A			
ZZ0	128	16:51	16:57	*6*	2	1	A			
ZZ1	137	16:50	17:12	*22*	2	1	A			
ZZ2	132	16:51	17:09	*18*	2	1	A			
ZZ3	125	16:49	17:14	*25*	2	1	8		*	
ZZ4	125	16:50	16:56	*6*	2	1	A			
MZ3	133	16:52	16:58	*6*	2	1	A			
ZZ6	147	16:52	16:58	*6*	2	1	A			
ZZ7	133	16:54	16:59	*5*	2	1	A			
ZZ8	130	16:53	17:03	*10*	2	1	A			
ZZ9	147	16:53	16:57	*4*	2	1	A			
SA0	138	16:55	17:03	*8*	2	1	A			
SA1	143	16:56	17:04	*8*	2	1	A			
SA2	142	16:56	17:03	*7*	2	1	A			
SA3	136	16:55	17:01	*6*	2	1	A			
SA4	138	16:57	17:07	*10*	2	1	A			
SA5	148	17:24	17:31	*7*	2	1	A			
SA6	151	17:26	17:32	*6*	2	1	A			
SA7	133	17:21	17:31	*10*	2	1	A			
SA8	130	17:22	17:27	*5*	2	1	A			
SA9	148	17:25	17:30	*5*	2	1	A			
SB0	141	17:27	17:33	*6*	2	1	A			
SB1	142	17:28	17:34	*6*	2	1	A			
SB2	136	17:28			1	3				
SB3	135	17:27	17:38	*11*	2	1	A			
SB4	128	17:28	17:35	*7*	2	1	A			
23-Mar-07		**Testlot 8**	**Max power, Slot B**		**Water temp = 6.0°C**					
ZJ0	155	9:02				4				
ZJ1	133	9:01	9:07	*6*	2	1	A			
ZJ2	135	9:01	9:10	*9*	2	1	A			
ZJ3	128	9:01	9:19	*18*	2	1	A			
ZJ4	132	9:02	9:22	*20*	2	1	A			
ZJ5	128	9:03	9:09	*6*	2	1	A			
ZJ6	144	9:04				4				
ZJ7	148	9:03	9:16	*13*	2	1	H		*	
ZJ8	137	9:04	9:16	*12*	2	1	A			
ZJ9	133	9:05	9:24	*19*	2	1	A			
ZK0	143	9:06	9:12	*6*	2	1	A			
ZK1	142	9:07	9:15	*8*	2	1	A			
ZK2	127	9:06	9:11	*5*	2	1	A			
ZK3	135	9:05	9:12	*7*	2	1	A			
ZK4	142	9:06	9:13	*7*	2	1	A			
ZK5	151	9:53	9:59	*6*	2	1	A			
ZK6	127	9:51	10:04	*13*	2	1	A			
ZK7	133	9:51	10:00	*9*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZK8	125	9:52	10:05	*13*	2	1	A			
ZK9	130	9:52	10:03	*11*	2	1	A			
ZL0	136	9:55	10:00	*5*	2	1	A			
ZL1	129	9:54	9:59	*5*	2	1	A			
ZL2	132	9:54	10:15	*21*	2	1	A			
ZL3	131	9:53	9:59	*6*	2	1	A			
MZ2	132	9:55	10:03	*8*	2	1	A			
ZL5	127	9:56	10:16	*20*	2	1	A			
ZL6	152	9:56	10:01	*5*	2	1	A			
ZL7	128	9:56	10:07	*11*	2	1	A			
ZL8	137	9:57	10:02	*5*	2	1	A			
ZL9	143	9:57	10:02	*5*	2	1	A			
ZM0	126	11:03	11:11	*8*	2	1	A			
ZM1	127	11:04	11:12	*8*	2	1	A			
ZM2	128	11:03	11:09	*6*	2	1	A			
ZM3	140	11:05	11:14	*9*	2	1	A			
ZM4	125	11:04	11:14	*10*	2	1	A			
ZM5	137	11:06	15:49	*283*	1	1	B			
ZM6	129	11:07	11:15	*8*	2	1	A			
ZM7	143	11:06	11:22	*16*	2	2	6			*
ZM8	138	11:07	11:17	*10*	2	1	A			
ZN0	153	11:08	11:15	*7*	2	1	A			
ZN1	133	11:08	11:14	*6*	2	1	A			
ZN2	128	11:09	11:19	*10*	2	1	A			
ZN3	133	11:08	11:17	*9*	2	1	A			
ZN4	128	11:09	11:13	*4*	2	1	A			
ZM9	166	11:05	11:11	*6*	2	1	A			
ZN5	154	11:47	11:55	*8*	2	1	A			
ZN6	138	11:46			2	3				
ZN7	137	11:48	11:56	*8*	2	1	A			
ZN8	151	11:47	11:57	*10*	2	1	A			
ZN9	130	11:48	12:01	*13*	2	1	A			
ZP0	130	11:49	11:56	*7*	2	1	A			
ZP1	133	11:52	12:02	*10*	2	2	B	H		
ZP2	184	11:51	12:07	*16*	2	1	A			
ZP3	131	11:50	11:54	*4*	2	1	A			
ZP4	132	11:51	12:03	*12*	2	1	A			
23-Mar-07		**Testlot 8**	**Max power, Slot C**		**Water temp = 6.0°C**					
ZP5	137	12:23	12:33	*10*	2	1	A			
ZP6	138	12:22	12:56	*34*	2	1	A			
ZP7	147	12:22	12:29	*7*	2	1	A			
ZP8	137	12:23	12:35	*12*	2	1	A			
ZP9	148	12:23	12:29	*6*	2	1	A			
ZR0	147	12:25	12:34	*9*	2	1	A			
ZR1	152	12:26	12:31	*5*	2	1	A			
ZR2	133	12:24	12:31	*7*	2	1	A			
ZR3	135	12:25	12:32	*7*	2	1	A			
ZR4	128	12:24	12:29	*5*	2	1	A			
ZR5	136	12:29	12:34	*5*	2	1	A			
ZR6	137	12:28	12:38	*10*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZR7	130	12:27	12:42	*15*	2	1	A			
ZR8	137	12:28	12:40	*12*	2	1	A			
ZR9	151	12:27	12:46	*19*	2	1	A			
ZS0	128	13:19	13:28	*9*	2	1	A			
ZS1	147	13:17	13:24	*7*	2	1	A			
ZS2	137	13:17	13:24	*7*	2	1	A			
ZS3	136	13:18	13:25	*7*	2	1	A			
ZS4	141	13:18	13:29	*11*	2	1	A			
ZS5	137	13:21	13:44	*23*	2	1	A			
ZS6	127	13:20	13:30	*10*	2	1	A			
ZS7	174	13:21	13:41	*20*	2	2	7		*	
ZS8	137	13:21	13:29	*8*	2	1	A			
ZS9	151	13:22	13:30	*8*	2	1	A			
ZT0	132	13:24	13:36	*12*	2	1	A			
ZT1	146	13:24	13:29	*5*	2	1	A			
ZT2	138	13:24	13:31	*7*	2	1	A			
ZT3	147	13:23	13:40	*17*	2	1	A			
ZT4	142	13:25	13:35	*10*	2	1	A			
ZT5	147	14:02	14:33	*31*	2	1	A			
ZT6	135	14:01	14:11	*10*	2	1	A			
ZT7	147	14:03	14:10	*7*	2	1	A			
ZT8	158	14:02	14:09	*7*	2	1	A			
ZT9	150	14:01	14:09	*8*	2	1	A			
ZU0	133	14:05	14:10	*5*	2	1	A			
ZU1	139	14:04	14:13	*9*	2	1	A			
ZU2	132	14:04	14:28	*24*	2	1	A			
ZU3	163	14:05	14:13	*8*	2	1	A			
ZU4	143	14:06	14:12	*6*	2	1	A			
ZU5	135	14:09	14:22	*13*	2	1	A			
ZU6	139	14:08	14:13	*5*	2	1	A			
ZU7	147	14:07	14:13	*6*	2	1	A			
ZU8	142	14:10	14:14	*4*	2	1	A			
ZU9	132	14:07	14:18	*11*	2	1	A			
ZV0	126	14:44	14:46	*2*	1	1	B	H		
ZV1	131	14:44	14:52	*8*	2	1	A			
ZV2	138	14:42	14:51	*9*	2	1	A			
ZV3	133	14:43	14:49	*6*	2	1	A			
ZV4	133	14:43	14:53	*10*	2	1	A			
ZV5	155	14:47	14:55	*8*	2	1	A			
ZV6	171	14:45				4				
ZV7	138	14:47	14:55	*8*	2	1	A			
ZV8	138	14:46	15:04	*18*	2	1	A			
ZV9	148	14:45	14:51	*6*	2	1	A			
23-Mar-07		**Testlot 8**	**Control**		**Water temp = 6.0°C**					
SB5	124	17:58	18:02	*4*	2	1	A			
SB6	136	17:55	17:58	*3*	2	1	A			
SB7	131	17:54	17:59	*5*	2	1	A			
SB8	132	17:54	17:58	*4*	2	1	A			
SB9	154	17:54	17:57	*3*	2	1	A			
SC0	158	17:55	17:59	*4*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
SC1	182	17:52	17:57	*5*	2	1	A			
SC2	153	17:57	18:01	*4*	2	1	A			
SC3	134	17:56	18:01	*5*	2	1	A			
SC4	140	17:56	18:00	*4*	2	1	A			
SC5	135	18:02	18:06	*4*	2	1	A			
SC6	166	18:00	18:07	*7*	2	1	A			
SC7	130	18:03	18:07	*4*	2	1	A			
SC8	127	17:59	18:03	*4*	2	1	A			
SC9	136	18:00	18:05	*5*	2	1	A			
SD0	130	18:03	18:08	*5*	2	1	A			
SD1	136	18:04	18:08	*4*	2	1	A			
SD2	136	18:02	18:07	*5*	2	1	A			
SD3	133	17:59	18:04	*5*	2	1	A			
SD4	128	18:01	18:06	*5*	2	1	A			
SD5	143	18:27	18:32	*5*	2	1	A			
SD6	136	18:24	18:28	*4*	2	1	A			
SD7	143	18:23	18:27	*4*	2	1	A			
SD8	136	18:26	18:31	*5*	2	1	A			
SD9	128	18:23	18:32	*9*	2	1	A			
SE0	136	18:22	18:29	*7*	2	1	A			
SE1	135	18:27	18:33	*6*	2	1	A			
SE2	128	18:25	18:30	*5*	2	1	A			
SE3	127	18:22	18:28	*6*	2	1	A			
SE4	127	18:25	18:30	*5*	2	1	A			
SE5	134	18:32	18:38	*6*	2	1	A			
SE6	135	18:24	18:42	*18*	2	1	A			
SE7	133	18:30	18:40	*10*	2	1	A			
SE8	130	18:31	18:37	*6*	2	1	A			
SE9	132	18:28	18:35	*7*	2	1	A			
SF0	138	18:35	18:42	*7*	2	1	A			
SF1	125	18:30	18:39	*9*	2	1	A			
SF2	136	18:31	18:36	*5*	2	1	A			
SF3	149	18:29	18:35	*6*	2	1	A			
SF4	173	18:32	18:39	*7*	2	1	A			
24-Mar-07		**Testlot 9**	**Upper 1% power, Slot A**		**Water temp = 7.0°C**					
SF5	135	8:44	8:50	*6*	2	1	A			
SF6	148	8:43	8:48	*5*	2	1	A			
SF7	132	8:43	8:48	*5*	2	1	A			
SF8	155	8:43	8:50	*7*	2	1	A			
SF9	131	8:43	8:51	*8*	2	1	A			
SH0	128	8:46	8:52	*6*	2	1	A			
SH1	155	8:45	8:53	*8*	2	1	A			
SH2	144	8:46	8:53	*7*	2	1	A			
SH3	131	8:45	8:51	*6*	2	1	A			
SH4	125	8:44	9:00	*16*	2	1	A			
SH5	133	8:48	8:55	*7*	2	1	A			
SH6	127	8:48	8:55	*7*	2	1	A			
SH7	135	8:47	8:53	*6*	2	1	A			
SH8	132	8:48	8:54	*6*	2	1	A			
SH9	128	8:47	8:54	*7*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
SJ0	140	9:09	9:15	*6*	2	2	7		*	
SJ1	137	9:11	9:16	*5*	2	1	A			
SJ2	136	9:10	9:16	*6*	2	1	A			
SJ3	138	9:11	9:17	*6*	2	1	A			
SJ4	145	9:10	9:16	*6*	2	1	A			
SJ5	164	9:12	9:18	*6*	2	1	A			
SJ6	149	9:13	9:19	*6*	2	1	A			
SJ7	152	9:13	9:18	*5*	2	1	A			
SJ8	155	9:13	9:20	*7*	2	1	A			
SJ9	161	9:12	9:18	*6*	2	1	A			
SK0	133	9:15	9:20	*5*	2	1	A			
SK1	132	9:15	9:20	*5*	2	1	A			
SK2	147	9:14	9:21	*7*	2	1	A			
SK3	136	9:16	9:21	*5*	2	1	A			
SK4	140	9:14	9:21	*7*	2	1	A			
SK5	134	9:36	9:42	*6*	2	1	A			
SK6	133	9:34	9:40	*6*	2	1	A			
SK7	135	9:35	9:43	*8*	2	1	A			
SK8	136	9:36	9:47	*11*	1	2	B	G	*	
SK9	163	9:37	9:45	*8*	2	1	A			
SL0	136	9:34	9:41	*7*	2	1	A			
SL1	137	9:34	9:44	*10*	2	1	A			
SL2	133	9:33	9:41	*8*	2	1	A			
SL3	138	9:35	9:42	*7*	2	1	A			
SL4	132	9:36	9:42	*6*	2	1	A			
SL5	138	9:38	9:45	*7*	2	1	A			
SL6	135	9:38	9:46	*8*	2	1	A			
SL7	138	9:39	9:52	*13*	2	1	A			
SL8	132	9:38	9:48	*10*	2	1	A			
SL9	135	9:39	9:45	*6*	2	1	A			
ZB5	141	9:42	9:48	*6*	2	1	A			
ZB6	129	9:44	9:50	*6*	2	1	A			
ZB7	166	9:43	9:49	*6*	2	1	A			
ZB8	132	9:43	9:49	*6*	2	1	A			
ZB9	145	9:43	9:53	*10*	2	1	A			
24-Mar-07		**Testlot 9**	**Upper 1% power, Slot B**		**Water temp = 7.0°C**					
ZC0	137	10:06	10:12	*6*	2	1	A			
ZC1	141	10:08	10:13	*5*	2	1	A			
ZC2	142	10:07	10:14	*7*	2	1	A			
ZC3	132	10:07	10:15	*8*	2	1	A			
ZC4	145	10:06	10:11	*5*	2	1	A			
ZC5	155	10:10	10:16	*6*	2	1	A			
ZC6	157	10:09	10:16	*7*	2	1	A			
ZC7	127	10:09	10:15	*6*	2	1	A			
ZC8	137	10:09	10:16	*7*	2	1	A			
ZC9	142	10:08	10:15	*7*	2	1	A			
ZD0	138	10:11	10:18	*7*	2	1	A			
ZD1	138	10:12	10:18	*6*	2	1	A			
ZD2	143	10:11	10:17	*6*	2	1	A			
ZD3	128	10:12	10:18	*6*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZD4	140	10:11	10:16	*5*	2	1	A			
ZD5	137	10:35	10:43	*8*	2	1	A			
ZD6	132	10:34	10:40	*6*	2	1	A			
ZD7	143	10:35	10:43	*8*	2	1	A			
ZD8	156	10:34	10:39	*5*	2	1	A			
ZD9	144	10:34	10:56	*22*	2	1	A			
ZE0	140	10:37	10:42	*5*	2	1	A			
ZE1	142	10:36	10:44	*8*	1	2	B	G	*	
ZE2	135	10:36	10:42	*6*	2	1	A			
ZE3	142	10:36	10:43	*7*	2	1	A			
ZE4	166	10:37	10:46	*9*	2	1	A			
ZE5	138	10:39	10:47	*8*	2	1	A			
ZE6	128	10:38	11:00	*22*	2	1	A			
ZE7	136	10:39	10:46	*7*	2	1	A			
ZE8	148	10:38	10:45	*7*	2	1	A			
ZE9	133	10:38	10:45	*7*	2	1	A			
ZH5	132	11:12	11:20	*8*	2	1	A			
ZH6	126	11:11	11:18	*7*	2	1	A			
ZH7	129	11:10	11:18	*8*	2	1	A			
ZH8	140	11:12	11:17	*5*	2	1	A			
ZH9	143	11:11	11:18	*7*	2	1	A			
ZJ0	133	11:10	11:17	*7*	2	1	A			
ZJ1	127	11:14	11:19	*5*	2	1	A			
ZJ2	153	11:13	11:18	*5*	2	1	A			
ZJ3	165	11:13	11:23	*10*	2	1	A			
ZJ4	155	11:12	11:36	*24*	2	1	A			
ZJ5	150	11:16	11:22	*6*	2	1	A			
ZJ6	138	11:15	11:20	*5*	2	1	A			
ZJ7	137	11:14	11:20	*6*	2	1	A			
ZJ8	143	11:15	11:23	*8*	2	1	A			
ZJ9	135	11:16	11:21	*5*	2	1	A			
ZK0	143	11:22	11:32	*10*	2	1	A			
ZK1	132	11:23	11:27	*4*	2	1	A			
ZK2	140	11:23	11:30	*7*	2	1	A			
ZK3	145	11:21	11:25	*4*	2	1	A			
ZK4	146	11:22	11:28	*6*	2	1	A			
24-Mar-07		**Testlot 9**	**Upper 1% power, Slot C**		**Water temp = 7.0°C**					
ZK5	133	11:51	11:58	*7*	2	1	A			
ZK6	146	11:50	11:54	*4*	2	1	A			
ZK7	128	11:50	11:57	*7*	2	1	A			
ZK8	147	11:49	11:54	*5*	2	1	A			
ZK9	142	11:50	11:58	*8*	2	1	A			
ZL0	133	11:53	11:59	*6*	2	1	A			
ZL1	130	11:52	11:59	*7*	2	1	A			
ZL2	132	11:52	11:58	*6*	2	1	A			
ZL3	132	11:51	11:56	*5*	2	1	A			
ZL4	153	11:52	11:58	*6*	2	1	A			
ZL5	136	11:54	12:00	*6*	2	1	A			
ZL6	133	11:54	12:01	*7*	2	1	A			
ZL7	138	11:54	12:01	*7*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZL8	149	11:55	12:01	*6*	2	1	A			
ZL9	150	11:53	11:58	*5*	2	1	A			
ZM0	145	12:25	12:30	*5*	2	1	A			
ZM1	167	12:24	12:30	*6*	2	1	A			
ZM2	132	12:24	12:29	*5*	2	1	A			
ZM3	138	12:25	12:31	*6*	2	1	A			
ZM4	143	12:26	12:32	*6*	2	1	A			
ZM5	148	12:26	12:36	*10*	2	1	A			
ZM6	148	12:27	12:35	*8*	2	1	A			
ZM7	132	12:27	12:33	*6*	2	1	A			
ZM8	136	12:26	12:32	*6*	2	1	A			
ZM9	144	12:28	12:33	*5*	2	1	A			
ZN0	155	12:29	12:34	*5*	2	1	A			
ZN1	143	12:29	12:36	*7*	2	1	A			
ZN2	128	12:30	12:39	*9*	2	1	A			
ZN3	147	12:30	12:35	*5*	2	1	A			
ZN4	152	12:28	12:37	*9*	2	1	A			
ZN5	133	14:10	14:18	*8*	2	1	A			
ZN6	150	14:12	14:35	*23*	2	1	A			
ZN7	156	14:12	14:18	*6*	2	1	A			
ZN8	152	14:12	14:18	*6*	2	1	A			
ZN9	143	14:13	14:26	*13*	2	1	A			
ZP0	142	14:13	14:19	*6*	2	1	A			
ZP1	145	14:10	14:16	*6*	2	1	A			
ZP2	136	14:11	14:17	*6*	2	1	A			
ZP3	135	14:11	14:20	*9*	2	1	A			
ZP4	133	14:11	14:17	*6*	2	1	A			
ZP5	162	14:15	14:21	*6*	2	1	A			
ZP6	182	14:15	14:30	*15*	2	1	A			
ZP7	128	14:14	14:21	*7*	2	1	A			
ZP8	132	14:14	14:19	*5*	2	1	A			
ZP9	125	14:15	14:32	*17*	1	2	B	9	G	
ZR0	136	14:19	14:23	*4*	2	1	A			
ZR1	138	14:19	14:25	*6*	2	1	A			
ZR2	157	14:21	14:28	*7*	2	1	A			
ZR3	152	14:19	14:25	*6*	2	1	A			
ZR4	147	14:20	14:26	*6*	2	1	A			
24-Mar-07		**Testlot 9**	**Control**		**Water temp = 7.0°C**					
ZR5	132	14:49	14:55	*6*	2	1	A			
ZR6	127	14:49	14:53	*4*	2	1	A			
ZR7	147	14:50	14:55	*5*	2	1	A			
ZR8	127	14:48	14:55	*7*	2	1	A			
ZH4	150	14:47	14:52	*5*	2	1	A			
ZS0	147	14:51	14:56	*5*	2	1	A			
ZS1	128	14:47	14:51	*4*	2	1	A			
ZS2	146	14:47	14:52	*5*	2	1	A			
ZS3	131	14:48	14:53	*5*	2	1	A			
ZS4	142	14:50	14:54	*4*	2	1	A			
ZS5	137	14:54	14:58	*4*	2	1	A			
ZS6	136	14:54	14:59	*5*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZS7	154	14:56	15:00	*4*	2	1	A			
ZS8	140	14:53	14:57	*4*	2	1	A			
ZS9	151	14:54	14:59	*5*	2	1	A			
ZT0	158	14:52	14:57	*5*	2	1	A			
ZT1	137	14:52	14:56	*4*	2	1	A			
ZT2	137	14:55	15:01	*6*	2	1	A			
ZT3	138	14:54	14:57	*3*	2	1	A			
ZT4	142	14:55	15:00	*5*	2	1	A			
ZU0	138	15:14	15:20	*6*	2	1	A			
ZU1	142	15:14	15:20	*6*	2	1	A			
ZU2	133	15:17	15:23	*6*	2	1	A			
ZU3	128	15:14	15:19	*5*	2	1	A			
ZU4	138	15:16	15:23	*7*	2	1	A			
ZT5	143	15:16	15:22	*6*	2	1	A			
ZT6	137	15:17	15:22	*5*	2	1	A			
ZT7	138	15:16	15:21	*5*	2	1	A			
ZT8	147	15:17	15:23	*6*	2	1	A			
ZT9	148	15:15	15:22	*7*	2	1	A			
ZU5	132	15:24	15:30	*6*	2	1	A			
ZU6	128	15:21	15:29	*8*	2	1	A			
ZU7	125	15:23	15:29	*6*	2	1	A			
ZU8	144	15:22	15:28	*6*	2	1	A			
ZU9	128	15:20	15:26	*6*	2	1	A			
ZV0	146	15:22	15:27	*5*	2	1	A			
ZV1	147	15:24	15:28	*4*	2	1	A			
ZV2	126	15:19	15:24	*5*	2	1	A			
ZV3	142	15:21	15:25	*4*	2	1	A			
ZV4	182	15:21	15:27	*6*	2	1	A			
25-Mar-07		**Testlot 10**	**Intermediate power, Slot C**		**Water temp = 6.0°C**					
ZT5	153	12:21	12:27	*6*	2	1	A			
ZT6	134	12:20	12:28	*8*	2	1	A			
ZT7	147	12:19	12:26	*7*	2	1	A			
ZT8	146	12:21	12:32	*11*	2	1	A			
ZB4	141	12:20	12:28	*8*	2	1	H		*	
Z50	153	12:23	12:29	*6*	2	1	A			
Z51	163	12:22	12:34	*12*	2	1	A			
Z52	132	12:22	12:32	*10*	2	1	A			
Z53	157	12:23	12:30	*7*	2	1	A			
Z54	147	12:22	12:29	*7*	2	1	A			
Z55	155	12:25	12:33	*8*	2	1	A			
Z56	136	12:25	12:31	*6*	2	1	A			
Z57	138	12:25	12:32	*7*	2	1	A			
Z58	131	12:24	12:30	*6*	2	1	A			
Z59	153	12:24	12:30	*6*	2	1	A			
Z60	150	12:43	12:57	*14*	2	1	A			
Z61	148	12:43	12:52	*9*	2	1	A			
Z62	173	12:44	13:02	*18*	2	1	A			
Z63	140	12:44	13:02	*18*	2	1	A			
Z64	132	12:44	12:52	*8*	2	1	A			
Z65	152	12:47	12:55	*8*	2	1	A			

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Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
Z66	138	12:46	12:52	*6*	2	1	A			
Z67	157	12:46	12:51	*5*	2	1	A			
Z68	140	12:45	12:52	*7*	2	1	A			
Z69	147	12:45	12:53	*8*	2	1	A			
Z70	153	12:48	12:56	*8*	2	1	A			
Z71	153	12:48	12:55	*7*	2	1	A			
Z72	132	12:49	13:00	*11*	2	1	A			
Z73	138	12:49	12:58	*9*	2	1	A			
Z74	142	12:47	12:55	*8*	2	1	A			
Z75	143	13:16	13:23	*7*	2	1	A			
Z76	153	13:14	13:20	*6*	2	1	A			
Z77	157	13:15	13:21	*6*	2	1	A			
Z78	139	13:16	13:24	*8*	2	1	A			
Z79	142	13:14	13:24	*10*	2	1	A			
Z80	137	13:13	13:37	*24*	2	1	A			
Z81	127	13:15	13:23	*8*	2	1	A			
Z82	137	13:12	13:20	*8*	2	1	A			
Z83	135	13:16	13:24	*8*	2	1	A			
Z84	128	13:14	13:20	*6*	2	1	A			
Z85	158	13:19	13:26	*7*	2	1	A			
Z86	136	13:25	13:34	*9*	2	1	A			
Z87	143	13:19	13:27	*8*	2	1	A			
Z88	148	13:18	13:26	*8*	2	1	A			
Z89	157	13:18	13:25	*7*	2	1	A			
Z90	152	13:24	13:29	*5*	2	1	A			
Z91	134	13:25	13:32	*7*	2	1	A			
Z92	135	13:17	13:26	*9*	2	1	A			
Z93	148	13:17	13:23	*6*	2	1	A			
Z94	146	13:26	13:31	*5*	2	1	A			
25-Mar-07		**Testlot 10**	**Intermediate power, Slot A**		**Water temp = 6.0°C**					
ZV5	158	8:46	8:51	*5*	2	1	A			
ZV6	143	8:47	8:53	*6*	2	1	A			
ZV7	130	8:46	8:52	*6*	2	1	A			
ZV8	156	8:47	8:56	*9*	2	1	A			
ZV9	155	8:45	8:53	*8*	2	1	A			
ZW0	140	8:48	8:55	*7*	2	1	A			
ZW1	133	8:49	8:54	*5*	2	1	A			
ZW2	166	8:49	8:56	*7*	2	1	A			
ZW3	130	8:49	8:54	*5*	2	1	A			
ZW4	140	8:48			1	3				
ZW5	138	8:51	8:57	*6*	2	1	A			
ZW6	157	8:51	8:58	*7*	2	1	A			
ZW7	158	8:50	8:57	*7*	2	1	A			
ZW8	157	8:50	9:00	*10*	2	1	A			
ZW9	132	8:52	8:58	*6*	2	1	A			
ZX0	145	9:23	9:28	*5*	2	1	A			
ZX1	162	9:23	9:28	*5*	2	1	A			
ZX2	131	9:22	9:27	*5*	2	1	A			
ZX3	130	9:23	9:29	*6*	2	1	A			
ZX4	131	9:22			2	3				

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZX5	128	9:25	9:36	*11*	2	1	A			
ZX6	137	9:24	9:30	*6*	2	1	A			
ZX7	164	9:24	9:32	*8*	1	1	H	B	9	*
ZX8	137	9:26	9:33	*7*	2	1	A			
ZX9	147	9:25	9:36	*11*	2	1	A			
ZY0	127	9:28	9:35	*7*	2	1	A			
ZY1	138	9:27			1	3	Q			
ZY2	128	9:27	9:33	*6*	2	1	A			
ZY3	132	9:28	9:36	*8*	2	1	A			
ZY4	144	9:26	9:32	*6*	2	1	A			
ZY5	135	10:04	10:11	*7*	2	1	A			
ZY6	142	10:02	10:08	*6*	2	1	A			
ZY7	138	10:03	10:09	*6*	2	1	A			
ZY8	126	10:04	10:18	*14*	2	1	A			
ZY9	133	10:04	10:36	*32*	2	1	A			
ZZ0	130	10:02	10:07	*5*	2	1	A			
ZZ1	128	10:02	10:16	*14*	2	1	A			
ZZ2	134	10:03	10:08	*5*	2	1	A			
ZZ3	124	10:05	10:10	*5*	2	1	A			
ZZ4	135	10:05	10:12	*7*	2	1	A			
ZZ5	138	10:06	10:11	*5*	2	1	A			
ZZ6	143	10:06	10:18	*12*	2	1	A			
ZZ7	148	10:07	10:13	*6*	2	1	A			
ZZ8	134	10:12	10:17	*5*	2	1	A			
ZZ9	132	10:06	10:15	*9*	2	1	A			
ZM0	136	10:13	10:29	*16*	2	1	A			
ZM1	128	10:12	10:28	*16*	2	1	A			
ZM2	127	10:13	10:20	*7*	2	1	A			
ZM3	128	10:07	10:16	*9*	2	1	A			
ZM4	127	10:13	10:19	*6*	2	1	A			
25-Mar-07		**Testlot 10**	**Intermediate power, Slot B**		**Water temp = 6.0°C**					
ZM5	137	10:49	11:00	*11*	2	1	A			
ZM6	145	10:50	10:56	*6*	2	1	A			
ZM7	172	10:48	10:54	*6*	2	1	A			
ZM8	142	10:49	11:03	*14*	2	1	A			
ZM9	145	10:49	10:59	*10*	2	1	A			
ZN0	151	10:51	11:02	*11*	2	1	A			
ZN1	160	10:50	10:58	*8*	2	1	A			
ZN2	159	10:52	11:01	*9*	2	1	A			
ZN3	139	10:51	11:03	*12*	2	1	A			
ZN4	139	10:52	10:58	*6*	2	1	A			
ZN5	134	10:53	11:04	*11*	2	1	A			
ZN6	134	10:53	10:59	*6*	2	1	A			
ZN7	135	10:53	10:59	*6*	2	1	A			
ZN8	142	10:54	11:02	*8*	2	1	A			
ZN9	128	10:54	11:01	*7*	2	1	A			
ZP0	131	11:14	11:21	*7*	2	1	A			
ZP1	131	11:14	11:21	*7*	2	1	A			
ZP2	143	11:14	11:20	*6*	2	1	A			
ZP3	133	11:15	11:21	*6*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time Released	Time Recovered	Minutes at large	No. HI-Z tags recovered	Survival Code	Status Codes 1	2	3	4
ZP4	143	11:16	11:33	*17*	2	1	A			
ZP5	153	11:18	11:25	*7*	2	1	A			
ZP6	155	11:16	11:22	*6*	2	1	A			
ZP7	149	11:17	11:25	*8*	2	1	A			
ZP8	168	11:17	11:28	*11*	2	1	A			
ZP9	147	11:17	11:23	*6*	2	1	A			
ZR0	134	11:18	11:25	*7*	2	1	A			
ZR1	137	11:20	11:27	*7*	2	1	A			
ZR2	137	11:19	11:26	*7*	2	1	A			
ZR3	148	11:20	11:30	*10*	2	1	A			
ZR4	143	11:19	11:25	*6*	2	1	A			
ZR5	144	11:47	11:55	*8*	2	1	A			
ZR6	146	11:49	11:57	*8*	2	1	A			
ZR7	138	11:46	11:51	*5*	2	1	A			
ZR8	176	11:47	11:54	*7*	2	1	A			
ZR9	128	11:48	11:56	*8*	2	1	A			
ZS0	141	11:46	11:59	*13*	2	1	A			
ZS1	136	11:47	11:53	*6*	2	1	A			
ZS2	128	11:46	11:56	*10*	2	1	A			
ZS3	133	11:48	11:58	*10*	2	1	A			
ZS4	158	11:48	11:52	*4*	2	1	A			
ZS5	146	11:56	12:00	*4*	2	1	A			
ZS6	136	11:57	12:03	*6*	2	1	A			
ZS7	151	11:56	12:04	*8*	2	1	A			
ZS8	133	11:50	12:01	*11*	2	1	A			
ZS9	126	11:50	11:56	*6*	2	1	A			
ZT0	132	11:57	12:04	*7*	2	1	A			
ZT1	177	11:51	12:01	*10*	2	1	A			
ZT2	128	11:57	12:03	*6*	2	1	A			
ZT3	135	11:51	11:56	*5*	2	1	A			
ZT4	128	11:50	11:58	*8*	2	1	A			
25-Mar-07		**Testlot 10**	**Control**		**Water temp = 6.0°C**					
Z95	133	13:49	13:54	*5*	2	1	A			
Z96	144	13:51	13:54	*3*	2	1	A			
Z97	131	13:47	13:51	*4*	2	1	A			
Z98	132	13:50	13:54	*4*	2	1	A			
Z99	161	13:48	13:51	*3*	2	1	A			
XF0	134	13:49	13:52	*3*	2	1	A			
XF1	148	13:48	13:53	*5*	2	1	A			
XF2	132	13:50	13:53	*3*	2	1	A			
XF3	144	13:48	13:54	*6*	2	1	A			
XF4	143	13:50	13:55	*5*	2	1	A			
XF5	134	13:55	13:59	*4*	2	1	A			
XF6	125	13:53	13:58	*5*	2	1	A			
XF7	144	13:52	13:58	*6*	2	1	A			
XF8	141	13:53	14:00	*7*	2	1	A			
XF9	147	13:54	13:58	*4*	2	1	A			
XH0	152	13:53	13:58	*5*	2	1	A			
XH1	153	13:54	13:59	*5*	2	1	A			
XH2	143	13:52	13:56	*4*	2	1	A			

Appendix Table D

Continued.

Fish ID	Total Length (mm)	Time			No. HI-Z tags recovered	Survival Code	Status Codes			
		Released	Recovered	Minutes at large			1	2	3	4
XH3	148	13:55	13:59	*4*	2	1	A			
XH4	143	13:52	13:56	*4*	2	1	A			
XH5	129	14:21	14:27	*6*	2	1	A			
XH6	138	14:23	14:29	*6*	2	1	A			
XH7	152	14:20	14:24	*4*	2	1	A			
XH8	141	14:23	14:27	*4*	2	1	A			
XH9	146	14:19	14:22	*3*	2	1	A			
XJ0	142	14:24	14:28	*4*	2	1	A			
XJ1	136	14:21	14:28	*7*	2	1	A			
XJ2	144	14:24	14:29	*5*	2	1	A			
XJ3	125	14:22	14:25	*3*	2	1	A			
XJ4	135	14:20	14:23	*3*	2	1	A			
XJ5	128	14:26	14:31	*5*	2	1	A			
XJ6	128	14:25	14:30	*5*	2	1	A			
XJ7	131	14:29	14:33	*4*	2	1	A			
XJ8	137	14:27	14:32	*5*	2	1	A			
XJ9	158	14:25	14:28	*3*	2	1	A			