JUVENILE SALMONID SURVIVAL AND CONDITION IN PASSAGE THROUGH MODIFIED SPILLBAYS AT BONNEVILLE DAM, COLUMBIA RIVER

Contract No. DACW68-02-D-0002
Task Order DT02

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NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

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Prepared for

U. S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT
333 Southwest First Avenue
Portland, Oregon 97204

Prepared by

NORMANDEAU ASSOCIATES, INC.
1921 River Road
Drumore, Pennsylvania 17518

MID COLUMBIA CONSULTING, INC.
201 Cascade View Court
East Wenatchee, Washington 98802

and

JOHN R. SKALSKI
University of Washington
1325 Fourth Avenue, Suite 1820
Seattle, Washington 98101

Normandeau Job Number 18929.001

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EXECUTIVE SUMMARY

The recent structural modifications, for total dissolved gas (TDG) abatement, to some spillbays at Bonneville Dam stimulated this investigation. These modifications involved installation of a flow deflector submerged 7 ft deeper than the existing deflectors, which are at elevation 14 ft msl. Empirical studies were needed to ascertain the magnitude of gas abatement and the effects of the new flow deflectors on fish condition. The fish passage experiment was conducted at high tailwater (18.4 to 25.4 ft msl) and low tailwater (11.0 to 13.6 ft msl) elevations at two spill volumes (75 kcfs and at gas cap discharge) using the HI-Z balloon tag-recapture technique. The high tailwater (spring) study occurred from 20 May through 1 June 2002 (water temperature 12.3 to 14.2°C or 54.2 to 57.6°F) and the low tailwater (summer) experiment occurred from 18 through 29 August 2002 (water temperature 19.5 to 20.5°C or 67.1 to 68.9°F). The spill volume was up to 2 kcfs higher through Spillbay 16 than through Spillbay 14; the spill volume through each spillbay also differed between the two spill conditions tested.

Hatchery-reared chinook salmon smolts, *Oncorhynchus tshawytscha*, were used in the experiment and were released through Spillbays 14 (existing flow deflector) and 16 (new deep flow deflector). Control fish were released downstream of Spillbay 17 to evaluate the effects of handling, holding, tagging, and recapture.

Recapture rates (physical retrieval of alive and dead fish) of both the treatment and control groups were higher in spring than in summer. In spring, recapture rates of the treatment groups ranged from 95.8 to 98.3%; for control groups these were 95.4 to 100%. In summer, recapture rates of the control group were 87.6 to 87.9% and for the treatment groups they ranged from 83.7 to 89.6%. A relatively high proportion of fish in the summer was assigned to the dead category either as a result of tag dislodgment or lost to predation. Control fish losses in the summer equaled or exceeded 10%. In contrast, losses to predation or the recovery of dislodged tags were less than 2% for the spring releases. A combination of smaller fish size in summer (about 157 mm in spring and 119 mm in summer) and greater predator activity at higher water temperatures (≥19.5°C or 67.1°F) likely contributed to the low recapture rates in summer. Similar observations were made in the corresponding periods at The Dalles Dam spillway passage survival experiments.

Additionally, the flow patterns, particularly from Spillbay 14 in the low tailwater experiment, also appeared to affect the recapture rates. The flow pattern directed fish to an eddy in the middle of the tailwater over a deep hole, trapping some fish for long time periods and subsequently making them non-recoverable.

Except for two estimates of survival probabilities (both at 75 kcfs in summer), the other six estimates equaled or exceeded 96% (range 96 to 100%). The two low survival estimates in summer (88.6% at Spillbay 16 and 90.5% at Spillbay 14) are towards the lower range of spillway passage survival probabilities (direct effects) reported from several other Columbia River hydroelectric dams. Two of the survival estimates in summer exceeded 1.0; these resulted from a slightly higher mortality of control groups relative to that of the treatment groups.

The 48 h survival ($\hat{\tau}$) probabilities, along with the 90% confidence intervals were established as follows:

	Spillbay 14		Spillbay 16	
	75 kcfs	Gas Cap	75 kcfs	Gas Cap
High tailwater	0.979	0.986	0.959	0.990
	(0.957-1.002)	(0.971-1.0)	(0.933-0.986)	(0.977-1.003)
Low tailwater	0.905	1.010*	0.886	1.050*
	(0.836-0.975)	(0.950-1.070)	(0.813-0.960)	(0.991-1.106)

*Survival established at 1.0

The objective of achieving a precision (ε) level of $\leq\pm$3%, 90% of the time on the survival estimates was met for the spring releases but not for all the summer releases. For the latter experiment, the realized precision (ε) on the survival estimates was lower ($5.7\% \pm\leq \varepsilon \leq\pm 7.5\%$, 90% of the time). The lower precision (ε) in summer was primarily due to a combination of lower recapture rates and high control losses. Stress due to handling, tagging, and releasing fish (both treatment and control) at high summer water temperatures (>19.0°C or 66.2°F) and losses to predation were contributing factors to the lower precision (ε). Losses from these sources were >10% in the summer and less than 2% in the spring. Although non-quantified, a higher than typical percentage (>1%) of fish died in the holding pools prior to tagging and release in the summer. Many of the dead fish appeared to be diseased.

The effects of new flow deflectors on fish survival were difficult to isolate in a consistent manner under all tested conditions. However, the effects of spill volume, *per se*, were more evident at Spillbay 16 than at Spillbay 14. Passage survival was between 3 and 12% lower at 75 kcfs than at the gas cap at Spillbay 16 in summer. This level of difference was evident at Spillbay 14 only in summer. However, as noted earlier, a portion of this difference may have been contributed by higher than expected mortality, particularly for controls, during the 48 h holding period. The immediate (1 h) estimated survival exceeded 98% for all conditions. Thus, there is some uncertainty associated with this level of difference in the survival estimates attributable to flow deflectors.

As in the case of survival estimates, injury potential was low at the gas cap spill volume. The injury rates at the gas cap spill were generally less than 1.0% (adjusted for controls), but reached as high as 8.6% for fish entrained in Spillbay 16 at 75 kcfs in the summer. Injury rates in general were higher for fish entrained in Spillbay 16. Most injuries observed were hemorrhages, with some scrapes/bruises and lacerations. Causal mechanisms for the observed injury types were shear-related or contact with solid objects.

Another metric, "clean fish" (fish without visible injuries, scale loss, or loss of equilibrium) was also computed to provide additional insight into which passage conditions may provide safer fish passage; not all injuries are lethal during the 48 h holding period. The trends of clean fish estimates ($\hat{CF}$) were similar to those for the survival rates given above. The clean fish estimates were ≥0.97 (all of the four possible estimates) at gas cap spill at both spillbays in both periods. However, estimates at 75 kcfs varied with respect to individual spillbay and period. At both spillbays during the low tailwater condition at 75 kcfs, the clean fish estimate ranged from 0.879 (Spillbay 14) to 0.907 (Spillbay 16); at high tailwater and 75 kcfs the clean fish estimate was 0.931 and 0.973 at Spillbays 16 and 14, respectively. The estimated clean fish probabilities along with the 90% confidence intervals were as follows:

	Spillbay 14		Spillbay 16	
	75 kcfs	Gas Cap	75 kcfs	Gas Cap
High tailwater	0.973	0.982	0.931	0.986
	(0.933-1.0)	(0.955-1.0)	(0.887-0.966)	(0.960-1.0)
Low tailwater	0.879	0.976	0.907	0.977
	(0.832-0.919)	(0.950-0.997)	(0.862-0.944)	(0.951-0.997)

Except for the confidence intervals around the two lowest estimates (0.879 and 0.907) at Spillbays 14 and 16 at 75 kcfs, the confidence intervals of the remaining estimates overlapped each other.

Based on the experiences from the present study and at The Dalles Dam, potential losses to predation and the tag-recapture process could be minimized if future similar experiments are conducted at cooler water temperatures, generally ≤15°C (≤59°F). Also, to enhance the ability to isolate treatment effects, attempts should be made to 1) maintain an equal volume of spill to minimize confounding the potential effects of differential spill volumes through each tested spillbay; and 2) release fish of a similar size, preferably >120 mm in length. The incidence of tag dislodgment and potential for fish predation generally increases with smaller sized fish.

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1.0 INTRODUCTION

Juvenile salmonids on their seaward journey encounter any or all of the following exit routes at hydroelectric dams: turbines, spillways, and bypasses. There are two inter-related concerns associated with passage through any of these routes for overall survival. One is the proportion of fish utilizing any of these routes during emigration and the other is their subsequent post-passage condition and survival. Spill of varying magnitude and duration is used at most hydroelectric dams on the Columbia River Basin to enhance passage effectiveness and overall survival of juvenile salmonids (Schoeneman *et al.* 1961; Wilson *et al.* 1991). However, spill is expensive in terms of lost power generation and with some spillway configurations and flow patterns, potentially lethal levels of total dissolved gas (TDG) in the river can result. To alleviate the TDG supersaturation levels at Bonneville Dam, flow deflectors were first installed downstream of the spillbays in 1975. The existing flow deflectors apparently did not meet the expected magnitude of TDG abatement under various spill patterns at Bonneville Dam. Recent model study results have indicated that a new configuration of flow deflectors may provide better TDG abatement. Consequently, Spillbay 16 was modified by the Corps with the installation of a new flow deflector 7 ft deeper than the existing ones. The existing flow deflectors are submerged at elevation 14 ft mean sea level (msl).

Flow deflectors are concrete sills installed on the downstream face of a spillway to maximize the surface skimming effect of spilled water and prevent plunging to the bottom of the stilling basin thus reducing the pressure gradient that forces atmospheric gases into the solution.

A comparative account of chinook salmon smolts, *Oncorhynchus tshawytscha*, condition and survival immediately after passage over Spillbay 4 (equipped with an existing type flow deflector) and Spillbay 2 (without a flow deflector) was reported by Normandeau Associates *et al.* (1996a). The survival probabilities of smolts in passage over both spillbays (spill volume of 12 kcfs) were estimated at 1.0 with little or no spill from other spillbays. Relative to post-passage fish survival and condition, it is unknown whether the same spill volume through fewer spillbays is better than being apportioned into smaller volumes through many spillbays. The performance of the new flow deflector relative to condition and survival of fish entrained in spillbays versus existing flow deflectors is also unknown. The two deflector configurations at Bonneville were to be evaluated at a total spill volume of either 75 kcfs or gas cap spread over all spillbays with no bay spilling >10 kcfs. At some sites, a multi-year investigation was needed to assess whether the goals of protecting fish, conserving water, and minimizing TDG were achieved (Heisey *et al.* 2003).

There are considerable physical and hydraulic differences among hydroelectric dams which may influence spill effectiveness, fish survival, or both. Bell *et al.* (1972) and Heisey *et al.* (2003) have reported survival rates ranging from 83 to 100% in passage through spillways on the Columbia River Basin. About 34% of the reported estimates were less than 98%.

1.1 Objectives

The specific objectives of the present study were to (1) estimate direct effects of passage on immediate (1 h) and 48 h survival of juvenile salmon within $\leq \pm 3\%$, 90% of the time, through a spillbay equipped with a new flow deflector (Spillbay 16) and another with an existing flow deflector (Spillbay 14); and (2) identify the probable source and magnitude of injury/mortality. Because TDG uptake may be influenced by plunging depth, survival and injury rates (direct effects) were estimated at low (10.4 to 13.9 ft msl) and high (18.2 to 25.0 ft msl) tailwater elevations at two spill volumes (75 kcfs and gas cap spill). The spill volume tested was spread over 18 spillbays, each spilling 0 to 9.7 kcfs during the testing period.

1.2 Project Description

Bonneville Dam is the first dam upriver (river mile 145 or 232 river km) on the main stem of the Columbia River (Figure 1-1) and is located east of Portland, Oregon. It consists of two powerhouses, a spillway, and a navigation lock. The first powerhouse (B1) was completed in 1938 and is located between the Oregon shore and Bradford Island. The second powerhouse (B2) was built in 1982 and is located between the Washington shore and Cascades Island. The spillway, consisting of 18 gates, each 50 ft wide, is located between Bradford and Cascades Island, spanning the north channel. The spill gates are raised to allow excess river flow to pass under them at a depth of about 50 ft below the upstream water surface. Spill gates are typically raised 1 to 7 ft to facilitate downstream migration of juvenile salmonids. The total hydraulic capacity of both the B1 and B2 powerhouses is 288 kcfs. B1 has a rated generating capacity of 612 MW at full forebay. Hydraulic capacity of the spillway is 1,600 kcfs. An outfall sluice chute is located on the south side of B2 powerhouse (Figure 1-1).

In order to reduce the level of TDG supersaturation produced by water passing over a spillway, the Corps had installed flow deflectors in 1975 on the downstream face of the spillway that direct the flow along the surface of the tailrace rather than allowing it to plunge to the bottom of the spilling basin; these flow deflectors (also designated flip-lips) are located at elevation 14 ft msl. Thirteen of the 18 spillbays were originally equipped with these flow deflectors. The magnitude of TDG abatement apparently did not meet the expectations for a range of operating conditions by the existing flow deflectors. Thus, six deeper flow deflectors were installed in Spillbays 1, 2, 3, 16, 17, and 18 in 2001. These new flow deflectors were submerged 7 ft deeper than the existing ones.

A double row of concrete dentates extend across the spillway to aid in energy dissipation. These flow dissipaters are 14 ft wide at the base and slope up to a 2 ft width at the top. They are 6 ft above the bottom sill of the spillbay and their tops should have been approximately 20 to 35 ft below the water surface when the fish passage tests were conducted. Spillbays 14 and 16 were studied for comparison of the potential effects of the two types of flow deflectors on fish survival and condition. A concurrent TDG abatement investigation was undertaken by the Corps.

2.0 STUDY DESIGN

There are two primary components which effect fish using any exit route: direct and indirect effects. Direct effects are manifested immediately after passage (*e.g.*, instantaneous fish mortality, injury, loss of equilibrium); indirect effects (*e.g.*, predation, disease, physiological stress) may occur over an extended period or distance after passage. As in the earlier spillway survival investigation at Bonneville Dam (Normandeau Associates *et al.* 1996a), the present study was similarly designed to estimate the direct effects, using the HI-Z tag-recapture technique (Heisey *et al.* 1992). Spillway fish passage survival and condition were measured by a straightforward approach of introducing a known number of balloon tagged live fish into each spillbay (treatment), recapturing them immediately after passage, enumerating the alive and dead fish, and then carefully examining the condition of each fish. The sample sizes needed to estimate survival within a prespecified precision (ε) level were based on estimating the direct effects of passage.

Treatment fish were released into Spillbays 14 (existing flow deflector) and 16 (new deep flow deflector). Control fish were released downstream of Spillbay 17 to assess the effects of handling, transport, tagging, release, and recapture. Fish releases were set to occur over a two-week period in the spring (May/June) and a two-week period during the summer (August). Table 2-1 provides the daily fish released during the study.

Ambient river temperature during the study ranged from 12.3 to 14.2°C (54.2 to 57.6°F) in May/June and 19.5 to 20.5°C (67.1 to 68.9°F) in August (Table 2-1). Table 2-2 provides the range of spill

volumes at each tested spillbay and over the entire spillway during the study. The actual spill volume through Spillbays 14 and 16 differed by up to 2 kcfs (Table 2-2 and Figures 2-1 and 2-2). During fish releases, spill volume through Spillbays 14 and 16 ranged from 3.2 to 9.8 kcfs in May/June and from 4.0 to 7.9 kcfs in August, respectively (Table 2-2).

Total river flow also differed between the two periods (Table 2-2). Total river flow ranged from 229.3 to 352.4 kcfs during the May/June experiment and 112.8 to 178.8 kcfs during the August experiment. Total spill volume was maintained near 75 kcfs for that study condition in May/June and August and for the gas cap condition it ranged from 100 to 254 kcfs and from 98 to 121 kcfs in May/June and August, respectively. Tailwater elevation ranged from 18.2 to 25.0 ft msl in May/June and 10.4 to 13.9 ft msl in August. Forebay elevations ranged from 75.0 to 76.2 ft in May/June and 73.7 to 75.9 ft in August (Table 2-2). Figures 2-3 and 2-4 depict typical tailrace conditions during the May/June and August tests, respectively.

2.1 Sample Size Requirement

Prior to initiating the fish survival investigation at Bonneville Dam, the sample size requirement was determined to fulfill the primary objective of the study: achieving a prespecified precision (ε) level (within $\leq\pm 0.03$, 90% of the time) on the individual estimates of passage survival ($\hat{\tau}$). The sample size is a function of the recapture rate (P_A), expected passage survival ($\hat{\tau}$) or mortality ($1-\hat{\tau}$), survival of control fish (S), and the desired precision (ε) at a given probability of significance (α). In general, sample size requirements decrease with an increase in control survival and recapture rates. Only precision (ε) and α levels can be strictly controlled by an investigator. The expression to calculate sample sizes for achieving a prespecified precision (ε) level is given in Normandeau Associates *et al.* (1996a).

We calculated that with the following assumptions: a recapture rate of 0.98, control survival rate (S) of 0.99, and spillbay survival ($\hat{\tau}$) of 0.97, a precision (ε) level of $\leq\pm 0.03$, 90% of the time might be achievable with releasing 264 fish per treatment (Table 2-3). However, assuming a control survival of 0.95, recapture rate of 0.95, and the expected spillbay survival ($\hat{\tau}$) of 0.97, a sample size of 451 fish is needed to attain precision (ε) of ≤ 0.03, 90% of the time.

Based on the results of several recent spillbay survival experiments from other sites on the Columbia River Basin (Table 2-4), a sample size of approximately 250 fish per treatment release was deemed sufficient to attain a prespecified precision level (ε) of $\leq\pm 0.03$, 90% of the time. Given the above assumptions, the projected number of fish allocated for each study period was 1,600.

Past experience suggests that the sample sizes can be adjusted as a study progresses because the statistical results are available daily. If recapture and control survival rates are higher than initially assumed, sample size can be reduced. Conversely, if the values of these parameters are lower than initially assumed, as was the case in summer, then sample size must be increased to achieve the pre-specified statistical precision. However, under certain extenuating circumstances (*e.g.*, time, fish availability, or desired test condition constraints) sample size adjustments may not always be possible during the course of an experiment (Normandeau Associates *et al.* 2003).

2.2 Source and Maintenance of Specimens

Juvenile chinook salmon smolts used in the study were obtained from the Carson National Fish Hatchery, Bingen, Washington. Lots of 500 to 800 fish were transported from the hatchery via truck to the Bonneville Second Powerhouse Fingerling Engineering and Research Laboratory (BSPFERL) where they were held in raceways. The fish transport tank was equipped with a recirculation system and supplemental oxygen supply. The approximate transport time from the hatchery to the study site was 0.5 h. Approximately 24 h prior to tagging about 150 fish were transferred to a 200 gal holding

tank on the upper spillway deck. Fish holding tanks were supplied continuously with ambient river water and degassing units. All fish held in the BSPFERL raceways were supplied continuously with degassed ambient river water. Fish were held a minimum of 24 h prior to tagging to alleviate handling stress and to acclimate them to ambient river conditions. However, because of the shortage of fish during the summer experiment (the last two days), fish were supplemented from holding pools at The Dalles Dam where a similar survival investigation was ongoing. It is likely that additional transport time at high water temperatures may have imposed some stress on these transported fish.

2.3 Tagging and Release

Fish handling and balloon tagging techniques were identical to those previously used at Bonneville Dam in 1995 (Normandeau Associates *et al.* 1996a) and other hydroelectric projects on the Columbia River Basin (Heisey *et al.* 1992; Mathur *et al.* 1996, 1999; Normandeau Associates *et al.* 1996a,b,c,d). Briefly, lots of 5 to 10 fish were randomly removed from holding tanks on the spillway deck and transferred to the adjacent tagging site in nets equipped with a water sanctuary. 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. Fish were anesthetized in a 0.5% MS 222 solution (<5 min) and equipped with two uninflated balloon tags and a miniature radio tag. Table 2-1 shows the number of treatment and control fish, including the pre-test, released each day.

Figure 2-5 summarizes the length data of the treatment and control fish groups. Fish length averaged about 157 mm (range 132 to 238 mm) in May/June and 119 mm (range 96 to 153 mm) in August. All fish were longer than 130 mm in spring, while in summer most fish measured less than 130 mm.

Tags were attached via a stainless steel pin inserted through the musculature beneath the dorsal and adipose fins. A radio tag was attached in combination with the dorsal balloon tag (Heisey *et al.* 1992). A uniquely numbered VI tag (Visual Implant, Northwest Marine Technology, Inc., Shaw Island, Washington) was also inserted in the postocular tissue for use in tracking 48 h survival of individual recaptured fish. Fish also received a fin clip in the event the VI tag became dislodged. Balloon tagged fish were placed in a covered, 20 gal container continually supplied with ambient river water until fully recovered from anesthesia (generally 30 to 45 min, minimum 20 min). After full recovery from anesthesia, fish were individually placed into the induction system, tags were activated, and the fish were released. Inflation time of the tags was partially regulated by the temperature and amount of water injected into the tags just prior to release.

All treatment and control fish were released through an induction apparatus that consisted of a small holding basin attached to a 4 in diameter flexible hose (Normandeau Associates and Skalski 1999, 2000a; Normandeau Associates and Mid Columbia Consulting 2001; Normandeau Associates *et al.* 1996a,b,c). The release hose was supplied with river water to ensure fish were transported quickly within a continuous flow of water to the desired release point.

At each release site the 4 in diameter flexible hose was threaded through a 6 in diameter welded steel pipe. The steel pipe and hose was held in position by braces mounted on the upstream face of the spillbay lift gate. The terminus of each treatment release hose was oriented downstream and flush with the bottom of the lift gate.

Treatment fish were released at the mid locations of Spillbays 14 and 16. All release hoses were approximately 3 ft upstream of the lift gate. The tailrace control release pipe with induction hose was positioned downstream of Spillbay 17.

All procedures for handling, tagging, release, and recapture of fish were identical for all treatment and control groups. Fish were randomly selected from each day's transport. The goal was to release

40 fish through each of the two spillbays and 40 control fish for a daily total of 120 fish. However, due to extenuating circumstances, on a few days this release scheme could not be strictly adhered and less than 20 fish were released through any passage route and control and treatment releases could not be matched.

In spring (May/June) 368 and 407 fish were released through Spillbays 14 and 16, respectively (Table 2-1). A common control (total 404) was released for two treatment conditions. This release scheme proved logistically effective and provided some economy and utilized a relatively smaller number of fish. The release during the summer (August) consisted of 458 and 435 treatment fish through Spillbays 14 and 16, respectively, and 447 control fish (Table 2-1).

2.3.1 Autonomous Sensor Fish

Sensor fish, an instrumented package designed to determine exposure histories to turbulence and pressure during passage (PNNL *et al.* 2001) were equipped with three balloon tags and a miniature radio tag and released using the identical induction release hose into the same spillbays as for the live fish. Sensor fish were also released through the control release hose. The results of sensor fish passage are to be provided by PNNL in a separate report and may assist in explaining the hydraulic conditions causing the observed injuries on recaptured HI-Z tagged fish.

2.4 Fish Recapture

Upon passage, fish were tracked and retrieved when buoyed to the surface downstream of the spillbays by one of three recapture boat crews. Boat crews were notified of the radio tag frequency of each fish upon its release. Only crew members trained in fish handling were used to retrieve tagged fish. To minimize crew bias, no crew was specifically assigned to retrieve either control or treatment fish.

Radio signals were received on a 5-element Yagi antenna coupled to an Advanced Telemetry System receiver. The radio signal transmission enabled the boat crew(s) to follow the movement of each fish after passage and position the boats downstream for retrieval when the balloon tag buoyed the fish to the surface; the boats were required to remain a safe distance downstream of the turbulent discharge. Active radio tags which failed to surface were tracked for a minimum of 30 min and then periodically thereafter to ascertain if fish displayed movement patterns typical of emigrating smolts or that of a predator. Recaptured fish were placed into an on-board holding facility and tags were removed (Heisey *et al.*1992). Each fish was immediately examined for descaling and injuries and assigned appropriate condition codes, if necessary, per the descriptions presented in Table 2-5. Tagging and data recording personnel were notified via a two-way radio system of each fish's recovery time and condition.

Each recaptured injured fish was assigned a likely causal mechanism. Limited controlled experiments (Neitzel *et al.* 2000; PNNL *et al.* 2001) to replicate and correlate injury type and characteristic to a specific causative mechanism provides some indication of the cause of observed injuries in the field. Some injury symptoms can be manifested by two different sources which may lessen the probability of accurate delineation of a cause and effect relationship (Eicher Associates 1987).

All fish recaptured alive were transferred in 5 gal pails to a BSPFERL sectioned raceway for assessment of delayed effects (48 h). The raceway was continuously supplied with degassed ambient river water and shielded to prevent potential fish escape. Each day's treatment and control fish were held together in the same section of the raceway for 48 h.

As a precautionary measure, the Corps secured the services of personnel from the U. S. Department of Agriculture to scare gulls from the tailrace. Past experience has shown that the hazing of gulls minimizes the potential loss of buoyed experimental fish to gulls, and thus maintains the use of

prespecified sample sizes. However, predation by piscivores (*e.g.*, northern pikeminnow, smallmouth bass, or walleye) on tagged fish could not be controlled.

2.5 Classification of Recaptured Fish

As in the previous investigation at Bonneville Dam spillway (Normandeau Associates *et al.* 1996a) and other experiments (Normandeau Associates *et al.* 1996b,c,d, 1997; Normandeau Associates and Skalski 1998, 1999, 2000a,b,c) the immediate post-passage status of an individual recaptured fish and recovery of inflated tags dislodged from fish was designated as alive, dead, tag and pin recovered, unknown, or predation. The following criteria have been established to make these designations: (1) alive--recaptured alive and remaining so for 1 h; (2) alive--fish does not surface but radio signals indicate movement patterns typical of emigrating juveniles; (3) dead--recaptured dead or dead within 1 h of release; (4) dead--only inflated dislodged tag(s) are recovered, and telemetric tracking or the manner in which inflated tags surfaced is not indicative of predation; (5) unknown--no fish or dislodged tags are recaptured, or radio signals are received only briefly, and the subsequent status cannot be ascertained; and (6) predation--fish are either observed being preyed upon, the predator is buoyed to the surface, or subsequent radio telemetric tracking indicates predation (*i.e.*, rapid movements of tagged fish in and out of turbulent waters or sudden appearance of fully inflated tags). Unrecovered preyed upon fish are assumed dead in the survival calculations; alive recaptured fish suspected of predator attack were included with the alive category. However, because of higher fish losses due to predation in August, additional effort was expended to track potential predators with ingested HI-Z tagged fish.

Mortalities of recaptured fish occurring after 1 h were assigned 48 h post-passage effects although fish were observed at approximately 12 h intervals. Specimens were examined for descaling and injury, and those that died were necropsied to determine the probable cause of death. Additionally all specimens alive at 48 h were re-anesthetized and closely examined for injury and descaling. The re-examination of immobilized fish minimizes the need for extensive handling and associated stress upon immediate recapture. The initial examination allows detection of some injuries, such as bleeding and minor bruising that may not be evident after 48 h due to natural healing processes (Normandeau Associates *et al.* 1996a,b,c). Injury and descaling were categorized by type, extent, and area of body.

Injuries were also categorized as minor or major, based on laboratory studies by PNNL *et al.* (2001). These are as follows:

- Minor – Injuries that were visible but not life threatening and tended to heal and disappear over the post-exposure observation period. Small bruises (approximately 0.5 cm in diameter) with minor discoloration (most commonly observed at the dorsal insertion of the operculum) were given a minor injury rating because fish quickly recovered from such injuries with no apparent ill effects.
- Major – Any injury that resulted in prolonged (48 h) loss of equilibrium was life threatening, or persisted throughout the post–exposure observation were rated major. For example, a large bruise (>0.5 cm in diameter), damage to the spinal column, cuts with visible bleeding, injured eyeballs (bulging, hemorrhaged, or missing), gill damage (inverted gill arches severe enough to result in bleeding).

Fish without any visible injuries that are not actively swimming were classified as “loss of equilibrium”. This condition has been noted in past studies and often disappears within 10 to 15 min after recapture if the fish is not injured. Another metric, malady rate, was calculated based on fish with visible injuries, scale loss (>20% on either side), or loss of equilibrium attributed to spillbay

passage. Fish without maladies were designated "clean fish". The clean fish estimate ($\hat{CF}$) was based solely on fish physically recaptured and examined. This metric may provide insight into what passage conditions would provide safer fish passage.

2.6 Survival and Clean Fish Estimation and Data Analysis

Passage survival probabilities ($\hat{\tau}$) for each spillbay were estimated relative to the control fish survival (Heisey *et al.* 2003; Mathur *et al.* 1996). Data from individual daily trials (Appendix Tables A-1 and A-2) were used in the analysis. However, daily trials when less than 20 fish per treatment were released or excessive immediate control mortality (>10%) occurred were excluded in the survival estimation.

A likelihood ratio test was used to determine whether recapture probabilities were similar for alive (P_A) and dead (P_D) fish. The statistic tested the null hypothesis of the simplified model (H_O:P_A=P_D) versus the alternative of the generalized model (H_A:$P_A \neq P_D$). Depending upon the outcome of this analysis for the 1 h survival the parameters and their associated standard errors were calculated using that model.

Separate chi-square analyses were performed to test for homogeneity (P=0.05) between daily treatment and control releases with respect to recapture frequencies of alive, dead, and non-recovered fish. Homogeneity (P>0.05) between daily control trials within each season allowed pooling of data. Thus, data from all of the daily control releases within each season were pooled and survival for the two treatment conditions (two spillbays at each spill volume) was estimated relative to survival of the pooled control group in each season.

The 90% confidence intervals on the survival and clean fish estimates were calculated using the profile likelihood method (Normandeau Associates and Skalski 2000a; Normandeau Associates *et al.* 1996a,b,c; Appendix B). Differences in survival estimates and clean fish estimates between spillbays were tested, *a posteriori*, by log likelihood statistics (Appendix B).

As for the estimation of survival probabilities ($\hat{\tau}$), clean fish estimates ($\hat{CF}$) were similarly made relative to control fish. Only recaptured fish (both alive and dead) which were visibly examined were included in the clean fish analysis. Malady data from the individual daily trials (Appendix Tables A-3 through A-5) were used in the clean fish estimation. Fish injuries solely attributable to predator attack or tag induced (tear at tag site) were not considered passage related (Appendix Tables A-6 and A-7).

The statistical outputs are provided in Appendix B (output discussed in the report are highlighted) and the disposition of individual fish is given in Appendix A. The corresponding physical data is presented in Appendix C. Only summarized information is discussed in the body of the report.

2.7 Sluice Evaluation

A limited study was conducted at the B1 sluice on 30 August 2002 to ascertain if the relatively high predation and dislodged tag(s) rates observed for spillbay entrained fish also occurred for sluice passed fish. The same fish handling and testing procedures used for the spillbay experiment were followed here. No attempt was made to estimate passage survival for this limited experiment.

The fish were released into the collection channel, approximately 1 ft above the water surface, just downstream of the most downstream entrance. The Project was passing 137.4 kcfs, with approximately 3 kcfs spill through the sluice. Forebay and tailrace elevations were 75.8 and 11.1 ft, respectively, and ambient river temperature was 20.5°C (68.9°F).

3.0 RESULTS

3.1 Recapture Rates

Recapture rates (physical retrieval of both alive and dead fish) of treatment and control groups differed between May/June and August releases (Table 3-1). Recapture rates of treatment groups in May/June were greater than 95%; they ranged from 95.8 (Spillbay 16 at 75 kcfs) to 98.3% (Spillbay 14 at gas cap). Recapture rates of the control groups ranged from 95.4 (gas cap) to 100% (75 kcfs). Most of the recaptured fish were alive; most fish recaptured dead were entrained in Spillbay 16 at 75 kcfs (Table 3-1).

In August, recapture rates of both treatment and control groups were lower than 90% (Table 3-1). Recapture rates for treatment groups ranged from 83.7 (Spillbay 14 at 75 kcfs) to 89.6% (Spillbay 16 at gas cap). Recapture rates of control groups ranged from 87.5 (gas cap) to 87.8% (75 kcfs). A relatively high percentage (8.6 to 11.5%) of fish from all groups was assigned to the dead category, either the fish were preyed upon or the balloon tags had become detached from the fish (fish assumed dead). Likely contributors to a relatively high percentage of fish classified as either dead or captured dead were fish being attacked by predators (Figure 3-1), the high susceptibility of fish to stress associated with handling, tagging, and release at high water temperatures (≥19.5°C or 67.1°F), and smaller fish size in summer (average about 119 mm) than in spring (average about 157 mm), which may have also contributed to some tag dislodgment. Some effects of these factors could be gleaned on the disposition of daily control releases; mortality in 8 of 11 daily control trials in August exceeded 10%.

Despite the above observations, chi-square analyses indicated homogeneity ($P>0.05$) between daily control trials, allowing for the pooling of data. Homogeneity ($P>0.05$) was also revealed between each daily treatment trial. Thus, survival for each treatment condition was estimated relative to survival of the pooled control data.

Likelihood ratio tests indicated no significant differences ($P>0.05$) between the simplified ($H_O:P_A=P_D$) and generalized ($H_A:P_A\neq P_D$) models. Thus, survival probabilities and their associated standard errors were calculated using the simplified model for all test conditions. These values are highlighted in Appendix B (statistical outputs).

3.2 Retrieval Times

Retrieval times (the interval between fish release through the induction system and physical retrieval) for various releases were short and similar (Figure 3-2). Average times were 10 to 11 min for treatment groups and 12 min for control groups in the spring. Some fish, however, took more than two hours (maximum 144 min) to be retrieved; these fish had become trapped in an area inaccessible to boat crews and had to be retrieved from shore.

In summer, the retrieval times averaged 9 to 12 min for treatment groups and 8 min for control groups. As in the spring experiment, some fish were initially inaccessible by boat when they became trapped in the eddy over a deep hole in the middle of the tailrace and took nearly two hours (119 min) for retrieval.

3.3 Survival Probabilities ($\hat{\tau}$)

Some differences (≤2%) in immediate (1 h) survival probabilities occurred but were mostly limited to between spillbays at 75 kcfs in both seasons but with opposing trends (Table 3-2). In spring, survival was estimated at 0.959 for fish entrained in Spillbay 16 at 75 kcfs and at 0.979 for those entrained in Spillbay 14 at the same spill volume. In summer, however, the immediate survival was

slightly higher (1.0) at Spillbay 16 than at Spillbay 14 (0.989) at 75 kcfs. Immediate survival exceeded 0.98 at all other test conditions.

Precision (ε) on immediate survival estimates for spring were $\leq\pm$0.03, 90% of the time. However, precision (ε) on all estimates in the summer was lower ($0.057 \leq\pm\ \varepsilon \leq\pm\ 0.075$). The lower precision ($\varepsilon$) in summer was primarily due to low recapture rates (loss of experimental and control fish to various sources). Time constraints and the availability of the desired spill volume for the test precluded an opportunity to release additional fish to improve precision (ε) on the summer estimates.

The 48 h survival probabilities followed a similar trend (Table 3-2). The survival probability at 75 kcfs was lower (0.886) in summer at Spillbay 16 than Spillbay 14 (0.905) at the same spill volume. Survival exceeded 1.0 at other test conditions in summer. The latter conditions in summer occurred due to a greater loss of control fish than of the treatment groups. Again, the prespecified precision (ε) level of $\leq\pm$0.03, 90% of the time, was met on all 48 h estimates in spring but not in summer (Table 3-2).

As stated above, loss of tagged experimental and control fish to various non-passage sources in summer were contributory factors; in some cases control fish losses exceeded acceptable levels (>10%). As an example, 11% of control fish were assigned dead due to predation, dislodged tags, or stationary radio signals (Table 3-1). Some additional mortality also occurred among the control fish during the 48 h holding period; overall, greater than 16% of controls were lost during the 48 h holding period in summer. In contrast, in spring 1 to 2% of the control fish were lost during the 48 h period (Table 3-1).

3.4 Injury Classification, Rates, and Probable Causal Mechanisms

All recaptured fish were examined for types of external injuries and those that were recaptured dead without external injuries were examined for internal injuries. Detailed descriptions of all recaptured injured fish are presented in Appendix Tables A-6 and A-7. Injury percentages given below are based on the total number of recaptured fish examined and not the total number of fish released and refer to only passage-related injuries, adjusted for controls.

Passage-related injury rates appeared to be both a function of spill volumes and spillbays (Table 3-3). Higher injury rates (1.9 to 8.6%, adjusted for controls) occurred at the lower spill volume (75 kcfs) in both seasons than at the gas cap spill (0.4 to 0.9%). Injury rates between spillbays were more pronounced at 75 kcfs than at the gas cap. Injury rates at Spillbay 14 ranged from 1.9 to 6.3% and 5.7 to 8.6% at Spillbay 16 at 75 kcfs, yet rates were less than 1% at the gas cap spill at both spillbays.

The common injury types were hemorrhaged or damaged eye(s), bruises, and scrapes (Table 3-3 and Figure 3-1). Few treatment fish sustained lacerations (1) or internal injuries (4), and no fish sustained opercular damage.

When the incidence of equilibrium loss and or scale loss are included with the visibly injured fish to obtain a malady rate (Table 3-4) a similar pattern is observed. Adjusted for controls, spring and summer malady rates for both spillbays are lower (1.2 to 2.3%) at gas cap spill than at 75 kcfs (2.9 to 12.1%). Fish entrained in Spillbay 14 had a lower rate (2.9%) than those passed through Spillbay 16 (7.0%) in the spring at 75 kcfs, but a higher level (12.1%) than Spillbay 16 (9.3%) in the summer. At the gas cap spill the malady rates were similar (1.2 to 2.3%) for both spillbays and seasons.

Shear forces were the probable cause for most of the eye injuries (especially hemorrhage) observed among treatment fish. Bruises and scrapes are most likely the result of contact with spillway or tailrace structures.

3.5 Clean Fish Estimates ($\hat{CF}$)

Estimates of clean fish (*i.e.*, fish without visible injury, scale loss, or loss of equilibrium), based on recaptured fish, are provided in Tables 3-4 and 3-5.

The clean fish estimates differed more between spill volumes than between spillbays or tailwater condition (Table 3-5). At the gas cap spill, all of the clean fish estimates were ≥0.97. However, at 75 kcfs, estimates varied with respect to individual spillbay and period. During the low tailwater (summer) condition at 75 kcfs, estimates ranged from 0.879 (Spillbay 14) to 0.907 (Spillbay 16); at the high tailwater condition (spring) at Spillbays 14 and 16 at 75 kcfs, the estimates were 0.973 and 0.931, respectively. Except for the confidence intervals around the two lowest estimates (0.879 and 0.907) at Spillbays 14 and 16 at 75 kcfs, the confidence intervals of the remaining estimates overlapped each other (Figure 3-3).

The frequency of occurrence of fish with and without maladies approached a significance level (P=0.0764, 3 df) across all conditions tested in the spring (Appendix B). Spillbay 16 at 75 kcfs contributed to most of the total chi-square value (4.92 of 6.86). When tested for differences in frequencies of fish with and without maladies between spill volumes at Spillbay 16 in spring chi-square revealed significance (P=0.022, 1 df). No other significant differences (P>0.10) were noted between other conditions tested in the spring.

Differences were significant (P=0.0001, 3 df) across conditions in the summer; the differences were primarily due to spill volumes. At both spillbays at low tailwater the frequencies of fish without maladies at gas cap spill were higher than fish with maladies (P=0.007 and 0.0055, 1 df). Also, when pooled across spillbays, the frequencies of fish without maladies were significantly higher (P=0.0001, 1 df) at the gas cap spill than at 75 kcfs.

3.6 Sluice Passed Fish

The recapture rate of the sluice passed fish in August was 93.0% (93 of 100). The seven non-recaptured fish propagated stationary radio signals and were assumed dead. These fish may have been trapped in crevices between rocks. All recaptured fish were alive. However, 12 of 93 (12.9%) fish died over the 48 h holding period, a pattern similar to that observed for some spillbay entrained fish held for 48 h. None of the 93 recaptured fish were injured or suffered loss of equilibrium. The disposition of these individual fish is given in Appendix Table A-2.

3.7 Sensor Fish

The results of sensor fish passage are to be provided by PNNL in a separate report.

4.0 DISCUSSION

The primary objectives and assumptions established for the experiment were met for the spring, high tailwater condition (May/June). However, the objectives for the summer (August), low tailwater condition could not be fully realized, particularly the prespecified precision level (ε), due to some unmet assumptions. The summer investigation was affected by a relatively high loss of experimental and control fish to predation (most likely by northern pikeminnow) and tag dislodgment resulting in lower recapture rates than anticipated and lowering the effective sample size. Prior to initiating the investigation a sample size of about 250 fish for each treatment group was selected with the following assumptions: recapture rate of 98.0%, expected survival rate of 97%, and control survival of 98.0% to obtain a precision (ε) of ≤±3%, 90% of the time on the resulting survival rates. Precision (ε) on survival estimates generated for spring released fish was within the prespecified criterion. The realized recapture rates of summer treatment fish ranged from 83.7 (Spillbay 14 at 75 kcfs) to 89.6% (Spillbay 16 at gas

cap) and those of control ranged from 87.5 (gas cap) to 87.8% (75 kcfs). It was estimated that 3.9 (Spillbay 16) to 4.8% (Spillbay 14) of treatment and 5.1% of control fish were lost to predation in summer. Thus, the preselected sample size was deemed inadequate to achieve the desired precision (ε) level of $\leq\pm$3%, 90% of the time on survival rates. For the spring releases, the estimated loss of tagged fish to predation was considerably less both on treatment (0 to 0.8%) and control (0 to 0.8%) and fish appeared more tolerant to stress associated with handling, tagging, and release.

Smaller fish size (*i.e.*, less musculature, resulting in potential tag dislodgment) may have also affected the summer estimates to a certain extent. Tag dislodgment (fish conservatively assumed dead) was more common on fish <120 mm long than on fish >120 mm; in some studies tag dislodgment did not necessarily indicate fish mortality (Mathur *et al.* 1996). Of the 70 tag dislodgment(s) observed in summer, 45 (64%) occurred on fish <120 mm long and the remainder on larger sized fish. In the spring, only four tag dislodgment(s) occurred; all fish were longer than 130 mm.

A relatively high loss of control fish in summer also affected the precision (ε) of the survival estimates. The higher fish losses were likely due to the susceptibility of fish to stress associated with handling, tagging, and release at higher water temperatures (>19.5°C or 67.1°F). Immediate (1 h) losses of fish in the daily control trials (either through predation or handling/tagging stress) ranged from 8.0 to 29.5%; in 8 of 11 daily summer trials control losses exceeded 10%, the immediate loss across all control releases was 14.5%. Further losses occurred over the 48 h holding period. Muscle atrophy, particularly at the tagging site, was observed, along with bacterial or fungal infection. These observations were also corroborated by the fish vulnerability in holding tanks and raceways prior to tagging, handling, and release. Fish losses, though non-quantified, occurred throughout the summer experiment. The handling, tagging, and recapture methods were identical both in the spring and summer. These observations are similar to those made in a concurrent survival experiment at The Dalles Dam where control fish losses in combination with predation losses were severe enough that the investigation had to be prematurely curtailed (Normandeau Associates *et al.* 2003); fish from both studies came from the same hatchery. In contrast, control losses in excess of 6% are rare; in only 3 of 48 (6%) similar investigations conducted at lower water temperatures in spring and fall (<15°C or 59°F) elsewhere on the Columbia River Basin did losses exceed 6% (Normandeau Associates *et al.* 2003).

The effects of new flow deflectors at Spillbay 16 on immediate (1 h) passage survival relative to Spillbay 14 (existing deflectors) were not consistent across all conditions tested. At the gas cap spill in spring, survival was identical (0.99) at both spillbays; however, at 75 kcfs spill survival at Spillbay 14 (0.979) was slightly higher than at Spillbay 16 (0.96). At the gas cap spill in summer, survival at both spillbays was identical and higher (1.0) than at 75 kcfs (0.905 at Spillbay 14 and 0.886 at Spillbay 16).

The effects of the new shallow flow deflector in Spillbay 16 *per se* on fish survival may be confounded by differential spill volumes at the two spill rates tested within and between spillbays. Spill volume, particularly at gas cap, was higher by as much as 2 kcfs through Spillbay 16 than through Spillbay 14. A similar magnitude of variability existed in spill volumes within a spillbay between 75 kcfs and gas cap spill.

Although the present study was not specifically designed to assess the potential effects of differential spill volumes from a single spillbay, some evidence emerged suggesting a higher spill volume from a single spillbay, rather than the same flow volume split over multiple spillbays, may be beneficial to fish passage. The estimated survival rates of chinook salmon smolts in passage through Spillbay 14 (equipped with shallow flow deflectors similar to those at Spillbay 4) in the present study were lower (90.5 to 97.9%) with the spill volume ranging from 3.2 to 4.8 kcfs. The survival of chinook salmon

smolts in passage through Spillbay 4 was estimated at 100% (Normandeau Associates *et al.* 1996a). The spill volume was 12 kcfs with little discharge from other spillbays during fish release. It is possible that a greater spill volume through a single spillbay provided a higher "water cushion" to entrained fish at Spillbay 4 than the 3.2 to 4.8 kcfs through Spillbay 14 at 75 kcfs in the present study.

Some evidence exists to suggest that a higher spill volume through a single spillbay may be more beneficial for fish passage survival than dividing the same spill volume among two or more spillbays. In an earlier study at Bonneville Dam the survival of chinook salmon smolts in passage through Spillbays 2 (without a flow deflector) and 4 (shallow flow deflectors similar to those at Spillbay 14) was estimated at 100%; the spill volume was 12 kcfs with no discharge from other spillbays. Survival at Spillbay 14 (spill volume 3.2 to 7.9 kcfs) for all test conditions in the present study was estimated at 90.5 to 97.9%. At the gas cap with a higher spill volume through each spillbay survival ranged from 98.6 to 100%. Differences may be due to a greater "water cushion" for entrained fish at a higher spill volume. Injury rates were negligible (<1%) in the earlier study as well.

The magnitude of the variability in the potential effects of flow deflectors at spillbays on fish survivability may be a function of configuration and hydraulics, stilling basin depth, obstructions in the flow path, species tested, experimental protocols, and spill volume (Normandeau Associates *et al.* 1996a,b,c). Survival of chinook salmon smolts in passage through a spillbay (spill volume of 4 kcfs) at Lower Granite Dam was reported at 0.975 (Mathur *et al.* 1999). All eight spillbays at Lower Granite Dam are equipped with flow deflectors. Findings were similar (survival 0.980 to 1.0) for juvenile steelhead (*Oncorhynchus mykiss*) released at three spill rates (1.8, 5.6, and 9.5 kcfs) through a spillbay at the Little Goose Dam (Normandeau Associates *et al.* 1997); these spillbays are equipped with a "roller bucket" type of energy dissipating structure in the stilling basin. At The Dalles Dam (no flow deflector and spillbay equipped with downstream energy dissipating baffles and end sill) the estimated survival at an unmodified spillbay (spill volume tested was 10.5 kcfs) was 0.954 and 0.992 at a modified I-slot configured spillbay (Normandeau Associates *et al.* 1996b). At the Wanapum Dam on the mid Columbia River, survival of juvenile salmonids ranged from 0.946 to 1.0 in passage through non-modified spillbays and from 0.920 to 0.990 at spillbays equipped with various configurations of flow deflectors (shallow and deep seated) or an overflow weir (Normandeau Associates *et al.* 1996c; Normandeau Associates and Skalski 1999, 2000b). Survival was greater than 0.980 (range 0.984 to 1.0) in passage through spillbays equipped with shallow or deep flow deflectors at Rock Island Dam, Columbia River (Heisey *et al.* 2003).

Even though some problems were encountered during the conduct of the study, which may have affected the point estimates of the survival probabilities and associated precision, literature review indicates spillway passage survival probabilities (direct effects) for juvenile salmonids may not be assumed at an ideal 1.0 (Mathur *et al.* 1999; Heisey *et al.* 2003). Results from the present study at Bonneville are no exception. Six of the eight survival estimates were less than 1.0 and two point estimates (88.6% for Spillbay 16 and 90.5% for Spillbay 14 at 75 kcfs in summer) in the present study are among the lowest reported by Heisey *et al.* (2003). They summarized the results of 56 different juvenile salmonid spillway passage survival tests at hydroelectric dams on the Columbia River Basin and found survival rates from 91 to 100% with 34% of the point estimates less than 98%. An earlier study (Normandeau Associates *et al.* 1996a) at Bonneville Dam reported a survival rate of chinook salmon smolts at 100% in passage through Spillbays 2 (no flow deflector) and 4 (equipped with existing shallow type flow deflectors). Differences between site-specific characteristics and experiment conditions may have contributed to the variability in the reported estimates (Heisey *et al.* 2003).

Passage through spillways can subject entrained fish to widely varying stilling basin hydraulic conditions. Some of the site-specific characteristics include obstructions in the flow path, abrasive surfaces, magnitude of water cushion, spill pattern, volume, spillway configuration, pressure changes,

and shear. The actual path traversed by each live balloon tagged fish released into each spillbay in the present study is unknown. However, data from concurrent release of balloon tagged "sensor fish" by Battelle Northwest Laboratory personnel to simulate the hydraulic conditions experienced by live released fish may provide some insights into the magnitude and duration of exposure to prevailing hydraulic conditions. These data may explain the observed results of the live fish releases.

Survival is lower when a fish strikes a solid object, even at lower velocities, than when they enter standing water without obstructions. A variable mortality rate was observed by Bell *et al.* (1972) when fish struck a solid object at a velocity exceeding 20 ft/s, yet no fish injury was observed when fish impacted flowing water at a velocity of about 60 ft/s. They concluded that fish could be injured in any high-energy flow situation that creates momentarily localized sharp velocity changes. Based on field and laboratory tests on fish little to no injury (<1%) was observed on juvenile salmon subjected to entry velocities as high as 50 ft/s (PNNL *et al.* 2001). The estimated velocity ($V = \sqrt{2gh}$) of the discharge jet upon tailrace interception ranged from 57 to 64 ft/s at Bonneville Dam.

As indicated earlier, differential losses of experimental fish to predators affected the study results to a certain extent, particularly the precision on survival estimates in summer. These losses were undoubtedly related to differences in water temperatures and associated predator activity. Water temperatures were less than 14.0°C (57.2°F, range 10.5 to 13.5°C or 50.9 to 56.3°F) in spring and greater than 19.0°C (66.2°F, range 19.5 to 21.0°C or 67.1 to 69.8°F) in summer. Predator activity, primarily northern pikeminnow on smaller sized juvenile salmonids, increases substantially when water temperature ≥17.2°C or ≥63.0°F (Brown and Moyle 1981; Reiman *et al.* 1991; Vigg and Burley 1991). The effect of high water temperatures on predation losses of experimental fish was also evident in a concurrent spillway survival investigation at The Dalles Dam; the configuration and spill patterns are, however, different between The Dalles and Bonneville. The predation losses of experimental fish at The Dalles (Normandeau Associates *et al.* 2003) in summer were estimated at about 11% when the water temperature exceeded 19.5°C (67.2°F). The test specimens used at both Bonneville and The Dalles spillways were obtained from the same hatchery and were of similar size. The importance of higher water temperatures and the associated higher predator activity was also borne out by spillbay tests conducted at Bonneville Dam in October and November 1995 (Normandeau Associates *et al.* 1996a). Juvenile chinook salmon (mean length 124 mm) were released through Spillbays 2 and 4. Spill through the two test bays was about 12 kcfs. The overall predation loss was zero; the water temperature was 14.5 to 17.0°C (57.2 to 62.6°F). It should be noted that none of the balloon tag-recapture studies were specifically designed to quantify predation, but the above observations provide some information on the reduced experimental precision, predation potential, and timing of future similar studies.

The assignment of causal mechanisms to individual injury types in the field, though difficult, followed symptoms noted by Neitzel *et al.* (2000) in laboratory studies. They reported that localized shear forces caused a variety of injuries to the eyes, opercles, and body of juvenile salmonids. In the current study, almost all of the passage-related eye injuries and tears to the opercle were attributed to shear forces. Injuries such as scrapes and bruises on the head or body were attributed to contact or impact with spillbay or tailwater structures (baffles, boulders, etc.). Some bruises, however, can be caused by shear forces (Neitzel *et al.* 2000).

Survival and clean fish estimates followed similar trends (Table 4-1). However, the clean fish estimates were lower (0.4 to 2.8%) than the survival estimates except at the 75 kcfs discharge through Spillbay 16 in the summer (90.7%, clean fish, and 88.6%, survival). The clean fish estimate would be expected to be lower than the survival estimate since not all maladies result in death.

Even though the effects of flow deflectors *per se* on fish survival may have been confounded by differential spill volumes through each tested spillbay, it appears clean fish estimates provided more

consistent results on the potential effects of spill volumes. Clean fish estimates at 75 kcfs were lower, particularly at both spillbays, than at the gas cap spill during the summer low tailwater experiments. It is possible that the higher gas cap spill during low tailwater may have provided a greater water "cushioning" effect by increasing the submergence depth in the immediate vicinity of the flow deflector. At high tailwater in the spring such water cushioning may not have such an additive effect.

5.0 CONCLUSIONS

As estimated by the two metrics (survival and clean fish) high spill volume (gas cap) appeared to be more benign to fish than a lower spill volume (75 kcfs), particularly at low tailwater. At the gas cap spill, fish passage survival (direct effects) through Spillbays 14 (equipped with a shallow flow deflector) and 16 (equipped with a deep flow deflectors) ranged from 99 to 100%; the corresponding clean fish estimates ranged from 98 to 99%.

Relative to tailwater elevations, differences in survival were more pronounced at 75 kcfs than at the gas cap at both spillbays. During the spring high tailwater period, survival at 75 kcfs was 96% (Spillbay 16) to 98% (Spillbay 14), but at the low tailwater experiment survival was 89% (Spillbay 16) and 90% (Spillbay 14). The corresponding clean fish estimates at 75 kcfs for Spillbays 16 and 14 were 93 and 97% at high tailwater and 91 and 88% at low tailwater.

It is possible that the higher spill volume through each tested spillbay at the gas cap may have provided a greater "water cushion" than at 75 kcfs when the spill volume through each spillbay was lower by as much as 2 kcfs. Causal mechanisms of injuries were attributed to shear and collisions with hard objects in the stilling basin.

The effects of spillbay flow deflectors were not easily discernable. These effects on fish survival *per se* may have been confounded to a certain extent by the differential in absolute spill volumes between the two tested spillbays; a potential consequence is in the difference in the water "cushion" provided downstream of a tested spillbay. At the gas cap, particularly at Spillbay 16, spill volume was as much as 2 kcfs higher than through Spillbay 14 and may have provided a greater water cushion. Future studies should strive to maintain a similar spill volume through the tested spillbays to more clearly isolate the effects of flow deflectors on fish survival.

The susceptibility of juvenile salmonids to the stress associated with handling, tagging, and release at high water temperatures (>19.0°C or 66.2°F), resulting in high control losses (>10%), and losses to predation (2.8 to 6.4%), lowered precision (5.7% $\pm\leq \varepsilon \leq \pm$7.5%) on summer survival estimates. In contrast, losses to these sources in spring (water temperatures of 12.3 to 14.2°C or 54.1 to 57.6°F) were less than 2%. To minimize losses from these sources and improve the precision of the estimates, future studies at the Bonneville Project should be conducted at water temperatures ≤15.0°C (59.0°F).

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TABLES

Table 2-1

Daily spring (20 May to 1 June) and summer (18 to 30 August) releases of juvenile chinook salmon smolts into Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) and downstream of Spillbay 17 (control) and water temperatures under two spill volumes (75 kcfs and gas cap), Bonneville Dam 2002.

	River Temperature		Spillbay 14		Spillbay 16		Control	
Date	**(°C)**	**(°F)**	**75 kcfs**	**Gas Cap**	**75 kcfs**	**Gas Cap**	**75 kcfs**	**Gas Cap**
			May/June (Spring, High Tailwater)					
20 May*	12.8	55.1	5	--	4	--	5	--
21 May	12.3	54.2	40	--	39	--	39	--
22 May	12.6	54.7	--	35	--	33	--	10
23 May	12.8	55.1	--	39	--	36	--	38
24 May	12.8	55.1	--	36	--	39	--	45
25 May	13.1	55.6	--	35	--	35	--	38
26 May	13.4	56.2	40	--	41	--	41	--
27 May	13.8	56.9	40	--	41	--	40	--
28 May	13.7	56.7	10	--	45	--	44	--
29 May	13.7	56.7	--	35	--	35	--	33
30 May	13.7	56.7	--	29	--	33	--	36
31 May	13.7	56.7	--	29	--	30	--	40
01 Jun	14.2	57.6	--	15	--	13	--	19
Totals			***135***	***253***	***170***	***254***	***169***	***259***
			August (Summer, Low Tailwater)					
18 Aug	20.5	68.9	--	40	--	39	--	30
19 Aug	20.5	68.9	--	40	--	41	--	40
20 Aug	20.0	68.0	--	40	--	40	--	40
21 Aug	19.5	67.1	--	40	--	40	--	50
22 Aug	19.5	67.1	40	--	40	--	40	--
23 Aug	20.0	68.0	40	--	40	--	40	--
24 Aug	20.0	68.0	28	--	38	--	28	--
25 Aug	20.0	68.0	40	--	37	--	47	--
26 Aug	20.0	68.0	--	45	--	45	--	45
27 Aug	20.0	68.0	--	45	--	45	--	44
28 Aug	20.5	68.9	18	--	20	--	43	--
29 Aug	20.5	68.9	42	--	10	--	--	--
Totals			***208***	***250***	***185***	***250***	***198***	***249***
			August (Summer, Low Tailwater)					
30 Aug	20.5	68.9	100 fish released through the sluice with 3.0 kcfs spill)					

* Pretest release to identify potential problems with tag-release and recapture.

Table 2-2

Summary of physical conditions during release of juvenile salmon through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) and downstream of Spillbay 17 (control) at two spill volumes (75 kcfs and gas cap), Bonneville Dam, May/June (spring) and August (summer), 2002. Hourly physical conditions data is presented in Appendix C.

Condition Tested	Spill Volume (kcfs)		Total Spill Volume (kcfs)	Spill as Percent of River Flow	River Flow (kcfs)	Elevation (ft)		Net Head (ft)
	Spillbay 14	Spillbay 16				Forebay	Tailwater	
				May/June (Spring)				
75 kcfs	3.2-4.8	3.2-6.4	75.2-91.5	26-34	229.3-292.8	75.5-76.2	18.2-21.7	54.2-57.8
Gas cap	5.1-7.9	7.1-9.8	99.9-254.2	31-57	253.2-352.4	75.0-76.1	20.5-25.0	50.4-55.3
				August (Summer)				
75 kcfs	4.0-4.1	5.0-6.0	74.6-76.9	43-66	112.8-178.8	73.8-75.9	10.4-13.7	60.4-64.5
Gas cap	5.0-6.0	6.9-7.9	97.5-120.5	72-77	132.8-158.6	73.7-75.6	11.1-13.9	60.1-64.3

Table 2-3

Required sample sizes (R) if control survival (S) is 0.99, 0.98, or 0.95, recapture rate (P_A) is 0.99, 0.98, or 0.95, and expected survival probability ($\hat{\tau}$) of treatment fish passed is 0.95, 0.97, and 0.99 to achieve a precision level (ε) of ≤±0.03, 90% of the time.

	Expected Survival ($\hat{\tau}$)		
Control Survival (S)	**0.95**	**0.97**	**0.99**
	Recapture Rate=0.99		
0.99	256	205	150
0.98	314	264	212
0.95	496	451	405
	Recapture Rate=0.98		
0.99	314	264	218
0.98	373	325	274
0.95	556	514	469
	Recapture Rate=0.95		
0.99	496	451	405
0.98	556	514	469
0.95	745	709	670

Table 2-4

Sample size, recapture and control survival rates, and estimated 48 h survival (direct effects) of anadromous fishes in passage through non-turbine exit routes at hydroelectric dams. Estimates based on balloon tag-recapture methodology (Heisey *et al.* 1992). Reproduced from Normandeau Associates *et al.* (2003). Present study data are shown in italics.

Station	Exit Route	Species	Sample Size	Head (ft)	Test Spill Discharge (kcfs)	Recapture Rates (%)		Control Survival (%)	Passage Survival (%)
						Control	Treatment		
The Dalles, WA	Spillway	Chinook salmon	270	81	10.5	97.0	94.1	97.0	95.5
	Spillway[b]	Chinook salmon	271	81	10.5	97.0	97.4	97.0	99.3
	Spillway[b]	Chinook salmon	210	81	4.5	96.2	94.3	96.2	99.0
	Spillway	Chinook salmon	391	75-80	7.5-10.5	98.7	96.7	98.0	97.4
	Spillway	Chinook salmon	396	75-80	4.5-7.5	98.7	95.4	98.0	97.4
	Spillway	Chinook salmon	405	75-80	3.0-6.0	98.7	93.8	98.0	93.8
Wanapum, WA	Sluice	Chinook salmon	195	79	2.0	100.0	97.9	100.0	97.4
	Spillway	Chinook salmon	235	79	4.3	100.0	99.6	99.6	99.6
	Spillway[a]	Chinook salmon	235	79	4.3	100.0	97.9	99.6	95.7
	Spillway[b]	Chinook salmon	155	79	2.0	100.0	97.4	100.0	92.0
	Spillway[b]	Chinook salmon	160	79	4.0	96.7	98.8	96.7	96.9
	Spillway	Chinook salmon	180	82	2.8	100.0	100.0	94.5	100.0
	Spillway	Chinook salmon	244	82	6.0	100.0	99.6	95.8	99.3
	Spillway	Chinook salmon	130	82	11.5	98.4	99.2	94.3	94.6
	Spillway[a]	Chinook salmon	200	82	2.8	100.0	100.0	96.5	99.0
	Spillway[a]	Chinook salmon	199	82	6.0	100.0	98.5	95.3	97.6
	Spillway[a]	Chinook salmon	191	82	11.5	98.4	96.7	94.3	92.8
	Spillway	Chinook salmon	180	82	2.8	100.0	100.0	97.5	99.4
	Spillway	Chinook salmon	169	82	6.0	100.0	100.0	95.8	97.6
	Spillway	Chinook salmon	198	82	7.5	100.0	100.0	94.3	99.5
	Spillway[a]	Chinook salmon	180	82	2.8	100.0	100.0	96.5	98.3
	Spillway[a]	Chinook salmon	170	82	6.0	100.0	98.8	95.3	98.2
	Spillway[a]	Chinook salmon	210	82	7.5	100.0	99.0	82.3	97.6
	Bypass Pipe	Chinook salmon	500	76-80	0.4	99.6	99.8	99.6	100.0
Bonneville, WA	Spillway	Chinook salmon	280	60	12.0	96.1	96.8	96.1	100.0
	Spillway[a]	Chinook salmon	280	60	12.0	96.1	99.3	96.1	100.0
	Spillway[a]	*Chinook salmon*	*130*	*54-58*	*3.2-4.8*	*100.0*	*97.7*	*97.7*	*97.9*
	Spillway[a*]	*Chinook salmon*	*166*	*54-58*	*3.2-6.4*	*100.0*	*95.8*	*97.7*	*95.9*
	Spillway[a]	*Chinook salmon*	*238*	*50-55*	*5.1-7.9*	*95.4*	*98.3*	*97.7*	*98.6*
	Spillway[a*]	*Chinook salmon*	*241*	*50-55*	*7.1-9.8*	*95.4*	*97.1*	*97.7*	*99.0*
	Spillway[a]	*Chinook salmon*	*166*	*60-65*	*4.0-4.1*	*86.9*	*83.7*	*82.6*	*90.5*
	Spillway[a*]	*Chinook salmon*	*175*	*60-65*	*5.0-6.0*	*86.9*	*88.1*	*82.6*	*88.6*
	Spillway[a]	*Chinook salmon*	*250*	*60-64*	*5.0-6.0*	*87.6*	*87.6*	*82.6*	*100.0*
	Spillway[a*]	*Chinook salmon*	*250*	*60-64*	*6.9-7.9*	*87.6*	*89.6*	*82.6*	*100.0*

Table 2-4

Continued.

Station	Exit Route	Species	Sample Size	Head (ft)	Test Spill Discharge (kcfs)	Recapture Rates (%)		Control Survival (%)	Passage Survival (%)
						Control	Treatment		
Lower Granite, WA	Spillway[a]	Chinook salmon	120	90	3.4	100.0	100.0	100.0	97.5
	Surface Bypass Collector[a]	Chinook salmon	120	90	3.4	100.0	99.2	100.0	95.8
	Spillway[a]	Chinook salmon	130	90	3.4	92.1	94.6	92.1	97.6
	Surface Bypass Collector[a]	Chinook salmon	133	90	3.4	92.1	97.8	92.1	97.0
Little Goose, WA	Spillway	Steelhead	150	90	5.6	100.0	100.0	100.0	100.0
	Spillway	Steelhead	150	90	9.5	100.0	100.0	100.0	100.0
	Spillway	Steelhead	100	90	1.8	99.0	100.0	99.0	100.0
	Spillway[c]	Steelhead	40	90	5.6	100.0	98.0	100.0	100.0
	Spillway[c]	Steelhead	120	90	9.5	100.0	99.0	100.0	98.3
	Spillway[a]	Steelhead	150	90	5.6	100.0	99.0	100.0	98.0
	Spillway[a]	Steelhead	150	90	9.5	100.0	100.0	100.0	100.0
	Spillway[a]	Steelhead	100	90	1.8	99.0	100.0	99.0	99.0
	Spillway[a,c]	Steelhead	39	90	5.6	100.0	100.0	100.0	100.0
	Spillway[a,c]	Steelhead	120	90	9.5	100.0	99.0	100.0	99.2
Rock Island, WA	Spillway[b,d]	Chinook salmon	250	41	1.9	NA	98.0	NA	95.1
	Spillway[b]	Chinook salmon	250	41	10.0	NA	100.0	NA	98.4
	Spillway[b]	Chinook salmon	200	41-49	2.5	100.0	99.5	99.5	99.5
	Spillway[b]	Chinook salmon	200	41-49	10.0	100.0	100.0	99.5	99.5
	Spillway[a,b,e]	Chinook salmon	200	40-43	2.5	100.0	99.5	100.0	99.0
	Spillway[a,b]	Chinook salmon	200	40-43	2.5	100.0	100.0	100.0	100.0

a Spillbay with flow deflector.
a* Spillbay with deep flow deflector.
b Overflow weir or slot to attract surface oriented juvenile salmonids.
c Fish released into head pond vortices upstream of tainter gates.
d Spill directed onto concrete slab; survival is relative to survival at another spillbay.
e Periphery release.

Table 2-5

Condition codes assigned to fish and dislodged balloon tags for fish passage survival evaluation.

FISH CODES

A	No visible marks on fish
B	Flesh tear at tag site(s)
C	Minor scale loss, 3 to 20% (%s for entire body in immediate recovery; for detailed injury examination %s are for section only)
D	Scale loss, >20% per side
E	Laceration(s); tear(s) on body
F	Severed body parts
G	Hemorrhaging, bruised
H	Stressed (lethargic, swimming poorly or sporadically)
I	Spasmodic movement of body
J	Very weak, barely gilling, died within 60 minutes of recovery
K	Failed to enter system
L	Fish likely preyed on based on telemetry, and/or circumstances relative to Turb'N recapture
M	Substantial bleeding at tag site
N	Bulging or missing eye(s)
P	Observed predator attack or marks indicative of predator
Q	Other information
R	Replaced due to entrapment in unrecoverable locations (i.e., in rocks, gate slot; recovery time expired)
T	Trapped inside tunnel/gate well
V	Fins damaged (ripped, split, torn) or pulled from origin
W	Abrasion/scrape
X	No recovery information at all; fish remains unrecovered
Z	Radio telemetry or other information; fish remains unrecovered

DISSECTION CODES

B	Swim bladder ruptured or expanded
D	Kidneys damaged (hemorrhaging)
E	Broken bones obvious
F	Hemorrhaging internally
L	Organ displacement
N	Heart damage, ruptured, hemorrhaging, etc.
O	Liver damage, ruptured, hemorrhaging, etc.
R	Necropsied, no obvious injuries
S	Necropsied, internal injuries observed
W	Head removed, i.e., otolith

TURB'N TAG CODES (not used in database)

A	Fully inflated
B	Partially inflated
C	Pinhole, leaking
D	Burst
E	Not inflated at all

Table 3-1

Summary of tag-recapture data of juvenile chinook salmon released through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector), and downstream of Spillbay 17 (control), at two spill volumes (75 kcfs and gas cap), Bonneville Dam, May/June (spring) and August (summer) 2002. Proportions given in parentheses. Data used for survival estimation.

	Spillbay 14	Spillbay 16	Control
	May/June (Spring, High Tailwater, 75 kcfs)		
Number released	130	166	164
Number recaptured alive	125 (0.962)	155 (0.934)	164 (1.000)
Number recaptured dead	2 (0.015)	4 (0.024)	0 (0.000)
Number assigned dead*	1 (0.008)	3 (0.018)	0 (0.000)
Unknown	2 (0.015)	4 (0.024)	0 (0.000)
Number held	125	155	164
Number alive at 48 h	125	152	162
	May/June (Spring, High Tailwater, Gas Cap)		
Number released	238	241	240
Number recaptured alive	231 (0.971)	232 (0.963)	229 (0.954)
Number recaptured dead	3 (0.013)	2 (0.008)	0 (0.000)
Number assigned dead*	1 (0.004)	1 (0.004)	1 (0.004)
Unknown	3 (0.013)	6 (0.025)	10 (0.042)
Number held	231	232	229
Number alive at 48 h	228	228	223
	August (Summer, Low Tailwater, 75 kcfs)		
Number released	208	185	198
Number recaptured alive	167 (0.803)	156 (0.843)	168 (0.848)
Number recaptured dead	7 (0.034)	7 (0.038)	6 (0.030)
Number assigned dead*	24 (0.115)	16 (0.086)	22 (0.111)
Unknown	10 (0.048)	6 (0.032)	2 (0.010)
Number held	167	156	168
Number alive at 48 h	148	131	161
	August (Summer, Low Tailwater, Gas Cap)		
Number released	250	250	249
Number recaptured alive	211 (0.844)	221 (0.884)	209 (0.839)
Number recaptured dead	8 (0.032)	3 (0.012)	9 (0.036)
Number assigned dead*	22 (0.088)	22 (0.088)	28 (0.112)
Unknown	9 (0.036)	4 (0.016)	3 (0.012)
Number held	211	221	209
Number alive at 48 h	201	213	204

* Includes dislodged tags, predation and stationary signals (see Section 2.6).

Table 3-2

Estimated 1 h and 48 h survival probabilities ($\hat{\tau}$) of juvenile chinook salmon smolts in passage through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) at two spill volumes (75 kcfs and gas cap), Bonneville Dam, May/June (spring) and August (summer) 2002. The 90% confidence intervals are shown in parentheses. Estimates are based on the reduced model (H_O:P_A=P_D).

	Spillbay 14		Spillbay 16	
Survival ($\hat{\tau}$)	**75 kcfs**	**Gas Cap**	**75 kcfs**	**Gas Cap**
	May/June (Spring, High Tailwater)			
1 h	0.979* (0.957-1.002)	0.986* (0.971-1.00)	0.959* (0.933-0.986)	0.990* (0.977-1.003)
48 h	0.999 (0.974-1.025)	0.993 (0.970-1.015)	0.960 (0.926-0.994)	0.993 (0.970-1.015)
	August (Summer, Low Tailwater)			
1 h	0.989 (0.930-1.048)	1.027** (0.974-1.079)	1.022** (0.963-1.080)	1.053** (1.003-1.104)
48 h	0.905 (0.836-0.975)	1.010** (0.950-1.070)	0.886 (0.813-0.960)	1.050** (0.991-1.106)

* 1 h equals 48 h survival; 48 h survival cannot exceed 1 h survival.

** Survival established at 1.0; survival cannot exceed 1.0.

Table 3-3

Types of passage-related visible injuries observed on recaptured juvenile chinook salmon passed through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) and downstream of Spillbay 17 (control) at two spill volumes (75 kcfs and gas cap), Bonneville Dam, May/June (spring) and August (summer) 2002. Some fish had multiple injuries.

				Injury Type				
	Number Released	Number Examined	Visible Injuries	Damaged/ Hemorrhaged Eye(s)	Operculum Damage	Bruise/ Scrapes on Body/Head	Lacerations Body/Head	Internal Injury
May/June (Spring, High Tailwater)								
75 kcfs								
Spillbay 14	130	127	4 (3.1%)	2 (1.6%)	0 (0.0%)	2 (1.6%)	0 (0.0%)	0 (0.0%)
Spillbay 16	166	159	11 (6.9%)	7 (4.4%)	0 (0.0%)	4 (2.5%)	0 (0.0%)	1 (0.6%)
Control	164	164	2 (1.2%)	0 (0.0%)	0 (0.0%)	2 (1.2%)	0 (0.0%)	0 (0.0%)
Gas Cap								
Spillbay 14	238	234	3 (1.3%)	1 (0.4%)	0 (0.0%)	2 (0.9%)	0 (0.0%)	0 (0.0%)
Spillbay 16	241	234	4 (1.7%)	2 (0.9%)	0 (0.0%)	1 (0.4%)	0 (0.0%)	1 (0.4%)
Control	240	229	2 (0.9%)	0 (0.0%)	0 (0.0%)	2 (0.9%)	0 (0.0%)	0 (0.0%)
August (Summer, Low Tailwater)								
75 kcfs								
Spillbay 14	208	174	11 (6.3%)	11 (6.3%)	0 (0.0%)	1 (0.6%)	0 (0.0%)	1 (0.6%)
Spillbay 16	185	163	14 (8.6%)	12 (7.4%)	0 (0.0%)	2 (1.2%)	1 (0.6%)	0 (0.0%)
Control	198	174	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Gas Cap								
Spillbay 14	250	219	3 (1.4%)	3 (1.4%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	1 (0.5%)
Spillbay 16	250	224	2 (0.9%)	0 (0.0%)	0 (0.0%)	2 (0.9%)	0 (0.0%)	0 (0.0%)
Control	249	218	1 (0.5%)	0 (0.0%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	0 (0.0%)
Total spill 100 kcfs, Sluice spill 3 kcfs								
Sluice	100	93	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 3-4

Passage related malady rates (combined visible injuries, major scale loss, or loss of equilibrium) observed on recaptured juvenile chinook salmon passed through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) and downstream of Spillbay 17 (control) at two spill volumes (75 kcfs and gas cap), Bonneville Dam, May/June (spring) and August (summer) 2002.

	Number Released	Number Examined	Visible Injuries Related to Passage	Loss of Equilibrium (exclusively)	Major Scale Loss (exclusively)	Combined Passage Related Maladies	Number Without Maladies[1]
			May/June (Spring, High Tailwater)				
75 kcfs							
Spillbay 14*	130	127 (97.7%)	4 (3.1%)	2 (1.6%)	0 (0.0%)	6 (4.7%)	121 (95.3%)
Spillbay 16*	166	159 (95.8%)	11 (6.9%)	3 (1.9%)	0 (0.0%)	14 (8.8%)	145 (91.2%)
Control*	164	164 (100.0%)	2 (1.2%)	1 (0.6%)	0 (0.0%)	3 (1.8%)	161 (98.2%)
Gas Cap							
Spillbay 14*	238	234 (98.3%)	3 (1.3%)	6 (2.6%)	0 (0.0%)	9 (3.8%)	225 (96.2%)
Spillbay 16	241	234 (97.1%)	4 (1.7%)	4 (1.7%)	0 (0.0%)	8 (3.4%)	226 (96.6%)
Control	240	229 (95.4%)	2 (0.9%)	3 (1.3%)	0 (0.0%)	5 (2.2%)	224 (97.8%)
			August (Summer, Low Tailwater)				
75 kcfs							
Spillbay 14	208	174 (83.7%)	11 (6.3%)	9 (5.2%)	3 (1.7%)	23 (13.2%)	151 (86.8%)
Spillbay 16	185	163 (88.1%)	14 (8.6%)	3 (1.8%)	0 (0.0%)	17 (10.4%)	146 (89.6%)
Control	198	174 (87.9%)	0 (0.0%)	1 (0.6%)	1 (0.6%)	2 (1.1%)	172 (98.9%)
Gas Cap							
Spillbay 14	250	219 (87.6%)	3 (1.4%)	5 (2.3%)	0 (0.0%)	8 (3.7%)	211 (96.3%)
Spillbay 16	250	224 (89.6%)	2 (0.9%)	5 (2.2%)	1 (0.4%)	8 (3.6%)	216 (96.4%)
Control	249	218 (87.6%)	1 (0.5%)	2 (0.9%)	0 (0.0%)	3 (1.4%)	215 (98.6%)
Total spill 100 kcfs, Sluice spill 3 kcfs							
Sluice	100	93 (93.0%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	1 (1.1%)	92 (98.9%)

* Number released excludes releases from either May 20 (pre test) or June 1 (immediate control loss >10%, less than 20 fish released).

1 Fish with non-passage (predator, tag) inflicted maladies included.

Table 3-5

Clean fish estimates ($\hat{CF}$) juvenile chinook salmon smolts in passage through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) at two spill volumes (75 kcfs and gas cap), Bonneville Dam, May/June (spring) and August (summer) 2002. The standard errors (bold italicized) and 90% confidence intervals shown in parentheses. Values given herein are based on the reduced model (H_O:P_A=P_D).

	Spillbay 14		Spillbay 16	
	75 kcfs	**Gas Cap**	**75 kcfs**	**Gas Cap**
	May/June (Spring, High Tailwater)			
$\hat{CF}$	0.973***(0.021)*** (0.933-1.00)	0.982***(0.015)*** (0.955-1.00)	0.931***(0.024)*** (0.887-0.966)	0.986***(0.014)*** (0.960-1.00)
	August (Summer, Low Tailwater)			
$\hat{CF}$	0.879***(0.026)*** (0.832-0.919)	0.976***(0.014)*** (0.950-0.997)	0.907***(0.025)*** (0.862-0.944)	0.977***(0.014)*** (0.951-0.997)

Table 4-1

Comparison of 48 h survival and clean fish estimates of chinook salmon smolts in passage through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) at two spill volumes (75 kcfs and gas cap), Bonneville Dam, May/June (spring) and August (summer) 2002.

	Spillbay 14		Spillbay 16	
	75 kcfs	Gas Cap	75 kcfs	Gas Cap
	May/June (Spring, High Tailwater)			
48 h survival	0.979	0.986	0.959	0.990
Clean fish	0.973	0.982	0.931	0.986
	August (Summer, Low Tailwater)			
48 h survival	0.905	100.0	0.886	100.0
Clean fish	0.879	0.976	0.907	0.977

FIGURES

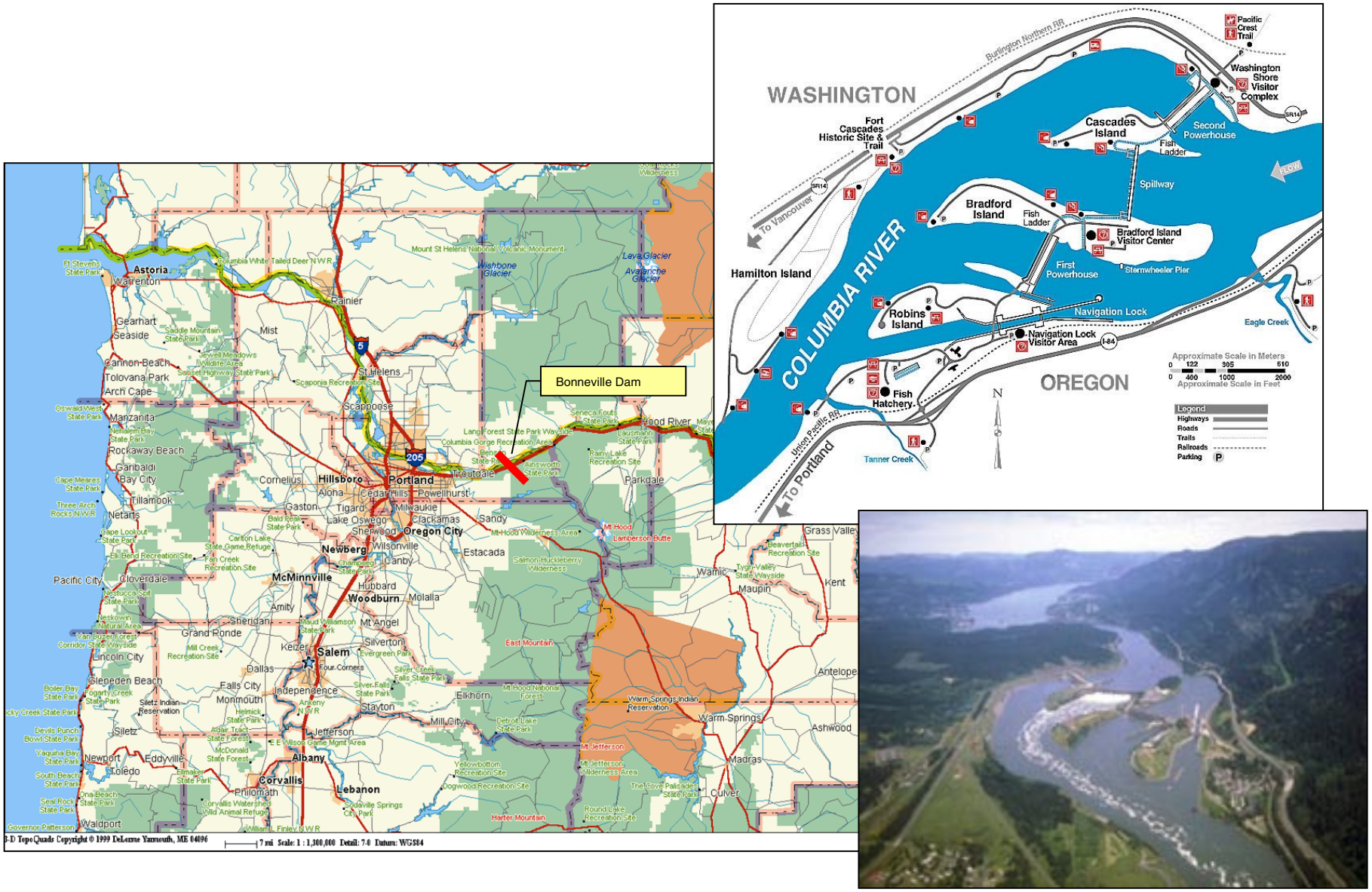

Figure 1-1

General location and layout of Bonneville Dam.

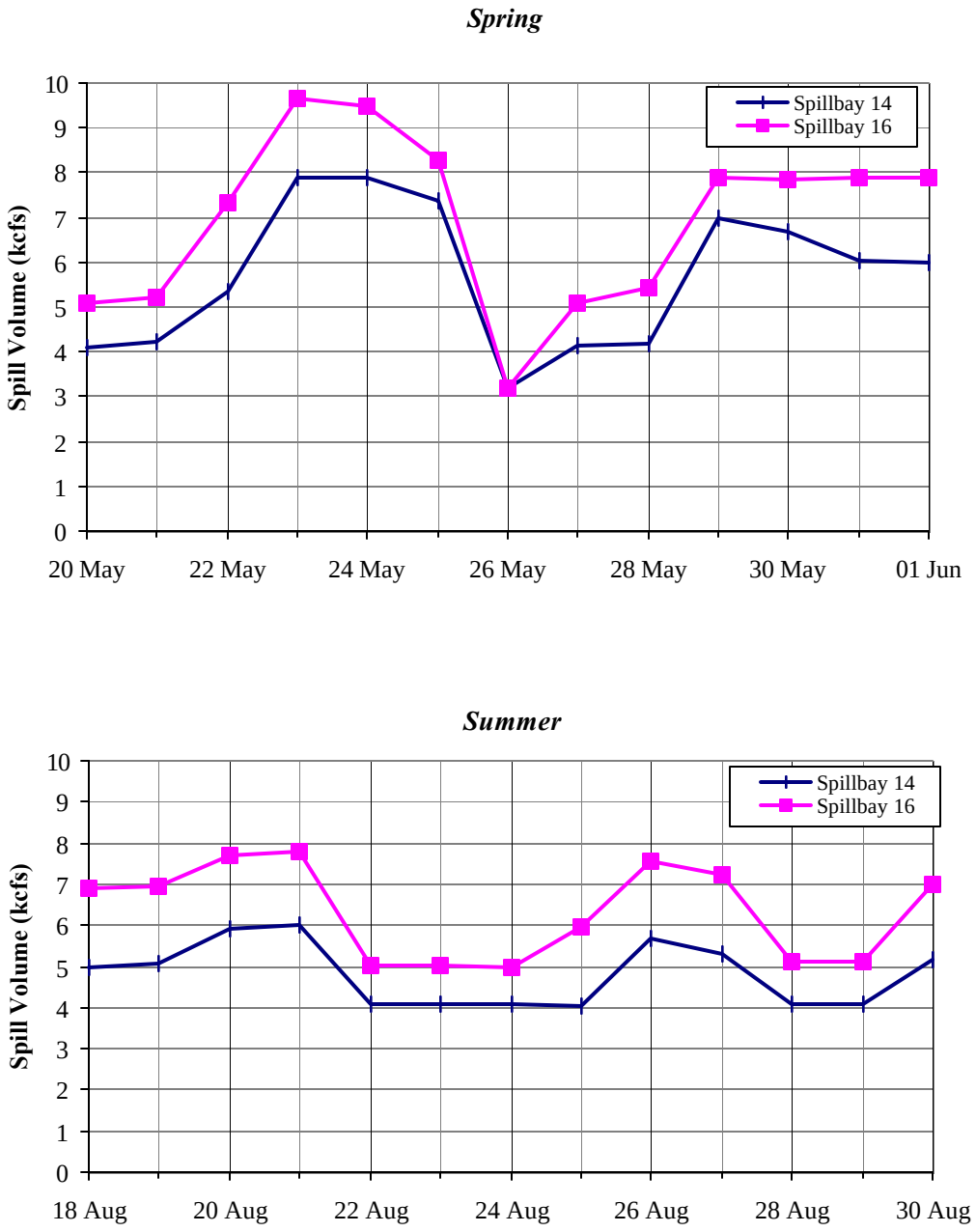

Figure 2-1

Fluctuations in spill volume (kcfs) from Spillbays 14 (with existing shallow flow deflector) and 16 (with deep flow deflectors) on dates for survival estimation of chinook salmon at Bonneville Dam, May/June (spring) and August (summer) 2002.

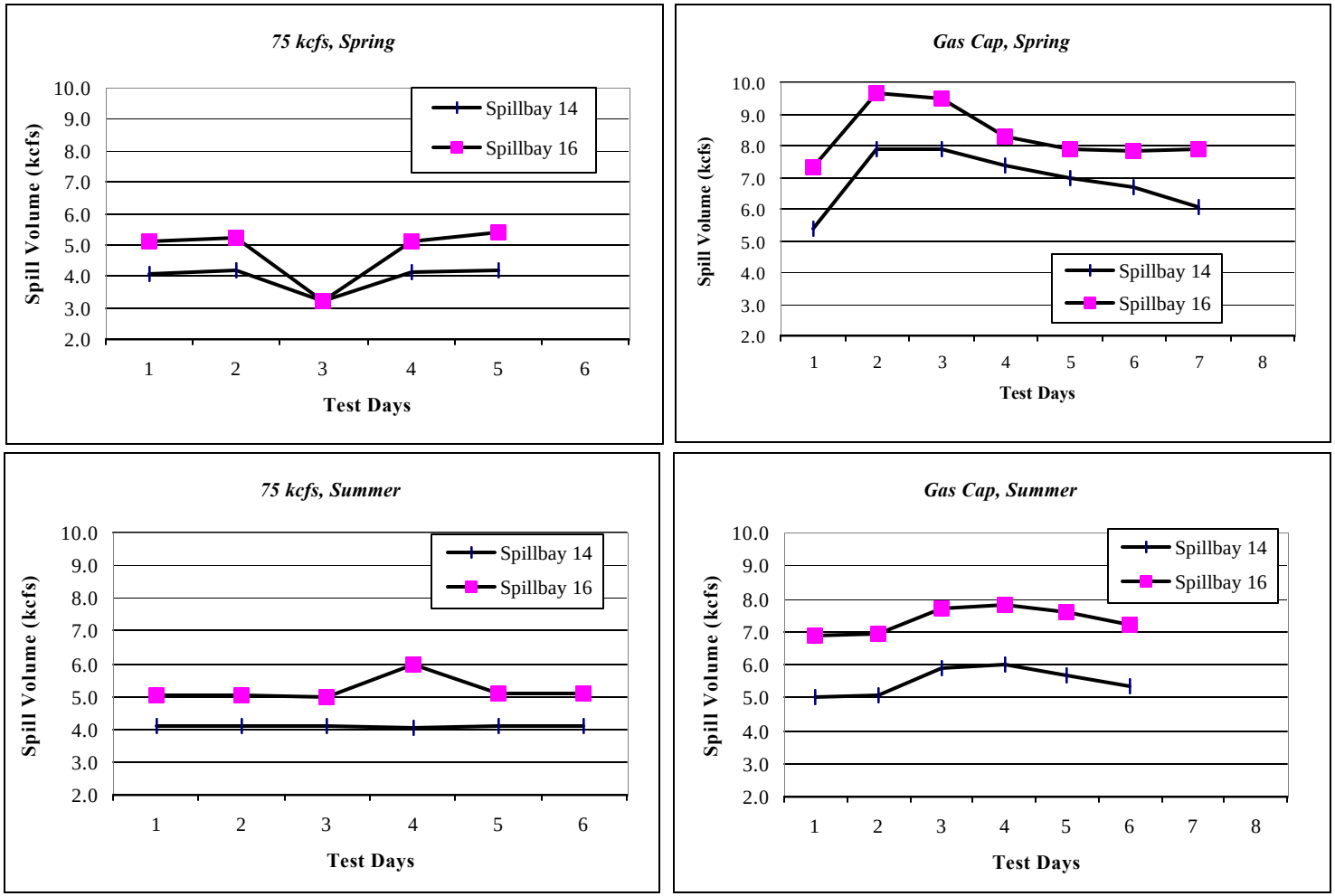

Figure 2-2

Spill volumes through Spillbays 14 (existing flow deflectors) and 16 (deep flow deflectors) during chinook salmon releases at Bonneville Dam, May/June (spring) and August (summer), 2002. Test days refer to sequential fish releases and were not identical for all test conditions.

Figure 2-3

Spring, high tailwater (top photo), and summer, low tailwater (bottom photo), conditions tested at Bonneville Dam, 2002. Note flow/lack of flow around rock (within yellow circles).

Figure 2-4

Photo depicting summer spill conditions at Bonneville Dam, 2002. Also noted are tested spillbays during spring and summer.

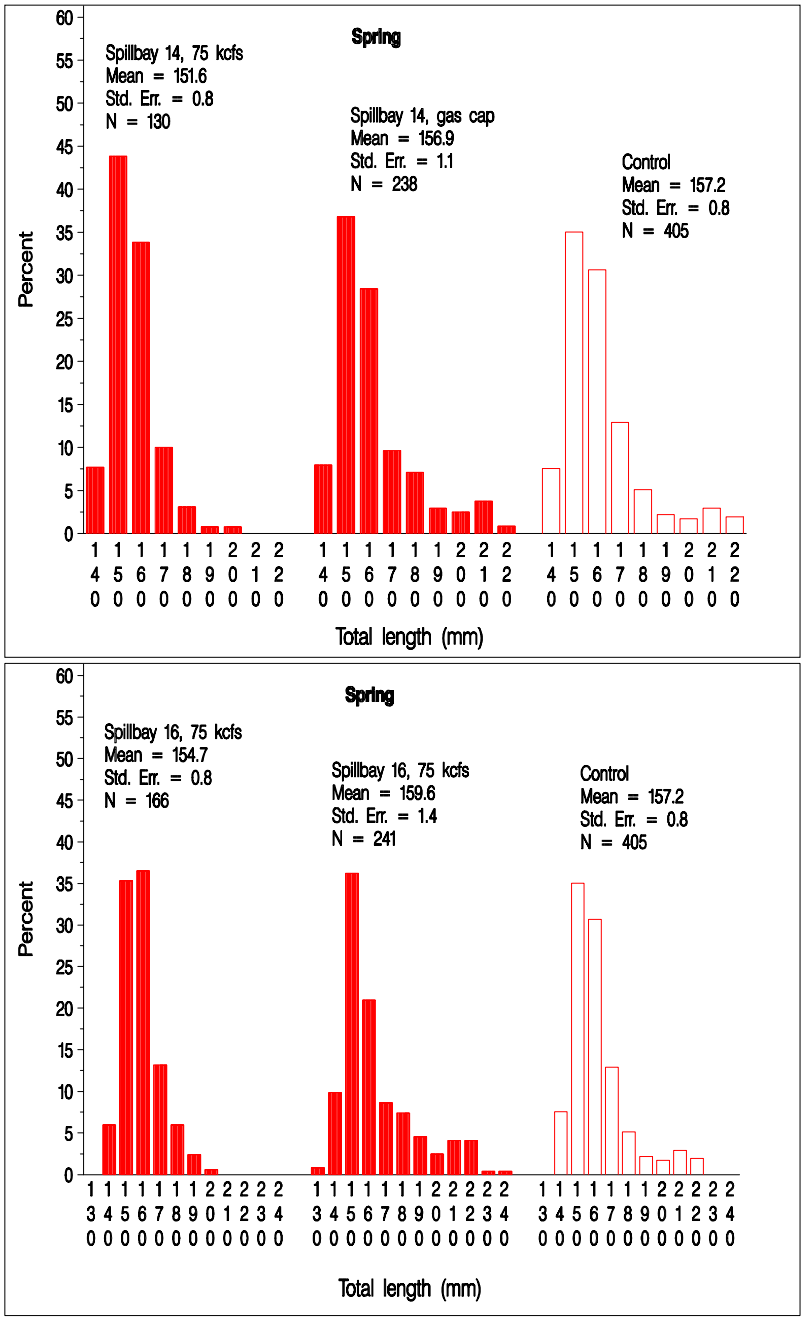

Figure 2-5a Total length (mm) frequency distribution of chinook salmon smolts, released at Spillbays 14 (old flow deflectors) and 16 (new flow deflectors) of Bonneville Dam, May-June (spring) 2002.

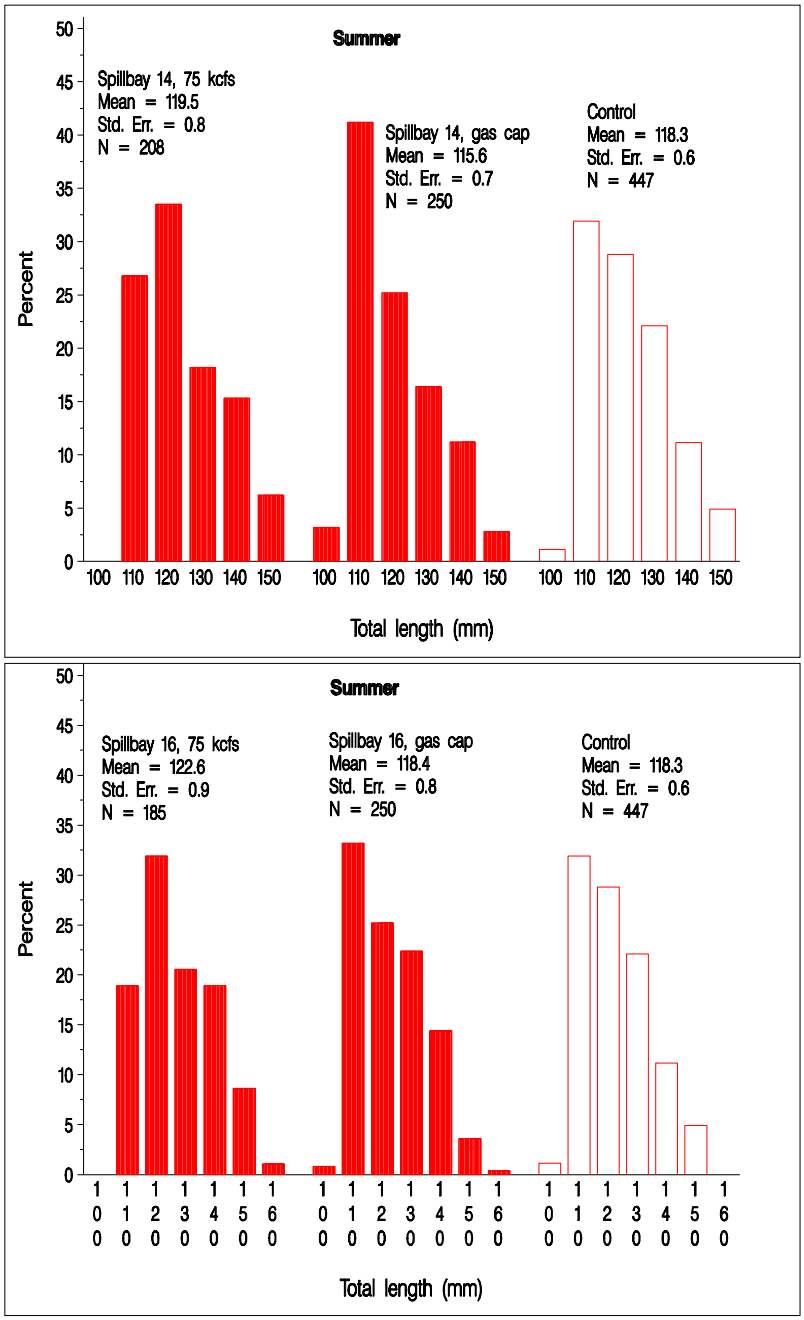

Figure 2-5b Total length (mm) frequency distribution of chinook salmon smolts, released at Spillbays 14 (old flow deflectors) and 16 (new flow deflectors) of Bonneville Dam, August (summer) 2002.

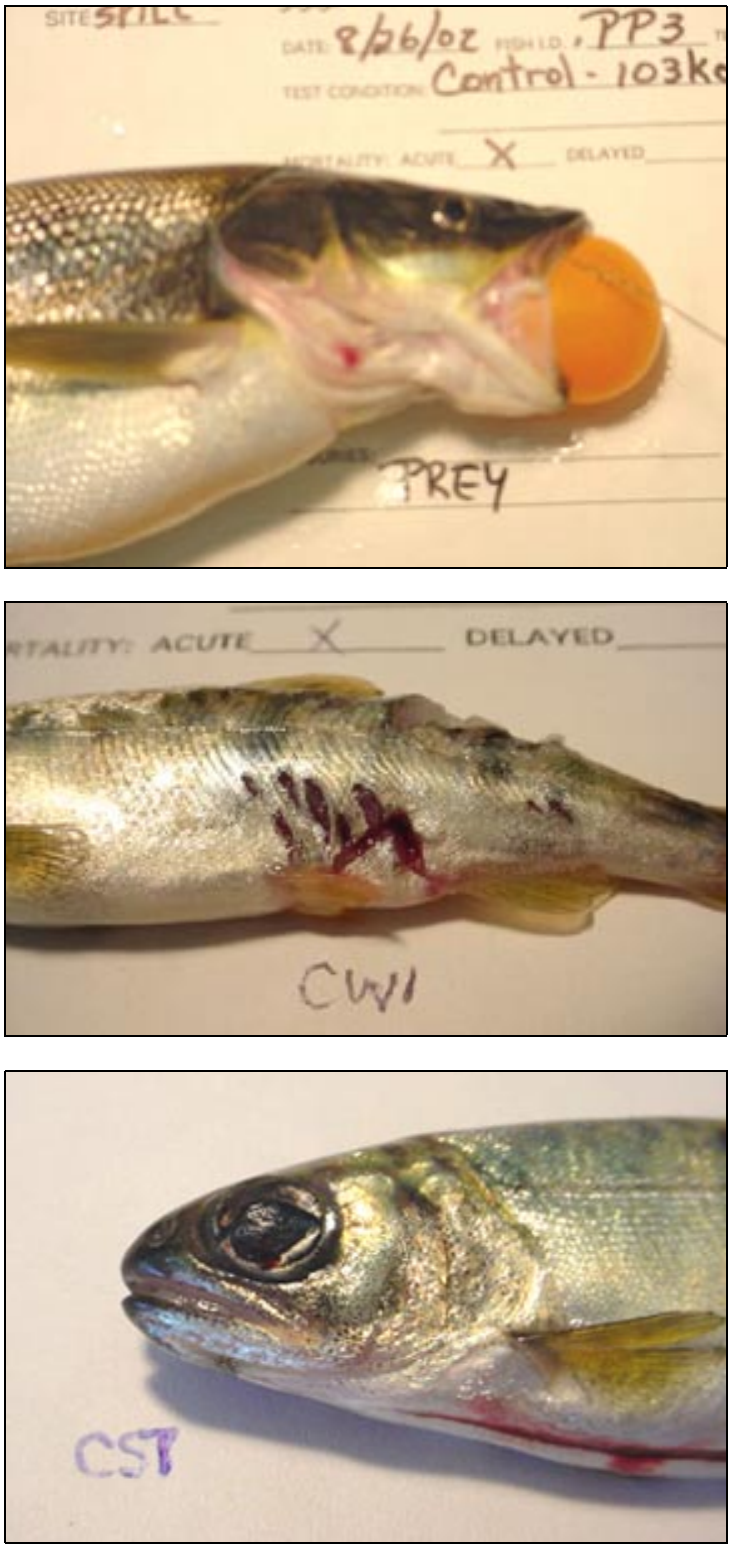

Figure 3-1

Examples of injuries inflicted to juvenile salmon during spillbay passage at Bonneville Dam, 2002. Top photo shows a northern pikeminnow with ingested balloon tagged salmon; middle photo depicts typical predator inflicted wounds; bottom photo shows a hemorrhaged eye.

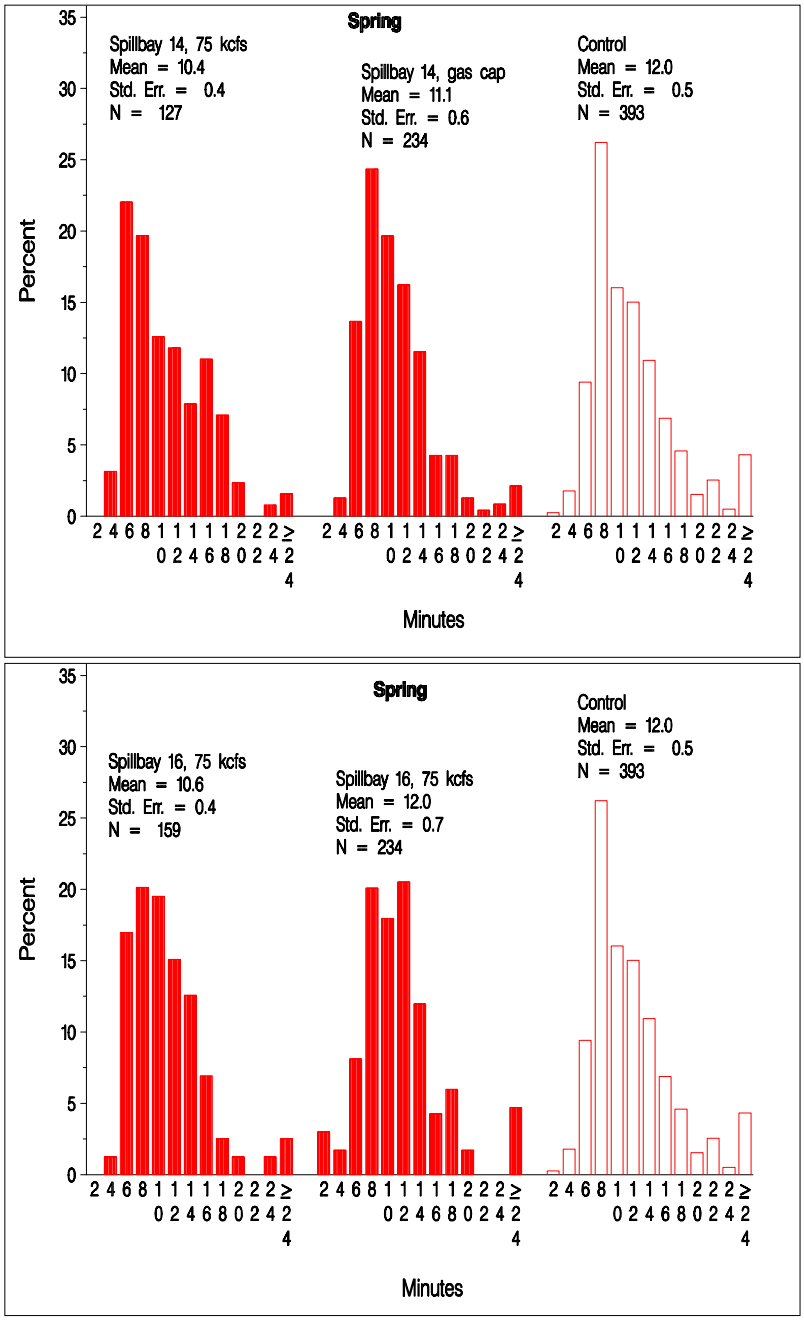

Figure 3-2a Frequency distribution of recapture times (minutes) of chinook salmon smolts, released at Spillbays 14 (old flow deflectors) and 16 (new flow detectors) of Bonneville Dam, May - June (spring) 2002.

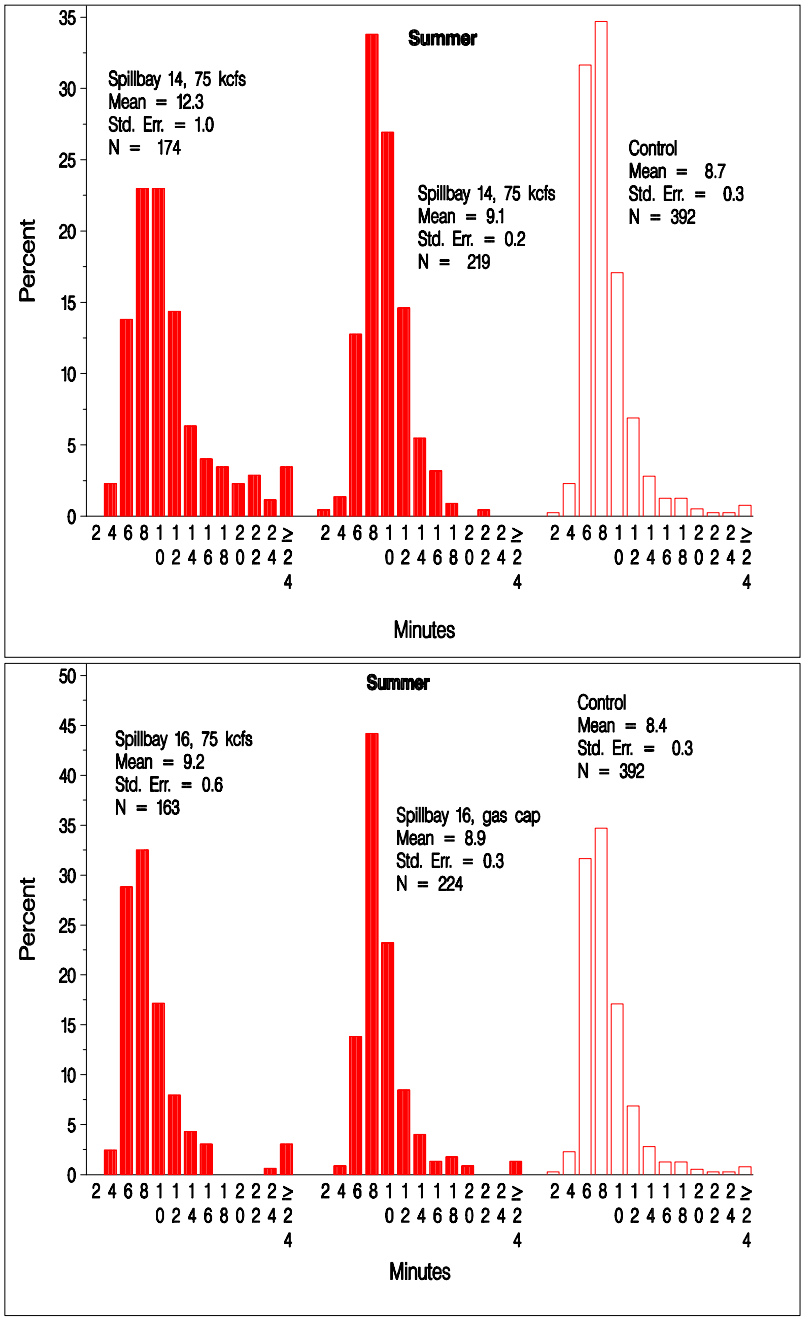

Figure 3-2b Frequency distribution of recapture times (minutes) of chinook salmon smolts, released at Spillbays 14 (old flow deflectors) and 16 (new flow detectors) of Bonneville Dam, August (summer) 2002.

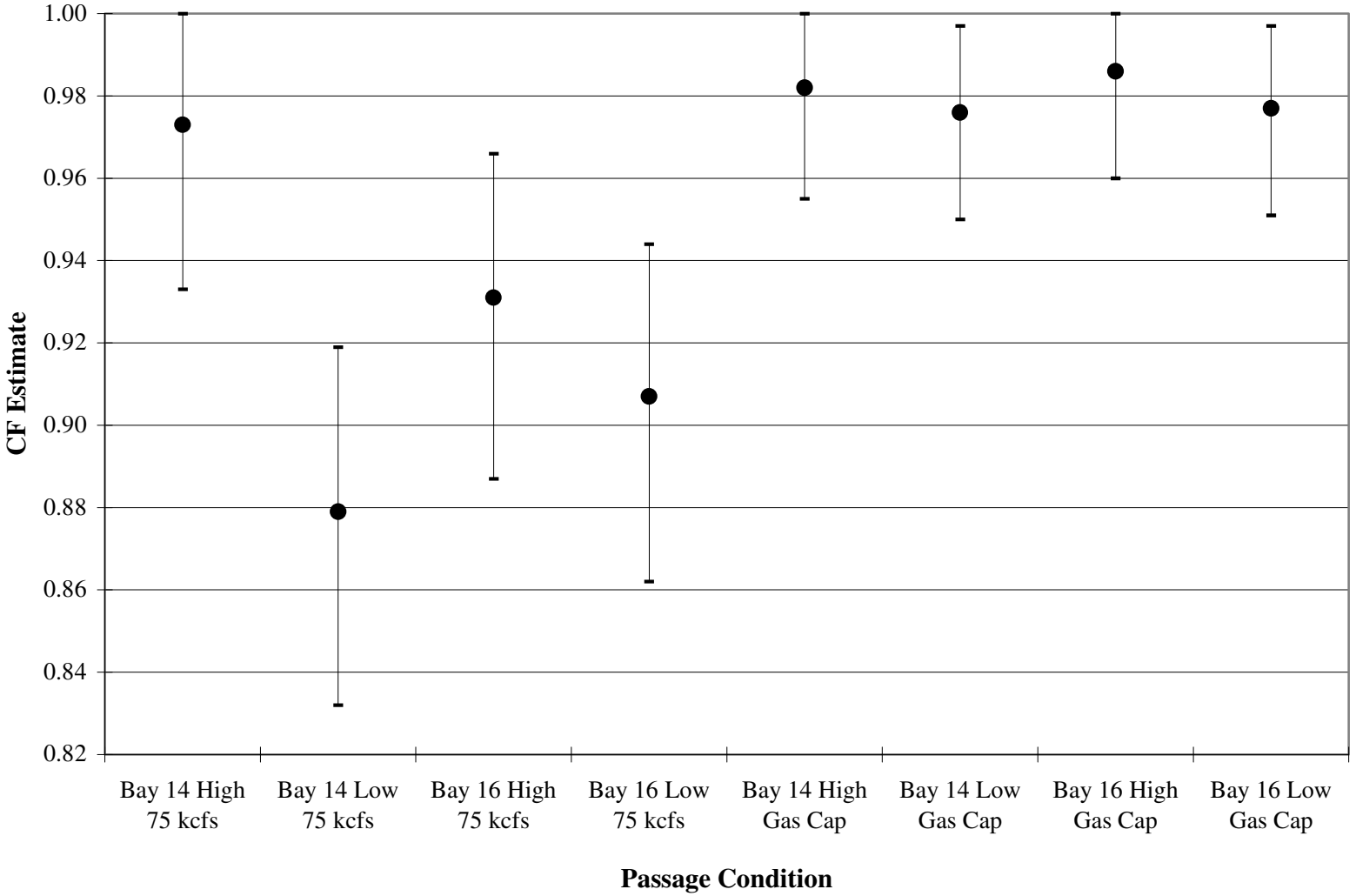

Figure 3-3

Comparison of two spill volumes (75 kcfs and gas cap) on clean fish ($\hat{CF}$) estimates with 90% confidence intervals (vertical bars) of juvenile salmon smolts in passage through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) at high (spring) and low (summer) tailwater conditions at Bonneville Dam, 2002.

APPENDIX A

INDIVIDUAL TRIAL DATA;
FISH INJURY DATA; AND
DAILY FISH DISPOSITION DATA

Appendix Table A-1

Daily tag-recapture data for juvenile chinook salmon passed through Bonneville Dam Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) and downstream of Spillbay 17 (control) at two spill volumes (75 kcfs and gas cap), May/June 2002. Numbers in parentheses represent predation related injuries and mortalities.

	5/20**	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1***	Totals
Spillbay 14 (75 kcfs)														
Released	5	40	--	--	--	--	40	40	10	--	--	--	--	**135**
Recovered alive	5	37	--	--	--	--	40	38	10	--	--	--	--	**130**
Recovered dead	0	2	--	--	--	--	0	0	0	--	--	--	--	**2**
Assigned dead*														
Dislodged tags	0	1	--	--	--	--	0	0	0	--	--	--	--	**1**
Stationary radio signal	0	0	--	--	--	--	0	0	0	--	--	--	--	**0**
Unknown	0	0	--	--	--	--	0	2	0	--	--	--	--	**2**
Held	5	37	--	--	--	--	40	38	10	--	--	--	--	**130**
Alive at 48 h	5	37	--	--	--	--	40	38	10	--	--	--	--	**130**
Spillbay 16 (75 kcfs)														
Released	4	39	--	--	--	--	41	41	45	--	--	--	--	**170**
Recovered alive	4	34	--	--	--	--	39	40	42	--	--	--	--	**159**
Recovered dead	0	2	--	--	--	--	1	0	1	--	--	--	--	**4**
Assigned dead*														
Dislodged tags	0	2	--	--	--	--	0	0	0	--	--	--	--	**2**
Stationary radio signal	0	0	--	--	--	--	0	0	1(1)	--	--	--	--	**1(1)**
Unknown	0	1	--	--	--	--	1	1	1	--	--	--	--	**4**
Held	4	34	--	--	--	--	39	40	42	--	--	--	--	**159**
Alive at 48 h	4	34	--	--	--	--	38	39	41	--	--	--	--	**156**
Control (75 kcfs)														
Released	5	39	--	--	--	--	41	40	44	--	--	--	--	**169**
Recovered alive	5	39	--	--	--	--	41	40	44	--	--	--	--	**169**
Recovered dead	0	0	--	--	--	--	0	0	0	--	--	--	--	**0**
Assigned dead*														
Dislodged tags	0	0	--	--	--	--	0	0	0	--	--	--	--	**0**
Stationary radio signal	0	0	--	--	--	--	0	0	0	--	--	--	--	**0**
Unknown	0	0	--	--	--	--	0	0	0	--	--	--	--	**0**
Held	5	39	--	--	--	--	41	40	44	--	--	--	--	**169**
Alive at 48 h	5	39	--	--	--	--	39	40	44	--	--	--	--	**167**

Appendix Table A-1

Continued.

	5/20**	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1***	Totals
Spillbay 14 (Gas Cap)														
Released	--	--	35	39	36	35	--	--	--	35	29	29	15	**253**
Recovered alive	--	--	32	39	36	34	--	--	--	34(1)	28	28	15	**246(1)**
Recovered dead	--	--	1	0	0	1	--	--	--	1	0	0	0	**3**
Assigned dead*														
Dislodged tags	--	--	0	0	0	0	--	--	--	0	1(1)	0	0	**1(1)**
Stationary radio signal	--	--	0	0	0	0	--	--	--	0	0	0	0	**0**
Unknown	--	--	2	0	0	0	--	--	--	0	0	1	0	**3**
Held	--	--	32	39	36	34	--	--	--	34	28	28	15	**246**
Alive at 48 h	--	--	31	39	36	33	--	--	--	33	28	28	15	**243**
Spillbay 16 (Gas Cap)														
Released	--	--	33	36	39	35	--	--	--	35	33	30	13	**254**
Recovered alive	--	--	31	34	38	34	--	--	--	33	32	30	13	**245**
Recovered dead	--	--	0	0	1	0	--	--	--	1(1)	0	0	0	**2(1)**
Assigned dead*														
Dislodged tags	--	--	0	0	0	0	--	--	--	0	1	0	0	**1**
Stationary radio signal	--	--	0	0	0	0	--	--	--	0	0	0	0	**0**
Unknown	--	--	2	2	0	1	--	--	--	1	0	0	0	**6**
Held	--	--	31	34	38	34	--	--	--	33	32	30	13	**245**
Alive at 48 h	--	--	31	34	38	34	--	--	--	32	31	28	13	**241**
Control (Gas Cap)														
Released	--	--	10	38	45	38	--	--	--	33	36	40	19	**259**
Recovered alive	--	--	8	36	44	38	--	--	--	32	34	37	16	**245**
Recovered dead	--	--	0	0	0	0	--	--	--	0	0	0	0	**0**
Assigned dead*														
Dislodged tags	--	--	0	0	0	0	--	--	--	0	0	1(1)	1	**2(1)**
Stationary radio signal	--	--	0	0	0	0	--	--	--	0	0	0	1(1)	**1(1)**
Unknown	--	--	2	2	1	0	--	--	--	1	2	2	1	**11**
Held	--	--	8	36	44	38	--	--	--	32	34	37	16	**245**
Alive at 48 h	--	--	7	36	44	38	--	--	--	30	33	35	16	**239**

* Balloon(s) only recaptured, and/or stationary radio signal or moving in manner indicative of predation.

** Pre-test release excluded from survival estimation (see Section 2.6).

*** Less than 20 fish released, excluded from survival estimation, immediate control loss >10%.

Appendix Table A-2

Daily tag-recapture data for juvenile chinook salmon passed through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector), and downstream of Spillbay 17 (control) at two spill volumes (75 kcfs and gas cap), and through the sluice at Bonneville Dam, August 2002. Numbers in parentheses represent predation related injuries and mortalities.

	8/18	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	Total
Spillbay 14 (75 kcfs)														
Released	--	--	--	--	40	40	28	40	--	--	18	42	--	**208**
Recovered alive	--	--	--	--	32	33	24	37	--	--	13	28	--	**167**
Recovered dead	--	--	--	--	1(1)	1(1)	2	0	--	--	0	3(1)	--	**7(3)**
Assigned dead*														
Dislodged tags	--	--	--	--	2	1	1(1)	1	--	--	3(2)	5	--	**13(3)**
Stationary radio signal	--	--	--	--	3(2)	3(2)	0	1(1)	--	--	1	3	--	**11(5)**
Unknown	--	--	--	--	2	2	1	1	--	--	1	3	--	**10**
Held	--	--	--	--	32	33	24	37	--	--	13	28	--	**167**
Alive at 48 h	--	--	--	--	30	32	23	36	--	--	10	17	--	**148**
Spillbay 16 (75 kcfs)														
Released	--	--	--	--	40	40	38	37	--	--	20	10	--	**185**
Recovered alive	--	--	--	--	28	37	36	32	--	--	17	6	--	**156**
Recovered dead	--	--	--	--	2(2)	1(1)	1(1)	1	--	--	1	1	--	**7(4)**
Assigned dead*														
Dislodged tags	--	--	--	--	3(1)	1(1)	0	2	--	--	1	0	--	**7(2)**
Stationary radio signal	--	--	--	--	4(2)	0	1(1)	1	--	--	1	2(1)	--	**9(4)**
Unknown	--	--	--	--	3	1	0	1	--	--	0	1	--	**6**
Held	--	--	--	--	28	37	36	32	--	--	17	6	--	**156**
Alive at 48 h	--	--	--	--	27	33	32	29	--	--	8	2	--	**131**
Control (75 kcfs)														
Released	--	--	--	--	40	40	28	47	--	--	43	--	--	**198**
Recovered alive	--	--	--	--	35	35	23	41	--	--	34	--	--	**168**
Recovered dead	--	--	--	--	0	1(1)	1	1	--	--	3(3)	--	--	**6(4)**
Assigned dead*														
Dislodged tags	--	--	--	--	2	3(1)	0	1	--	--	1	--	--	**7(1)**
Stationary radio signal	--	--	--	--	3(1)	0	3(2)	4	--	--	5(2)	--	--	**15(5)**
Unknown	--	--	--	--	0	1	1	0	--	--	0	--	--	**2**
Held	--	--	--	--	35	35	23	41	--	--	34	--	--	**168**
Alive at 48 h	--	--	--	--	34	35	21	40	--	--	31	--	--	**161**

Appendix Table A-2

Continued.

	8/18	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	Total
Spillbay 14 (Gas Cap)														
Released	40	40	40	40	--	--	--	--	45	45	--	--	--	**250**
Recovered alive	32	32	34	35	--	--	--	--	40	38	--	--	--	**211**
Recovered dead	2(1)	1(1)	1(1)	0	--	--	--	--	2(1)	2(1)	--	--	--	**8(5)**
Assigned dead*														
Dislodged tags	4(1)	3	3	3	--	--	--	--	0	3(2)	--	--	--	**16(3)**
Stationary radio signal	1(1)	0	1	1	--	--	--	--	2(1)	1(1)	--	--	--	**6(3)**
Unknown	1	4	1	1	--	--	--	--	1	1	--	--	--	**9**
Held	32	32	34	35	--	--	--	--	40	38	--	--	--	**211**
Alive at 48 h	30	30	33	33	--	--	--	--	39	36	--	--	--	**201**
Spillbay 16 (Gas Cap)														
Released	39	41	40	40	--	--	--	--	45	45	--	--	--	**250**
Recovered alive	32	37	37	35	--	--	--	--	42	38	--	--	--	**221**
Recovered dead	2(2)	0	0	0	--	--	--	--	0	1	--	--	--	**3(2)**
Assigned dead*														
Dislodged tags	2	2	2	1	--	--	--	--	2	4	--	--	--	**13**
Stationary radio signal	2(2)	2(2)	0	3	--	--	--	--	1	1(1)	--	--	--	**9(5)**
Unknown	1	0	1	1	--	--	--	--	0	1	--	--	--	**4**
Held	32	37	37	35	--	--	--	--	42	38	--	--	--	**221**
Alive at 48 h	28	37	36	35	--	--	--	--	41	36	--	--	--	**213**
Control (Gas Cap)														
Released	30	40	40	50	--	--	--	--	45	44	--	--	--	**249**
Recovered alive	22	34	38	46	--	--	--	--	38	31	--	--	--	**209**
Recovered dead	2(2)	0	1(1)	2(2)	--	--	--	--	3(3)	1(1)	--	--	--	**9(9)**
Assigned dead*														
Dislodged tags	4(1)	3(2)	1	2	--	--	--	--	1(1)	3	--	--	--	**14(4)**
Stationary radio signal	1	1(1)	0	0	--	--	--	--	3(1)	9(1)	--	--	--	**14(3)**
Unknown	1	2	0	0	--	--	--	--	0	0	--	--	--	**3**
Held	22	34	38	46	--	--	--	--	38	31	--	--	--	**209**
Alive at 48 h	22	31	37	46	--	--	--	--	37	31	--	--	--	**204**

Appendix Table A-2

Continued.

	8/18	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	Total
Sluice														
Released	--	--	--	--	--	--	--	--	--	--	--	--	100	**100**
Recovered alive	--	--	--	--	--	--	--	--	--	--	--	--	93	**93**
Recovered dead	--	--	--	--	--	--	--	--	--	--	--	--	0	**0**
Assigned dead*														
Dislodged tags	--	--	--	--	--	--	--	--	--	--	--	--	0	**0**
Stationary radio signal	--	--	--	--	--	--	--	--	--	--	--	--	7	**7**
Unknown	--	--	--	--	--	--	--	--	--	--	--	--	0	**0**
Held	--	--	--	--	--	--	--	--	--	--	--	--	93	**93**
Alive at 48 h	--	--	--	--	--	--	--	--	--	--	--	--	81	**81**

* Balloon(s) only recaptured, and/or stationary radio signal or moving in manner indicative of predation.

Appendix Table A-3

Daily malady data for juvenile chinook salmon passed through Bonneville Dam Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) and downstream of Spillbay 17 (control) at two spill volumes (75 kcfs and gas cap), May/June 2002.

	5/20[1]	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1[2]	Totals	Totals[3]
Spillbay 14 (75 kcfs)															
Released	5	40	--	--	--	--	40	40	10	--	--	--	--	**135**	**130**
Examined	5	39	--	--	--	--	40	38	10	--	--	--	--	**132**	**127**
Passage related maladies	0	2	--	--	--	--	2	2	0	--	--	--	--	**6**	**6**
Visible injuries	0	0	--	--	--	--	2	2	0	--	--	--	--	**4**	**4**
Loss of equilibrium only	0	2	--	--	--	--	0	0	0	--	--	--	--	**2**	**2**
Scale loss only	0	0	--	--	--	--	0	0	0	--	--	--	--	**0**	**0**
Without maladies/or with maladies not attributed to passage*	5/0	37/0	--	--	--	--	38/0	36/0	10/0	--	--	--	--	**126/0**	**121/0**
Without maladies that died	0	1	--	--	--	--	0	0	0	--	--	--	--	**1**	**1**
Spillbay 16 (75 kcfs)															
Released	4	39	--	--	--	--	41	41	45	--	--	--	--	**170**	**166**
Examined	4	36	--	--	--	--	40	40	43	--	--	--	--	**163**	**159**
Passage related maladies	0	2	--	--	--	--	4	3	5	--	--	--	--	**14**	**14**
Visible injuries	0	2	--	--	--	--	3	2	4	--	--	--	--	**11**	**11**
Loss of equilibrium only	0	0	--	--	--	--	1	1	1	--	--	--	--	**3**	**3**
Scale loss only	0	0	--	--	--	--	0	0	0	--	--	--	--	**0**	**0**
Without maladies/or with maladies not attributed to passage*	4/0	33/1	--	--	--	--	35/1	36/1	37/1	--	--	--	--	**145/4**	**141/4**
Without maladies that died	0	0	--	--	--	--	0	0	1	--	--	--	--	**1**	**1**
Control (75 kcfs)															
Released	5	39	--	--	--	--	41	40	44	--	--	--	--	**169**	**164**
Examined	5	39	--	--	--	--	41	40	44	--	--	--	--	**169**	**164**
Passage related maladies	0	0	--	--	--	--	1	2	0	--	--	--	--	**3**	**3**
Visible injuries	0	0	--	--	--	--	0	2	0	--	--	--	--	**2**	**2**
Loss of equilibrium only	0	0	--	--	--	--	1	0	0	--	--	--	--	**1**	**1**
Scale loss only	0	0	--	--	--	--	0	0	0	--	--	--	--	**0**	**0**
Without maladies/or with maladies not attributed to passage*	5	39/0	--	--	--	--	40/2	37/1	44/0	--	--	--	--	**165/1**	**160/1**
Without maladies that died	0	0	--	--	--	--	2	0	0	--	--	--	--	**2**	**2**

Appendix Table A-3

Continued.

	5/20[1]	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31	6/1[2]	Totals	Totals[3]
Spillbay 14 (Gas Cap)															
Released	--	--	35	39	36	35	--	--	--	35	29	29	15	**253**	**238**
Examined	--	--	33	39	36	35	--	--	--	35	28	28	15	**249**	**234**
Passage related maladies	--	--	1	1	0	1	--	--	--	4	0	2	1	**10**	**9**
Visible injuries	--	--	0	0	0	1	--	--	--	1	0	1	1	**4**	**3**
Loss of equilibrium only	--	--	1	1	0	0	--	--	--	3	0	1	0	**6**	**6**
Scale loss only	--	--	0	0	0	0	--	--	--	0	0	0	0	**0**	**0**
Without maladies/or with maladies not attributed to passage*	--	--	32/0	38/0	36/0	33/1	--	--	--	30/1	28/0	26/0	14/0	**237/2**	**223/2**
Without maladies that died	--	--	0	0	0	0	--	--	--	0	0	0	0	**0**	**0**
Spillbay 16 (Gas Cap)															
Released	--	--	33	36	39	35	--	--	--	35	33	30	13	**254**	**241**
Examined	--	--	31	34	39	34	--	--	--	34	32	30	13	**247**	**234**
Passage related maladies	--	--	0	0	1	2	--	--	--	2	2	1	0	**8**	**8**
Visible injuries	--	--	0	0	0	2	--	--	--	1	0	1	0	**4**	**4**
Loss of equilibrium only	--	--	0	0	1	0	--	--	--	1	2	0	0	**4**	**4**
Scale loss only	--	--	0	0	0	0	--	--	--	0	0	0	0	**0**	**0**
Without maladies/or with maladies not attributed to passage*	--	--	31/0	34/0	38/0	32/0	--	--	--	31/1	30/0	29/1	13/0	**238/1**	**225/1**
Without maladies that died	--	--	0	0	0	0	--	--	--	0	2	1	0	**3**	**3**
Control (Gas Cap)															
Released	--	--	10	38	45	38	--	--	--	33	36	40	19	**259**	**240**
Examined	--	--	8	36	44	38	--	--	--	32	34	37	16	**245**	**229**
Passage related maladies	--	--	0	0	0	0	--	--	--	3	1	1	0	**5**	**5**
Visible injuries	--	--	0	0	0	0	--	--	--	1	0	1	0	**2**	**2**
Loss of equilibrium only	--	--	0	0	0	0	--	--	--	2	1	0	0	**3**	**3**
Scale loss only	--	--	0	0	0	0	--	--	--	0	0	0	0	**0**	**0**
Without maladies/or with maladies not attributed to passage*	--	--	8/0	36/0	44/0	38/0	--	--	--	29/0	33/0	36/0	16/0	**240/0**	**224/0**
Without maladies that died	--	--	2	0	0	0	--	--	--	1	1	2	0	**6**	**6**

* Includes fish with maladies attributed to predators or tags. This category is referred to as "clean fish" in the text.

1 Pre-test release excluded from survival estimation (see Section 2.6).

2 Less than 20 fish released, excluded from survival estimation, immediate control loss >10%.

3 Excluding either May 20 or June 1.

Appendix Table A-4

Daily malady data for juvenile chinook salmon passed through Bonneville Dam Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) and downstream of Spillbay 17 (control) at two spill volumes (75 kcfs and gas cap), August 2002.

	8/18	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	Totals
Spillbay 14 (75 kcfs)														
Released	--	--	--	--	40	40	28	40	--	--	18	42	--	**208**
Examined	--	--	--	--	33	34	26	37	--	--	13	31	--	**174**
Passage related maladies	--	--	--	--	4	1	6	4	--	--	2	6	--	**23**
Visible injuries	--	--	--	--	4	0	2	1	--	--	2	2	--	**11**
Loss of equilibrium only	--	--	--	--	0	0	3	2	--	--	0	4	--	**9**
Scale loss only	--	--	--	--	0	1	1	1	--	--	0	0	--	**3**
Without maladies/or with maladies not attributed to passage*	--	--	--	--	28/1	32/1	20/0	33/0	--	--	11/0	24/1	--	**148/3**
Without maladies that died	--	--	--	--	0	1	0	1	--	--	0	0	--	**2**
Spillbay 16 (75 kcfs)														
Released	--	--	--	--	40	40	38	37	--	--	20	10	--	**185**
Examined	--	--	--	--	30	38	37	33	--	--	18	7	--	**163**
Passage related maladies	--	--	--	--	2	6	5	2	--	--	2	0	--	**17**
Visible injuries	--	--	--	--	1	5	4	2	--	--	2	0	--	**14**
Loss of equilibrium only	--	--	--	--	1	1	1	0	--	--	0	0	--	**3**
Scale loss only	--	--	--	--	0	0	0	0	--	--	0	0	--	**0**
Without maladies/or with maladies not attributed to passage*	--	--	--	--	26/2	31/1	30/2	31/0	--	--	16/0	7/0	--	**141/5**
Without maladies that died	--	--	--	--	0	3	2	2	--	--	0	2	--	**9**
Control (75 kcfs)														
Released	--	--	--	--	40	40	28	47	--	--	43	--	--	**198**
Examined	--	--	--	--	35	36	24	42	--	--	37	--	--	**174**
Passage related maladies	--	--	--	--	0	0	0	1	--	--	1	--	--	**2**
Visible injuries	--	--	--	--	0	0	0	0	--	--	0	--	--	**0**
Loss of equilibrium only	--	--	--	--	0	0	0	1	--	--	0	--	--	**1**
Scale loss only	--	--	--	--	0	0	0	0	--	--	1	--	--	**1**
Without maladies/or with maladies not attributed to passage*	--	--	--	--	35/0	35/1	22/2	40/1	--	--	33/3	--	--	**165/7**
Without maladies that died	--	--	--	--	1	0	1	1	--	--	3	--	--	**6**

Appendix Table A-4

Continued.

	8/18	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29	8/30	Totals
Spillbay 14 (Gas Cap)														
Released	40	40	40	40	--	--	--	--	45	45	--	--	--	**250**
Examined	34	33	35	35	--	--	--	--	42	40	--	--	--	**219**
Passage related maladies	1	3	2	0	--	--	--	--	2	0	--	--	--	**8**
Visible injuries	1	1	0	0	--	--	--	--	1	0	--	--	--	**3**
Loss of equilibrium only	0	2	2	0	--	--	--	--	1	0	--	--	--	**5**
Scale loss only	0	0	0	0	--	--	--	--	0	0	--	--	--	**0**
Without maladies/or with maladies not attributed to passage*	31/2	30/0	32/1	35/0	--	--	--	--	39/1	39/1	--	--	--	**206/5**
Without maladies that died	1	2	0	2	--	--	--	--	1	3	--	--	--	**9**
Spillbay 16 (Gas Cap)														
Released	39	41	40	40	--	--	--	--	45	45	--	--	--	**250**
Examined	34	37	37	35	--	--	--	--	42	39	--	--	--	**224**
Passage related maladies	2	3	0	0	--	--	--	--	2	1	--	--	--	**8**
Visible injuries	1	0	0	0	--	--	--	--	0	1	--	--	--	**2**
Loss of equilibrium only	1	3	0	0	--	--	--	--	1	0	--	--	--	**5**
Scale loss only	0	0	0	0	--	--	--	--	1	0	--	--	--	**1**
Without maladies/or with maladies not attributed to passage*	28/4	34/0	37/0	35/0	--	--	--	--	40/0	36/2	--	--	--	**210/6**
Without maladies that died	0	0	1	0	--	--	--	--	1	1	--	--	--	**3**
Control (Gas Cap)														
Released	30	40	40	50	--	--	--	--	45	44	--	--	--	**249**
Examined	24	34	39	48	--	--	--	--	41	32	--	--	--	**218**
Passage related maladies	0	2	0	0	--	--	--	--	1	0	--	--	--	**3**
Visible injuries	0	0	0	0	--	--	--	--	1	0	--	--	--	**1**
Loss of equilibrium only	0	2	0	0	--	--	--	--	0	0	--	--	--	**2**
Scale loss only	0	0	0	0	--	--	--	--	0	0	--	--	--	**0**
Without maladies/or with maladies not attributed to passage*	22/0	32/0	38/1	46/2	--	--	--	--	36/4	31/1	--	--	--	**205/10**
Without maladies that died	0	2	1	0	--	--	--	--	1	1	--	--	--	**5**

* Includes fish with maladies attributed to predators or tags. This category is referred to as "clean fish" in the text.

Appendix Table A-5

Summary of malady data for juvenile chinook salmon passed through Bonneville Dam Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector) and downstream of Spillbay 17 (control) at two spill volumes (75 kcfs and gas cap), May/June (spring) and August (summer) 2003. These data used for clean fish estimation.

	Spillbay 14				Spillbay 16				Control			
	75 kcfs		Gas Cap		75 kcfs		75 kcfs		75 kcfs		Gas Cap	
	All	Subset[1]	All	Subset[1]	All	Subset[1]	All	Subset[1]	All	Subset[1]	All	Subset[1]
May/June (Spring, High Tailwater)												
Released	135	130	253	238	170	166	254	241	169	164	259	240
Examined	132	127	249	234	163	159	247	234	169	164	245	229
Passage related maladies	6	6	10	9	14	14	8	8	3	3	5	5
Visible injuries	4	4	4	3	11	11	4	4	2	2	2	2
Loss of equilibrium only	2	2	6	6	3	3	4	4	1	1	3	3
Scale loss only	0	0	0	0	0	0	0	0	0	0	0	0
Without maladies/or with maladies not attributed to passage*	126/0	121/0	237/2	223/2	145/4	141/4	238/1	225/1	165/1	160/1	240/0	224/0
Without maladies that died	1	1	0	0	1	1	3	3	2	2	6	6
August (Summer, Low Tailwater)												
Released	208	--	250	--	185	--	250	--	198	--	249	--
Examined	174	--	219	--	163	--	224	--	174	--	218	--
Passage related maladies	23	--	8	--	17	--	8	--	2	--	3	--
Visible injuries	11	--	3	--	14	--	2	--	0	--	1	--
Loss of equilibrium only	9	--	5	--	3	--	5	--	1	--	2	--
Scale loss only	3	--	0	--	0	--	1	--	1	--	0	--
Without maladies/or with maladies not attributed to passage*	148/3	--	206/5	--	141/5	--	210/6	--	165/7	--	205/10	--
Without maladies that died	2	--	9	--	9	--	3	--	6	--	5	--

1 Excluding either May 20 (pretest) or June 1 (partial test); subset as used for survival and clean fish analysis.

Appendix Table A-6

Incidence of injury, scale loss, and temporary loss of equilibrium observed on treatment juvenile salmonids passed through Spillbays 14 and 16 (treatment) and downstream of Spillbay 17 (control), Bonneville Dam, May/June 2002.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
		Spillbay 14 (75 kcfs)				
21 May	JV4	No visible injuries	Dead 1 h			No
21 May	JV7	Loss of equilibrium	Dead 1 h			No
21 May	JW3	Loss of equilibrium	Alive			No
26 May	PS4	Hemorrhaged left eye	Alive	Shear	Major	No
26 May	PT6	Scrape on head/Gill plate	Alive	Contact	Minor	No
27 May	159 mm	Hemorrhaged right eye	Alive	Shear	Major	No
27 May	RV2	Bruise behind left gill cover	Alive	Contact	Major	No
		Spillbay 16 (75 kcfs)				
21 May	JP1	Hemorrhaged left eye, loss of equilibrium	Alive	Shear	Major	No
21 May	JT3	Broken backbone, loss of equilibrium	Dead 1 h	Shear	Major	Yes
21 May	JT9	Prey marks, severed body*	Dead 1 h	Predation		Yes
26 May	PR3	Gas bubble right eye*	Alive			No
26 May	PU1	Bruise right eye	Dead 1 h	Shear	Major	No
26 May	PU4	Hemorrhaged right eye	Alive	Shear	Major	No
26 May	PX3	Loss of equilibrium	Alive			No
26 May	PX8	Hemorrhaged right eye, bruise on head, major scale loss	Dead 24 h	Shear	Major	Yes
27 May	RP8	Prey marks, loss of equilibrium*	Dead 24 h	Predation		Yes
27 May	RS0	Hemorrhaged eye	Alive	Shear	Major	No
27 May	RS3	Loss of equilibrium	Alive			No
27 May	RT9	Hemorrhaged eye, loss of equilibrium	Alive	Shear	Major	No
28 May	144 mm	No visible injuries	Dead 24 h			No
28 May	SU6	Hemorrhaged head	Alive	Shear	Minor	No
28 May	SU7	Loss of equilibrium	Alive			No
28 May	SV8	Predation marks*	Dead 1 h	Predation		Yes
28 May	SX3	Scrape	Alive	Contact	Minor	No
28 May	SY9	Hemorrhaged right eye, loss of equilibrium	Alive	Shear	Minor	No
28 May	SZ3	Hemorrhaged tail and dorsal fin, major scale loss, loss of equilibrium	Alive	Contact	Major	No

Appendix Table A-6

Continued.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
		Control (75 kcfs)				
26 May	RN5	No visible injuries	Dead 24 h			No
26 May	RN6	No visible injuries	Dead 24 h			No
26 May	RN9	Loss of equilibrium	Alive			No
27 May	RY3	Gas bubble right eye*	Alive			No
27 May	RZ9	Hemorrhaged pectoral fin	Alive	Contact	Major	No
27 May	SN9	Hemorrhaged pectoral fin	Alive	Contact	Major	No
		Spillbay 14 (Gas Cap)				
22 May	KR8	Loss of equilibrium	Dead 1 h			No
23 May	LT0	Loss of equilibrium	Alive			No
25 May	NZ9	Scrape on head, major scale loss	Dead 1 h	Contact	Major	No
25 May	PN1	Loss of equilibrium, tear at tag site*	Dead 24 h			Yes
29 May	PN8	Hemorrhaged right eye	Alive	Shear	Minor	No
29 May	TV3	Loss of equilibrium	Alive			No
29 May	TW4	Loss of equilibrium	Dead 1 h			No
29 May	TW5	Prey marks, loss of equilibrium*	Dead 24 h	Predation		Yes
29 May	UM8	Loss of equilibrium	Alive			No
31 May	VP8	Loss of equilibrium	Alive			No
31 May	VR1	Scrape on right side near tail	Alive	Contact	Major	No
01 Jun	TS7	Laceration on right operculum, hemorrhaged right eye	Alive	Contact/Shear		No
		Spillbay 16 (Gas Cap)				
24 May	MS4	Loss of equilibrium	Dead 1 h			No
25 May	NN5	Hemorrhaged left eye, loss of equilibrium	Alive	Shear	Major	No
25 May	NN9	Scrape on head, loss of equilibrium	Alive	Contact	Minor	No
29 May	SY4	Hemorrhaged right eye	Alive	Shear	Major	No
29 May	TY0	Loss of equilibrium	Dead 24 h			No
29 May	TZ2	Prey marks*	Dead 1 h	Predation		Yes
30 May	211 mm	No visible injuries	Dead 24 h			No

Appendix Table A-6

Continued.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
30 May	TM8	Loss of equilibrium	Alive			No
30 May	UR4	Loss of equilibrium	Alive			No
30 May	UT0	No visible injuries	Dead 24 h			No
31 May	VY1	No visible injuries	Dead 24 h			No
31 May	VY6	Ruptured air bladder	Dead 24 h	Pressure	Major	No
		Control (Gas Cap)				
22 May	KR3	No visible injuries	Dead 48 h			No
22 May	KY6	No visible injuries	Dead 48 h			No
29 May	152 mm	Hemorrhaged caudal fin	Alive	Contact	Major	No
29 May	UM3	No visible injuries	Dead 24 h			No
29 May	UN0	Loss of equilibrium	Alive			No
29 May	UR0	Loss of equilibrium	Dead 24 h			No
30 May	UU7	No visible injuries	Dead 48 h			No
30 May	UV9	Loss of equilibrium	Alive			No
31 May	211 mm	No visible injuries	Dead 24 h			No
31 May	VS2	Scrape on fin	Alive	Contact	Minor	No
31 May	VV5	No visible injuries	Dead 24 h			No

* Non-passage related.

Appendix Table A-7

Incidence of injury, scale loss, and temporary loss of equilibrium observed on treatment juvenile salmonids passed through Spillbays 14 and 16 (treatment), downstream of Spillbay 17 (control), and the sluice, Bonneville Dam, August 2002.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
		Spillbay 14 (75 kcfs)				
22 Aug	BW6	Hemorrhaged right eye	Alive	Shear	Minor	No
22 Aug	BX1	Hemorrhaged heart and left eye, loss of equilibrium	Dead 24 h	Shear	Major	No
22 Aug	BY1	Prey marks*	Dead 1 h	Predation		Yes
22 Aug	BY5	Hemorrhaged right eye, major scale loss, loss of equilibrium	Dead 48 h	Shear	Major	No
22 Aug	BY9	Hemorrhaged right eye	Alive	Shear	Minor	No
23 Aug	121 mm	No visible injuries, fungus infection*	Dead 48 h			No
23 Aug	CW6	Prey marks, hemorrhaged right eye*	Dead 1 h	Predation		Yes
23 Aug	CX2	Major scale loss right side	Alive			No
24 Aug	JJ0	Major scale loss both sides	Alive			No
24 Aug	JJ2	Hemorrhaged left eye, damaged right eye	Dead 1 h	Shear	Major	No
24 Aug	JJ3	Hemorrhaged left eye	Alive	Shear	Minor	No
24 Aug	JK4	Loss of equilibrium	Alive			No
24 Aug	JK5	Loss of equilibrium	Dead 1 h			No
24 Aug	JK6	Loss of equilibrium	Dead 48 h			No
25 Aug	105 mm	Infection at pin site*	Dead 48 h			No
25 Aug	JR2	Loss of equilibrium	Alive			No
25 Aug	JS0	Major scale loss	Alive			No
25 Aug	JS5	Hemorrhaged right eye	Dead 24 h	Shear	Major	No
25 Aug	JU3	Loss of equilibrium	Alive			No
28 Aug	RP3	Hemorrhaged eye	Alive	Shear	Minor	No
28 Aug	RR0	Hemorrhaged right eye	Alive	Shear	Minor	No
29 Aug	RS8	Prey marks*	Dead 1 h	Predation		No
29 Aug	RU7	Hemorrhaged right eye, major scale loss	Dead 1 h	Shear	Major	No
29 Aug	RU9	Loss of equilibrium	Alive			No
29 Aug	RV1	Loss of equilibrium	Alive			No
29 Aug	RV5	Loss of equilibrium	Alive			No

Appendix Table A-7

Continued.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
29 Aug	RV6	Hemorrhaged right eye/abrasion on jaw	Dead 1 h	Shear/Contact	Major	No
29 Aug	RW4	Loss of equilibrium	Alive			No
		Spillbay 16 (75 kcfs)				
22 Aug	CA5	Loss of equilibrium	Alive			No
22 Aug	CC1	Prey marks*	Dead 1 h	Predation		Yes
22 Aug	CC2	Prey marks*	Dead 1 h	Predation		Yes
22 Aug	CD9	Hemorrhaged left eye	Dead 24 h	Shear	Major	No
23 Aug	126 mm	No visible injuries, fungus infection*	Dead 48 h			No
23 Aug	130 mm	No visible injuries, fungus infection*	Dead 48 h			No
23 Aug	CP6	Hemorrhaged and bulged eye, loss of equilibrium	Alive	Shear	Major	No
23 Aug	CR1	No visible injuries, fungus infection*	Dead 48 h			No
23 Aug	CR4	Hemorrhaged left eye	Alive	Shear	Minor	No
23 Aug	CS4	Hemorrhaged right eye	Alive	Shear	Major	No
23 Aug	CS6	Hemorrhaged left eye	Alive	Shear	Minor	No
23 Aug	CS7	Hemorrhaged and bulging left eye	Dead 1 h	Shear	Major	Yes
23 Aug	CT2	Prey marks*	Dead 24 h	Predation		Yes
23 Aug	CT6	Loss of equilibrium	Alive			No
24 Aug	108	No visible injuries, infection*	Dead 48 h			No
24 Aug	127	Major tear at tag site*	Dead 48 h			No
24 Aug	CY1	Hemorrhaged right eye, loss of equilibrium	Alive	Shear	Minor	No
24 Aug	CY5	Loss of equilibrium	Alive			No
24 Aug	CY9	Hemorrhaged right eye, loss of equilibrium	Alive	Shear	Minor	No
24 Aug	CZ0	Lacerated on right side near tail	Dead 48 h	Contact	Major	No
24 Aug	JA0	No visible injuries, infection*	Dead 48 h			No
24 Aug	JA9	Hemorrhaged between eyes, loss of equilibrium	Alive	Contact	Minor	No
24 Aug	JB7	Prey marks*	Dead 1 h	Predation		Yes
25 Aug	JR0	No visible injuries	Dead 48 h			No
25 Aug	JW6	Bulged right eye	Dead 1 h	Shear	Major	No
25 Aug	JY0	No visible injuries	Dead 48 h			No

Appendix Table A-7

Continued.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
25 Aug	JZ4	Hemorrhaged left eye and head, loss of equilibrium	Dead 24 h	Shear	Major	No
28 Aug	RM9	Hemorrhaged and bulged right eye	Dead 1 h	Shear	Major	No
28 Aug	RN2	Hemorrhaged right eye	Alive	Shear	Minor	No
29 Aug	RX5	Hole in swim bladder, infection on head*	Dead 24 h		Major	No
29 Aug	RX8	No visible injuries	Dead 1 h			No
		Control (75 kcfs)				
22 Aug	CE2	No visible injuries	Dead 24 h			No
23 Aug	CN0	Prey marks*	Dead 1 h	Predation		Yes
24 Aug	130 mm	No visible injuries	Dead 24 h			No
24 Aug	JD8	Prey marks, loss of equilibrium*	Dead 1 h	Predation		No
24 Aug	JF0	Tear at tag site, infection*	Dead 48 h			No
25 Aug	JL7	Loss of equilibrium	Alive			No
25 Aug	JR1	Prey marks, infection at pin site*	Dead 48 h	Predation		No
25 Aug	TT7	No visible injuries	Dead 1 h			No
28 Aug	102 mm	No visible injuries, infection *	Dead 24 h			No
28 Aug	CN6	Major scale loss, loss of equilibrium	Alive			No
28 Aug	RH2	Prey marks*	Dead 1 h	Predation		No
28 Aug	RJ9	Prey marks*	Dead 1 h	Predation		No
28 Aug	RK2	Prey marks*	Dead 1 h	Predation		No
28 Aug	RK7	No visible injuries, infection at pin site*	Dead 48 h			No
28 Aug	RL4	No visible injuries, infection at pin site*	Dead 48 h			No
		Spillbay 14 (Gas Cap)				
18 Aug	D55	Prey marks*	Dead 1 h	Predation		Yes
18 Aug	D67	No visible injuries	Dead 1 h			No
18 Aug	U10	Hemorrhaged right eye	Alive	Shear	Minor	No
18 Aug	U33	Prey marks*	Dead 1 h	Predation		Yes
19 Aug	103 mm	No visible injuries	Dead 48 h			No
19 Aug	125 mm	No visible injuries	Dead 48 h			No

Appendix Table A-7

Continued.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
19 Aug	U35	Loss of equilibrium	Alive			No
19 Aug	U39	Hemorrhaged right eye, loss of equilibrium	Dead 24 h	Shear	Minor	No
19 Aug	U44	Loss of equilibrium	Dead 24 h			No
20 Aug	BB1	Loss of equilibrium	Dead 24 h			No
20 Aug	BC1	Prey marks*	Dead 1 h	Predation		No
20 Aug	BD9	Loss of equilibrium	Alive			No
21 Aug	117 mm	No visible injuries	Dead 48 h			No
21 Aug	BK2	No visible injuries	Dead 48 h			No
26 Aug	PE5	Predation marks*	Dead 1 h	Predation		No
26 Aug	PE8	No visible injuries, infection at pin site*	Dead 48 h			No
26 Aug	PF0	Ruptured heart, scrape on snout, bulged eye	Dead 1 h	Shear/Contact	Major	No
26 Aug	PF2	Loss of equilibrium	Alive			No
27 Aug	100 mm	No visible injuries, infection*	Dead 48 h			No
27 Aug	111 mm	No visible injuries, infection*	Dead 48 h			No
27 Aug	PS9	No visible injuries	Dead 1 h			No
27 Aug	PV1	Prey marks*	Dead 1 h	Predation		No
		Spillbay 16 (Gas Cap)				
18 Aug	110 mm	Tear at pin site, infection*	Dead 48 h			No
18 Aug	D22	Prey marks*	Dead 1 h	Predation		Yes
18 Aug	D23	Bruise behind nape	Dead 48 h	Contact	Major	No
18 Aug	D42	Loss of equilibrium	Dead 24 h			No
18 Aug	D45	Major tear at tag site*	Dead 48 h			No
18 Aug	D49	Prey marks*	Dead 1 h	Predation		Yes
19 Aug	U97	Loss of equilibrium	Alive			No
19 Aug	W08	Loss of equilibrium	Alive			No
19 Aug	W26	Loss of equilibrium	Alive			No
20 Aug	W80	No visible injuries, infection*	Dead 48 h			No
26 Aug	103 mm	No visible injuries, infection at jaw*	Dead 24 h			No
26 Aug	PC6	Loss of equilibrium	Alive			No

Appendix Table A-7

Continued.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
26 Aug	PE4	Major scale loss	Alive			No
27 Aug	103 mm	Prey marks*	Dead 24 h	Predation		No
27 Aug	104 mm	No visible injuries, infection*	Dead 48 h			No
27 Aug	PW1	Tear at pin site*	Dead 1 h			No
27 Aug	PY5	Scrapes on jaw	Alive	Contact	Minor	No
		Control (Gas Cap)				
18 Aug	U01	Prey marks*	Dead 1 h	Predation		Yes
18 Aug	U09	Prey marks*	Dead 1 h	Predation		Yes
19 Aug	U50	No apparent injury	Dead 48 h			No
19 Aug	U52	Loss of equilibrium	Alive			No
19 Aug	U77	No visible injuries	Dead 48 h			No
19 Aug	U86	Loss of equilibrium	Dead 24 h			No
20 Aug	110 mm	No visible injuries	Dead 48 h			No
20 Aug	W47	Prey marks*	Dead 1 h	Predation		Yes
21 Aug	BM5	Prey marks*	Dead 1 h	Predation		Yes
21 Aug	BR6	Prey marks*	Dead 1 h	Predation		No
26 Aug	102 mm	No visible injuries	Dead 24 h			No
26 Aug	PL7	Prey marks, hemorrhaged right eye*	Dead 1 h	Predation		No
26 Aug	PM6	Prey marks*	Alive	Predation		No
26 Aug	PN9	Prey marks*	Dead 1 h	Predation		No
26 Aug	PP1	Scrape on nose, loss of equilibrium	Alive	Contact	Minor	No
26 Aug	PP3	Prey marks/recovered from stomach of northern pikeminnow*	Dead 1 h	Predation		Yes
27 Aug	144 mm	Missing lower jaw due to infection*	Alive			No
27 Aug	RD8	Prey marks*	Dead 1 h	Predation		No
		Sluice (Total spill 100 kcfs, Sluice spill 3.0 kcfs)				
30 Aug	104 mm	No visible injuries, fungus infection*	Dead 48 h			No
30 Aug	107 mm	No visible injuries, fungus infection*	Dead 48 h			No
30 Aug	107 mm	No visible injuries, fungus infection*	Dead 48 h			No

Appendix Table A-7

Continued.

Date	Fish ID	Injury Description	Status	Probable Cause of Injury	Injury Designation	Photo
30 Aug	112 mm	No visible injuries, fungus infection*	Dead 48 h			No
30 Aug	112 mm	No visible injuries, fungus infection*	Dead 48 h			No
30 Aug	116 mm	No visible injuries, fungus infection*	Dead 48 h			No
30 Aug	118 mm	No visible injuries, fungus infection*	Dead 48 h			No
30 Aug	128 mm	No visible injuries, fungus infection*	Dead 48 h			No
30 Aug	WE3	No visible injuries, fungus infection*	Dead 48 h			No
30 Aug	WF0	Loss of equilibrium	Alive			No
30 Aug	WF2	No visible injuries, fungus infection*	Dead 24 h			No
30 Aug	WK3	No visible injuries, fungus infection*	Dead 24 h			No
30 Aug	WL7	No visible injuries, fungus infection *	Dead 24 h			No

* Non-passage related.

APPENDIX TABLE A-8

Short-term turbine passage survival data on individual chinook salmon released in Spillbays 14 and 16 at Bonneville Dam, May/June 2002. Fish were tagged with Normandeau's HI-Z Turb-N tags. Description of condition codes and details on injured fish are presented in Table 2-5.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
21 May 2002 - Testlot 2 : Spillbay 14, 75 kcfs - Water temp=12.3 C								
JN5	15:13	15:28	15	2	ALIVE	A	150	
JU0	12:38	12:46	8	2	ALIVE	A	141	
JU1	12:39	12:49	10	2	ALIVE	A	144	
JU2	12:39	12:51	12	2	ALIVE	A	162	
JU3	12:26	12:40	14	2	ALIVE	A	135	
JU4	12:37	12:45	8	2	ALIVE	A	151	
JU5	12:50	13:02	12	2	ALIVE	A	150	
JU6	12:49	13:00	11	2	ALIVE	A	147	
JU7	12:52	12:59	7	2	ALIVE	A	143	
JU8	12:52	13:03	11	2	ALIVE	A	146	
JU9	12:51	12:57	6	2	ALIVE		134	
JV0	13:03	13:08	5	2	ALIVE	A	142	
JV1	13:05	13:20	15	2	ALIVE	A	149	
JV2	13:04	13:08	4	2	ALIVE	A	152	
JV3	13:05	13:11	6	2	ALIVE	A	148	
JV4	13:04	13:22	18	2	DEAD	JA	146	
JV5	13:28	13:33	5	2	ALIVE	A	148	
JV6	13:28	13:35	7	2	ALIVE	A	150	
JV7	13:29	13:36	7	2	DEAD	JH	145	
JV8	13:34	13:40	6	2	ALIVE	A	156	
JV9	13:30	.	.	0	TAG & PIN		161	
JW0	14:35	14:46	11	2	ALIVE	A	148	
JW1	14:35	14:40	5	2	ALIVE	A	132	
JW2	14:36	14:43	7	2	ALIVE	A	150	
JW3	14:37	14:49	12	2	ALIVE	BHC	148	
JW4	14:37	14:42	5	2	ALIVE	A	144	
JW5	14:52	15:00	8	2	ALIVE	A	145	
JW6	14:51	14:57	6	2	ALIVE	A	154	
JW7	14:53	14:59	6	2	ALIVE	A	145	
JW8	14:53	15:10	17	2	ALIVE	A	150	
JW9	14:51	15:04	13	2	ALIVE	A	144	
JX0	15:11	15:18	7	2	ALIVE	A	161	
JX1	15:12	15:30	18	2	ALIVE	A	152	
JX3	15:10	15:17	7	2	ALIVE	A	142	
JX4	15:11	15:29	18	2	ALIVE	A	162	
JX5	15:31	15:39	8	2	ALIVE	A	146	
JX6	15:32	15:45	13	2	ALIVE	A	153	
JX7	15:32	15:41	9	2	ALIVE	A	153	
JX8	15:33	15:52	19	2	ALIVE	A	192	
JX9	15:33	15:44	11	2	ALIVE	A	150	
21 May 2002 - Testlot 2 : Spillbay 16, 75 kcfs - Water temp=12.3 C								
JP0	8:28	8:36	8	2	ALIVE	A	147	
JP1	8:27	8:35	8	2	ALIVE	GH	161	
JP2	8:25	8:32	7	2	ALIVE	A	155	
JP3	8:26	8:33	7	2	ALIVE	A	160	
JP4	8:26	8:36	10	2	ALIVE	A	150	
JP5	8:38	8:44	6	2	ALIVE	A	153	
JP6	8:38	8:44	6	2	ALIVE	A	144	
JP7	8:39	.	.	0	UNKNOWN	X	148	
JP8	8:40	8:47	7	2	ALIVE	A	146	
JP9	8:41	8:54	13	2	ALIVE		140	
JR0	9:01	9:07	6	2	ALIVE	A	161	
JR1	8:59	9:06	7	2	ALIVE	A	151	
JR2	9:00	9:09	9	2	ALIVE	A	167	
JR3	8:59	.	.	2	TAG & PIN		165	
JR4	9:08	9:15	7	2	ALIVE	A	165	
JR5	9:25	9:34	9	2	ALIVE	A	145	
JR6	9:22	9:30	8	2	ALIVE	A	174	
JR7	9:21	9:30	9	2	ALIVE	A	143	
JR9	9:31	.	.	0	TAG & PIN		184	
JS0	10:39	10:54	15	2	ALIVE	A	156	
JS1	10:41	10:54	13	2	ALIVE	A	176	
JS2	10:39	10:47	8	2	ALIVE	A	148	
JS3	10:40	10:59	19	2	ALIVE	A	158	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Re-leased	Re-covered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
JS4	10:40	10:50	10	2	ALIVE	A	139	
JS5	11:00	11:07	7	2	ALIVE	A	145	
JS6	10:57	11:03	6	2	ALIVE	A	149	
JS7	10:58	11:09	11	2	ALIVE	A	150	
JS8	10:58	11:11	13	2	ALIVE	A	158	
JS9	11:08	11:14	6	2	ALIVE		161	
JT0	11:11	11:22	11	2	ALIVE	A	168	
JT1	11:13	11:26	13	2	ALIVE	A	155	
JT2	11:14	11:28	14	2	ALIVE	A	155	
JT3	11:12	11:24	12	2	DEAD	CHJ	156	
JT4	11:13	11:21	8	2	ALIVE	A	150	
JT5	11:28	11:35	7	2	ALIVE	A	149	
JT6	11:31	11:39	8	2	ALIVE	A	151	
JT7	11:27	11:33	6	2	ALIVE	A	150	
JT8	11:30	11:37	7	2	ALIVE	A	161	
JT9	11:28	12:02	34	2	DEAD		139	
21 May 2002 - Testlot 2 : Control - Water temp=12.3 C								
JY0	16:23	16:31	8	2	ALIVE	A	144	
JY1	16:24	16:29	5	2	ALIVE	A	153	
JY2	16:24	16:45	21	2	ALIVE	A	147	
JY3	16:26	16:32	6	2	ALIVE	A	147	
JY4	16:22	16:28	6	2	ALIVE	A	161	
JY5	16:36	16:43	7	2	ALIVE	A	142	
JY6	16:36	16:45	9	2	ALIVE	A	138	
JY7	16:33	16:43	10	2	ALIVE	A	162	
JY8	16:35	16:43	8	2	ALIVE	A	145	
JY9	16:34	16:38	4	2	ALIVE	A	145	
JZ0	16:52	17:00	8	2	ALIVE	A	140	
JZ1	16:52	16:56	4	2	ALIVE	A	150	
JZ2	16:51	17:00	9	2	ALIVE	A	149	
JZ3	16:50	16:57	7	2	ALIVE	A	152	
JZ4	16:49	16:55	6	2	ALIVE	A	132	
JZ5	17:06	17:27	21	2	ALIVE	A	195	
JZ6	17:03	17:07	4	2	ALIVE	A	150	
JZ7	17:02	17:09	7	2	ALIVE	A	150	
JZ8	17:04	17:12	8	2	ALIVE	A	170	
JZ9	17:05	17:13	8	2	ALIVE	A	153	
KM0	17:48	17:54	6	2	ALIVE	A	148	
KM1	17:55	18:10	15	2	ALIVE	A	154	
KM2	17:52	18:04	12	2	ALIVE	A	168	
KM3	17:51	18:05	14	2	ALIVE	A	168	
KM4	17:50	17:56	6	2	ALIVE	A	141	
KM5	18:12	18:23	11	2	ALIVE	A	143	
KM6	18:07	18:16	9	2	ALIVE	A	175	
KM7	18:09	18:17	8	2	ALIVE	A	136	
KM8	18:08	18:14	6	2	ALIVE	A	144	
KM9	18:11	18:21	10	2	ALIVE	A	159	
KN0	18:35	18:40	5	2	ALIVE	A	137	
KN1	18:33	18:38	5	2	ALIVE	A	145	
KN2	18:27	18:34	7	2	ALIVE	A	144	
KN3	18:32	18:36	4	2	ALIVE	A	149	
KN4	18:30	18:34	4	2	ALIVE	A	142	
KN5	18:41	18:49	8	2	ALIVE	A	166	
KN6	18:38	18:42	4	2	ALIVE	A	142	
KN8	18:43	18:47	4	2	ALIVE	A	145	
KN9	18:40	18:45	5	2	ALIVE	A	145	
22 May 2002 - Testlot 3 : Spillbay 14, gas cap - Water temp=12.6 C								
JN6	8:19	.	.	0	UNKNOWN	X	161	
JN7	10:15	10:26	11	2	ALIVE	A	148	
JN8	11:55	12:09	14	2	ALIVE	A	185	
KP0	9:51	9:56	5	2	ALIVE	A	160	
KP1	9:07	9:36	29	2	ALIVE	A	148	
KP3	9:17	.	.	0	UNKNOWN	X	143	
KP4	9:09	9:26	17	2	ALIVE	A	175	
KP6	9:54	10:01	7	2	ALIVE	A	151	
KP7	9:50	10:08	18	2	ALIVE	A	144	
KP8	9:52	10:13	21	2	ALIVE	A	157	
KP9	9:53	10:00	7	2	ALIVE		175	

APPENDIX TABLE A-8 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data Alive/ Dead	Condition Codes	Total Length (mm)	Comments
KR0	10:17	10:34	17	2	ALIVE	A	142	
KR1	10:14	10:20	6	2	ALIVE	A	140	
KR2	10:16	10:32	16	2	ALIVE	A	155	
KR3	10:18	10:27	9	2	ALIVE	A	145	
KR5	10:36	10:43	7	2	ALIVE	A	143	
KR6	10:37	10:49	12	2	ALIVE	A	152	
KR7	10:38	10:51	13	2	ALIVE	A	152	
KR8	10:39	11:03	24	2	DEAD	CHJ	141	
KR9	10:37	10:43	6	2	ALIVE		146	
KS0	10:44	11:01	17	2	ALIVE	A	162	
KS1	11:21	11:28	7	2	ALIVE	A	149	
KS2	11:23	11:32	9	2	ALIVE	A	147	
KS3	11:23	11:32	9	2	ALIVE	A	158	
KS4	11:21	11:25	4	2	ALIVE	A	158	
KS5	11:22	11:30	8	2	ALIVE	A	157	
KS6	11:33	11:39	6	2	ALIVE	A	157	
KS7	11:34	11:38	4	2	ALIVE	A	143	
KS8	11:36	11:55	19	2	ALIVE	A	188	
KS9	11:35	11:42	7	2	ALIVE		151	
KT0	11:35	11:41	6	2	ALIVE	A	142	
KT1	11:50	11:56	6	2	ALIVE	A	149	
KT2	11:49	12:05	16	2	ALIVE	A	158	
KT3	11:49	12:04	15	2	ALIVE	A	149	
KT4	11:48	11:53	5	2	ALIVE	A	147	
22 May 2002 - Testlot 3 : Spillbay 16, gas cap - Water temp=12.6 C								
KU0	12:42	12:43	1	2	ALIVE	A	146	
KU1	12:39	12:46	7	2	ALIVE	A	150	
KU2	12:40	12:44	4	2	ALIVE	A	155	
KU3	12:41	12:48	7	2	ALIVE	A	150	
KU4	12:41	13:11	30	2	ALIVE	A	146	
KU5	12:50	12:58	8	2	ALIVE	A	152	
KU6	12:52	12:58	6	2	ALIVE	A	150	
KU7	12:51	12:56	5	2	ALIVE	A	140	
KU8	12:49	12:55	6	2	ALIVE	A	150	
KU9	12:53	13:02	9	2	ALIVE		137	
KV0	13:00	13:08	8	1	ALIVE	B	130	
KV1	13:03	13:09	6	2	ALIVE	A	148	
KV2	13:01	13:13	12	2	ALIVE	A	143	
KV5	13:24	13:25	1	2	ALIVE	A	150	
KV6	13:24	13:33	9	2	ALIVE	A	172	
KV7	13:23	.	.	0	UNKNOWN		146	
KV8	13:23	13:27	4	2	ALIVE	A	161	
KV9	13:25	13:39	14	2	ALIVE		159	
KW0	14:01	14:12	11	2	ALIVE	A	139	
KW1	14:03	14:15	12	2	ALIVE	A	149	
KW2	14:02	14:12	10	2	ALIVE	A	161	
KW3	14:03	14:15	12	2	ALIVE	A	135	
KW4	14:01	14:09	8	2	ALIVE	A	158	
KW5	14:18	14:23	5	2	ALIVE	A	156	
KW6	14:17	14:25	8	2	ALIVE	A	136	
KW8	14:18	14:32	14	2	ALIVE	A	172	
KW9	14:17	14:28	11	2	ALIVE	A	144	
KX0	14:35	.	.	0	UNKNOWN	X	145	
KX2	14:36	14:49	13	2	ALIVE	A	149	
KX3	14:33	14:41	8	2	ALIVE	A	138	
KX4	14:35	14:39	4	2	ALIVE	A	138	
KX5	14:49	14:55	6	2	ALIVE	A	143	
KX6	14:50	15:00	10	2	ALIVE	A	152	
22 May 2002 - Testlot 3 : Control - Water temp=12.6 C								
KY0	15:48	15:54	6	2	ALIVE	A	142	
KY1	15:47	16:05	18	2	ALIVE	A	152	
KY2	15:45	16:00	15	2	ALIVE	A	157	
KY3	15:46	15:59	13	2	ALIVE	A	140	
KY4	15:48	16:09	21	2	ALIVE	A	189	
KY5	16:13	16:29	16	2	ALIVE	A	146	
KY6	16:10	16:25	15	2	ALIVE	A	137	
KY7	16:09	16:18	9	2	ALIVE	A	145	
KY8	16:07	.	.	0	UNKNOWN	X	145	
KY9	16:11	.	.	0	UNKNOWN	X	168	

APPENDIX TABLE A-8 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data: Alive/ Dead	Condition Codes	Total Length (mm)	Comments
23 May 2002 - Testlot 4 : Spillbay 14, gas cap - Water temp=12.8 C								
LT0	11:51	12:02	11	1	ALIVE	HB	171	
LT1	11:53	12:00	7	2	ALIVE	A	160	
LT2	11:53	12:02	9	2	ALIVE	A	136	
LT3	11:52	12:11	19	2	ALIVE	A	145	
LT4	11:50	11:57	7	2	ALIVE	A	153	
LT5	12:06	12:13	7	2	ALIVE	A	140	
LT6	12:07	12:15	8	2	ALIVE	A	152	
LT7	12:07	12:15	8	2	ALIVE		143	
LT8	12:11	12:18	7	2	ALIVE	A	146	
LT9	12:04	12:11	7	2	ALIVE		150	
LU0	12:20	12:26	6	2	ALIVE	A	144	
LU1	12:21	12:31	10	2	ALIVE	A	153	
LU2	12:19	12:25	6	2	ALIVE	A	136	
LU3	12:23	12:31	8	2	ALIVE	A	146	
LU4	12:20	12:28	8	2	ALIVE	A	168	
LU5	12:34	12:41	7	2	ALIVE	A	144	
LU6	12:35	12:43	8	2	ALIVE	A	153	
LU7	12:35	12:48	13	2	ALIVE	A	151	
LU9	12:36	12:49	13	2	ALIVE	A	149	
LV0	13:19	13:26	7	2	ALIVE	A	138	
LV1	13:21	13:34	13	2	ALIVE	A	150	
LV2	13:20	13:28	8	2	ALIVE	A	148	
LV3	13:22	13:29	7	2	ALIVE	A	149	
LV4	13:22	13:32	10	2	ALIVE	A	158	
LV5	13:35	13:45	10	2	ALIVE	A	141	
LV6	13:36	13:43	7	2	ALIVE	A	150	
LV7	13:33	13:39	6	2	ALIVE		150	
LV8	13:35	13:41	6	2	ALIVE	A	141	
LV9	13:34	13:43	9	2	ALIVE		141	
LW0	13:48	13:59	11	2	ALIVE	A	155	
LW1	13:52	14:09	17	2	ALIVE	A	150	
LW2	13:51	14:03	12	2	ALIVE	A	144	
LW3	13:49	13:53	4	2	ALIVE	A	150	
LW4	13:50	13:57	7	2	ALIVE	A	170	
LW5	14:05	14:11	6	2	ALIVE	A	178	
LW6	14:05	14:15	10	2	ALIVE	A	150	
LW7	14:07	14:18	11	2	ALIVE	A	136	
LW8	14:07	14:21	14	2	ALIVE	A	153	
LW9	14:06	14:20	14	2	ALIVE	A	151	
23 May 2002 - Testlot 4 : Spillbay 16, gas cap - Water temp=12.8 C								
LM9	18:27	18:31	4	2	ALIVE	A	150	
LX0	15:04	15:16	12	2	ALIVE	A	144	
LX1	15:02	15:10	8	2	ALIVE		142	
LX2	15:01	.	.	0	UNKNOWN	X	148	
LX3	15:03	15:20	17	2	ALIVE		136	
LX4	15:03	15:45	42	2	ALIVE	A	143	
LX5	15:52	16:09	17	2	ALIVE	A	146	
LX6	15:53	16:10	17	2	ALIVE	A	143	
LX7	15:51	16:04	13	2	ALIVE	A	142	
LX9	15:50	15:59	9	2	ALIVE	A	140	
LY0	16:25	16:36	11	2	ALIVE	A	155	
LY1	16:21	16:21	0	2	ALIVE	A	150	
LY3	16:29	16:40	11	2	ALIVE	A	153	
LY4	16:37	16:45	8	2	ALIVE	A	140	
LY5	16:45	17:00	15	2	ALIVE	A	148	
LY6	16:42	16:51	9	2	ALIVE	A	147	
LY7	16:53	17:00	7	2	ALIVE	A	154	
LY8	16:42	16:54	12	2	ALIVE	A	142	
LY9	16:52	.	.	0	UNKNOWN	X	161	
LZ0	17:25	17:35	10	2	ALIVE	A	148	
LZ1	17:24	17:31	7	2	ALIVE	A	157	
LZ2	17:24	17:32	8	2	ALIVE	A	160	
LZ3	17:26	17:38	12	2	ALIVE	A	155	
LZ4	17:26	17:43	17	2	ALIVE	A	146	
LZ5	17:43	17:56	13	2	ALIVE	A	141	
LZ6	17:40	17:54	14	1	ALIVE	B	144	
LZ8	17:40	17:50	10	2	ALIVE	A	152	
LZ9	17:42	17:50	8	2	ALIVE	A	176	
MM0	18:09	18:15	6	2	ALIVE		141	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
MM1	18:01	18:14	13	2	ALIVE	A	144	
MM2	18:00	18:09	9	2	ALIVE	A	142	
MM4	17:59	18:08	9	2	ALIVE	A	148	
MM6	18:28	18:46	18	2	ALIVE	A	135	
MM7	18:26	18:33	7	2	ALIVE	A	152	
MM8	18:27	18:32	5	2	ALIVE	A	150	
MM9	18:29	18:31	2	2	ALIVE	A	184	
23 May 2002 - Testlot 4 : Control - Water temp=12.8 C								
KT5	10:50	10:56	6	2	ALIVE	A	146	
KT6	10:49	11:00	11	2	ALIVE	A	142	
KT7	10:43	10:50	7	2	ALIVE	A	145	
KT9	10:45	10:56	11	2	ALIVE	A	164	
LM8	11:10	11:23	13	2	ALIVE	A	133	
LN0	8:00	8:10	10	2	ALIVE	A	154	
LN1	8:06	8:18	12	2	ALIVE	A	158	
LN2	8:05	8:13	8	2	ALIVE	A	145	
LN3	7:59	8:12	13	2	ALIVE	A	143	
LN4	8:05	8:18	13	2	ALIVE	A	164	
LN5	8:21	8:32	11	2	ALIVE	A	139	
LN6	8:20	8:27	7	2	ALIVE	A	153	
LN7	8:22	8:33	11	2	ALIVE	A	150	
LN8	8:32	8:44	12	2	ALIVE	A	137	
LN9	8:24	8:39	15	2	ALIVE		154	
LP0	9:13	9:27	14	2	ALIVE	A	163	
LP1	9:02	9:12	10	2	ALIVE	A	147	
LP2	8:53	9:01	8	2	ALIVE	A	142	
LP3	9:04	9:13	9	2	ALIVE	A	155	
LP4	8:55	9:03	8	2	ALIVE	A	147	
LP5	9:40	.	.	0	UNKNOWN	X	148	
LP6	9:41	9:53	12	2	ALIVE	A	135	
LP7	9:36	9:44	8	2	ALIVE	A	154	
LP8	9:17	9:30	13	2	ALIVE	A	151	
LR0	10:17	10:29	12	2	ALIVE	A	155	
LR1	9:50	10:05	15	2	ALIVE	A	142	
LR2	10:16	10:23	7	2	ALIVE	A	153	
LR3	9:48	9:55	7	2	ALIVE	A	144	
LR4	10:19	10:28	9	2	ALIVE	A	152	
LR5	10:27	10:35	8	2	ALIVE	A	156	
LR6	10:24	10:32	8	2	ALIVE	A	150	
LR7	10:31	10:38	7	2	ALIVE	A	152	
LR8	10:30	10:38	8	2	ALIVE	A	144	
LR9	10:29	.	.	0	UNKNOWN		139	
LS0	11:08	11:21	13	2	ALIVE	A	151	
LS1	11:13	11:23	10	2	ALIVE	A	172	
LS2	11:09	11:32	23	2	ALIVE	A	146	
LS4	11:06	11:24	18	2	ALIVE	A	195	
24 May 2002 - Testlot 5 : Spillbay 14, gas cap - Water temp=12.8 C								
JN9	13:13	13:20	7	2	ALIVE	A	143	
MT0	11:12	11:19	7	1	ALIVE	A	136	
MT1	11:11	11:25	14	2	ALIVE	A	157	
MT2	11:11	11:21	10	2	ALIVE	A	141	
MT3	11:10	11:18	8	2	ALIVE	A	164	
MT4	11:10	11:19	9	2	ALIVE	A	162	
MT5	11:25	11:34	9	2	ALIVE	A	150	
MT6	11:24	11:42	18	2	ALIVE	A	148	
MT7	11:25	11:31	6	2	ALIVE		153	
MT8	11:22	11:32	10	2	ALIVE	A	143	
MT9	11:23	11:29	6	2	ALIVE		147	
MU0	11:40	11:46	6	2	ALIVE	A	143	
MU1	11:40	11:49	9	2	ALIVE	A	170	
MU2	11:52	12:00	8	2	ALIVE	A	158	
MU3	11:53	12:00	7	2	ALIVE	A	148	
MU4	11:41	11:50	9	2	ALIVE	A	181	
MU5	12:03	12:10	7	2	ALIVE	A	191	
MU6	12:01	12:15	14	2	ALIVE	A	157	
MU7	11:55	12:09	14	2	ALIVE	A	145	
MU8	12:02	12:15	13	2	ALIVE	A	155	
MU9	11:54	12:09	15	2	ALIVE	A	188	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
MV0	12:39	12:45	6	2	ALIVE	A	191	
MV1	12:36	12:46	10	2	ALIVE	A	150	
MV2	12:37	12:44	7	2	ALIVE	A	150	
MV3	12:36	12:42	6	2	ALIVE	A	164	
MV4	12:37	12:46	9	2	ALIVE	A	143	
MV5	12:49	12:56	7	2	ALIVE	A	169	
MV6	12:47	13:00	13	2	ALIVE	A	167	
MV7	12:48	12:53	5	2	ALIVE		165	
MV8	12:48	12:54	6	2	ALIVE	A	155	
MV9	12:50	12:58	8	2	ALIVE		145	
MW0	13:05	13:12	7	2	ALIVE	A	147	
MW1	13:12	13:20	8	2	ALIVE	A	137	
MW2	13:06	13:24	18	2	ALIVE	A	154	
MW3	13:04	13:12	8	2	ALIVE	A	145	
MW4	13:05	13:15	10	2	ALIVE	A	148	
24 May 2002 - Testlot 5 : Spillbay 16, gas cap - Water temp=12.8 C								
MN0	7:54	7:56	2	2	ALIVE	A	161	
MN1	7:53	7:58	5	2	ALIVE	A	153	
MN2	7:53	7:59	6	2	ALIVE	A	162	
MN3	7:52	7:57	5	2	ALIVE	A	140	
MN4	7:53	8:02	9	2	ALIVE	A	143	
MN5	8:05	8:16	11	2	ALIVE	A	138	
MN6	8:03	8:14	11	2	ALIVE	A	178	
MN7	8:04	8:10	6	2	ALIVE	A	146	
MN8	8:05	8:21	16	2	ALIVE	A	136	
MN9	8:04	8:15	11	2	ALIVE		152	
MP0	8:24	8:25	1	2	ALIVE	A	149	
MP1	8:25	8:34	9	2	ALIVE	A	140	
MP2	8:23	8:31	8	2	ALIVE	A	140	
MP3	8:23	8:31	8	2	ALIVE	A	150	
MP4	8:26	8:39	13	2	ALIVE	A	143	
MP5	8:39	8:45	6	2	ALIVE		153	
MP6	8:36	8:44	8	2	ALIVE	A	146	
MP7	8:37	8:47	10	2	ALIVE	A	155	
MP8	8:38	8:46	8	2	ALIVE	A	141	
MP9	8:40	8:52	12	2	ALIVE		140	
MR0	9:21	9:30	9	2	ALIVE	A	186	
MR1	9:19	9:26	7	2	ALIVE	A	144	
MR2	9:18	9:26	8	2	ALIVE	A	143	
MR3	9:20	9:32	12	2	ALIVE	A	174	
MR4	9:19	9:28	9	2	ALIVE	A	141	
MR5	9:33	9:40	7	2	ALIVE	A	183	
MR6	9:31	9:39	8	2	ALIVE	A	149	
MR7	9:32	9:46	14	2	ALIVE	A	187	
MR8	9:33	9:34	1	2	ALIVE	A	157	
MR9	9:32	9:40	8	2	ALIVE		147	
MS0	9:57	10:11	14	2	ALIVE	A	141	
MS1	9:48	10:00	12	2	ALIVE	A	137	
MS2	9:48	10:06	18	1	ALIVE	B	149	
MS3	9:49	10:09	20	2	ALIVE	A	144	
MS4	9:50	10:02	12	2	DEAD	JH	145	
MS5	10:14	10:25	11	2	ALIVE	A	141	
MS7	10:15	10:26	11	2	ALIVE	A	146	
MS8	10:18	10:29	11	2	ALIVE	A	155	
MS9	10:13	10:22	9	2	ALIVE		143	
24 May 2002 - Testlot 5 : Control - Water temp=12.8 C								
MX0	14:00	14:14	14	2	ALIVE	A	136	
MX1	14:02	14:17	15	2	ALIVE		149	
MX2	14:00	14:09	9	2	ALIVE	A	142	
MX3	13:59	14:07	8	2	ALIVE		148	
MX4	13:58	14:05	7	2	ALIVE	A	150	
MX5	14:19	14:25	6	2	ALIVE	A	137	
MX6	14:20	14:31	11	2	ALIVE	A	144	
MX7	14:21	14:36	15	2	ALIVE	A	148	
MX8	14:18	14:36	18	2	ALIVE	A	157	
MX9	14:22	14:34	12	2	ALIVE	A	146	
MY0	14:41	14:50	9	2	ALIVE	A	148	
MY1	14:40	14:50	10	2	ALIVE	A	157	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
MY2	14:42	14:52	10	2	ALIVE	A	149	
MY3	14:38	14:48	10	2	ALIVE	A	151	
MY4	14:39	14:50	11	2	ALIVE	A	162	
MY5	14:53	15:03	10	2	ALIVE	A	146	
MY7	14:56	15:30	34	2	ALIVE	A	161	
MY8	14:54	15:00	6	2	ALIVE	A	170	
MY9	14:54	15:07	13	2	ALIVE	A	145	
MZ1	15:32	15:43	11	2	ALIVE	A	141	
MZ2	15:23	15:31	8	2	ALIVE	A	145	
MZ3	15:22	15:30	8	2	ALIVE	A	137	
MZ5	15:57	16:08	11	2	ALIVE	A	144	
MZ6	15:58	16:08	10	1	ALIVE	A	169	
MZ7	15:55	16:06	11	2	ALIVE	A	156	
MZ8	15:59	16:13	14	2	ALIVE	A	155	
MZ9	15:58	16:04	6	2	ALIVE	A	178	
NM1	16:37	.	.	0	UNKNOWN	X	145	
NM2	16:38	16:47	9	2	ALIVE	A	137	
NM3	16:37	16:43	6	2	ALIVE	A	138	
NM4	16:39	16:46	7	2	ALIVE	A	152	
NM5	16:17	16:31	14	2	ALIVE	A	148	
NM7	16:16	16:28	12	2	ALIVE	A	136	
NM8	16:17	16:36	19	2	ALIVE	A	139	
NM9	16:16	16:28	12	2	ALIVE	A	146	
NT0	17:08	17:20	12	2	ALIVE		148	
NT1	17:20	17:33	13	2	ALIVE	A	150	
NT2	17:09	17:14	5	2	ALIVE	A	150	
NT3	17:10	17:18	8	2	ALIVE	A	154	
NT4	17:19	17:30	11	2	ALIVE	A	144	
NT5	17:31	17:37	6	2	ALIVE	A	153	
NT6	17:38	17:44	6	2	ALIVE	A	147	
NT7	17:35	17:45	10	2	ALIVE	A	146	
NT8	17:26	17:31	5	2	ALIVE	A	145	
NT9	17:31	17:39	8	2	ALIVE	A	142	
25 May 2002 - Testlot 6 : Spillbay 14, gas cap - Water temp=13.1 C								
NY0	15:48	15:55	7	2	ALIVE	A	143	
NY1	15:49	15:58	9	2	ALIVE	A	166	
NY2	15:47	15:54	7	2	ALIVE	A	149	
NY3	15:46	16:00	14	2	ALIVE	A	151	
NY4	15:47	15:58	11	2	ALIVE	A	160	
NY5	16:01	16:11	10	2	ALIVE		157	
NY6	16:03	16:09	6	2	ALIVE	A	150	
NY7	16:00	16:14	14	2	ALIVE	A	156	
NY8	16:02	16:09	7	2	ALIVE	A	154	
NY9	16:01	16:12	11	2	ALIVE		153	
NZ0	16:23	16:40	17	2	ALIVE	A	146	
NZ1	16:21	16:28	7	2	ALIVE	A	156	
NZ2	16:30	16:43	13	2	ALIVE	A	157	
NZ3	16:20	16:29	9	2	ALIVE	A	149	
NZ4	16:30	16:40	10	2	ALIVE	A	162	
NZ5	16:44	16:56	12	2	ALIVE		158	
NZ6	16:42	16:55	13	2	ALIVE	A	142	
NZ7	16:43	16:55	12	2	ALIVE	A	160	
NZ8	16:43	16:53	10	2	ALIVE	A	158	
NZ9	16:45	17:53	68	1	DEAD	DEB	147	
PM0	17:26	17:33	7	2	ALIVE	A	147	
PM1	17:25	17:34	9	2	ALIVE	A	144	
PM2	17:26	17:35	9	2	ALIVE	A	144	
PM3	17:27	17:37	10	2	ALIVE	A	152	
PM4	17:28	17:40	12	2	ALIVE	A	146	
PM5	17:41	17:52	11	2	ALIVE		143	
PM6	17:43	17:54	11	2	ALIVE	A	175	
PM7	17:40	17:56	16	2	ALIVE	A	143	
PM8	17:43	17:58	15	2	ALIVE	A	154	
PM9	17:42	17:55	13	2	ALIVE		165	
PN0	18:01	18:13	12	2	ALIVE	A	137	
PN1	18:02	18:12	10	2	ALIVE	HB	175	
PN2	18:00	18:06	6	2	ALIVE	A	140	
PN3	18:00	18:11	11	2	ALIVE	A	157	
PN4	18:02	18:16	14	2	ALIVE	A	145	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
25 May 2002 - Testlot 6 : Spillbay 16, gas cap - Water temp=13.1 C								
NN0	7:45	7:53	8	2	ALIVE	A	153	
NN1	7:45	8:24	39	2	ALIVE	A	146	
NN2	7:43	7:54	11	2	ALIVE	A	151	
NN3	7:46	7:54	8	2	ALIVE	A	147	
NN5	8:10	8:36	26	2	ALIVE		147	
NN6	8:08	8:25	17	2	ALIVE	A	157	
NN7	8:26	8:34	8	2	ALIVE	A	136	
NN8	8:09	8:16	7	2	ALIVE	A	146	
NN9	8:09	8:26	17	2	ALIVE		146	
NP0	8:40	8:51	11	2	ALIVE	A	152	
NP1	8:44	8:57	13	2	ALIVE	A	157	
NP2	8:39	11:03	144	2	ALIVE	A	144	
NP4	8:42	8:49	7	2	ALIVE	A	158	
NP6	9:24	9:36	12	2	ALIVE	A	157	
NP7	9:35	9:42	7	2	ALIVE	A	136	
NP8	9:47	9:53	6	2	ALIVE	A	168	
NP9	9:36	9:44	8	2	ALIVE		158	
NR0	10:28	10:39	11	2	ALIVE	A	155	
NR1	10:26	10:32	6	2	ALIVE	A	151	
NR2	10:27	10:34	7	2	ALIVE	A	146	
NR4	10:28	10:46	18	2	ALIVE	A	187	
NR5	10:43	10:50	7	2	ALIVE		154	
NR6	10:45	10:52	7	2	ALIVE	A	148	
NR7	10:47	10:59	12	2	ALIVE	A	146	
NR8	10:47	.	.	0	UNKNOWN	X	152	
NR9	10:45	10:55	10	2	ALIVE		180	
NS0	11:18	11:31	13	1	ALIVE	B	139	
NS1	11:10	11:20	10	2	ALIVE	A	172	
NS2	11:17	11:25	8	2	ALIVE	A	155	
NS3	11:18	11:25	7	2	ALIVE	A	163	
NS4	11:10	11:15	5	2	ALIVE	A	160	
NS5	11:33	11:40	7	2	ALIVE		152	
NS6	11:34	11:46	12	2	ALIVE	A	182	
NS8	11:31	11:41	10	2	ALIVE		142	
NS9	11:35	11:48	13	2	ALIVE	A	153	
25 May 2002 - Testlot 6 : Control - Water temp=13.1 C								
NU0	12:34	12:54	20	2	ALIVE	A	146	
NU1	12:35	12:49	14	2	ALIVE	A	139	
NU2	12:36	12:52	16	2	ALIVE	A	143	
NU3	12:38	12:48	10	2	ALIVE	A	144	
NU4	12:33	12:45	12	2	ALIVE	A	148	
NU5	12:54	13:01	7	2	ALIVE		149	
NU6	12:55	13:08	13	2	ALIVE	A	150	
NU7	12:57	13:04	7	2	ALIVE	A	150	
NU8	12:54	13:08	14	2	ALIVE	A	150	
NU9	12:56	13:09	13	2	ALIVE		151	
NV0	13:15	13:29	14	2	ALIVE	A	147	
NV1	13:16	13:32	16	2	ALIVE	A	148	
NV2	13:12	13:30	18	2	ALIVE	A	153	
NV3	13:13	13:28	15	2	ALIVE	A	142	
NV4	13:22	13:22	0	2	ALIVE	A	152	
NV5	13:33	13:44	11	2	ALIVE		139	
NV6	13:37	13:54	17	2	ALIVE	A	147	
NV7	13:36	13:46	10	2	ALIVE	A	150	
NV8	13:32	13:46	14	2	ALIVE	A	152	
NV9	13:35	13:53	18	2	ALIVE		150	
NW0	14:03	14:15	12	2	ALIVE	A	141	
NW1	14:04	14:20	16	2	ALIVE	A	153	
NW2	14:05	14:17	12	2	ALIVE	A	148	
NW3	14:00	14:07	7	2	ALIVE	A	146	
NW4	14:02	14:16	14	2	ALIVE	A	153	
NW5	14:22	14:34	12	2	ALIVE		180	
NW6	14:24	16:19	115	2	ALIVE	A	159	
NW7	14:25	14:31	6	2	ALIVE	A	164	
NW8	14:20	14:27	7	2	ALIVE	A	146	
NX0	14:54	15:06	12	2	ALIVE	A	153	
NX1	14:52	15:00	8	2	ALIVE	A	147	
NX2	15:00	15:12	12	2	ALIVE	A	147	

APPENDIX TABLE A-8 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data Alive/ Dead	Condition Codes	Total Length (mm)	Comments
NX3	15:00	15:07	7	2	ALIVE	A	139	
NX4	14:58	15:06	8	2	ALIVE	A	160	
NX5	15:12	15:19	7	2	ALIVE		137	
NX6	15:10	15:16	6	2	ALIVE	A	144	
NX8	15:11	16:58	107	2	ALIVE	A	157	
NX9	15:13	15:21	8	2	ALIVE		153	
26 May 2002 - Testlot 7 : Spillbay 14, 75 kcfs - Water temp=13.4 C								
LM1	9:45	9:56	11	2	ALIVE		144	
PP0	7:48	7:59	11	2	ALIVE	A	149	
PP1	7:49	8:02	13	2	ALIVE	A	142	
PP2	7:50	8:08	18	2	ALIVE	A	152	
PP3	7:50	7:57	7	2	ALIVE	A	176	
PP4	7:51	7:59	8	2	ALIVE	A	141	
PP5	8:07	8:15	8	2	ALIVE		173	
PP6	8:05	8:17	12	2	ALIVE	A	155	
PP7	8:06	8:17	11	2	ALIVE	A	165	
PP8	8:03	8:13	10	2	ALIVE	A	150	
PP9	8:04	8:20	16	2	ALIVE		144	
PR0	8:20	8:30	10	2	ALIVE	A	141	
PR1	8:19	8:26	7	2	ALIVE	A	149	
PR2	8:19	8:26	7	2	ALIVE	A	167	
PR3	8:22	8:35	13	2	ALIVE	A	160	
PR4	8:21	8:36	15	2	ALIVE	A	153	
PR5	8:49	9:06	17	2	ALIVE		153	
PR6	8:48	9:03	15	2	ALIVE	A	138	
PR7	8:49	8:55	6	2	ALIVE	A	142	
PR8	8:47	8:53	6	2	ALIVE	A	151	
PR9	8:46	8:53	7	2	ALIVE		147	
PS0	9:29	9:44	15	2	ALIVE	A	138	
PS1	9:26	9:41	15	2	ALIVE	A	147	
PS2	9:29	9:38	9	1	ALIVE	B	143	
PS3	9:27	9:34	7	2	ALIVE	A	145	
PS4	9:28	9:34	6	2	ALIVE	G	152	
PS5	9:45	9:51	6	2	ALIVE		162	
PS6	9:46	9:56	10	2	ALIVE	A	146	
PS7	9:47	9:59	12	2	ALIVE	A	143	
PS8	9:47	9:56	9	2	ALIVE	A	155	
PT0	10:05	10:22	17	2	ALIVE	A	157	
PT1	10:03	10:16	13	2	ALIVE	A	143	
PT2	10:04	10:17	13	2	ALIVE	A	161	
PT3	10:03	10:08	5	2	ALIVE	A	158	
PT4	10:02	10:11	9	2	ALIVE	A	136	
PT5	10:21	10:33	12	2	ALIVE		146	
PT6	10:20	10:32	12	2	ALIVE	W	150	
PT7	10:19	10:31	12	2	ALIVE	A	145	
PT8	10:18	10:28	10	2	ALIVE	A	140	
PT9	10:19	10:35	16	2	ALIVE		166	
26 May 2002 - Testlot 7 : Spillbay 16, 75 kcfs - Water temp=13.4 C								
KZ6	14:06	14:20	14	2	ALIVE		138	
KZ8	14:05	14:19	14	2	ALIVE	A	143	
LM3	12:02	12:17	15	2	ALIVE		153	
LM4	14:06	14:15	9	2	ALIVE	A	155	
PU0	11:01	11:11	10	2	ALIVE	A	142	
PU1	11:02	11:11	9	2	DEAD	G	146	
PU2	11:00	11:13	13	2	ALIVE	A	163	
PU3	11:01	11:15	14	2	ALIVE	A	140	
PU4	11:03	11:13	10	2	ALIVE	G	147	
PU5	11:17	11:23	6	2	ALIVE		142	
PU6	11:21	11:34	13	2	ALIVE	A	155	
PU7	11:20	11:35	15	2	ALIVE	A	170	
PU8	11:18	11:30	12	2	ALIVE	A	150	
PU9	11:19	11:29	10	2	ALIVE		170	
PV0	11:41	11:50	9	2	ALIVE	A	157	
PV1	11:43	11:58	15	2	ALIVE	A	157	
PV3	11:43	11:54	11	2	ALIVE	A	146	
PV4	11:41	11:50	9	2	ALIVE	A	146	
PV5	12:04	12:13	9	2	ALIVE		154	
PV6	12:01	12:09	8	2	ALIVE	A	185	

APPENDIX TABLE A-8 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Released	Recovered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
PV7	12:03	12:12	9	2	ALIVE	A	160	
PV8	12:04	12:16	12	2	ALIVE	A	146	
PW0	12:44	12:55	11	2	ALIVE	A	152	
PW1	12:45	13:00	15	2	ALIVE	A	144	
PW2	12:46	12:54	8	2	ALIVE	A	146	
PW3	12:44	12:58	14	2	ALIVE	A	166	
PW4	12:45	12:58	13	2	ALIVE	A	155	
PW5	13:03	13:10	7	2	ALIVE		157	
PW6	13:00	13:09	9	2	ALIVE	A	150	
PW7	13:02	13:12	10	2	ALIVE	A	160	
PW8	13:01	13:16	15	1	ALIVE	CB	167	
PW9	13:03	.	.	0	UNKNOWN		150	
PX0	13:25	13:33	8	2	ALIVE	A	163	
PX1	13:32	13:43	11	2	ALIVE	A	136	
PX2	13:24	13:31	7	2	ALIVE	A	153	
PX3	13:25	13:49	24	2	ALIVE	H	141	
PX4	13:26	13:35	9	2	ALIVE	A	149	
PX5	13:47	14:04	17	2	ALIVE		150	
PX7	13:52	14:03	11	2	ALIVE	A	175	
PX8	13:50	14:04	14	2	ALIVE	A	150	
PX9	13:50	13:57	7	2	ALIVE		179	
26 May 2002 - Testlot 7 : Control - Water temp=13.4 C								
KZ5	17:08	17:18	10	2	ALIVE	A	155	
KZ9	15:54	16:07	13	2	ALIVE	A	159	
PY0	14:58	15:55	57	2	ALIVE	A	157	
PY1	14:55	15:06	11	2	ALIVE	A	168	
PY2	14:59	15:06	7	2	ALIVE	A	148	
PY3	14:57	15:10	13	2	ALIVE	A	163	
PY4	14:56	15:12	16	2	ALIVE	A	161	
PY5	15:15	15:23	8	2	ALIVE		155	
PY6	15:14	15:19	5	2	ALIVE	A	160	
PY7	15:16	15:22	6	2	ALIVE	A	155	
PY8	15:17	15:25	8	2	ALIVE	A	150	
PY9	15:17	15:29	12	2	ALIVE		159	
PZ0	15:35	16:03	28	2	ALIVE	A	158	
PZ1	15:34	15:42	8	2	ALIVE	A	150	
PZ2	15:43	15:52	9	2	ALIVE	A	152	
PZ3	15:36	15:42	6	2	ALIVE	A	173	
PZ4	15:34	15:43	9	2	ALIVE	A	157	
PZ5	15:54	16:02	8	2	ALIVE		154	
PZ6	16:04	16:13	9	2	ALIVE	A	150	
PZ8	15:57	16:23	26	2	ALIVE	A	157	
PZ9	15:55	16:02	7	2	ALIVE		156	
RM0	16:29	16:37	8	2	ALIVE	A	162	
RM1	16:31	16:38	7	2	ALIVE	A	150	
RM2	16:32	16:43	11	2	ALIVE	A	150	
RM3	16:30	16:42	12	2	ALIVE	A	161	
RM4	16:33	16:41	8	2	ALIVE	A	151	
RM5	16:45	16:58	13	2	ALIVE		150	
RM6	16:46	17:01	15	2	ALIVE	A	148	
RM7	16:47	16:57	10	2	ALIVE	A	164	
RM8	16:45	16:53	8	2	ALIVE	A	138	
RM9	16:48	17:17	29	2	ALIVE		175	
RN0	17:15	17:36	21	2	ALIVE	A	176	
RN1	17:30	17:52	22	2	ALIVE		156	
RN2	17:05	17:15	10	2	ALIVE	A	160	
RN3	17:07	17:17	10	2	ALIVE	A	164	
RN4	17:06	17:21	15	2	ALIVE	A	168	
RN5	17:38	17:48	10	2	ALIVE		148	
RN6	17:27	17:38	11	2	ALIVE	A	148	
RN7	17:28	17:36	8	2	ALIVE	A	152	
RN8	17:29	17:40	11	2	ALIVE	A	155	
RN9	17:25	17:36	11	2	ALIVE		149	
27 May 2002 - Testlot 8 : Spillbay 14, 75 kcfs - Water temp=13.8 C								
LM6	11:10	11:19	9	2	ALIVE	A	160	
RU0	11:08	.	.	0	UNKNOWN	X	155	
RU1	11:09	11:16	7	2	ALIVE	A	157	
RU2	11:06	11:11	5	2	ALIVE	A	155	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
RU4	11:07	11:13	6	2	ALIVE	A	159	
RU5	11:33	11:39	6	2	ALIVE		158	
RU6	11:34	11:50	16	2	ALIVE	A	151	
RU7	11:35	11:54	19	2	ALIVE	A	181	
RU8	11:32	11:37	5	2	ALIVE	A	153	
RU9	11:33	11:38	5	2	ALIVE		149	
RV0	11:59	12:06	7	2	ALIVE	A	156	
RV1	11:57	12:13	16	2	ALIVE	A	148	
RV2	11:58	12:04	6	2	ALIVE	A	167	
RV3	11:58	.	.	0	UNKNOWN	X	136	
RV4	12:00	12:19	19	2	ALIVE	A	171	
RV5	12:54	13:01	7	2	ALIVE		140	
RV6	12:35	12:51	16	2	ALIVE	A	177	
RV7	12:54	12:59	5	2	ALIVE	A	158	
RV8	12:34	12:49	15	2	ALIVE	A	155	
RV9	12:53	13:02	9	2	ALIVE		165	
RW0	13:32	13:39	7	2	ALIVE	A	153	
RW1	13:37	13:47	10	2	ALIVE	A	153	
RW2	13:31	13:38	7	2	ALIVE	A	158	
RW3	13:30	13:39	9	2	ALIVE	A	141	
RW4	13:38	13:44	6	2	ALIVE	A	159	
RW5	13:40	13:46	6	2	ALIVE		154	
RW6	13:49	14:03	14	2	ALIVE	A	155	
RW7	13:49	14:04	15	2	ALIVE	A	154	
RW8	13:48	13:52	4	2	ALIVE	A	143	
RW9	13:41	13:47	6	2	ALIVE		146	
RX0	14:09	14:15	6	2	ALIVE	A	156	
RX1	14:09	14:22	13	2	ALIVE	A	165	
RX2	14:17	14:22	5	2	ALIVE	A	149	
RX3	14:10	14:16	6	2	ALIVE	A	140	
RX4	14:18	14:26	8	2	ALIVE	A	148	
RX5	14:29	14:53	24	2	ALIVE		163	
RX6	14:23	14:32	9	2	ALIVE	A	155	
RX7	14:22	14:29	7	2	ALIVE	A	157	
RX8	14:24	14:29	5	2	ALIVE	A	148	
RX9	14:30	14:47	17	2	ALIVE		147	
27 May 2002 - Testlot 8 : Spillbay 16, 75 kcfs - Water temp=13.8 C								
LM5	10:13	10:24	11	2	ALIVE		142	
RP0	7:43	7:55	12	2	ALIVE	A	151	
RP1	7:44	7:58	14	2	ALIVE	A	173	
RP2	7:41	7:48	7	2	ALIVE	A	154	
RP3	7:43	7:57	14	2	ALIVE	A	152	
RP4	7:42	7:48	6	2	ALIVE	A	137	
RP5	8:01	8:10	9	2	ALIVE		146	
RP6	7:59	8:09	10	2	ALIVE	A	142	
RP7	8:01	.	.	0	UNKNOWN	X	144	
RP8	8:00	8:08	8	2	ALIVE	H	147	
RP9	7:59	8:05	6	2	ALIVE		143	
RR0	8:15	8:38	23	2	ALIVE	A	155	
RR1	8:15	8:25	10	2	ALIVE	A	185	
RR2	8:14	8:23	9	2	ALIVE	A	135	
RR3	8:13	8:18	5	2	ALIVE	A	144	
RR4	8:14	8:29	15	2	ALIVE	A	153	
RR5	8:37	8:42	5	2	ALIVE		159	
RR6	8:35	8:53	18	2	ALIVE	A	142	
RR7	8:38	8:55	17	2	ALIVE	A	152	
RR8	8:36	8:41	5	2	ALIVE	A	160	
RR9	8:37	8:52	15	2	ALIVE		151	
RS0	8:40	8:46	6	2	ALIVE	A	158	
RS1	9:14	9:24	10	2	ALIVE	A	146	
RS2	9:12	9:18	6	2	ALIVE	A	150	
RS3	9:14	10:00	46	2	ALIVE	H	163	
RS4	9:12	9:23	11	2	ALIVE	A	150	
RS5	9:13	9:21	8	2	ALIVE		135	
RS6	9:45	9:52	7	2	ALIVE	A	152	
RS7	9:26	9:31	5	2	ALIVE	A	143	
RS8	9:27	9:42	15	2	ALIVE	A	153	
RS9	9:26	9:43	17	2	ALIVE		176	
RT0	9:25	9:39	14	2	ALIVE	A	154	
RT1	10:10	10:19	9	2	ALIVE	A	152	
RT2	9:47	9:58	11	2	ALIVE	A	150	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
RT3	9:46	9:59	13	2	ALIVE	A	154	
RT4	9:48	9:54	6	2	ALIVE	A	152	
RT5	9:48	9:59	11	2	ALIVE		142	
RT6	10:14	10:29	15	2	ALIVE	A	149	
RT7	10:12	10:21	9	2	ALIVE	A	156	
RT8	10:13	10:23	10	2	ALIVE	A	172	
RT9	10:11	10:24	13	2	ALIVE		144	
	27 May 2002 - Testlot 8 : Control - Water temp=13.8 C							
KX7	16:38	16:47	9	2	ALIVE	A	150	
KX8	16:37	16:43	6	2	ALIVE	A	149	
RU3	15:34	15:47	13	2	ALIVE		165	
RY0	15:14	15:26	12	2	ALIVE	A	143	
RY1	15:15	15:31	16	2	ALIVE	A	148	
RY2	15:18	15:30	12	2	ALIVE	A	152	
RY3	15:26	15:34	8	2	ALIVE	A	170	
RY4	15:17	15:29	12	2	ALIVE	A	158	
RY5	15:36	15:47	11	2	ALIVE		157	
RY6	15:33	15:53	20	2	ALIVE	A	161	
RY7	15:35	15:49	14	2	ALIVE	A	162	
RY8	15:32	15:39	7	2	ALIVE	A	147	
RZ0	15:57	16:05	8	2	ALIVE	A	158	
RZ1	16:05	16:18	13	2	ALIVE	A	155	
RZ2	15:55	16:01	6	2	ALIVE	A	148	
RZ3	16:04	16:11	7	2	ALIVE	A	175	
RZ4	15:56	16:04	8	2	ALIVE	A	148	
RZ5	16:19	16:27	8	2	ALIVE		153	
RZ6	16:20	16:27	7	2	ALIVE	A	150	
RZ7	16:09	16:19	10	2	ALIVE	A	158	
RZ8	16:08	16:19	11	2	ALIVE	A	161	
RZ9	16:07	16:14	7	2	ALIVE		155	
SM0	16:45	16:53	8	2	ALIVE	A	159	
SM1	16:40	16:49	9	2	ALIVE	A	169	
SM2	16:36	16:42	6	2	ALIVE	A	157	
SM5	16:48	16:56	8	2	ALIVE		156	
SM6	16:49	17:00	11	2	ALIVE	A	162	
SM7	16:46	16:53	7	2	ALIVE	A	169	
SM8	16:47	16:56	9	2	ALIVE	A	150	
SM9	16:50	16:58	8	2	ALIVE		143	
SN0	17:14	17:22	8	2	ALIVE	A	163	
SN1	17:03	17:11	8	2	ALIVE	A	145	
SN2	17:05	17:18	13	2	ALIVE	A	150	
SN3	17:04	17:11	7	2	ALIVE	A	149	
SN4	17:13	17:21	8	2	ALIVE	A	160	
SN5	17:23	17:42	19	2	ALIVE		143	
SN6	17:24	17:34	10	2	ALIVE	A	165	
SN7	17:26	17:40	14	2	ALIVE	A	174	
SN8	17:22	17:29	7	2	ALIVE	A	157	
SN9	17:25	17:33	8	2	ALIVE		161	
	28 May 2002 - Testlot 9 : Spillbay 14, 75 kcfs - Water temp=13.7 C							
SZ0	14:56	15:00	4	2	ALIVE	A	155	
SZ1	14:43	14:53	10	2	ALIVE	A	159	
SZ2	14:54	14:58	4	2	ALIVE	A	157	
SZ3	14:55	15:04	9	2	ALIVE	DH	149	
SZ4	14:54	15:01	7	2	ALIVE	A	155	
SZ5	14:56	15:13	17	2	ALIVE		143	
SZ6	14:43	15:16	33	2	ALIVE	A	153	
SZ7	14:53	15:09	16	2	ALIVE	A	149	
SZ8	14:55	15:08	13	2	ALIVE		144	
SZ9	14:54	15:20	26	2	ALIVE	A	159	
	28 May 2002 - Testlot 9 : Spillbay 16, 75 kcfs - Water temp=13.7 C							
SU0	11:01	11:08	7	2	ALIVE	A	154	
SU1	11:04	11:15	11	2	ALIVE	A	158	
SU2	13:48	14:01	13	2	ALIVE		147	
SU3	11:02	11:07	5	2	ALIVE	A	158	
SU4	11:03	11:16	13	2	ALIVE	A	175	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
SU5	11:15	11:19	4	2	ALIVE		157	
SU6	11:18	11:25	7	1	ALIVE	GB	166	
SU7	11:16	11:50	34	2	ALIVE	H	145	
SU8	11:17	11:23	6	2	ALIVE	A	161	
SU9	11:16	11:21	5	2	ALIVE		163	
SV0	11:44	11:53	9	2	ALIVE	A	160	
SV1	11:43	11:55	12	2	ALIVE	A	165	
SV2	11:44	11:50	6	2	ALIVE	A	155	
SV3	11:42	11:49	7	2	ALIVE	A	178	
SV4	11:43	11:49	6	2	ALIVE	A	170	
SV5	11:59	12:04	5	2	ALIVE		150	
SV6	11:57	12:02	5	2	ALIVE	A	154	
SV7	11:57	12:02	5	2	ALIVE	A	150	
SV8	11:58	12:25	27	2	DEAD	DGE	147	
SV9	11:56	12:07	11	2	ALIVE		160	
SW0	12:11	12:21	10	2	ALIVE	A	154	
SW1	12:14	12:26	12	2	ALIVE	A	191	
SW2	12:13	12:33	20	2	ALIVE	A	182	
SW3	12:15	12:21	6	2	ALIVE	A	158	
SW4	12:12	12:18	6	2	ALIVE	A	157	
SW5	12:34	12:42	8	2	ALIVE		149	
SW6	12:35	12:38	3	2	ALIVE	A	155	
SW7	12:32	12:43	11	2	ALIVE	A	155	
SW8	12:32	12:41	9	2	ALIVE	A	150	
SW9	12:34	12:41	7	2	ALIVE		155	
SX0	13:49	.	.	0	UNKNOWN		151	
SX1	13:47	13:59	12	2	ALIVE	A	165	
SX2	13:48	13:55	7	2	ALIVE	A	158	
SX3	13:46	13:58	12	2	ALIVE	W	148	
SX4	12:51	13:03	12	2	ALIVE	A	178	
SX5	13:10	.	.	0	UNKNOWN		150	
SX6	13:09	13:18	9	2	ALIVE	A	149	
SX7	13:10	13:22	12	2	ALIVE	A	150	
SX8	13:23	13:31	8	2	ALIVE	A	154	
SX9	13:23	13:33	10	2	ALIVE		158	
SY5	11:03	11:09	6	2	ALIVE	A	154	
SY6	12:51	13:02	11	2	ALIVE	A	153	
SY7	12:50	12:59	9	2	ALIVE	A	164	
SY8	12:50	12:58	8	2	ALIVE	A	155	
SY9	12:52	13:07	15	2	ALIVE	GCH	150	
28 May 2002 - Testlot 9 : Control - Water temp=13.7 C								
KZ2	10:13	10:22	9	2	ALIVE		155	
MW5	10:14	10:20	6	2	ALIVE		145	
MW6	10:18	10:24	6	2	ALIVE	A	155	
MW7	10:22	.	.	.	UNKNOWN		153	
MW8	10:23	10:29	6	2	ALIVE	A	144	
MW9	10:15	10:31	16	2	ALIVE		147	
SP1	7:48	7:57	9	2	ALIVE	A	154	
SP2	7:49	7:57	8	2	ALIVE	A	156	
SP3	7:56	8:04	8	2	ALIVE	A	155	
SP4	7:53	8:01	8	2	ALIVE	A	161	
SP5	8:07	8:17	10	2	ALIVE		152	
SP6	7:58	8:06	8	2	ALIVE	A	180	
SP7	7:59	8:07	8	2	ALIVE	A	144	
SP8	8:08	8:19	11	2	ALIVE	A	158	
SP9	8:10	8:18	8	2	ALIVE		162	
SR0	8:43	8:55	12	2	ALIVE	A	152	
SR1	8:31	8:38	7	2	ALIVE	A	157	
SR2	8:33	8:41	8	2	ALIVE	A	153	
SR3	8:39	8:46	7	2	ALIVE	A	144	
SR4	8:42	8:51	9	2	ALIVE	A	188	
SR5	8:58	9:05	7	2	ALIVE		159	
SR6	8:57	9:04	7	2	ALIVE	A	150	
SR7	8:56	9:02	6	2	ALIVE	A	168	
SR8	8:48	9:11	23	2	ALIVE	A	158	
SR9	8:47	8:55	8	2	ALIVE		156	
SS0	9:13	9:21	8	2	ALIVE	A	136	
SS1	9:21	9:28	7	2	ALIVE	A	147	
SS2	9:22	9:30	8	2	ALIVE	A	153	
SS3	9:15	9:34	19	2	ALIVE	A	160	
SS4	9:12	9:30	18	2	ALIVE	A	173	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Re-leased	Re-covered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
SS5	9:35	9:41	6	2	ALIVE		163	
SS6	9:31	9:38	7	2	ALIVE	A	155	
SS7	9:31	9:37	6	2	ALIVE	A	148	
SS8	9:32	9:38	6	2	ALIVE	A	153	
SS9	9:33	9:40	7	2	ALIVE		165	
ST0	9:54	10:01	7	2	ALIVE	A	147	
ST1	9:44	9:54	10	2	ALIVE	A	149	
ST2	9:49	9:58	9	2	ALIVE	A	148	
ST3	9:45	9:56	11	2	ALIVE	A	144	
ST4	9:56	10:02	6	2	ALIVE	A	147	
ST5	10:02	10:10	8	2	ALIVE		149	
ST6	9:59	10:08	9	2	ALIVE	A	151	
ST7	9:58	10:06	8	2	ALIVE	A	159	
ST8	10:03	10:10	7	2	ALIVE	A	158	
ST9	10:01	10:08	7	2	ALIVE		169	
29 May 2002 - Testlot 10 : Spillbay 14, gas cap - Water temp=13.7 C								
KX9	9:52	10:03	11	2	ALIVE	A	155	
PN5	10:17	10:27	10	2	ALIVE	A	153	
PN6	10:18	10:27	9	2	ALIVE	A	155	
PN7	10:17	10:23	6	2	ALIVE	A	163	
PN8	10:18	10:23	5	2	ALIVE	G	174	
PN9	10:16	10:23	7	2	ALIVE	A	144	
TU0	8:07	8:15	8	2	ALIVE	A	140	
TU1	8:06	8:12	6	2	ALIVE	A	148	
TU2	8:09	8:15	6	2	ALIVE	A	180	
TU3	8:09	8:22	13	2	ALIVE	A	152	
TU4	8:08	8:14	6	2	ALIVE	A	153	
TU5	8:24	8:33	9	2	ALIVE		146	
TU6	8:22	8:29	7	2	ALIVE	A	153	
TU7	8:22	8:30	8	2	ALIVE	A	159	
TU8	8:23	8:34	11	2	ALIVE	A	161	
TU9	8:24	8:35	11	2	ALIVE		150	
TV0	8:38	8:47	9	2	ALIVE	A	140	
TV1	8:39	8:58	19	2	ALIVE	C	143	
TV2	8:41	8:55	14	2	ALIVE	A	146	
TV3	8:39	8:49	10	1	ALIVE	HCB	140	
TV4	8:40	8:55	15	2	ALIVE	A	139	
TV5	8:59	9:10	11	2	ALIVE		142	
TV6	8:59	9:15	16	2	ALIVE	A	147	
TV7	8:58	9:09	11	2	ALIVE	A	159	
TV8	8:59	9:16	17	2	ALIVE	A	152	
TV9	9:00	9:11	11	2	ALIVE		139	
TW0	9:35	9:42	7	2	ALIVE	A	143	
TW1	9:36	9:47	11	2	ALIVE	A	155	
TW2	9:35	9:48	13	2	ALIVE	A	161	
TW3	9:37	9:46	9	2	ALIVE	A	142	
TW4	9:37	10:15	38	2	DEAD	HCJ	150	
TW5	9:51	10:15	24	2	ALIVE		175	
TW6	9:50	10:00	10	2	ALIVE	A	169	
TW7	9:51	10:01	10	2	ALIVE	A	152	
TW9	9:50	9:59	9	2	ALIVE		150	
29 May 2002 - Testlot 10 : Spillbay 16, gas cap - Water temp=13.7 C								
LS6	14:01	14:10	9	2	ALIVE	A	154	
LS7	14:11	14:19	8	2	ALIVE	A	153	
LS9	14:01	14:13	12	2	ALIVE	A	153	
SY1	14:35	14:47	12	2	ALIVE	A	150	
SY2	14:20	14:38	18	2	ALIVE	A	147	
SY3	14:36	14:41	5	2	ALIVE	A	144	
SY4	14:37	14:57	20	2	ALIVE	A	151	
TM9	14:35	14:42	7	2	ALIVE	A	186	
TX0	11:07	11:14	7	2	ALIVE	A	158	
TX1	11:09	11:46	37	2	ALIVE	A	160	
TX2	11:09	11:40	31	2	ALIVE	A	150	
TX3	11:08	11:16	8	2	ALIVE	A	145	
TX4	11:10	11:18	8	2	ALIVE	C	154	
TX6	11:32	11:41	9	2	ALIVE	A	155	
TX7	11:32	11:38	6	2	ALIVE	A	161	
TX8	11:31	11:39	8	2	ALIVE	A	148	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
TX9	11:30	11:40	10	2	ALIVE		143	
TY0	12:01	12:59	58	2	ALIVE	H	165	
TY1	12:03	12:20	17	2	ALIVE	A	153	
TY2	12:02	12:15	13	2	ALIVE	A	148	
TY3	12:01	12:18	17	2	ALIVE	A	150	
TY5	12:26	12:33	7	2	ALIVE		146	
TY6	12:27	12:41	14	2	ALIVE	A	141	
TY7	12:29	.	.	0	UNKNOWN	X	150	
TY9	12:27	12:38	11	2	ALIVE		152	
TZ0	13:21	13:32	11	2	ALIVE	A	147	
TZ1	13:21	13:28	7	2	ALIVE	A	145	
TZ2	13:20	13:47	27	2	DEAD	PBD	165	
TZ3	13:20	13:31	11	2	ALIVE	A	167	
TZ4	13:32	13:43	11	2	ALIVE	A	161	
TZ5	13:49	14:00	11	2	ALIVE		185	
TZ6	13:48	14:00	12	2	ALIVE	A	162	
TZ7	13:34	13:45	11	2	ALIVE	A	150	
TZ8	13:44	13:53	9	2	ALIVE	A	141	
TZ9	13:45	13:57	12	2	ALIVE		155	
29 May 2002 - Testlot 10 : Control - Water temp=13.7 C								
TM0	18:48	18:58	10	2	ALIVE	A	149	
TM1	18:49	18:59	10	2	ALIVE	A	152	
TM2	18:51	19:00	9	2	ALIVE	A	162	
TM3	18:50	19:03	13	2	ALIVE		151	
UM0	16:11	16:39	28	2	ALIVE	A	152	
UM1	16:12	16:21	9	2	ALIVE	A	147	
UM2	16:07	16:21	14	2	ALIVE	A	146	
UM3	16:09	16:48	39	2	ALIVE	H	182	
UM4	16:08	.	.	0	UNKNOWN	X	152	
UM5	16:48	16:58	10	2	ALIVE		157	
UM6	16:49	16:56	7	2	ALIVE	A	152	
UM7	16:45	16:52	7	2	ALIVE	A	164	
UM8	16:47	17:18	31	1	ALIVE	H	137	
UM9	16:49	17:01	12	2	ALIVE		151	
UN0	17:04	17:30	26	2	ALIVE	H	160	
UN2	17:05	17:15	10	2	ALIVE	A	186	
UN3	17:06	17:14	8	2	ALIVE	A	155	
UN4	17:03	17:12	9	2	ALIVE	A	142	
UN5	17:27	17:43	16	2	ALIVE		153	
UN6	17:28	17:39	11	2	ALIVE	A	143	
UN7	17:29	17:40	11	2	ALIVE	A	170	
UN8	17:30	17:39	9	2	ALIVE	A	150	
UP0	18:10	18:28	18	2	ALIVE	A	153	
UP1	18:13	18:30	17	2	ALIVE	A	154	
UP2	18:11	18:23	12	2	ALIVE	A	181	
UP3	18:12	18:33	21	2	ALIVE	A	152	
UP4	18:10	18:18	8	2	ALIVE	A	151	
UP5	18:35	18:46	11	2	ALIVE		182	
UP6	18:34	18:43	9	2	ALIVE	A	167	
UP7	18:31	18:39	8	2	ALIVE	A	155	
UP8	18:32	18:43	11	2	ALIVE	A	152	
UP9	18:36	18:46	10	2	ALIVE		152	
UR0	18:48	19:07	19	2	ALIVE		165	
30 May 2002 - Testlot 11 : Spillbay 14, gas cap - Water temp=13.7 C								
UX4	16:02	16:14	12	2	ALIVE	A	148	
UX5	16:30	16:37	7	2	ALIVE		207	
UX6	16:23	16:32	9	2	ALIVE	A	147	
UX8	16:22	16:28	6	2	ALIVE	A	162	
UX9	16:29	16:35	6	2	ALIVE		139	
UY0	16:14	16:27	13	2	ALIVE	A	205	
UY1	16:01	16:09	8	2	ALIVE	A	197	
UY2	16:10	16:20	10	2	ALIVE	A	179	
UY3	16:14	.	.	0	DEAD	L	155	
UZ0	17:06	17:12	6	2	ALIVE	A	155	
UZ1	16:56	17:05	9	2	ALIVE	A	201	
UZ2	17:06	17:17	11	2	ALIVE	A	138	
UZ3	16:56	17:04	8	2	ALIVE	A	136	
UZ4	17:06	17:15	9	2	ALIVE	A	174	

APPENDIX TABLE A-8 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data: Alive/ Dead	Condition Codes	Total Length (mm)	Comments
UZ5	17:20	17:29	9	2	ALIVE		149	
UZ6	17:20	18:14	54	2	ALIVE	A	143	
UZ7	17:07	17:21	14	2	ALIVE	A	160	
UZ8	17:21	17:29	8	2	ALIVE	A	175	
UZ9	17:22	17:34	12	2	ALIVE		204	
VM0	18:06	18:15	9	2	ALIVE	A	157	
VM1	18:07	18:20	13	2	ALIVE	A	142	
VM2	18:05	18:16	11	2	ALIVE	A	178	
VM3	18:07	18:21	14	2	ALIVE	A	205	
VM4	18:05	18:16	11	2	ALIVE	A	141	
VM5	18:21	18:29	8	2	ALIVE		133	
VM6	18:22	18:28	6	2	ALIVE	A	182	
VM7	18:21	18:30	9	2	ALIVE	A	156	
VM8	18:23	18:31	8	2	ALIVE	A	216	
VM9	18:23	18:30	7	2	ALIVE		220	
30 May 2002 - Testlot 11 : Spillbay 16, gas cap - Water temp=13.7 C								
TM4	7:42	8:20	38	2	ALIVE	A	173	
TM7	10:09	10:22	13	2	ALIVE	A	170	
TM8	10:08	11:01	53	2	ALIVE		176	
TT9	10:08	10:23	15	2	ALIVE		148	
UR1	7:41	7:50	9	2	ALIVE	A	163	
UR2	7:42	7:56	14	2	ALIVE	A	192	
UR3	7:44	7:51	7	2	ALIVE	A	176	
UR4	7:43	7:58	15	1	ALIVE	HBC	150	
UR5	8:04	8:18	14	2	ALIVE		153	
UR6	8:03	8:22	19	2	ALIVE	A	212	
UR7	8:02	8:14	12	2	ALIVE	A	171	
UR8	8:01	8:11	10	2	ALIVE	A	143	
UR9	8:04	8:16	12	1	ALIVE		158	
US0	8:26	8:31	5	2	ALIVE	A	227	
US1	8:23	8:41	18	2	ALIVE	A	193	
US2	8:24	8:38	14	2	ALIVE	A	164	
US3	8:25	8:36	11	2	ALIVE	A	219	
US4	8:22	8:32	10	2	ALIVE	A	210	
US5	8:41	8:59	18	2	ALIVE		220	
US6	8:42	8:54	12	2	ALIVE	A	147	
US7	8:42	8:57	15	2	ALIVE	A	155	
US8	8:40	8:48	8	2	ALIVE	A	175	
US9	8:44	8:53	9	2	ALIVE		206	
UT0	9:34	9:44	10	2	ALIVE	A	135	
UT1	9:35	9:47	12	2	ALIVE	A	169	
UT2	9:32	9:42	10	2	ALIVE	A	184	
UT3	9:33	9:47	14	2	ALIVE	A	191	
UT4	9:31	.	.	0	TAG & PIN		164	
UT5	9:53	10:02	9	2	ALIVE		175	
UT6	9:54	10:09	15	2	ALIVE	A	207	
UT7	9:55	10:05	10	2	ALIVE	A	149	
UT8	9:52	10:05	13	2	ALIVE	A	206	
UT9	9:51	10:04	13	2	ALIVE		210	
30 May 2002 - Testlot 11 : Control - Water temp=13.7 C								
TT8	11:22	11:31	9	2	ALIVE	A	180	
UU0	11:22	11:29	7	2	ALIVE	A	139	
UU1	11:23	11:35	12	2	ALIVE	A	142	
UU3	11:23	11:40	17	2	ALIVE	A	177	
UU4	11:20	11:32	12	2	ALIVE	A	187	
UU5	11:34	11:47	13	2	ALIVE		158	
UU6	11:33	11:50	17	2	ALIVE	A	197	
UU7	11:37	11:55	18	2	ALIVE	A	143	
UU8	11:35	.	.	0	UNKNOWN	X	150	
UV0	12:06	12:15	9	2	ALIVE	A	151	
UV1	12:05	12:15	10	2	ALIVE	A	153	
UV2	12:07	12:15	8	2	ALIVE	A	175	
UV3	12:06	12:19	13	2	ALIVE	A	152	
UV5	12:43	12:59	16	2	ALIVE		173	
UV6	12:21	13:41	80	2	ALIVE	A	148	
UV8	12:44	13:13	29	2	ALIVE	A	170	
UV9	12:20	12:37	17	2	ALIVE		153	
UW0	14:08	14:22	14	2	ALIVE	A	181	

APPENDIX TABLE A-8 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
UW1	14:07	14:20	13	2	ALIVE	A	146	
UW2	14:09	14:40	31	2	ALIVE	A	153	
UW3	14:10	14:36	26	2	ALIVE	A	205	
UW4	14:11	14:19	8	2	ALIVE	A	171	
UW5	14:33	14:44	11	2	ALIVE		211	
UW6	14:32	14:42	10	2	ALIVE	A	138	
UW7	14:30	14:41	11	2	ALIVE	A	155	
UW8	15:03	15:09	6	2	ALIVE	A	162	
UW9	14:31	14:43	12	2	ALIVE		209	
UX1	16:01	16:32	31	2	ALIVE	A	152	
UX2	16:10	16:27	17	2	ALIVE	A	215	
UX3	16:14	16:27	13	2	ALIVE	A	204	
UY4	16:02	16:24	22	2	ALIVE	A	154	
UY5	16:30	16:39	9	2	ALIVE		160	
UY6	16:23	16:45	22	2	ALIVE	A	160	
UY7	16:31	.	.	0	UNKNOWN	X	169	
UY8	16:22	16:43	21	2	ALIVE	A	150	
UY9	16:29	16:39	10	2	ALIVE		162	
31 May 2002 - Testlot 12 : Spillbay 14, gas cap - Water temp=13.7 C								
TM5	9:49	9:56	7	2	ALIVE	A	158	
VN0	7:41	7:54	13	2	ALIVE	A	168	
VN1	7:41	7:52	11	2	ALIVE	A	179	
VN2	7:43	7:59	16	2	ALIVE	A	174	
VN3	7:42	7:58	16	2	ALIVE	A	156	
VN4	7:43	7:50	7	2	ALIVE	A	165	
VN5	8:00	8:11	11	2	ALIVE		160	
VN6	8:00	8:07	7	2	ALIVE	A	177	
VN7	8:02	8:07	5	2	ALIVE	A	192	
VN8	8:01	8:15	14	2	ALIVE	A	173	
VP0	9:22	9:32	10	2	ALIVE	A	156	
VP1	8:24	8:41	17	2	ALIVE	A	190	
VP2	8:24	8:36	12	2	ALIVE	A	193	
VP3	8:26	8:36	10	2	ALIVE	A	210	
VP5	8:47	8:58	11	2	ALIVE		165	
VP6	8:47	8:57	10	2	ALIVE	A	170	
VP7	8:49	9:00	11	2	ALIVE	A	206	
VP8	8:48	10:26	98	2	ALIVE	HCB	147	
VP9	8:46	8:52	6	2	ALIVE		159	
VR0	9:37	9:49	12	2	ALIVE	A	155	
VR1	9:23	9:34	11	2	ALIVE	A	182	
VR2	9:23	9:34	11	2	ALIVE	A	152	
VR3	9:24	9:36	12	2	ALIVE	A	150	
VR4	9:27	9:38	11	2	ALIVE	A	151	
VR5	9:39	9:47	8	2	ALIVE		148	
VR6	9:39	.	.	0	UNKNOWN	X	203	
VR7	9:50	9:57	7	2	ALIVE	A	195	
VR8	9:40	9:47	7	2	ALIVE	A	142	
VR9	9:41	9:52	11	2	ALIVE		152	
31 May 2002 - Testlot 12 : Spillbay 16, gas cap - Water temp=13.7 C								
UU2	17:17	17:28	11	2	ALIVE	A	214	
VW0	15:34	15:44	10	2	ALIVE	A	128	
VW1	15:34	15:43	9	2	ALIVE	A	207	
VW2	15:33	15:46	13	2	ALIVE	A	214	
VW3	15:32	15:42	10	2	ALIVE	A	162	
VW4	15:31	15:46	15	2	ALIVE	A	176	
VW5	15:48	15:57	9	2	ALIVE		161	
VW6	15:50	15:59	9	2	ALIVE	C	190	
VW7	15:49	16:04	15	2	ALIVE	A	175	
VW8	15:49	16:02	13	2	ALIVE	A	180	
VW9	15:50	16:01	11	2	ALIVE		149	
VX0	16:09	16:18	9	2	ALIVE	A	137	
VX1	16:09	16:21	12	2	ALIVE	C	209	
VX2	16:08	16:28	20	2	ALIVE	A	215	
VX3	16:10	16:23	13	2	ALIVE	A	174	
VX4	16:07	16:17	10	2	ALIVE	A	198	
VX5	16:24	16:35	11	2	ALIVE		150	
VX6	16:27	16:39	12	2	ALIVE	A	151	
VX7	16:26	16:38	12	2	ALIVE	A	178	

APPENDIX TABLE A-8 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Re-leased	Re-covered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
VX8	16:25	16:34	9	2	ALIVE	A	195	
VX9	16:25	16:35	10	2	ALIVE		196	
VY0	17:15	17:24	9	2	ALIVE	A	185	
VY1	17:16	17:30	14	2	ALIVE	A	202	
VY3	17:14	17:24	10	2	ALIVE	A	212	
VY4	17:17	17:29	12	2	ALIVE	A	232	
VY5	17:33	17:48	15	2	ALIVE		203	
VY6	17:32	17:46	14	2	ALIVE	A	212	
VY7	17:33	17:49	16	2	ALIVE	A	215	
VY8	17:31	17:44	13	2	ALIVE	A	210	
VY9	17:32	17:40	8	2	ALIVE		219	
31 May 2002 - Testlot 12 : Control - Water temp=13.7 C								
VS0	11:02	11:12	10	2	ALIVE	A	208	
VS1	11:01	.	.	0	UNKNOWN	X	169	
VS2	10:58	11:13	15	2	ALIVE	W	185	
VS3	10:59	11:12	13	2	ALIVE	A	150	
VS4	11:00	11:07	7	2	ALIVE	A	170	
VS5	11:19	11:32	13	2	ALIVE		208	
VS6	11:20	11:37	17	2	ALIVE	A	178	
VS7	11:18	11:26	8	2	ALIVE	A	149	
VS8	11:18	11:28	10	2	ALIVE	A	160	
VS9	11:17	11:27	10	2	ALIVE		135	
VT0	11:39	11:55	16	2	ALIVE	A	192	
VT1	11:41	11:58	17	2	ALIVE	A	206	
VT2	11:38	11:53	15	2	ALIVE	A	194	
VT3	11:37	11:45	8	2	ALIVE	A	166	
VT4	11:40	11:51	11	2	ALIVE		204	
VT5	11:58	12:27	29	2	ALIVE	A	158	
VT6	11:57	12:10	13	2	ALIVE	A	200	
VT7	11:59	12:12	13	2	ALIVE	A	157	
VT8	11:59	12:09	10	2	ALIVE		216	
VT9	12:00	12:12	12	2	ALIVE		220	
VU0	13:08	13:25	17	2	ALIVE	A	204	
VU1	13:07	13:23	16	2	ALIVE	A	215	
VU2	13:05	13:22	17	2	ALIVE	A	158	
VU3	13:05	13:20	15	2	ALIVE	A	180	
VU4	13:04	13:12	8	2	ALIVE	A	135	
VU5	13:25	.	.	0	UNKNOWN		210	
VU6	13:28	13:42	14	2	ALIVE	A	207	
VU7	13:29	13:44	15	2	ALIVE	A	165	
VU8	13:26	13:36	10	2	ALIVE	A	217	
VU9	13:27	13:39	12	2	ALIVE		212	
VV0	13:56	.	.	0	DEAD	L	148	
VV1	13:58	14:19	21	2	ALIVE	A	204	
VV2	13:54	14:07	13	2	ALIVE	A	180	
VV3	13:57	14:12	15	2	ALIVE	A	180	
VV4	13:55	14:08	13	2	ALIVE	A	153	
VV5	14:27	14:39	12	2	ALIVE		198	
VV6	14:22	14:30	8	2	ALIVE	A	144	
VV7	14:24	14:35	11	2	ALIVE	A	174	
VV8	14:26	14:40	14	2	ALIVE	A	212	
VV9	14:22	14:37	15	2	ALIVE		205	

APPENDIX TABLE A-9

Short-term turbine passage survival data on individual chinook salmon released in Spillbays 14 and 16 at Bonneville Dam, August 2002. Fish were tagged with Normandeau's HI-Z Turb-N tags. Description of condition codes and details on injured fish are presented in Table 2-5.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
18 August 2002 - Testlot 1 : Spillbay 14, gas cap - Water temp=20.5 C								
D00	8:38	8:44	6	2	ALIVE	A	121	
D01	8:40	8:49	9	2	ALIVE	A	119	
D02	8:36	8:43	7	2	ALIVE	A	100	
D03	8:39	8:46	7	2	ALIVE	A	115	
D04	8:38	8:48	10	2	ALIVE	A	110	
D05	8:51	9:01	10	2	ALIVE	A	106	
D06	8:53	9:01	8	2	ALIVE	A	107	
D07	8:49	8:55	6	2	ALIVE	A	112	
D08	8:50	8:56	6	2	ALIVE	A	106	
D09	8:52	9:02	10	2	ALIVE	A	105	
D50	13:16	13:22	6	2	ALIVE	C	122	
D51	13:18	13:26	8	2	ALIVE	A	117	
D52	13:17	13:28	11	2	ALIVE	A	101	
D53	13:16	.	.	0	TAG & PIN		100	
D54	13:15	.	.	0	TAG & PIN		96	
D55	13:46	13:58	12	2	DEAD	PD	101	
D56	13:47	.	.	0	UNKNOWN	X	105	
D57	13:44	13:49	5	2	ALIVE	A	107	
D58	13:45	.	.	0	DEAD	ZL	100	
D59	13:46	13:53	7	2	ALIVE	A	100	
D60	14:31	14:38	7	2	ALIVE	C	121	
D61	14:32	14:38	6	2	ALIVE	A	120	
D62	14:30	14:36	6	2	ALIVE	A	105	
D63	14:29	14:39	10	2	ALIVE	A	124	
D64	14:31	14:39	8	2	ALIVE	C	105	
D65	14:42	14:46	4	2	ALIVE	A	128	
D66	14:42	14:50	8	2	ALIVE	A	119	
D67	14:42	14:51	9	2	DEAD	C	131	
D68	14:41	14:47	6	2	ALIVE	A	125	
D69	14:43	.	.	0	DEAD	L	101	
D70	15:12	15:21	9	2	ALIVE	A	119	
D71	15:11	15:17	6	2	ALIVE	A	120	
D72	15:13	.	.	0	TAG & PIN		111	
D73	15:11	15:16	5	2	ALIVE	A	126	
D74	15:10	15:18	8	2	ALIVE	A	121	
D75	15:27	15:30	3	2	ALIVE	A	104	
D76	15:25	15:30	5	2	ALIVE	A	122	
D77	15:26	15:31	5	2	ALIVE	C	119	
D78	15:28	15:35	7	2	ALIVE	A	134	
D79	15:27	15:34	7	2	ALIVE	A	114	
18 August 2002 - Testlot 1 : Spillbay 16, gas cap - Water temp=20.5 C								
D10	9:23	9:33	10	2	ALIVE	A	113	
D11	9:22	9:30	8	2	ALIVE	A	112	
D12	9:22	9:30	8	2	ALIVE	A	115	
D13	9:25	9:34	9	2	ALIVE	A	132	
D14	9:24	.	.	0	UNKNOWN	X	102	
D15	9:40	9:48	8	2	ALIVE	C	109	
D16	9:39	9:44	5	2	ALIVE	A	104	
D17	9:38	9:46	8	2	ALIVE	A	105	
D18	9:39	9:48	9	2	ALIVE	A	109	
D19	9:40	.	.	0	DEAD	ZL	104	
D20	10:33	10:46	13	2	ALIVE	QA	108	
D21	10:31	10:39	8	2	ALIVE	C	110	
D22	10:31	10:51	20	1	DEAD	GBP	124	
D23	10:30	11:05	35	2	ALIVE	QA	128	
D24	10:32	10:38	6	2	ALIVE	A	139	
D25	11:03	.	.	0	TAG & PIN		104	
D26	11:04	11:10	6	2	ALIVE	A	108	
D27	11:01	11:06	5	2	ALIVE	A	128	
D28	11:01	11:09	8	2	ALIVE	A	126	
D29	11:05	11:14	9	2	ALIVE	A	108	
D30	11:20	11:26	6	2	ALIVE	A	133	
D31	11:18	11:23	5	2	ALIVE	A	108	
D32	11:21	11:34	13	1	ALIVE	CB	110	
D33	11:19	11:28	9	2	ALIVE	A	122	
D34	11:22	11:31	9	2	ALIVE	A	128	

APPENDIX TABLE A-9 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
D35	11:38	11:46	8	2	ALIVE	A	111	
D37	11:36	11:44	8	2	ALIVE	A	98	
D38	11:37	11:50	13	2	ALIVE	A	102	
D39	11:39	11:47	8	1	ALIVE	B	110	
D40	12:26	12:33	7	2	ALIVE	A	112	
D41	12:26	12:35	9	2	ALIVE	A	130	
D42	12:27	12:37	10	1	ALIVE	HCB	105	
D43	12:25	12:32	7	2	ALIVE	A	103	
D44	12:23	.	.	0	TAG & PIN		100	
D45	12:39	12:50	11	2	ALIVE	A	131	
D46	12:40	12:50	10	2	ALIVE	QA	125	
D47	12:38	.	.	0	DEAD	ZL	109	
D48	12:42	12:54	12	2	ALIVE	A	122	
D49	12:41	12:57	16	1	DEAD	PE	114	
18 August 2002 - Testlot 1 : Control - Water temp=20.5 C								
D80	16:35	16:41	6	2	ALIVE	A	112	
D81	16:38	16:48	10	2	ALIVE	A	130	
D82	16:37	16:44	7	2	ALIVE	A	133	
D83	16:35	.	.	0	DEAD	L	100	
D84	16:36	16:43	7	2	ALIVE	A	129	
D85	16:52	17:03	11	2	ALIVE	A	116	
D86	16:54	17:04	10	2	ALIVE	A	120	
D87	16:55	17:04	9	2	ALIVE	A	101	
D88	16:53	17:01	8	2	ALIVE	A	128	
D89	16:55	17:07	12	2	ALIVE	A	116	
D90	17:14	17:26	12	2	ALIVE	A	109	
D91	17:16	17:24	8	2	ALIVE	A	97	
D92	17:16	.	.	0	TAG & PIN		105	
D93	17:13	17:21	8	2	ALIVE	A	102	
D94	17:15	17:21	6	2	ALIVE	A	103	
D95	17:33	17:43	10	2	ALIVE	A	132	
D96	17:32	17:49	17	2	ALIVE	A	126	
D97	17:32	17:39	7	2	ALIVE	A	123	
D98	17:31	17:39	8	2	ALIVE	A	115	
D99	17:33	.	.	0	TAG & PIN		117	
U00	18:14	.	.	0	DEAD	QZ	121	
U01	18:15	18:36	21	2	DEAD	P	118	
U02	18:16	18:24	8	2	ALIVE	A	117	
U03	18:16	18:25	9	2	ALIVE	C	126	
U04	18:14	18:22	8	2	ALIVE	A	118	
U05	18:36	18:44	8	2	ALIVE	A	110	
U06	18:38	.	.	0	UNKNOWN	X	137	
U07	18:37	18:45	8	2	ALIVE	A	110	
U08	18:37	.	.	0	TAG & PIN		110	
U09	18:35	18:50	15	1	DEAD	P	108	
19 August 2002 - Testlot 2 : Spillbay 14, gas cap - Water temp=20.5 C								
U10	8:13	8:19	6	2	ALIVE	G	120	
U11	8:12	8:26	14	2	ALIVE	A	115	
U12	8:12	8:26	14	2	ALIVE	A	111	
U13	8:14	8:21	7	2	ALIVE	A	111	
U14	8:14	8:20	6	2	ALIVE	A	112	
U15	8:30	8:46	16	2	ALIVE	A	120	
U16	8:29	.	.	0	TAG & PIN		104	
U17	8:30	8:41	11	2	ALIVE	A	126	
U18	8:31	8:37	6	2	ALIVE	A	119	
U19	8:20	.	.	0	UNKNOWN	X	121	
U20	9:00	9:12	12	2	ALIVE	A	109	
U21	9:00	9:14	14	2	ALIVE	A	104	
U22	8:58	9:14	16	2	ALIVE	A	110	
U23	8:59	9:16	17	2	ALIVE	A	112	
U24	8:59	9:09	10	2	ALIVE	A	107	
U25	9:18	9:29	11	2	ALIVE	A	105	
U26	9:17	9:29	12	2	ALIVE	A	120	
U27	9:19	9:31	12	2	ALIVE	A	109	
U28	9:18	9:27	9	2	ALIVE	A	102	
U29	9:16	9:23	7	2	ALIVE	A	108	
U30	10:07	.	.	0	UNKNOWN	X	110	
U31	10:06	10:18	12	2	ALIVE	A	114	
U32	10:07	10:17	10	2	ALIVE	A	116	
U33	10:08	10:21	13	2	DEAD	PEJ	118	

APPENDIX TABLE A-9 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Re-leased	Re-covered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
U34	10:08	.	.	0	UNKNOWN	X	103	
U35	10:40	10:47	7	2	ALIVE	HC	115	
U36	10:42	10:54	12	2	ALIVE	A	116	
U37	10:43	.	.	0	TAG & PIN		108	
U38	10:42	10:48	6	2	ALIVE	A	110	
U39	10:41	10:51	10	2	ALIVE	HG	104	
U40	11:15	11:21	6	2	ALIVE	A	130	
U41	11:14	.	.	0	UNKNOWN	X	104	
U42	11:21	11:29	8	2	ALIVE	A	106	
U43	11:13	11:20	7	2	ALIVE	A	107	
U44	11:22	11:29	7	2	ALIVE	HC	120	
U45	11:44	.	.	0	TAG & PIN		106	
U46	11:32	11:39	7	2	ALIVE	A	109	
U47	11:31	11:39	8	2	ALIVE	A	112	
U48	11:40	11:46	6	2	ALIVE	A	110	
U49	11:40	11:54	14	2	ALIVE	A	105	
19 August 2002 - Testlot 2 : Spillbay 16, gas cap - Water temp=20.5 C								
U90	16:20	16:27	7	2	ALIVE	A	128	
U91	16:36	16:43	7	2	ALIVE	A	124	
U92	16:26	16:43	17	2	ALIVE	A	118	
U93	16:20	16:29	9	2	ALIVE	A	106	
U94	16:20	16:34	14	2	ALIVE	A	109	
U95	16:37	16:44	7	2	ALIVE	A	127	
U96	16:45	16:50	5	2	ALIVE	C	124	
U97	16:44	17:02	18	1	ALIVE	CHB	117	
U98	16:43	16:51	8	2	ALIVE	A	111	
U99	16:50	16:57	7	2	ALIVE	A	127	
W00	17:17	17:23	6	2	ALIVE	A	114	
W01	17:03	17:10	7	2	ALIVE	A	105	
W02	17:11	17:20	9	2	ALIVE	C	128	
W03	17:10	17:16	6	2	ALIVE	C	113	
W04	17:00	17:09	9	1	ALIVE	BC	126	
W05	17:18	17:24	6	2	ALIVE	A	128	
W06	17:30	17:38	8	2	ALIVE	A	115	
W07	17:25	17:32	7	2	ALIVE	A	115	
W08	17:21	17:29	8	1	ALIVE	HB	125	
W09	17:24	17:32	8	2	ALIVE	A	108	
W10	18:06	18:12	6	2	ALIVE	C	126	
W11	18:06	18:14	8	2	ALIVE	A	116	
W12	18:14	18:24	10	2	ALIVE	A	104	
W13	18:13	18:20	7	2	ALIVE	A	133	
W14	18:07	.	.	0	TAG & PIN		104	
W15	18:24	18:34	10	2	ALIVE	A	104	
W16	18:34	18:41	7	2	ALIVE	A	131	
W17	18:21	18:27	6	2	ALIVE	A	114	
W18	18:36	18:45	9	2	ALIVE	C	115	
W19	18:28	18:34	6	2	ALIVE	A	106	
W20	18:36	18:45	9	2	ALIVE	C	131	
W21	18:47	18:56	9	2	ALIVE	C	141	
W22	18:57	.	.	0	DEAD	ZL	108	
W23	18:47	18:51	4	2	ALIVE	A	103	
W24	18:52	18:58	6	2	ALIVE	A	118	
W25	19:17	.	.	0	TAG & PIN		107	
W26	19:09	19:19	10	1	ALIVE	HB	106	
W27	19:00	19:08	8	2	ALIVE	A	128	
W28	19:10	19:17	7	2	ALIVE	A	116	
W29	19:00	19:09	9	2	ALIVE	A	121	
XR6	19:20	.	.	0	DEAD	ZL	138	
19 August 2002 - Testlot 2 : Control - Water temp=20.5 C								
U50	12:40	12:48	8	2	ALIVE	A	116	
U51	12:27	12:35	8	2	ALIVE	A	111	
U52	12:36	12:47	11	1	ALIVE	HB	107	
U53	12:28	12:39	11	2	ALIVE	A	130	
U54	12:27	.	.	0	UNKNOWN	X	108	
U55	13:11	13:18	7	2	ALIVE	A	108	
U56	13:10	13:16	6	2	ALIVE	A	112	
U57	12:50	.	.	0	DEAD	L	117	
U58	12:50	13:00	10	2	ALIVE	A	113	
U59	13:17	13:30	13	2	ALIVE	A	108	
U60	13:19	.	.	0	DEAD	ZL	101	
U61	13:31	13:38	7	2	ALIVE	A	107	

APPENDIX TABLE A-9 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Re-leased	Re-covered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
U62	13:44	13:51	7	2	ALIVE	A	104	
U63	13:55	14:01	6	2	ALIVE	A	120	
U64	13:43	13:49	6	2	ALIVE	A	117	
U65	14:09	14:16	7	2	ALIVE	A	110	
U66	14:04	14:11	7	2	ALIVE	A	102	
U67	14:02	14:08	6	2	ALIVE	C	121	
U68	13:57	14:04	7	2	ALIVE	A	116	
U69	14:06	14:14	8	2	ALIVE	A	111	
U70	14:53	15:00	7	2	ALIVE	A	107	
U71	14:43	14:50	7	2	ALIVE	A	113	
U72	14:45	14:53	8	2	ALIVE	A	108	
U73	14:50	14:56	6	2	ALIVE	A	107	
U74	14:44	.	.	0	DEAD	L	116	
U75	14:55	15:05	10	2	ALIVE	A	105	
U76	15:07	15:14	7	2	ALIVE	A	103	
U77	14:57	15:09	12	2	ALIVE	A	100	
U78	15:00	.	.	0	UNKNOWN	X	110	
U79	15:10	15:21	11	2	ALIVE	A	107	
U80	15:38	15:44	6	2	ALIVE	A	104	
U81	15:33	15:42	9	2	ALIVE	A	102	
U82	15:30	15:37	7	2	ALIVE	A	103	
U83	15:37	15:42	5	2	ALIVE	A	119	
U84	15:24	15:30	6	2	ALIVE	A	124	
U85	15:57	16:02	5	2	ALIVE	C	124	
U86	15:44	15:57	13	1	ALIVE	HB	105	
U87	16:01	16:02	1	2	ALIVE	A	129	
U88	15:46	.	.	0	TAG & PIN		132	
U89	15:45	15:56	11	2	ALIVE	A	109	
20 August 2002 - Testlot 3 : Spillbay 14, gas cap - Water temp=20.0 C								
BB0	15:13	15:24	11	2	ALIVE	C	129	
BB1	15:12	15:28	16	2	ALIVE	HC	108	
BB2	15:10	15:25	15	2	ALIVE	A	115	
BB3	15:11	15:20	9	2	ALIVE	A	127	
BB4	15:11	.	.	0	TAG & PIN		109	
BB5	15:31	15:39	8	2	ALIVE	C	108	
BB6	15:33	15:44	11	2	ALIVE	A	104	
BB7	15:30	15:37	7	2	ALIVE	A	108	
BB8	15:29	15:37	8	2	ALIVE	A	120	
BB9	15:30	15:39	9	2	ALIVE	A	105	
BC0	15:55	16:06	11	2	ALIVE	A	117	
BC1	15:57	16:14	17	2	DEAD	P	122	
BC2	15:56	16:03	7	2	ALIVE	A	104	
BC3	15:54	16:04	10	2	ALIVE	A	104	
BC4	15:56	16:05	9	2	ALIVE	A	102	
BC5	16:12	16:20	8	2	ALIVE	A	126	
BC6	16:10	16:21	11	2	ALIVE	A	114	
BC7	16:11	16:20	9	2	ALIVE	A	122	
BC8	16:10	16:19	9	2	ALIVE	A	113	
BC9	16:11	.	.	0	UNKNOWN	X	128	
BD0	16:54	17:07	13	2	ALIVE	A	104	
BD1	16:53	.	.	0	TAG & PIN		100	
BD2	16:53	17:00	7	2	ALIVE	A	117	
BD3	16:53	17:04	11	2	ALIVE	C	111	
BD4	16:52	17:00	8	2	ALIVE	A	110	
BD5	17:12	.	.	0	DEAD	Z	109	
BD6	17:09	17:18	9	2	ALIVE	A	107	
BD7	17:08	17:15	7	2	ALIVE	A	109	
BD8	17:09	17:17	8	2	ALIVE	A	136	
BD9	17:10	17:21	11	1	ALIVE	HB	112	
BE0	17:32	17:42	10	2	ALIVE	A	114	
BE1	17:31	.	.	0	TAG & PIN		109	
BE2	17:29	17:37	8	2	ALIVE	A	115	
BE3	17:30	17:37	7	2	ALIVE	A	132	
BE4	17:30	17:38	8	2	ALIVE	A	112	
BE5	17:46	17:54	8	2	ALIVE	A	136	
BE6	17:48	17:56	8	2	ALIVE	A	112	
BE7	17:44	17:51	7	2	ALIVE	A	126	
BE8	17:45	17:52	7	2	ALIVE	A	123	
BE9	17:42	17:51	9	2	ALIVE	A	102	

APPENDIX TABLE A-9 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data: Alive/ Dead	Condition Codes	Total Length (mm)	Comments
20 August 2002 - Testlot 3 : Spillbay 16, gas cap - Water temp=20.0 C								
BA0	14:20	14:31	11	2	ALIVE	A	103	
BA1	14:19	14:27	8	2	ALIVE	A	103	
BA2	14:19	14:26	7	2	ALIVE	A	103	
BA3	14:18	14:25	7	2	ALIVE	A	122	
BA4	14:20	14:28	8	2	ALIVE	A	107	
BA5	14:32	14:42	10	2	ALIVE	A	121	
BA6	14:30	14:40	10	2	ALIVE	A	113	
BA7	14:30	14:36	6	2	ALIVE	A	116	
BA8	14:31	14:40	9	2	ALIVE	A	110	
BA9	14:33	.	.	0	TAG & PIN		120	
W70	12:19	12:27	8	2	ALIVE	A	105	
W71	12:21	12:33	12	2	ALIVE	A	109	
W72	12:20	12:29	9	2	ALIVE	A	107	
W73	12:18	12:28	10	2	ALIVE	A	108	
W74	12:21	12:30	9	2	ALIVE	A	114	
W75	12:33	12:41	8	2	ALIVE	A	110	
W76	12:31	12:38	7	2	ALIVE	A	105	
W77	12:32	12:40	8	2	ALIVE	A	118	
W78	12:33	12:40	7	2	ALIVE	A	113	
W79	12:31	12:38	7	2	ALIVE	C	128	
W80	12:45	12:53	8	2	ALIVE	C	117	
W81	12:46	12:55	9	2	ALIVE	A	120	
W82	12:44	12:52	8	2	ALIVE	A	111	
W83	12:45	12:54	9	2	ALIVE	A	120	
W84	12:46	.	.	0	TAG & PIN		108	
W85	12:59	13:08	9	2	ALIVE	A	107	
W86	13:00	13:07	7	2	ALIVE	A	118	
W87	13:01	13:13	12	2	ALIVE	A	103	
W88	13:02	13:11	9	2	ALIVE	C	132	
W89	12:58	13:06	8	2	ALIVE	C	130	
W90	13:40	13:47	7	2	ALIVE	A	116	
W91	13:41	13:49	8	2	ALIVE	A	118	
W92	13:42	13:48	6	2	ALIVE	A	116	
W93	13:40	13:49	9	2	ALIVE	A	108	
W94	13:42	13:51	9	2	ALIVE	A	103	
W95	13:51	13:59	8	2	ALIVE	A	102	
W96	13:53	14:02	9	2	ALIVE	A	111	
W97	13:51	14:00	9	2	ALIVE	A	112	
W98	13:50	.	.	0	UNKNOWN	X	118	
W99	13:52	14:02	10	2	ALIVE	A	105	
20 August 2002 - Testlot 3 : Control - Water temp=20.0 C								
W30	8:19	8:25	6	2	ALIVE	A	110	
W31	8:17	8:24	7	2	ALIVE	A	128	
W32	8:24	8:33	9	2	ALIVE	C	121	
W34	8:26	8:35	9	2	ALIVE	C	117	
W35	8:38	8:47	9	2	ALIVE	A	115	
W36	8:46	8:54	8	2	ALIVE	A	104	
W37	8:35	8:45	10	2	ALIVE	A	106	
W38	8:43	8:59	16	2	ALIVE	A	110	
W39	8:34	8:43	9	2	ALIVE	A	105	
W40	8:47	8:54	7	2	ALIVE	A	107	
W41	8:55	9:01	6	2	ALIVE	A	109	
W42	8:56	9:06	10	2	ALIVE	A	104	
W43	9:00	9:09	9	2	ALIVE	A	116	
W44	9:02	9:12	10	2	ALIVE	A	114	
W45	9:21	9:34	13	2	ALIVE	QA	123	
W46	9:24	9:32	8	2	ALIVE	A	110	
W47	9:17	9:32	15	1	DEAD	P	112	
W48	9:08	9:16	8	2	ALIVE	A	145	
W49	9:12	9:20	8	2	ALIVE	A	107	
W50	9:52	10:09	17	2	ALIVE	QA	114	
W51	9:38	9:49	11	2	ALIVE	A	109	
W52	9:50	9:56	6	2	ALIVE	A	130	
W53	9:46	9:51	5	2	ALIVE	A	106	
W54	9:37	.	.	0	TAG & PIN		118	
W55	10:04	10:10	6	2	ALIVE	A	104	
W56	10:13	10:20	7	2	ALIVE	A	120	
W57	9:57	10:03	6	2	ALIVE	A	111	
W58	10:12	10:17	5	2	ALIVE	A	103	
W59	10:10	10:21	11	2	ALIVE	A	103	

APPENDIX TABLE A-9 Continued.

Fish No.	Time				Fish Data			
	Re-leased	Re-covered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
W60	10:22	10:29	7	2	ALIVE	A	116	
W61	10:30	10:36	6	2	ALIVE	A	113	
W62	10:32	10:44	12	2	ALIVE	A	105	
W63	10:23	10:31	8	2	ALIVE	A	146	
W64	10:37	10:43	6	2	ALIVE	A	124	
W65	10:47	10:54	7	2	ALIVE	A	112	
W66	10:53	11:00	7	2	ALIVE	A	113	
W67	10:52	11:09	17	2	ALIVE	QA	112	
W68	10:45	10:51	6	2	ALIVE	A	109	
W69	10:44	10:53	9	2	ALIVE	A	112	
XS8	8:31	8:38	7	2	ALIVE	A	129	
21 August 2002 - Testlot 4 : Spillbay 14, gas cap - Water temp=19.5 C								
BF0	8:21	8:31	10	2	ALIVE	C	125	
BF1	8:19	8:28	9	2	ALIVE	A	106	
BF2	8:21	8:32	11	2	ALIVE	A	106	
BF3	8:19	8:29	10	2	ALIVE	A	107	
BF4	8:20	8:29	9	2	ALIVE	A	115	
BF5	8:34	8:49	15	2	ALIVE	A	124	
BF6	8:32	8:41	9	2	ALIVE	A	120	
BF7	8:34	8:44	10	2	ALIVE	A	105	
BF8	8:33	8:46	13	2	ALIVE	A	110	
BF9	8:32	8:42	10	2	ALIVE	A	105	
BH0	8:52	9:01	9	2	ALIVE	A	121	
BH1	8:53	9:02	9	2	ALIVE	A	115	
BH2	8:53	9:03	10	2	ALIVE	A	135	
BH3	8:51	.	.	0	DEAD	Z	115	
BH4	8:51	9:03	12	2	ALIVE	A	108	
BH5	9:04	9:12	8	2	ALIVE	A	104	
BH6	9:06	9:13	7	2	ALIVE	A	133	
BH7	9:04	9:16	12	2	ALIVE	A	116	
BH8	9:06	9:14	8	2	ALIVE	A	128	
BH9	9:05	9:12	7	2	ALIVE	A	128	
BJ0	9:41	.	.	0	UNKNOWN	X	116	
BJ1	9:42	9:50	8	2	ALIVE	A	114	
BJ2	9:41	9:49	8	2	ALIVE	C	142	
BJ3	9:43	9:52	9	2	ALIVE	A	119	
BJ4	9:42	.	.	0	TAG & PIN		107	
BJ5	10:12	10:13	1	2	ALIVE	A	127	
BJ6	10:11	10:21	10	2	ALIVE	A	124	
BJ7	10:12	10:20	8	2	ALIVE	A	109	
BJ8	10:13	10:22	9	2	ALIVE	A	136	
BJ9	10:13	10:23	10	2	ALIVE	A	107	
BK0	10:28	.	.	0	TAG & PIN		105	
BK1	10:28	10:39	11	2	ALIVE	A	104	
BK2	10:27	10:36	9	1	ALIVE	B	103	
BK3	10:27	10:34	7	2	ALIVE	A	109	
BK4	10:26	10:37	11	2	ALIVE	A	107	
BK5	10:47	11:00	13	2	ALIVE	A	118	
BK6	10:44	10:53	9	2	ALIVE	C	143	
BK7	10:45	.	.	0	TAG & PIN		132	
BK8	10:46	10:56	10	2	ALIVE	A	119	
BK9	10:45	10:53	8	2	ALIVE	A	105	
21 August 2002 - Testlot 4 : Spillbay 16, gas cap - Water temp=19.5 C								
BS0	14:48	14:56	8	2	ALIVE	A	124	
BS1	14:49	15:00	11	2	ALIVE	A	113	
BS2	14:49	14:55	6	2	ALIVE	C	140	
BS3	14:47	.	.	0	TAG & PIN		112	
BS4	14:47	14:54	7	2	ALIVE	A	111	
BS5	15:00	15:06	6	2	ALIVE	A	134	
BS6	15:03	15:13	10	2	ALIVE	A	110	
BS7	15:02	15:11	9	2	ALIVE	A	132	
BS8	15:01	15:07	6	2	ALIVE	A	122	
BS9	15:04	15:09	5	2	ALIVE	A	138	
BT0	15:22	15:28	6	2	ALIVE	A	121	
BT1	15:22	15:33	11	2	ALIVE	C	122	
BT2	15:20	15:45	25	2	ALIVE	A	125	
BT3	15:21	15:34	13	2	ALIVE	A	115	
BT4	15:20	15:29	9	2	ALIVE	A	134	
BT5	15:36	15:44	8	2	ALIVE	A	123	

APPENDIX TABLE A-9 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
BT6	15:38	15:48	10	2	ALIVE	A	133	
BT7	15:37	15:43	6	2	ALIVE	A	111	
BT8	15:38	15:48	10	2	ALIVE	A	120	
BT9	15:37	15:47	10	2	ALIVE	A	128	
BU0	16:21	16:27	6	2	ALIVE	A	128	
BU1	16:22	.	.	0	DEAD	Z	132	
BU2	16:22	.	.	0	DEAD	Z	113	
BU3	16:21	16:29	8	2	ALIVE	A	113	
BU4	16:20	16:27	7	2	ALIVE	A	108	
BU5	16:38	16:47	9	2	ALIVE	A	122	
BU6	16:39	16:44	5	2	ALIVE	A	108	
BU7	16:36	16:45	9	2	ALIVE	A	115	
BU8	16:38	16:45	7	2	ALIVE	A	120	
BU9	16:37	.	.	0	DEAD	Z	110	
BV0	17:10	.	.	0	UNKNOWN	X	110	
BV1	17:11	17:18	7	2	ALIVE	A	105	
BV2	17:08	17:16	8	2	ALIVE	A	135	
BV3	17:09	17:14	5	2	ALIVE	A	132	
BV4	17:10	17:19	9	2	ALIVE	A	122	
BV5	17:44	17:50	6	2	ALIVE	A	123	
BV6	17:47	17:55	8	2	ALIVE	A	138	
BV7	17:46	17:53	7	2	ALIVE	C	125	
BV8	17:43	17:55	12	2	ALIVE	A	110	
BV9	17:45	17:52	7	2	ALIVE	A	108	
21 August 2002 - Testlot 4 : Control - Water temp=19.5 C								
BL0	11:37	11:47	10	2	ALIVE	A	124	
BL1	11:35	11:41	6	2	ALIVE	A	105	
BL2	11:36	11:45	9	2	ALIVE	A	113	
BL3	11:38	11:45	7	2	ALIVE	A	112	
BL4	11:34	11:44	10	2	ALIVE	A	108	
BL5	11:48	11:55	7	2	ALIVE	A	129	
BL6	11:50	11:57	7	2	ALIVE	A	125	
BL7	11:51	11:58	7	2	ALIVE	C	110	
BL8	11:47	11:58	11	2	ALIVE	A	114	
BL9	11:49	11:57	8	2	ALIVE	A	112	
BM0	12:02	12:08	6	2	ALIVE	A	107	
BM1	12:04	.	.	0	TAG & PIN		110	
BM2	12:01	12:10	9	2	ALIVE	A	115	
BM3	12:05	12:10	5	2	ALIVE	A	104	
BM4	12:06	12:10	4	2	ALIVE	A	105	
BM5	12:19	12:43	24	1	DEAD	BP	114	
BM6	12:24	12:33	9	2	ALIVE	A	128	
BM7	12:23	12:38	15	2	ALIVE	A	132	
BM8	12:21	12:28	7	2	ALIVE	A	138	
BM9	12:21	12:26	5	2	ALIVE	A	108	
BN0	12:56	13:02	6	2	ALIVE	A	132	
BN1	12:55	13:00	5	2	ALIVE	A	116	
BN2	12:54	13:04	10	2	ALIVE	C	124	
BN3	12:58	13:05	7	2	ALIVE	A	127	
BN4	12:57	13:03	6	2	ALIVE	A	130	
BN5	13:05	13:10	5	2	ALIVE	A	115	
BN6	13:06	13:13	7	2	ALIVE	A	111	
BN7	13:09	13:16	7	2	ALIVE	A	127	
BN8	13:07	13:14	7	2	ALIVE	A	110	
BN9	13:08	13:16	8	2	ALIVE	A	111	
BP0	13:29	13:35	6	2	ALIVE	A	115	
BP1	13:28	13:35	7	2	ALIVE	A	139	
BP2	13:32	13:39	7	2	ALIVE	A	127	
BP3	13:31	13:37	6	2	ALIVE	A	104	
BP4	13:30	13:37	7	2	ALIVE	A	118	
BP5	13:42	13:47	5	2	ALIVE	A	133	
BP6	13:41	13:51	10	2	ALIVE	A	110	
BP7	13:39	13:45	6	2	ALIVE	A	128	
BP8	13:42	13:48	6	2	ALIVE	A	115	
BP9	13:40	13:45	5	2	ALIVE	A	109	
BR0	13:57	14:11	14	2	ALIVE	C	128	
BR1	13:59	14:06	7	2	ALIVE	A	117	
BR2	13:56	14:01	5	2	ALIVE	A	119	
BR3	13:58	14:05	7	2	ALIVE	C	121	
BR4	13:55	14:03	8	2	ALIVE	A	130	
BR5	14:11	.	.	0	TAG & PIN		112	

APPENDIX TABLE A-9 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Re-leased	Re-covered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
BR6	14:09	14:20	11	1	DEAD	PJ	110	
BR7	14:14	14:21	7	2	ALIVE	C	128	
BR8	14:12	14:18	6	2	ALIVE	A	109	
BR9	14:13	14:24	11	2	ALIVE	A	119	
22 August 2002 - Testlot 5 : Spillbay 14, 75 kcfs - Water temp=19.5 C								
BW0	8:48	8:58	10	2	ALIVE	A	111	
BW1	8:51	9:00	9	2	ALIVE	A	122	
BW2	8:54	9:02	8	2	ALIVE	A	113	
BW3	8:52	9:01	9	2	ALIVE	A	117	
BW4	8:49	9:07	18	2	ALIVE	A	120	
BW5	9:06	9:14	8	2	ALIVE	A	108	
BW6	9:08	9:19	11	2	ALIVE	G	119	
BW7	9:06	.	.	0	UNKNOWN	X	136	
BW8	9:08	.	.	0	DEAD	ZL	115	
BW9	9:07	9:16	9	2	ALIVE	A	110	
BX0	9:41	9:47	6	2	ALIVE	A	115	
BX1	9:42	9:56	14	1	ALIVE	HB	130	
BX2	9:41	9:47	6	2	ALIVE	A	113	
BX3	9:42	9:53	11	2	ALIVE	A	133	
BX4	9:40	9:51	11	2	ALIVE	A	115	
BX5	9:58	10:07	9	2	ALIVE	A	130	
BX6	9:59	10:07	8	2	ALIVE	A	119	
BX7	9:58	.	.	0	TAG & PIN		107	
BX8	9:59	10:07	8	2	ALIVE	A	125	
BX9	9:57	.	.	0	DEAD	ZL	112	
BY0	10:40	10:49	9	2	ALIVE	A	120	
BY1	10:41	10:52	11	1	DEAD	FP	117	
BY2	10:39	10:59	20	2	ALIVE	C	124	
BY3	10:41	.	.	0	DEAD	Z	128	
BY4	10:42	10:49	7	2	ALIVE	A	108	
BY5	11:07	11:17	10	2	ALIVE	CGH	120	
BY6	11:06	.	.	0	UNKNOWN	X	122	
BY7	11:07	.	.	0	TAG & PIN		127	
BY8	11:06	11:23	17	2	ALIVE	A	125	
BY9	11:05	11:12	7	2	ALIVE	G	131	
BZ0	11:51	12:00	9	2	ALIVE	A	115	
BZ1	11:48	12:09	21	2	ALIVE	A	109	
BZ2	11:49	12:03	14	2	ALIVE	A	125	
BZ3	11:49	11:56	7	2	ALIVE	A	112	
BZ4	11:50	12:05	15	2	ALIVE	A	128	
BZ5	12:16	12:22	6	2	ALIVE	A	131	
BZ6	12:16	12:34	18	2	ALIVE	A	121	
BZ7	12:14	12:32	18	2	ALIVE	A	107	
BZ8	12:15	12:23	8	2	ALIVE	A	113	
BZ9	12:17	12:26	9	2	ALIVE	A	138	
22 August 2002 - Testlot 5 : Spillbay 16, 75 kcfs - Water temp=19.5 C								
CA0	13:04	13:19	15	2	ALIVE	A	112	
CA1	13:05	13:15	10	2	ALIVE	A	112	
CA2	13:03	.	.	0	DEAD	L	121	
CA3	13:02	13:12	10	2	ALIVE	A	113	
CA4	13:04	13:18	14	2	ALIVE	A	115	
CA5	13:21	13:32	11	1	ALIVE	HB	105	
CA6	13:20	13:26	6	2	ALIVE	A	128	
CA7	13:35	13:41	6	2	ALIVE	A	110	
CA8	13:22	13:29	7	2	ALIVE	A	133	
CA9	13:21	.	.	0	DEAD	Z	117	
CB0	13:56	14:04	8	2	ALIVE	A	133	
CB1	13:56	.	.	0	UNKNOWN	X	125	
CB2	13:55	14:08	13	2	ALIVE	C	152	
CB3	13:57	14:05	8	2	ALIVE	A	144	
CB4	13:57	.	.	0	TAG & PIN		126	
CB5	14:30	.	.	0	DEAD	ZL	120	
CB6	14:30	.	.	0	UNKNOWN	X	120	
CB7	14:29	14:37	8	2	ALIVE	A	120	
CB8	14:28	14:37	9	2	ALIVE	A	128	
CB9	14:31	14:41	10	2	ALIVE	A	124	
CC0	15:07	.	.	0	DEAD	ZL	138	
CC1	15:10	15:46	36	2	DEAD	PD	115	
CC2	15:09	15:32	23	1	DEAD	P	133	

APPENDIX TABLE A-9 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Released	Recovered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
CC3	15:09	15:25	16	2	ALIVE	A	105	
CC4	15:08	15:14	6	2	ALIVE	A	112	
CC5	15:41	15:49	8	2	ALIVE	A	116	
CC6	15:40	15:48	8	2	ALIVE	A	108	
CC7	15:39	15:54	15	2	ALIVE	A	105	
CC8	15:39	15:44	5	2	ALIVE	A	125	
CC9	15:40	.	.	0	UNKNOWN	X	111	
CD0	16:03	16:09	6	2	ALIVE	A	114	
CD1	16:04	.	.	0	DEAD	Z	116	
CD2	16:04	16:12	8	2	ALIVE	A	123	
CD3	16:03	16:10	7	2	ALIVE	A	130	
CD4	16:05	16:14	9	2	ALIVE	A	126	
CD5	16:26	16:36	10	2	ALIVE	A	144	
CD6	16:24	.	.	0	TAG & PIN		118	
CD7	16:26	16:31	5	2	ALIVE	A	115	
CD8	16:25	16:32	7	2	ALIVE	A	110	
CD9	16:25	16:33	8	2	ALIVE	G	134	
22 August 2002 - Testlot 5 : Control - Water temp=19.5 C								
CE0	17:02	17:07	5	2	ALIVE	A	130	
CE1	17:03	17:09	6	2	ALIVE	A	130	
CE2	17:05	17:15	10	2	ALIVE	A	123	
CE3	17:04	17:09	5	2	ALIVE	A	119	
CE4	17:05	17:11	6	2	ALIVE	A	124	
CE5	17:14	17:22	8	2	ALIVE	A	148	
CE6	17:15	.	.	0	DEAD	Z	109	
CE7	17:17	17:26	9	2	ALIVE	A	115	
CE8	17:13	17:17	4	2	ALIVE	A	137	
CE9	17:16	17:21	5	2	ALIVE	A	130	
CF0	17:42	17:48	6	2	ALIVE	A	128	
CF1	17:39	17:44	5	2	ALIVE	A	134	
CF2	17:44	17:52	8	2	ALIVE	A	118	
CF3	17:36	17:41	5	2	ALIVE		116	
CF4	17:34	17:41	7	2	ALIVE	A	130	
CF5	17:54	18:04	10	2	ALIVE	A	125	
CF6	17:51	17:57	6	2	ALIVE	A	123	
CF7	17:50	17:57	7	2	ALIVE	A	120	
CF8	17:53	18:00	7	2	ALIVE	A	124	
CF9	17:51	18:01	10	2	ALIVE	A	120	
CH0	18:12	18:19	7	2	ALIVE	A	128	
CH1	18:11	18:17	6	2	ALIVE	A	136	
CH2	18:14	18:21	7	2	ALIVE	A	123	
CH3	18:12	18:21	9	2	ALIVE	A	132	
CH4	18:13	18:21	8	2	ALIVE	A	122	
CH5	18:26	.	.	0	TAG & PIN		105	
CH6	18:24	18:29	5	2	ALIVE	A	115	
CH7	18:26	18:30	4	2	ALIVE	A	131	
CH8	18:25	18:28	3	2	ALIVE	A	136	
CH9	18:23	18:28	5	2	ALIVE	A	110	
CJ0	18:44	.	.	0	DEAD	Z	122	
CJ1	18:46	.	.	0	DEAD	ZL	122	
CJ2	18:45	.	.	0	TAG & PIN		118	
CJ3	18:45	18:49	4	2	ALIVE	A	128	
CJ4	18:47	18:51	4	2	ALIVE	A	103	
CJ5	19:06	19:15	9	2	ALIVE	A	143	
CJ6	19:09	19:13	4	2	ALIVE	A	105	
CJ7	19:08	19:15	7	2	ALIVE	A	110	
CJ8	19:07	19:16	9	2	ALIVE	A	112	
CJ9	19:05	19:10	5	2	ALIVE	A	110	
23 August 2002 - Testlot 6 : Spillbay 14, 75 kcfs - Water temp=20.0 C								
CU0	13:44	13:54	10	2	ALIVE	C	137	
CU1	13:46	13:55	9	2	ALIVE	A	116	
CU2	13:45	13:49	4	2	ALIVE	A	138	
CU3	13:46	13:53	7	2	ALIVE	A	116	
CU4	13:45	13:52	7	2	ALIVE	A	131	
CU5	13:57	.	.	0	DEAD	Z	135	
CU6	13:56	14:04	8	2	ALIVE	A	141	
CU7	13:58	14:06	8	2	ALIVE	A	112	
CU8	13:56	14:03	7	2	ALIVE	A	138	
CU9	13:57	14:03	6	2	ALIVE	A	122	

APPENDIX TABLE A-9 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Re-leased	Re-covered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
CV0	14:15	.	.	0	UNKNOWN	X	114	
CV1	14:14	.	.	0	DEAD	LZ	147	
CV2	14:13	14:34	21	2	ALIVE	A	105	
CV3	14:15	14:21	6	2	ALIVE	A	111	
CV4	14:14	14:23	9	2	ALIVE	A	135	
CV5	14:49	14:55	6	2	ALIVE	A	142	
CV6	14:49	.	.	0	UNKNOWN	X	108	
CV7	14:48	14:54	6	2	ALIVE	A	137	
CV8	14:48	14:56	8	2	ALIVE	A	111	
CV9	14:47	14:53	6	2	ALIVE	A	123	
CW0	15:38	15:43	5	2	ALIVE	A	133	
CW1	15:39	.	.	0	DEAD	ZL	131	
CW2	15:38	15:43	5	2	ALIVE	A	137	
CW3	15:39	15:45	6	2	ALIVE	A	123	
CW4	15:40	15:47	7	2	ALIVE	A	124	
CW5	15:50	15:55	5	2	ALIVE	A	127	
CW6	15:53	16:05	12	1	DEAD	PG	108	
CW7	15:52	15:59	7	2	ALIVE	A	114	
CW8	15:52	15:59	7	2	ALIVE	A	117	
CW9	15:51	15:56	5	2	ALIVE	A	111	
CX0	16:14	.	.	0	TAG & PIN		119	
CX1	16:11	16:21	10	2	ALIVE	A	133	
CX2	16:12	16:18	6	2	ALIVE	HD	123	
CX3	16:11	16:17	6	2	ALIVE	A	128	
CX4	16:12	16:18	6	2	ALIVE	A	134	
CX5	16:26	16:33	7	2	ALIVE	A	135	
CX6	16:27	16:33	6	2	ALIVE	A	122	
CX7	16:27	16:36	9	2	ALIVE	A	137	
CX8	16:25	16:40	15	2	ALIVE	A	124	
CX9	16:26	16:30	4	2	ALIVE	A	118	
23 August 2002 - Testlot 6 : Spillbay 16, 75 kcfs - Water temp=20.0 C								
CP0	10:42	10:54	12	2	ALIVE	A	134	
CP1	10:43	10:49	6	2	ALIVE	A	128	
CP2	10:44	10:53	9	2	ALIVE	A	114	
CP3	10:44	10:51	7	2	ALIVE	A	110	
CP4	10:42	10:49	7	2	ALIVE	A	117	
CP5	10:54	.	.	0	DEAD	L	131	
CP6	10:56	11:01	5	2	ALIVE	HGN	143	
CP7	10:56	11:05	9	2	ALIVE	A	134	
CP8	10:55	11:02	7	2	ALIVE	A	123	
CP9	10:57	11:03	6	2	ALIVE	A	133	
CR0	11:12	11:16	4	2	ALIVE	A	108	
CR1	11:14	11:23	9	2	ALIVE	A	138	
CR2	11:13	11:21	8	2	ALIVE	A	118	
CR3	11:14	11:24	10	2	ALIVE	A	115	
CR4	11:13	11:18	5	2	ALIVE	G	128	
CR5	11:27	11:35	8	2	ALIVE	A	110	
CR6	11:25	11:31	6	2	ALIVE	A	140	
CR8	11:27	11:33	6	2	ALIVE	A	125	
CR9	11:28	11:33	5	2	ALIVE	A	150	
CS0	12:43	12:50	7	2	ALIVE	A	111	
CS1	12:44	12:53	9	2	ALIVE	B	124	
CS2	12:42	12:54	12	2	ALIVE	A	133	
CS3	12:43	12:50	7	2	ALIVE	A	130	
CS4	12:44	12:57	13	2	ALIVE	G	143	
CS5	12:58	.	.	2	UNKNOWN	X	140	
CS6	13:00	13:07	7	2	ALIVE	G	137	
CS7	12:59	13:08	9	2	DEAD	JNG	106	
CS8	12:59	13:03	4	2	ALIVE	A	127	
CS9	12:57	13:07	10	2	ALIVE	A	110	
CT0	12:11	12:18	7	2	ALIVE	C	143	
CT1	12:12	12:18	6	2	ALIVE	A	131	
CT2	12:12	12:19	7	1	DEAD	BP	119	
CT3	12:10	12:16	6	2	ALIVE	C	116	
CT4	12:11	12:15	4	2	ALIVE	A	119	
CT5	12:21	12:27	6	2	ALIVE	A	136	
CT6	12:21	12:29	8	1	ALIVE	HB	104	
CT7	12:22	12:36	14	2	ALIVE	A	113	
CT8	12:22	12:32	10	2	ALIVE	A	121	
CT9	12:20	12:25	5	2	ALIVE	A	117	
XS9	11:26	11:30	4	2	ALIVE	A	133	

APPENDIX TABLE A-9 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
23 August 2002 - Testlot 6 : Control - Water temp=20.0 C								
CK0	7:43	7:48	5	2	ALIVE	A	131	
CK1	7:44	7:53	9	2	ALIVE	A	131	
CK2	7:41	7:46	5	2	ALIVE	A	125	
CK3	7:40	7:48	8	2	ALIVE	A	107	
CK4	7:45	7:50	5	2	ALIVE	A	115	
CK5	7:53	7:59	6	2	ALIVE	A	147	
CK6	7:55	8:01	6	2	ALIVE	A	135	
CK7	7:52	.	.	0	TAG & PIN		118	
CK8	7:54	8:03	9	2	ALIVE	A	122	
CK9	7:56	.	.	0	UNKNOWN	X	134	
CL0	8:32	8:37	5	2	ALIVE	A	119	
CL1	8:30	.	.	0	TAG & PIN		132	
CL2	8:33	8:39	6	2	ALIVE	A	129	
CL3	8:34	8:39	5	2	ALIVE	A	114	
CL4	8:29	8:37	8	2	ALIVE	A	123	
CL5	8:43	8:50	7	2	ALIVE	A	115	
CL6	8:45	8:52	7	2	ALIVE	A	148	
CL7	8:44	8:49	5	2	ALIVE	A	121	
CL8	8:42	8:48	6	2	ALIVE	A	111	
CL9	8:41	8:47	6	2	ALIVE	A	120	
CM0	8:57	9:03	6	2	ALIVE	A	145	
CM1	9:01	9:10	9	2	ALIVE	A	109	
CM2	9:00	.	.	0	DEAD	L	128	
CM3	8:56	9:01	5	2	ALIVE	A	110	
CM4	8:59	9:06	7	2	ALIVE	A	128	
CM5	9:14	9:20	6	2	ALIVE	A	133	
CM6	9:17	9:23	6	2	ALIVE	A	120	
CM7	9:14	9:23	9	2	ALIVE	A	114	
CM8	9:13	9:19	6	2	ALIVE	A	130	
CM9	9:15	9:21	6	2	ALIVE	A	140	
CN0	10:02	10:10	8	2	DEAD	PE	109	
CN1	9:58	10:04	6	2	ALIVE	A	130	
CN2	9:57	10:03	6	2	ALIVE	A	136	
CN3	10:00	10:06	6	2	ALIVE	A	112	
CN4	10:01	10:08	7	2	ALIVE	A	145	
CN5	10:12	10:19	7	2	ALIVE	A	130	
CN6	10:14	10:24	10	1	ALIVE	HDB	117	
CN7	10:12	10:20	8	2	ALIVE	A	124	
CN8	10:13	10:19	6	2	ALIVE	A	129	
CN9	10:16	10:21	5	2	ALIVE	A	142	
24 August 2002 - Testlot 7 : Spillbay 14, 75 kcfs - Water temp=20.0 C								
JH0	14:56	15:02	6	2	ALIVE	A	126	
JH1	14:58	15:07	9	2	ALIVE	A	139	
JH2	14:57	15:05	8	2	ALIVE	A	135	
JH4	14:56	15:05	9	2	ALIVE	A	121	
JH5	15:15	15:21	6	2	ALIVE	A	120	
JH7	15:14	16:24	70	2	ALIVE	A	122	
JH8	16:11	16:17	6	2	ALIVE	A	105	
JH9	15:11	15:19	8	2	ALIVE	A	125	
JJ0	15:35	15:45	10	2	ALIVE	D	121	
JJ1	15:38	15:44	6	2	ALIVE	A	122	
JJ2	15:38	15:51	13	2	DEAD	GC	124	
JJ3	15:36	15:43	7	2	ALIVE	G	110	
JJ4	15:37	15:44	7	2	ALIVE	C	136	
JJ5	15:54	16:00	6	2	ALIVE	A	105	
JJ6	15:55	.	.	0	DEAD	L	108	
JJ7	15:53	16:00	7	2	ALIVE	A	110	
JJ8	15:55	.	.	0	UNKNOWN	X	106	
JJ9	15:56	16:05	9	2	ALIVE	A	109	
JK0	16:33	16:42	9	2	ALIVE	A	116	
JK1	16:32	16:38	6	2	ALIVE	A	118	
JK2	16:31	16:46	15	2	ALIVE	A	138	
JK4	16:33	16:40	7	1	ALIVE	HB	108	
JK5	16:46	16:50	4	2	DEAD	JH	109	
JK6	16:43	16:56	13	2	ALIVE	HC	105	
JK7	16:44	16:53	9	2	ALIVE	A	130	
JK8	16:47	16:52	5	2	ALIVE	A	139	
JK9	16:45	16:52	7	2	ALIVE	A	137	
TT0	16:32	16:39	7	2	ALIVE	A	108	

APPENDIX TABLE A-9 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Released	Recovered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
24 August 2002 - Testlot 7 : Spillbay 16, 75 kcfs - Water temp=20.0 C								
CY0	8:15	8:24	9	2	ALIVE	A	117	
CY1	8:13	8:19	6	2	ALIVE	HCG	120	
CY2	8:14	8:20	6	2	ALIVE	A	130	
CY4	8:14	8:25	11	2	ALIVE	A	116	
CY5	8:32	8:48	16	2	ALIVE	H	110	
CY6	8:33	8:42	9	2	ALIVE	C	134	
CY7	8:34	8:42	8	2	ALIVE	A	144	
CY9	8:33	8:43	10	2	ALIVE	GH	105	
CZ0	9:05	9:17	12	2	ALIVE	E	142	
CZ3	9:06	9:13	7	2	ALIVE	C	108	
CZ5	9:43	9:48	5	2	ALIVE	A	120	
CZ6	9:45	9:51	6	2	ALIVE	A	134	
CZ7	9:46	9:54	8	2	ALIVE	A	128	
CZ8	9:45	9:54	9	2	ALIVE	A	128	
CZ9	9:44	9:49	5	2	ALIVE	A	139	
JA0	10:43	10:49	6	2	ALIVE	A	129	
JA1	10:41	10:48	7	2	ALIVE	A	121	
JA2	10:44	10:56	12	2	ALIVE	A	110	
JA3	10:42	10:48	6	2	ALIVE	A	118	
JA5	11:01	11:08	7	2	ALIVE	A	112	
JA6	10:59	11:05	6	2	ALIVE	A	140	
JA7	10:59	11:06	7	2	ALIVE	A	110	
JA8	11:00	11:06	6	2	ALIVE	A	126	
JA9	11:00	11:09	9	2	ALIVE	HCG	128	
JB0	11:17	11:24	7	2	ALIVE	A	148	
JB2	11:19	11:29	10	2	ALIVE	A	134	
JB3	11:18	.	.	0	DEAD	ZL	115	
JB4	11:17	11:25	8	2	ALIVE	A	142	
JB5	11:43	11:52	9	2	ALIVE	A	113	
JB6	11:40	11:48	8	2	ALIVE	A	110	
JB7	11:41	13:08	87	1	DEAD	FP	113	
JB8	11:42	11:51	9	2	ALIVE	A	120	
JB9	11:41	11:50	9	2	ALIVE	A	112	
JC0	11:55	12:05	10	2	ALIVE	A	111	
JC2	11:56	12:04	8	2	ALIVE	A	125	
JC3	11:55	12:01	6	2	ALIVE	A	135	
JC4	11:58	12:06	8	2	ALIVE	A	108	
JC5	11:57	12:10	13	2	ALIVE	A	153	
24 August 2002 - Testlot 7 : Control - Water temp=20.0 C								
JD1	12:39	.	.	0	DEAD	ZL	143	
JD2	12:41	12:48	7	2	ALIVE	A	112	
JD3	12:39	12:46	7	2	ALIVE	A	110	
JD4	12:40	12:46	6	2	ALIVE	A	105	
JD5	13:01	13:08	7	2	ALIVE	A	116	
JD7	13:00	13:06	6	2	ALIVE	A	133	
JD8	12:59	13:04	5	2	DEAD	HJ	128	
JD9	13:03	13:13	10	2	ALIVE	A	107	
JE0	13:32	13:39	7	2	ALIVE	A	117	
JE1	13:32	13:38	6	2	ALIVE	A	115	
JE2	13:33	13:39	6	2	ALIVE	A	135	
JE3	13:13	13:45	32	2	ALIVE	A	126	
JE4	13:34	13:40	6	2	ALIVE	A	114	
JE5	13:47	13:56	9	2	ALIVE	A	128	
JE6	13:45	.	.	0	DEAD	Z	107	
JE7	13:46	13:52	6	2	ALIVE	A	125	
JE8	13:45	13:51	6	2	ALIVE	A	105	
JE9	13:47	13:53	6	2	ALIVE	A	102	
JF0	14:10	14:16	6	1	ALIVE	B	129	
JF1	14:04	14:09	5	2	ALIVE	A	127	
JF2	14:10	14:17	7	2	ALIVE	A	133	
JF3	14:06	14:13	7	2	ALIVE	A	142	
JF4	14:05	.	.	0	UNKNOWN	X	118	
JF5	14:21	14:25	4	2	ALIVE	A	126	
JF6	14:24	14:32	8	2	ALIVE	C	139	
JF7	14:22	.	.	0	DEAD	ZL	130	
JF8	14:23	14:28	5	2	ALIVE	A	114	
JF9	14:25	14:30	5	2	ALIVE	A	120	

APPENDIX TABLE A-9 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data: Alive/ Dead	Condition Codes	Total Length (mm)	Comments
25 August 2002 - Testlot 8 : Spillbay 14, 75 kcfs - Water temp=20.0 C								
JR0	10:42	11:05	23	2	ALIVE	A	126	
JR1	10:42	12:17	95	2	ALIVE	A	114	
JR2	10:40	12:10	90	2	ALIVE	HB	109	
JR3	10:41	10:49	8	2	ALIVE	A	115	
JR4	10:43	10:52	9	2	ALIVE	A	149	
JR5	11:58	12:19	21	2	ALIVE	A	115	
JR7	12:00	12:13	13	2	ALIVE	A	117	
JR8	11:59	12:09	10	2	ALIVE	A	119	
JS0	12:23	12:35	12	2	ALIVE	D	131	
JS1	12:20	12:33	13	2	ALIVE	A	108	
JS2	12:21	12:34	13	2	ALIVE	A	108	
JS3	12:21	12:36	15	2	ALIVE	A	114	
JS4	12:22	12:31	9	2	ALIVE	A	118	
JS5	12:41	12:52	11	1	ALIVE	B	105	
JS6	12:42	12:52	10	2	ALIVE	A	111	
JS7	12:40	.	.	0	DEAD	ZL	143	
JS8	12:39	12:57	18	2	ALIVE	A	129	
JS9	12:40	12:48	8	2	ALIVE	C	143	
JT0	13:01	.	.	0	TAG & PIN		134	
JT1	13:01	13:10	9	2	ALIVE	C	137	
JT2	13:03	13:11	8	2	ALIVE	A	141	
JT3	13:02	13:14	12	2	ALIVE	A	137	
JT4	13:02	13:16	14	2	ALIVE	A	117	
JT5	13:20	13:40	20	2	ALIVE	A	136	
JT6	13:19	13:29	10	2	ALIVE	A	117	
JT7	13:21	13:31	10	2	ALIVE	A	129	
JT8	13:20	13:31	11	2	ALIVE	A	141	
JT9	13:21	13:30	9	2	ALIVE	A	142	
JU2	13:47	13:54	7	2	ALIVE	C	143	
JU3	13:49	14:20	31	1	ALIVE	HB	127	
JU4	13:47	13:55	8	2	ALIVE	A	146	
JU5	14:25	14:35	10	2	ALIVE	A	147	
JU6	14:24	14:34	10	2	ALIVE	A	122	
JU7	14:25	14:35	10	2	ALIVE	A	123	
JU8	14:24	14:35	11	2	ALIVE	A	127	
JU9	14:26	14:38	12	2	ALIVE	A	107	
JV0	14:48	15:05	17	2	ALIVE	A	120	
JV2	14:49	.	.	0	UNKNOWN	X	113	
JV4	14:53	14:57	4	2	ALIVE	A	113	
JV5	15:12	15:19	7	2	ALIVE	A	137	
25 August 2002 - Testlot 8 : Spillbay 16, 75 kcfs - Water temp=20.0 C								
JW0	16:12	16:19	7	2	ALIVE	A	114	
JW1	16:13	16:24	11	2	ALIVE	A	137	
JW2	16:14	.	.	0	TAG & PIN		110	
JW3	16:13	.	.	0	UNKNOWN	X	107	
JW4	16:15	16:22	7	2	ALIVE	A	150	
JW5	16:42	.	.	0	DEAD	Z	137	
JW6	16:43	16:49	6	2	DEAD	C	133	
JW7	16:42	16:48	6	2	ALIVE	A	146	
JW8	16:41	16:47	6	2	ALIVE	A	127	
JW9	16:43	16:50	7	2	ALIVE	A	145	
JX0	16:59	17:07	8	2	ALIVE	A	124	
JX1	17:01	17:33	32	2	ALIVE	C	142	
JX2	17:00	17:16	16	2	ALIVE	C	134	
JX3	16:59	17:05	6	2	ALIVE	A	109	
JX4	17:00	17:08	8	2	ALIVE	A	111	
JX5	17:20	17:25	5	2	ALIVE	A	118	
JX6	17:21	17:47	26	2	ALIVE	A	142	
JX7	17:22	17:30	8	2	ALIVE	A	146	
JX8	17:21	17:27	6	2	ALIVE	A	133	
JX9	17:19	17:44	25	2	ALIVE	A	128	
JY0	18:01	18:08	7	2	ALIVE	A	118	
JY1	18:00	18:06	6	2	ALIVE	A	123	
JY2	17:59	18:04	5	2	ALIVE	A	112	
JY3	18:00	18:07	7	2	ALIVE	A	126	
JY4	17:59	18:05	6	2	ALIVE	A	132	
JY5	18:10	18:22	12	2	ALIVE	A	130	

APPENDIX TABLE A-9 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data: Alive/ Dead	Condition Codes	Total Length (mm)	Comments
JY6	18:09	18:15	6	2	ALIVE	A	128	
JY7	18:10	18:17	7	2	ALIVE	A	123	
JY8	18:09	18:16	7	2	ALIVE	A	132	
JY9	18:11	18:20	9	1	ALIVE	CB	128	
JZ0	18:28	18:34	6	2	ALIVE	A	112	
JZ1	18:30	18:35	5	2	ALIVE	A	105	
JZ2	18:30	18:37	7	2	ALIVE	A	135	
JZ3	18:31	18:42	11	2	ALIVE	A	134	
JZ4	18:29	18:40	11	2	ALIVE	HG	122	
JZ5	18:42	18:48	6	2	ALIVE	A	137	
JZ6	18:43	.	.	0	TAG & PIN		127	
25 August 2002 - Testlot 8 : Control - Water temp=20.0 C								
JL0	7:48	7:56	8	2	ALIVE	A	144	
JL1	7:50	8:01	11	2	ALIVE	A	114	
JL2	7:49	7:57	8	2	ALIVE	A	124	
JL3	7:48	7:54	6	2	ALIVE	A	133	
JL4	7:49	8:01	12	2	ALIVE	A	125	
JL5	8:03	.	.	0	TAG & PIN		127	
JL6	8:02	8:12	10	2	ALIVE	A	129	
JL7	8:02	8:13	11	2	ALIVE	H	116	
JL8	8:03	8:09	6	2	ALIVE	A	127	
JL9	8:02	8:10	8	2	ALIVE	A	110	
JM0	8:26	8:34	8	2	ALIVE	A	112	
JM1	8:24	8:31	7	2	ALIVE	A	119	
JM2	8:24	8:34	10	2	ALIVE	A	106	
JM3	8:26	8:34	8	2	ALIVE	A	109	
JM4	8:25	8:32	7	2	ALIVE	A	106	
JM5	8:37	8:45	8	2	ALIVE	A	130	
JM6	8:36	.	.	2	DEAD	Z	140	
JM7	8:36	8:42	6	2	ALIVE	A	121	
JM8	8:37	8:43	6	2	ALIVE	A	135	
JM9	8:35	8:45	10	2	ALIVE	A	127	
JN0	9:04	9:13	9	2	ALIVE	A	129	
JN1	8:55	9:09	14	2	ALIVE	A	134	
JN2	8:56	.	.	0	DEAD	Z	105	
JN3	8:58	9:03	5	2	ALIVE	A	124	
JN4	8:58	.	.	0	DEAD	Z	117	
JN5	9:19	9:27	8	2	ALIVE	A	123	
JN6	9:22	9:31	9	2	ALIVE	A	105	
JN7	9:21	9:29	8	2	ALIVE	A	110	
JN8	9:21	9:27	6	2	ALIVE	A	106	
JN9	9:20	9:28	8	2	ALIVE	A	106	
JP0	9:38	9:47	9	2	ALIVE	A	109	
JP1	9:39	.	.	0	DEAD	Z	105	
JP2	9:40	9:47	7	2	ALIVE	A	120	
JP3	9:39	9:45	6	2	ALIVE	A	134	
JP4	9:38	9:45	7	2	ALIVE	A	137	
JP5	9:59	10:05	6	2	ALIVE	A	117	
JP6	9:56	10:03	7	2	ALIVE	A	107	
JP7	9:58	10:05	7	2	ALIVE	A	132	
JP8	9:58	10:03	5	2	ALIVE	A	128	
JP9	9:57	10:03	6	2	ALIVE	A	110	
TT1	10:11	10:17	6	2	ALIVE	A	134	
TT2	10:11	10:21	10	2	ALIVE	A	112	
TT3	10:12	10:18	6	2	ALIVE	A	114	
TT4	10:12	10:21	9	2	ALIVE	A	118	
TT5	10:10	10:20	10	2	ALIVE	A	106	
TT6	10:20	10:26	6	2	ALIVE	A	115	
TT7	10:20	10:28	8	2	DEAD		113	
26 August 2002 - Testlot 9 : Spillbay 14, gas cap - Water temp=20.0 C								
PE5	13:07	13:21	14	2	DEAD	P	132	
PE6	13:06	13:17	11	2	ALIVE	A	134	
PE7	13:08	13:17	9	2	ALIVE	C	136	
PE8	13:08	13:20	12	2	ALIVE	A	122	
PE9	13:07	13:29	22	2	ALIVE	C	132	
PF0	10:51	11:07	16	1	DEAD	ND	105	
PF1	10:50	10:56	6	2	ALIVE	A	127	
PF2	10:52	11:02	10	2	ALIVE	HB	113	

APPENDIX TABLE A-9 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
PF3	10:51	11:00	9	2	ALIVE	A	104	
PF4	10:53	.	.	0	DEAD	Z	140	
PF5	11:12	11:20	8	2	ALIVE	A	128	
PF6	11:11	11:17	6	2	ALIVE	A	114	
PF7	11:12	11:21	9	2	ALIVE	A	142	
PF8	11:10	11:18	8	2	ALIVE	A	106	
PF9	11:11	11:18	7	2	ALIVE	A	147	
PH0	11:31	.	.	0	UNKNOWN	X	116	
PH1	11:30	11:38	8	2	ALIVE	A	104	
PH2	11:32	11:42	10	2	ALIVE	C	133	
PH3	11:31	11:38	7	2	ALIVE	A	113	
PH4	11:32	11:40	8	2	ALIVE	A	147	
PH5	11:47	11:59	12	2	ALIVE	A	126	
PH6	11:48	11:56	8	2	ALIVE	A	120	
PH7	11:48	11:56	8	2	ALIVE	A	136	
PH8	11:46	11:56	10	2	ALIVE	A	108	
PH9	11:46	11:54	8	2	ALIVE	A	137	
PJ0	12:07	12:18	11	2	ALIVE	A	108	
PJ1	12:07	12:14	7	2	ALIVE	A	127	
PJ2	12:09	12:19	10	2	ALIVE	A	130	
PJ3	12:08	12:15	7	2	ALIVE	A	130	
PJ4	12:09	12:15	6	2	ALIVE	A	138	
PJ5	12:21	12:28	7	2	ALIVE	A	106	
PJ6	12:22	12:31	9	2	ALIVE	A	131	
PJ7	12:23	12:29	6	2	ALIVE	A	137	
PJ8	12:22	12:31	9	2	ALIVE	A	136	
PJ9	12:23	12:33	10	2	ALIVE	A	114	
PK0	12:37	12:45	8	2	ALIVE	A	127	
PK1	12:36	12:48	12	2	ALIVE	A	143	
PK2	12:36	12:43	7	2	ALIVE	A	117	
PK3	12:37	12:45	8	2	ALIVE	A	130	
PK4	12:38	12:46	8	2	ALIVE	A	132	
PK5	12:50	.	.	0	DEAD	ZL	137	
PK6	12:48	12:54	6	2	ALIVE	A	107	
PK7	12:51	12:58	7	2	ALIVE	A	103	
PK8	12:50	12:57	7	2	ALIVE	A	105	
PK9	12:49	12:57	8	2	ALIVE	A	138	
26 August 2002 - Testlot 9 : Spillbay 16, gas cap - Water temp=20.0 C								
PA0	7:39	7:46	7	2	ALIVE	A	118	
PA1	7:40	7:46	6	2	ALIVE	A	114	
PA2	7:41	.	.	0	TAG & PIN		107	
PA3	7:40	7:47	7	2	ALIVE	A	107	
PA4	7:39	7:43	4	2	ALIVE	A	143	
PA5	7:54	8:01	7	2	ALIVE	A	107	
PA6	7:54	8:01	7	2	ALIVE	A	123	
PA7	7:55	8:04	9	2	ALIVE	A	105	
PA8	7:53	8:00	7	2	ALIVE	A	110	
PA9	7:53	8:00	7	2	ALIVE	A	106	
PB0	8:07	8:14	7	2	ALIVE	A	138	
PB1	8:08	8:16	8	2	ALIVE	A	147	
PB2	8:09	8:20	11	2	ALIVE	A	116	
PB3	8:09	8:16	7	2	ALIVE	A	114	
PB4	8:08	8:16	8	2	ALIVE	A	105	
PB5	8:19	8:26	7	2	ALIVE	A	107	
PB6	8:20	8:29	9	2	ALIVE	A	121	
PB7	8:20	8:27	7	2	ALIVE	A	122	
PB8	8:19	8:32	13	2	ALIVE	A	105	
PB9	8:21	8:29	8	2	ALIVE	A	109	
PC0	8:36	9:10	34	2	ALIVE	A	152	
PC1	8:38	8:46	8	2	ALIVE	A	142	
PC2	8:36	8:44	8	2	ALIVE	A	106	
PC3	8:39	8:46	7	2	ALIVE	A	147	
PC4	8:37	8:48	11	2	ALIVE	A	113	
PC5	8:52	9:00	8	2	ALIVE	A	110	
PC6	8:51	8:58	7	1	ALIVE	HB	128	
PC7	8:50	9:10	20	2	ALIVE	A	133	
PC8	8:51	9:02	11	2	ALIVE	A	137	
PC9	8:52	9:04	12	2	ALIVE	A	136	
PD0	9:18	9:27	9	2	ALIVE	A	105	
PD1	9:17	9:24	7	2	ALIVE	A	108	
PD2	9:17	9:27	10	2	ALIVE	A	146	

APPENDIX TABLE A-9 Continued.

Fish No.	Time				Fish Data			
	Released	Recovered	At Large (min.)	No. of Turb-N Tags recovered	Alive/ Dead	Condition Codes	Total Length (mm)	Comments
PD3	9:16	9:28	12	2	ALIVE	A	111	
PD4	9:18	9:26	8	2	ALIVE	A	110	
PD5	9:32	9:39	7	2	ALIVE	A	134	
PD6	9:30	9:37	7	2	ALIVE	A	150	
PD7	9:31	9:38	7	2	ALIVE	A	122	
PD8	9:30	.	.	0	DEAD	Z	137	
PD9	9:32	9:39	7	2	ALIVE	A	138	
PE0	9:50	10:06	16	2	ALIVE	A	127	
PE1	9:51	10:04	13	2	ALIVE	A	106	
PE2	9:49	9:56	7	2	ALIVE	A	111	
PE3	9:50	.	.	0	TAG & PIN		129	
PE4	9:40	9:58	18	2	ALIVE	D	135	
26 August 2002 - Testlot 9 : Control - Water temp=20.0 C								
PL0	13:52	13:59	7	2	ALIVE	A	124	
PL1	13:54	14:01	7	2	ALIVE	A	129	
PL2	13:53	14:05	12	2	ALIVE	A	136	
PL3	13:52	13:57	5	2	ALIVE	C	136	
PL4	13:53	13:59	6	2	ALIVE	A	142	
PL5	14:06	14:18	12	2	ALIVE	A	112	
PL6	14:07	14:12	5	2	ALIVE	A	133	
PL7	14:05	14:19	14	1	DEAD	PG	103	
PL8	14:04	14:14	10	2	ALIVE	C	130	
PL9	14:05	14:14	9	2	ALIVE	A	112	
PM0	14:30	14:36	6	2	ALIVE	A	135	
PM1	14:30	14:36	6	2	ALIVE	A	109	
PM2	14:29	14:35	6	2	ALIVE	A	141	
PM3	14:29	14:35	6	2	ALIVE	A	145	
PM4	14:31	14:37	6	2	ALIVE	A	102	
PM5	14:40	14:46	6	2	ALIVE	A	136	
PM6	14:39	15:38	59	2	DEAD	HDP	111	
PM7	14:40	14:47	7	2	ALIVE	A	117	
PM8	14:42	.	.	0	DEAD	L	112	
PM9	14:41	14:48	7	2	ALIVE	A	129	
PN0	15:13	15:21	8	2	ALIVE	A	144	
PN1	15:15	15:22	7	2	ALIVE	A	129	
PN2	15:14	15:26	12	2	ALIVE	A	105	
PN3	15:12	15:21	9	2	ALIVE	A	108	
PN4	15:13	15:24	11	2	ALIVE	A	104	
PN5	15:52	16:11	19	2	ALIVE	A	105	
PN6	15:39	15:46	7	2	ALIVE	A	105	
PN7	15:37	15:44	7	2	ALIVE	A	125	
PN8	15:36	15:46	10	2	ALIVE	A	136	
PN9	15:40	15:54	14	1	DEAD	P	104	
PP0	15:36	15:45	9	2	ALIVE	A	100	
PP1	15:57	16:07	10	2	ALIVE	HW	106	
PP2	16:00	16:05	5	2	ALIVE	A	110	
PP3	15:59	16:19	20	2	DEAD	P	103	
PP4	16:00	16:07	7	2	ALIVE	A	130	
PP5	16:16	16:23	7	2	ALIVE	C	142	
PP6	16:17	16:25	8	2	ALIVE	A	111	
PP7	16:18	16:27	9	2	ALIVE	A	119	
PP8	16:18	.	.	0	DEAD	ZL	108	
PP9	16:17	16:23	6	2	ALIVE	A	132	
PR0	16:33	16:47	14	2	ALIVE	A	103	
PR1	16:33	.	.	0	DEAD	Z	105	
PR2	16:32	16:39	7	2	ALIVE	A	101	
PR3	16:35	16:41	6	2	ALIVE	A	104	
PR4	16:34	.	.	0	DEAD	Z	102	
27 August 2002 - Testlot 10 : Spillbay 14, gas cap - Water temp=20.0 C								
JV7	8:56	.	.	0	UNKNOWN	X	102	
PR5	10:33	10:39	6	2	ALIVE	A	112	
PR6	10:32	10:41	9	2	ALIVE	A	103	
PR7	10:33	10:44	11	2	ALIVE	A	137	
PR8	10:34	10:47	13	2	ALIVE	A	115	
PR9	10:32	10:40	8	2	ALIVE	A	130	
PS0	7:52	8:05	13	2	ALIVE	A	106	
PS1	7:51	8:00	9	2	ALIVE	A	104	
PS2	7:53	7:59	6	2	ALIVE	A	124	
PS3	7:54	8:08	14	2	ALIVE	A	104	

APPENDIX TABLE A-9 Continued.

Fish No.	Time			No. of Turb-N Tags recovered	Fish Data			
	Released	Recovered	At Large (min.)		Alive/ Dead	Condition Codes	Total Length (mm)	Comments
PS4	7:52	8:01	9	2	ALIVE	A	107	
PS5	8:10	8:20	10	2	ALIVE	A	104	
PS6	8:12	8:22	10	2	ALIVE	A	109	
PS7	8:10	.	.	0	DEAD	L	106	
PS8	8:11	8:18	7	2	ALIVE	A	105	
PS9	8:11	8:21	10	2	DEAD		112	
PT0	8:38	8:45	7	2	ALIVE	A	103	
PT1	8:43	.	.	0	DEAD	L	112	
PT2	8:41	8:50	9	2	ALIVE	A	101	
PT3	8:39	8:46	7	2	ALIVE	A	106	
PT4	8:39	8:46	7	2	ALIVE	A	102	
PT6	8:56	9:03	7	2	ALIVE	A	115	
PT7	8:54	9:05	11	2	ALIVE	A	115	
PT8	8:56	9:04	8	2	ALIVE	A	108	
PT9	8:55	.	.	0	TAG & PIN		109	
PU0	9:28	9:38	10	2	ALIVE	A	141	
PU1	9:27	9:38	11	2	ALIVE	A	104	
PU2	9:25	9:34	9	2	ALIVE	A	107	
PU3	9:26	9:33	7	2	ALIVE	A	133	
PU4	9:27	9:43	16	2	ALIVE	A	122	
PU5	9:41	9:53	12	2	ALIVE	A	103	
PU6	10:26	10:33	7	2	ALIVE	A	129	
PU7	9:40	9:51	11	2	ALIVE	A	103	
PU8	9:42	9:51	9	2	ALIVE	A	135	
PU9	9:40	9:50	10	2	ALIVE	A	121	
PV0	9:55	10:01	6	2	ALIVE	A	134	
PV1	9:58	10:10	12	2	DEAD	PF	100	
PV2	9:57	.	.	0	DEAD	ZL	106	
PV3	9:56	10:05	9	2	ALIVE	A	105	
PV4	9:57	10:04	7	2	ALIVE	A	102	
PV5	10:17	10:23	6	2	ALIVE	A	115	
PV6	10:16	10:28	12	2	ALIVE	A	109	
PV7	10:19	10:23	4	2	ALIVE	A	103	
PV8	10:40	10:46	6	2	ALIVE	A	108	
PV9	10:18	10:26	8	2	ALIVE	A	100	
27 August 2002 - Testlot 10 : Spillbay 16, gas cap - Water temp=20.0 C								
PW0	11:17	11:34	17	2	ALIVE	A	131	
PW1	11:17	11:29	12	2	DEAD	CB	106	
PW2	11:16	11:22	6	2	ALIVE	A	107	
PW3	11:16	11:24	8	2	ALIVE	A	111	
PW4	11:18	11:26	8	2	ALIVE	A	127	
PW5	11:35	11:43	8	2	ALIVE	A	138	
PW6	11:36	11:43	7	2	ALIVE	A	132	
PW7	11:39	11:46	7	2	ALIVE	A	130	
PW8	11:38	11:45	7	2	ALIVE	A	126	
PW9	11:37	11:45	8	2	ALIVE	A	147	
PX0	11:52	11:58	6	2	ALIVE	A	130	
PX1	11:53	12:02	9	2	ALIVE	A	103	
PX2	11:54	12:01	7	2	ALIVE	A	112	
PX3	11:54	12:00	6	2	ALIVE	A	116	
PX4	11:53	12:03	10	2	ALIVE	A	107	
PX5	12:06	12:13	7	2	ALIVE	A	111	
PX6	12:06	12:17	11	2	ALIVE	A	106	
PX7	12:07	12:13	6	2	ALIVE	A	132	
PX8	12:05	12:13	8	2	ALIVE	A	124	
PX9	12:07	12:19	12	2	ALIVE	A	128	
PY0	12:19	12:27	8	2	ALIVE	A	128	
PY1	12:18	.	.	0	TAG & PIN		106	
PY2	12:20	12:27	7	2	ALIVE	A	130	
PY3	12:20	12:28	8	2	ALIVE	A	146	
PY4	12:18	12:28	10	2	ALIVE	A	134	
PY5	12:35	12:43	8	2	ALIVE	W	120	
PY6	12:35	12:43	8	2	ALIVE	A	116	
PY7	12:36	.	.	0	DEAD	ZL	116	
PY8	12:37	.	.	0	TAG & PIN		108	
PY9	12:37	12:45	8	2	ALIVE	A	114	
PZ0	12:52	.	.	0	TAG & PIN		130	
PZ1	12:50	13:03	13	2	ALIVE	A	134	
PZ2	12:49	12:57	8	2	ALIVE	A	121	
PZ3	12:51	13:02	11	2	ALIVE	C	136	
PZ4	12:51	13:06	15	2	ALIVE	A	138	

APPENDIX TABLE A-9 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data: Alive/ Dead	Condition Codes	Total Length (mm)	Comments
PZ5	13:13	13:23	10	2	ALIVE	A	108	
PZ6	13:12	13:19	7	2	ALIVE	A	114	
PZ7	13:11	13:19	8	2	ALIVE	A	136	
PZ8	13:11	.	.	0	UNKNOWN	X	112	
PZ9	13:10	.	.	0	TAG & PIN		109	
RA0	13:33	13:45	12	2	ALIVE	A	116	
RA1	13:32	13:40	8	2	ALIVE	A	123	
RA2	13:34	13:45	11	2	ALIVE	A	127	
RA3	13:32	13:41	9	2	ALIVE	A	105	
RA4	13:33	13:46	13	2	ALIVE	A	102	
27 August 2002 - Testlot 10 : Control - Water temp=20.0 C								
RA5	17:51	.	.	0	DEAD	Z	116	
RA6	17:52	17:59	7	2	ALIVE	A	106	
RA7	17:53	.	.	0	DEAD	Z	112	
RA8	17:52	18:02	10	2	ALIVE	A	116	
RA9	17:53	.	.	0	TAG & PIN		110	
RB0	14:23	14:34	11	2	ALIVE	A	109	
RB1	14:25	14:33	8	2	ALIVE	A	115	
RB2	14:24	.	.	0	DEAD	Z	104	
RB3	14:24	14:31	7	2	ALIVE	A	129	
RB4	14:25	14:32	7	2	ALIVE	A	141	
RB5	14:39	14:47	8	2	ALIVE	A	147	
RB6	14:38	16:37	119	2	ALIVE	A	125	
RB7	14:37	14:48	11	2	ALIVE	A	116	
RB8	14:36	14:44	8	2	ALIVE	A	110	
RB9	14:38	14:44	6	2	ALIVE	A	131	
RC0	14:56	15:08	12	2	ALIVE	A	144	
RC1	14:56	.	.	0	DEAD	Z	131	
RC2	14:55	.	.	0	DEAD	Z	121	
RC3	14:57	15:15	18	2	ALIVE	A	119	
RC4	14:57	15:07	10	2	ALIVE	A	122	
RC5	15:31	15:38	7	2	ALIVE	A	114	
RC6	15:32	15:40	8	2	ALIVE	A	128	
RC7	15:31	15:38	7	2	ALIVE	A	141	
RC8	15:30	15:37	7	2	ALIVE	A	146	
RC9	15:32	15:41	9	2	ALIVE	A	129	
RD0	15:52	16:01	9	2	ALIVE	A	137	
RD1	15:51	.	.	0	DEAD	Z	134	
RD2	15:51	15:56	5	2	ALIVE	A	118	
RD3	15:52	16:01	9	2	ALIVE	A	136	
RD4	15:50	15:57	7	2	ALIVE	A	134	
RD6	16:06	.	.	0	DEAD	Z	127	
RD7	16:06	16:12	6	2	ALIVE	A	115	
RD8	16:05	16:18	13	1	DEAD	P	140	
RD9	16:04	.	.	0	TAG & PIN		120	
RE0	17:07	17:12	5	2	ALIVE	A	132	
RE1	17:08	17:15	7	2	ALIVE	A	116	
RE2	17:06	17:11	5	2	ALIVE	A	110	
RE3	17:07	17:14	7	2	ALIVE	A	110	
RE4	17:08	17:15	7	2	ALIVE	A	122	
RE5	17:17	17:26	9	2	ALIVE	A	105	
RE6	17:18	.	.	0	DEAD	Z	102	
RE7	17:18	.	.	0	TAG & PIN		103	
RE8	17:15	17:24	9	2	ALIVE	A	119	
RE9	17:19	.	.	0	DEAD	LZ	119	
28 August 2002 - Testlot 11 : Spillbay 14, 75 kcfs - Water temp=20.5 C								
RN5	17:48	18:00	12	2	ALIVE	A	120	
RN6	17:47	17:57	10	2	ALIVE	A	119	
RN7	17:47	18:06	19	2	ALIVE	A	120	
RN8	17:49	.	.	0	UNKNOWN	X	106	
RN9	17:48	17:59	11	2	ALIVE	A	106	
RP0	16:52	17:07	15	2	ALIVE	A	114	
RP1	16:50	.	.	0	DEAD	L	117	
RP2	16:51	.	.	0	DEAD	L	106	
RP3	16:52	17:00	8	2	ALIVE	HG	116	
RP4	16:51	17:02	11	2	ALIVE	A	104	
RP5	17:24	17:33	9	2	ALIVE	A	110	
RP6	17:23	.	.	0	DEAD	Z	109	
RP7	17:21	17:40	19	2	ALIVE	A	137	
RP8	17:25	17:32	7	2	ALIVE	C	116	
RP9	17:22	17:32	10	2	ALIVE	A	115	

APPENDIX TABLE A-9 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data: Alive/ Dead	Condition Codes	Total Length (mm)	Comments
RR0	18:12	18:33	21	2	ALIVE	G	102	
RR1	18:11	.	.	0	TAG & PIN		115	
RR4	18:11	18:21	10	2	ALIVE	A	113	
28 August 2002 - Testlot 11 : Spillbay 16, 75 kcfs - Water temp=20.5 C								
RM0	15:46	15:53	7	2	ALIVE	A	116	
RM1	15:46	15:52	6	2	ALIVE	A	102	
RM2	15:47	15:54	7	2	ALIVE	A	114	
RM3	15:47	15:54	7	2	ALIVE	A	117	
RM4	15:46	15:52	6	2	ALIVE	A	114	
RM5	15:56	.	.	0	DEAD	Z	103	
RM6	15:55	16:01	6	2	ALIVE	A	116	
RM7	15:57	16:04	7	2	ALIVE	A	118	
RM8	15:56	16:05	9	2	ALIVE	A	108	
RM9	15:55	16:00	5	2	DEAD	NJ	102	
RN0	16:19	.	.	0	TAG & PIN		106	
RN1	16:19	16:27	8	2	ALIVE	A	106	
RN2	16:20	16:26	6	2	ALIVE	G	110	
RN3	16:18	16:29	11	2	ALIVE	A	106	
RN4	16:18	16:24	6	2	ALIVE	A	108	
RR5	19:05	19:12	7	2	ALIVE	A	133	
RR6	19:05	19:12	7	2	ALIVE	A	108	
RR7	19:06	19:14	8	2	ALIVE	A	113	
RR8	19:07	19:15	8	2	ALIVE	A	106	
RR9	19:06	19:19	13	2	ALIVE	A	117	
28 August 2002 - Testlot 11 : Control - Water temp=20.5 C								
RF0	8:02	8:09	7	2	ALIVE	A	120	
RF1	8:01	8:07	6	2	ALIVE	A	114	
RF2	8:00	8:05	5	2	ALIVE	A	108	
RF3	8:02	8:10	8	2	ALIVE	A	120	
RF4	8:01	.	.	0	DEAD	ZL	102	
RF5	8:20	8:32	12	2	ALIVE	A	103	
RF6	8:21	8:26	5	2	ALIVE	A	105	
RF7	8:19	8:28	9	2	ALIVE	A	112	
RF8	8:22	8:30	8	2	ALIVE	A	104	
RF9	8:20	8:23	3	2	ALIVE	A	106	
RH0	8:35	8:42	7	2	ALIVE	A	124	
RH1	8:36	8:42	6	2	ALIVE	A	114	
RH2	8:36	8:51	15	1	DEAD	P	122	
RH3	8:37	.	.	0	DEAD	Z	100	
RH4	8:37	8:47	10	2	ALIVE	A	117	
RH5	8:55	9:01	6	2	ALIVE	A	108	
RH6	8:55	.	.	0	DEAD	Z	116	
RH7	8:56	9:03	7	2	ALIVE	A	109	
RH8	8:57	9:05	8	2	ALIVE	A	105	
RH9	8:56	9:02	6	2	ALIVE	A	106	
RJ0	9:15	9:22	7	2	ALIVE	A	115	
RJ1	9:17	9:25	8	2	ALIVE	A	106	
RJ2	9:17	9:29	12	2	ALIVE	A	114	
RJ3	9:16	9:33	17	2	ALIVE	A	105	
RJ4	9:16	9:30	14	2	ALIVE	A	116	
RJ5	9:31	9:38	7	2	ALIVE	A	126	
RJ6	9:33	.	.	0	DEAD	LZ	109	
RJ7	9:32	9:41	9	2	ALIVE	A	113	
RJ8	9:32	9:40	8	2	ALIVE	A	110	
RJ9	9:31	9:44	13	1	DEAD	PB	110	
RK0	9:58	10:08	10	2	ALIVE	A	104	
RK1	9:59	10:05	6	2	ALIVE	A	101	
RK2	9:58	10:10	12	2	DEAD	P	107	
RK3	9:57	10:04	7	2	ALIVE	A	107	
RK4	9:57	.	.	0	DEAD	Z	112	
RK6	10:16	10:24	8	2	ALIVE	A	116	
RK7	10:17	10:27	10	2	ALIVE	A	119	
RK8	10:15	10:21	6	2	ALIVE	A	118	
RK9	10:16	10:23	7	2	ALIVE	A	102	
RL1	10:32	10:40	8	2	ALIVE	A	113	
RL2	10:31	10:41	10	2	ALIVE	A	104	
RL3	10:34	.	.	0	TAG & PIN		102	
RL4	10:33	10:39	6	2	ALIVE	A	130	

APPENDIX TABLE A-9 Continued.

Fish No.	Time Released	Time Recovered	At Large (min.)	No. of Turb-N Tags recovered	Fish Data: Alive/ Dead	Condition Codes	Total Length (mm)	Comments
29 August 2002 - Testlot 12 : Spillbay 14, 75 kcfs - Water temp=20.5 C								
RS0	7:52	.	.	0	UNKNOWN	X	101	
RS1	7:53	.	.	0	TAG & PIN		109	
RS2	7:52	8:05	13	2	ALIVE	A	113	
RS3	7:53	8:05	12	2	ALIVE	A	108	
RS4	7:51	.	.	0	UNKNOWN	X	110	
RS5	8:29	8:37	8	2	ALIVE	A	113	
RS6	8:28	8:37	9	2	ALIVE	A	105	
RS7	8:30	8:41	11	2	ALIVE	A	105	
RS8	8:29	8:40	11	1	DEAD	P	102	
RS9	8:28	8:39	11	2	ALIVE	A	117	
RT0	8:46	8:55	9	2	ALIVE	A	103	
RT1	8:44	.	.	0	DEAD	Z	107	
RT2	8:47	8:58	11	2	ALIVE	A	104	
RT3	8:45	9:00	15	2	ALIVE	A	111	
RT4	8:45	8:53	8	2	ALIVE	A	109	
RT5	9:10	9:19	9	2	ALIVE	A	112	
RT6	9:10	9:22	12	2	ALIVE	A	112	
RT7	9:11	9:18	7	2	ALIVE	A	102	
RT8	9:12	9:20	8	2	ALIVE	A	111	
RT9	9:11	9:24	13	2	ALIVE	A	124	
RU0	9:50	10:01	11	2	ALIVE	A	110	
RU2	9:49	10:02	13	2	ALIVE	A	101	
RU3	9:49	10:11	22	2	ALIVE	A	113	
RU4	9:50	10:00	10	2	ALIVE	A	115	
RU5	10:15	.	.	0	TAG & PIN		105	
RU6	10:14	10:25	11	2	ALIVE	A	104	
RU7	10:12	10:24	12	2	DEAD	D	111	
RU8	10:15	10:22	7	2	ALIVE	A	122	
RU9	10:13	10:37	24	1	ALIVE	HB	109	
RV0	10:50	.	.	0	TAG & PIN		111	
RV1	10:50	11:01	11	1	ALIVE	HB	102	
RV2	10:51	11:02	11	2	ALIVE	A	112	
RV3	10:51	.	.	0	DEAD	Z	105	
RV5	11:22	11:32	10	2	ALIVE	HC	106	
RV6	11:20	11:35	15	2	DEAD	JGW	116	
RV7	11:21	.	.	0	UNKNOWN	X	110	
RV8	11:21	11:51	30	2	ALIVE	H	119	
RV9	11:21	.	.	0	TAG & PIN		107	
RW0	11:59	.	.	0	DEAD	Z	109	
RW2	12:02	.	.	0	TAG & PIN		112	
RW3	12:09	12:17	8	2	ALIVE	A	106	
RW4	12:02	14:00	118	2	ALIVE	H	117	
29 August 2002 - Testlot 12 : Spillbay 16, 75 kcfs - Water temp=20.5 C								
RX0	13:32	.	.	0	DEAD	Z	135	
RX1	13:10	13:22	12	2	ALIVE	A	115	
RX2	13:08	13:16	8	2	ALIVE	A	114	
RX3	13:09	13:20	11	2	ALIVE	A	112	
RX4	13:29	13:35	6	2	ALIVE	A	112	
RX5	13:30	13:40	10	2	ALIVE	A	108	
RX6	13:11	.	.	0	DEAD	LZ	117	
RX7	13:30	.	.	0	UNKNOWN	X	116	
RX8	13:11	13:24	13	2	DEAD		124	
RX9	13:31	13:40	9	2	ALIVE	A	111	

APPENDIX B

DERIVATION OF PRECISION, SAMPLE SIZE, AND MAXIMUM LIKELIHOOD PARAMETERS, AND STATISTICAL OUTPUTS

DERIVATION OF PRECISION, SAMPLE SIZE, AND MAXIMUM LIKELIHOOD PARAMETERS

The statistical description below is excerpted from Normandeau Associates and Skalski (2000a). For the sake of brevity, references within the text have been removed. However, interested readers can look up these citations in the report prepared by Normandeau Associates and Skalski (2000a) upon completion of a spillway passage survival investigation of chinook salmon at Rock Island Dam on the mid-Columbia River, Washington.

The estimation for the likelihood model parameters and sample size requirements discussed in the text are given herein. Additionally, the results of statistical analyses for evaluating homogeneity in recapture and survival probabilities, and in testing hypotheses of equality in parameter estimates under the simplified (H_O:P_A=P_D) versus the most generalized model (H_A:$P_A \neq P_D$) are given.

The following terms are defined for the equations and likelihood functions which follow:

R_C	=	Number of control fish released
R_T	=	Number of treatment fish released
R	=	R_C=R_T
n	=	Number of replicate estimates of $\hat{\tau}_i$ (i=1,…,n)
a_C	=	Number of control fish recaptured alive
d_C	=	Number of control fish recaptured dead
a_T	=	Number of treatment fish recaptured alive
d_T	=	Number of treatment fish recaptured dead
S	=	Probability fish survive from the release point of the controls to recapture
P_A	=	Probability a live fish is recaptured
P_D	=	Probability a dead fish is recaptured
$\hat{\tau}$	=	Probability a treatment fish survives to the point of the control releases (*i.e.*, passage survival)
$1-\hat{\tau}$	=	Passage-related mortality.

The precision of the estimate was defined as:

$$P(-\varepsilon < \hat{\tau} - \tau < \varepsilon) = 1-\alpha$$

or equivalently

$$P(-\varepsilon < \left| \hat{\tau} - \tau \right| < \varepsilon) = 1-\alpha$$

where the absolute errors in estimation, *i.e.*, $\left| \hat{\tau} - \tau \right|$, is $<\varepsilon$ $(1-\alpha)$ 100% of the time, $\hat{\tau}$ is the estimated passage survival, and ε is the half-width of a $(1-\alpha)$ 100% confidence interval for $\hat{\tau}$ or $1-\hat{\tau}$. A precision of ±5%, 90% of the time is expressed as $P(\left| \hat{\tau} - \tau \right| < 0.05) = 0.90$.

Using the above precision definition the required total sample size (R) is as follows:

$$P\left(\frac{-\varepsilon}{Var(\hat{\tau})} < Z < \frac{\varepsilon}{Var(\hat{\tau})} \right) = 1-\alpha$$

$$P\left(Z < \frac{-\varepsilon}{Var(\hat{\tau})}\right) = \alpha/2$$

$$\Phi\left(\frac{-\varepsilon}{Var(\hat{\tau})}\right) = \alpha/2$$

$$\frac{-\varepsilon}{Var(\hat{\tau})} = Z_{\alpha/2}$$

$$Var(\hat{\tau}) = \frac{\varepsilon^2}{Z^2_{1-\frac{\alpha}{2}}}$$

$$\frac{\tau}{SP_A}\left[\frac{(1-S\tau P_A)}{R_T} + \frac{(1-SP_A)\tau}{R_C}\right] = \frac{\varepsilon^2}{Z^2_{1-\frac{\alpha}{2}}} \ .$$

where Z is a standard normal deviate satisfying the relationship $P(Z>Z_{1-\alpha/2})=\alpha/2$, and Φ is the cumulative distribution function for a standard normal deviate.

If data can be pooled across trials and letting $R_C=R_T=R$, the sample size for each release is

$$R = \frac{\tau}{SP_A}\left[1+\tau-2S\tau P_A\right]\frac{Z^2_{1-\alpha/2}}{\varepsilon^2} \ .$$

By rearranging, this equation can be solved to predetermine the anticipated precision given the available number of fish for a study.

If data cannot be pooled across trials the precision is based on

$$\sum_{i=1}^{n}(1-\hat{\tau}_i)/n = 1-\sum_{i=1}^{n}\hat{\tau}_i/n = 1-\bar{\hat{\tau}} \ .$$

Precision is defined as

$$P(|\ \bar{\hat{\tau}} - \bar{\tau}\ | < \varepsilon) = 1-\alpha$$

$$P(-\varepsilon < \bar{\hat{\tau}} - \bar{\tau}\ | < \varepsilon) = 1-\alpha$$

$$P\left(\frac{-\varepsilon}{\sqrt{Var(\bar{\hat{\tau}})}} < \tau_{n-1} < \frac{\varepsilon}{\sqrt{Var(\bar{\hat{\tau}})}}\right) = 1-\alpha$$

$$P\left(\tau_{n-1} < \frac{-\varepsilon}{\sqrt{Var(\bar{\hat{\tau}})}}\right) = \alpha/2$$

$$\frac{\Phi}{\tau}\left(\frac{-\varepsilon}{Var(\bar{\hat{\tau}})}\right) = \alpha/2$$

$$\frac{-\varepsilon}{\sqrt{Var(\bar{\hat{\tau}})}} = t_{\alpha/2,n-1}$$

$$Var(\bar{\hat{\tau}}) = \frac{\varepsilon^2}{t^2_{1-\alpha/2,n-1}}$$

$$\frac{\sigma_\tau^2 + \frac{\tau}{SP_A}\left[\frac{(1-S\tau P_A)}{R_T} + \frac{(1-SP_A)^\tau}{R_C}\right]}{n} = \frac{\varepsilon^2}{t_{1-\alpha/2,n-1}}$$

where σ_τ^2=natural variation in passage-related mortality.

Now letting R_T=R_C

$$\frac{\sigma_\tau^2 + \frac{\tau}{SP_A}\left[\frac{(1-S\tau P_A)}{R} + \frac{(1-SP_A)^\tau}{R}\right]}{n} = \frac{\varepsilon^2}{t_{1-\alpha/2,n-1}}$$

which must be iteratively solved for n given R. Or R given n where

$$R = \frac{\frac{\tau}{SP_A}\left[(1-S\tau P_A) + (1-SP_A)\tau\right]}{\left[\frac{n\varepsilon^2}{t^2_{1-\alpha/2,n-1}} - \sigma_\tau^2\right]}$$

$$R = \frac{\frac{\tau(1+\tau)}{SP_A}}{\left[\frac{n\varepsilon^2}{t^2_{1-\alpha/2,n-1}} - \sigma_\tau^2\right]}$$

$$R = \frac{\tau(1+\tau)}{SP_A}\left[\frac{t^2_{1-\alpha/2,n-1}}{n\varepsilon^2 - \sigma_\tau^2 t^2_{1-\alpha/2,n-1}}\right].$$

The joint likelihood for the passage-related mortality is:

$$L(S,\ \tau,\ P_A,\ P_D \mid R_C,\ R_T,\ a_C,\ a_T,\ d_C,\ d_T) =$$

$$\binom{R_C}{a_c d_C}(SP_A)^{a_C}((1-S)P_D)^{d_C}(1-SP_A-(1-S)P_D)^{R_C-a_C-d_C}$$

$$\times\binom{R_T}{a_T d_T}(S\tau P_A)^{a_T}((1-S\tau)P_D)^{d_T}(1-S\tau P_A-(1-S\tau)P_D)^{R_T-a_T-d_T}\ .$$

The likelihood model is based on the following assumptions: (1) fate of each fish is independent, (2) the control and treatment fish come from the same population of inference and share that same survival probability, (3) all alive fish have the same probability, P_A, of recapture, (4) all dead fish have the same probability, P_D, of recapture, and (5) passage survival (τ) and survival (S) to the recapture point are conditionally independent. The likelihood model has four parameters (P_A, P_D, S, τ) and four minimum sufficient statistics (a_C, d_C, a_T, d_T).

Because any two treatment releases were made concurrently with a single shared control group we used the likelihood model which took into account dependencies within the study design (Normandeau Associates *et al.* 1995). For any two treatment groups (denoted T_1 and T_2), the likelihood model is as follows:

$$L(S,\tau_1,\tau_2,P_A,P_D \mid R_C,R_{T_1},R_{T_2},a_C,d_c,a_{T_1},d_{T_1},a_{T_2},d_{T_2}) =$$

$$\binom{R_C}{a_c d_C}(SP_A)^{a_C}((1-S)P_D)^{d_C}(1-SP_A-(1-S)P_D)^{R_C-a_C-d_C}$$

$$\times\binom{R_{T_1}}{a_{T_1} d_{T_1}}(S\tau_1 P_A)^{a_{T_1}}((1-S\tau_1)P_D)^{d_{T_1}}(1-S\tau_1 P_A-(1-S\tau_1)P_D)^{R_{T_1}-a_{T_1}-d_{T_1}}$$

$$\times\binom{R_{T_2}}{a_{T_2} d_{T_2}}(S\tau_2 P_A)^{a_{T_2}}((1-S\tau_2)P_D)^{d_{T_2}}(1-S\tau_2 P_A-(1-S\tau_2)P_D)^{R_{T_2}-a_{T_2}-d_{T_2}}\ .$$

This likelihood model has the same assumptions as stated in Normandeau Associates and Skalski (2000a) but has five estimable parameters (S, τ_1, τ_2, P_A, and P_D). The survival rate for treatment T_1 is estimated by τ_1 and for treatment T_2, by τ_2. A likelihood ratio test with 1 degree of freedom was used to test for equality in survival rates between treatments τ_1 and τ_2 based on the hypothesis H_O: $\tau_1 = \tau_2$ versus H_a: $\tau_1 \neq \tau_2$.

Likelihood models are based on the following assumptions: (a) the fate of each fish is independent; (b) the control and treatment fish come from the same population of inference and share the same natural survival probability, S; (c) all alive fish have the same probability, P_A, of recapture; (d) all dead fish have the same probability, P_D, of recapture; and (e) passage survival (τ) and natural survival (S) to the recapture point are conditionally independent.

The estimators associated with the likelihood model are:

$$\hat{\tau} = \frac{a_T R_C}{R_T a_C}$$

$$\hat{S} = \frac{R_T d_C a_C - R_C d_T a_C}{R_C d_C a_T - R_C d_T a_C}$$

$$\hat{P}_A = \frac{d_C a_T - d_T a_C}{R_T d_C - R_C d_T}$$

$$\hat{P}_D = \frac{d_C a_T - d_T a_C}{R_C a_T - R_T a_C} \ .$$

The variance (Var) and standard error (SE) of the estimated passage mortality ($1 - \hat{\tau}$) or survival ($\hat{\tau}$) are:

$$Var(1-\hat{\tau}) = Var(\hat{\tau}) = \frac{\hat{\tau}}{SP_A}\left[\frac{(1-S\hat{\tau}P_{A)}}{R_T} + \frac{(1-SP_A)\hat{\tau}}{R_C}\right]$$

$$SE(1-\hat{\tau}) = SE(\hat{\tau}) = \sqrt{Var(1-\hat{\tau})} \ .$$

DERIVATION OF VARIANCE FOR WEIGHTED AVERAGE SURVIVAL ESTIMATE

$$Var(1-\hat{\tau}_w) = Var\left[\frac{\sum(1-\hat{\tau}_i)\frac{1}{Var_i}}{\sum\frac{1}{Var_i}}\right]$$

$$= Var\frac{\left[\sum(1-\hat{\tau}_i)\frac{1}{Var_i}\right]}{\left(\sum\frac{1}{Var_i}\right)^2}$$

$$= \frac{\sum Var(1-\hat{\tau}_i)\frac{1}{(Var_{i^2})}}{\left(\sum\frac{1}{Var_i}\right)^2}$$

$$= \frac{\sum Var_i\left(\frac{1}{Var_i}\right)^2}{\left(\sum\frac{1}{Var_i}\right)^2}$$

$$= \frac{\sum\frac{1}{Var_i}}{\left(\sum\frac{1}{Var_i}\right)^2}$$

$$Var(1-\hat{\tau}_w) = \frac{1}{\sum_{i=1}^{n}\left(\frac{1}{Var(\hat{\tau}_i)}\right)} \ .$$

Appendix B

One hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at 75 kcfs, Bonneville Dam, May/June 2002. Pooled controls; pre-test data from 20 May omitted.

Control fish: released – 404, recovered alive – 393, dead – 1.
Spillbay 14 fish: released – 130, recovered alive – 125, dead – 3.
Spillbay 16 fish: released – 166, recovered alive – 155, dead – 7.

RESULTS FOR FULL MODEL (UNEQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.9975	(0.0025)	Control group survival
Pa =	0.9768	(0.0057)	Live recovery probability
Pd =	1.0	N/A	Dead recovery probability*
S2 =	0.9769	(0.0132)	Spillbay 14 survival
S3 =	0.9578	(0.0000)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -126.3001

Tau =	0.9793	(0.0134)	Spillbay 14/Control ratio
Tau =	0.9602	(0.0024)	Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 1.4040

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00000611	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00003292	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	-0.01477611	0.00000000	-0.00189612
0.00000000	0.00000000	0.00000000	0.00017342	0.00000000
0.00000000	0.00000000	-0.00189612	0.00000000	0.00000000

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9573, 1.0014)	(0.9563, 0.9641)
95 percent:	(0.9530, 1.0057)	(0.9555, 0.9649)
99 percent:	(0.9448, 1.0139)	(0.9541, 0.9663)

Continued.

Appendix B

One hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at 75 kcfs, Bonneville Dam, May/June 2002. Pooled controls; pre-test data (May 20) omitted.

Control fish: released – 404, recovered alive – 393, dead – 1.
Spillbay 14 fish: released – 130, recovered alive – 125, dead – 3.
Spillbay 16 fish: released – 166, recovered alive – 155, dead – 7.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.9975	(0.0025)	Control group survival
Pa = Pd	0.9771	(0.0056)	Recovery probability
S2 =	0.9766	(0.0134)	Spillbay 14 survival
S3 =	0.9568	(0.0160)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -126.3098

Tau = 0.9790 (0.0136) Spillbay 14/Control ratio
Tau = 0.9592 (0.0162) Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.9362

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00000643	0.00000000	0.00000000	0.00000000
0.00000000	0.00003191	0.00000000	0.00000000
0.00000000	0.00000000	0.00017881	0.00000000
0.00000000	0.00000000	0.00000000	0.00025520

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9566, 1.0015)	(0.9326, 0.9859)
95 percent:	(0.9523, 1.0058)	(0.9275, 0.9910)
99 percent:	(0.9439, 1.0142)	(0.9175, 1.0009)

==========

Likelihood ratio statistic for equality of recovery probabilities: 0.0195

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

Appendix B

One hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at Gas Cap, Bonneville Dam, May/June 2002. Pooled controls; data from 1 June omitted.

Control fish: released – 404, recovered alive – 393, dead – 1.
Spillbay 14 fish: released – 238, recovered alive – 231, dead – 4.
Spillbay 16 fish: released – 241, recovered alive – 232, dead – 3.

RESULTS FOR FULL MODEL (UNEQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.9975	(0.0025)	Control group survival
Pa =	0.9783	(0.0049)	Live recovery probability
Pd =	1.0	N/A	Dead recovery probability*
S2 =	0.9832	(0.0083)	Spillbay 14 survival
S3 =	0.9876	(0.0071)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -135.0082

Tau =	0.9856 (0.0087)	Spillbay 14/Control ratio
Tau =	0.9900 (0.0076)	Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.3788

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00000611	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00002428	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00006943	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00005101

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9713, 0.9999)	(0.9776, 1.0025)
95 percent:	(0.9686, 1.0027)	(0.9752, 1.0048)
99 percent:	(0.9632, 1.0080)	(0.9705, 1.0095)

Continued.

Appendix B

One hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at Gas Cap, Bonneville Dam, May/June 2002. Pooled controls; data from 1 June omitted.

Control fish: released – 404, recovered alive – 393, dead – 1.
Spillbay 14 fish: released – 238, recovered alive – 231, dead – 4.
Spillbay 16 fish: released – 241, recovered alive – 232, dead – 3.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.9975	(0.0025)	Control group survival
Pa = Pd	0.9785	(0.0049)	Recovery probability
S2 =	0.9830	(0.0084)	Spillbay 14 survival
S3 =	0.9872	(0.0073)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -135.0306

Tau = 0.9855 (0.0088) Spillbay 14/Control ratio
Tau = 0.9897 (0.0078) Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.3631

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00000643	0.00000000	0.00000000	0.00000000
0.00000000	0.00002384	0.00000000	0.00000000
0.00000000	0.00000000	0.00007120	0.00000000
0.00000000	0.00000000	0.00000000	0.00005363

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9710, 1.0000)	(0.9770, 1.0025)
95 percent:	(0.9682, 1.0028)	(0.9745, 1.0050)
99 percent:	(0.9628, 1.0082)	(0.9698, 1.0097)

==========

Likelihood ratio statistic for equality of recovery probabilities: 0.0449

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

Appendix B

Forty-eight hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at 75 kcfs, Bonneville Dam, May/June 2002. Pooled controls; pre-test data from 20 May omitted.

Control fish: released – 404, recovered alive – 385, dead – 9.
Spillbay 14 fish: released – 130, recovered alive – 125, dead – 3.
Spillbay 16 fish: released – 166, recovered alive – 152, dead – 10.

RESULTS FOR FULL MODEL (UNEQUAL LIVE/DEAD RECOVERY)

	estim. (std. err.)	
S1 =	0.9761 (0.0122)	Control group survival
Pa =	0.9785 (0.0127)	Live recovery probability
Pd =	0.9390 (0.3212)	Dead recovery probability
S2 =	0.9759 (0.0148)	Spillbay 14 survival
S3 =	0.9358 (0.0281)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -170.9332

Tau =	0.9998 (0.0166)	Spillbay 14/Control ratio
Tau =	0.9587 (0.0244)	Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 1.3927

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00014804	-0.00010759	0.00298191	0.00005271	0.00018702
-0.00010759	0.00016228	-0.00363437	-0.00006566	-0.00023295
0.00298191	-0.00363437	0.10317168	0.00181989	0.00645640
0.00005271	-0.00006566	0.00181989	0.00022047	0.00011414
0.00018702	-0.00023295	0.00645640	0.00011414	0.00078751

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9725, 1.0271)	(0.9187, 0.9988)
95 percent:	(0.9672, 1.0324)	(0.9110, 1.0065)
99 percent:	(0.9570, 1.0426)	(0.8960, 1.0214)

Continued.

Appendix B

Forty-eight hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at 75 kcfs, Bonneville Dam, May/June 2002. Pooled controls; pre-test data from 20 May omitted.

Control fish: released – 404, recovered alive – 385, dead – 9.
Spillbay 14 fish: released – 130, recovered alive – 125, dead – 3.
Spillbay 16 fish: released – 166, recovered alive – 152, dead – 10.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.9772	(0.0075)	Control group survival
Pa = Pd	0.9771	(0.0056)	Recovery probability
S2 =	0.9766	(0.0134)	Spillbay 14 survival
S3 =	0.9383	(0.0189)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -170.9399

Tau = 0.9994 (0.0157) Spillbay 14/Control ratio
Tau = 0.9602 (0.0207) Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 1.5075

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00005665	0.00000000	0.00000000	0.00000000
0.00000000	0.00003191	0.00000000	0.00000000
0.00000000	0.00000000	0.00017881	0.00000000
0.00000000	0.00000000	0.00000000	0.00035752

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9736, 1.0252)	(0.9261, 0.9943)
95 percent:	(0.9686, 1.0302)	(0.9196, 1.0008)
99 percent:	(0.9590, 1.0398)	(0.9069, 1.0135)

==========

Likelihood ratio statistic for equality of recovery probabilities: 0.0134

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

Appendix B

Forty-eight hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at Gas Cap, Bonneville Dam, May/June 2002. Pooled controls; data from 1 June omitted.

Control fish: released – 404, recovered alive – 385, dead – 9.
Spillbay 14 fish: released – 238, recovered alive – 228, dead – 7.
Spillbay 16 fish: released – 241, recovered alive – 228, dead – 7.

RESULTS FOR FULL MODEL (UNEQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.9777	(0.0073)	Control group survival
Pa =	0.9779	(0.0050)	Live recovery probability
Pd =	1.0	N/A	Dead recovery probability*
S2 =	0.9706	(0.0110)	Spillbay 14 survival
S3 =	0.9710	(0.0108)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -197.6127

Tau = 0.9927 (0.0135) Spillbay 14/Control ratio
Tau = 0.9931 (0.0133) Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.0198

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00005391	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00002512	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00011994	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00011702

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9706, 1.0148)	(0.9711, 1.0150)
95 percent:	(0.9663, 1.0191)	(0.9669, 1.0192)
99 percent:	(0.9581, 1.0274)	(0.9587, 1.0274)

Continued.

Appendix B

Forty-eight hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at Gas Cap, Bonneville Dam, May/June 2002. Pooled controls; data from 1 June omitted.

Control fish: released – 404, recovered alive – 385, dead – 9.
Spillbay 14 fish: released – 238, recovered alive – 228, dead – 7.
Spillbay 16 fish: released – 241, recovered alive – 228, dead – 7.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.9772	(0.0075)	Control group survival
Pa = Pd	0.9785	(0.0049)	Recovery probability
S2 =	0.9702	(0.0111)	Spillbay 14 survival
S3 =	0.9702	(0.0111)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -197.6223

Tau = 0.9929 (0.0137) Spillbay 14/Control ratio
Tau = 0.9929 (0.0137) Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.0000

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00005665	0.00000000	0.00000000	0.00000000
0.00000000	0.00002384	0.00000000	0.00000000
0.00000000	0.00000000	0.00012298	0.00000000
0.00000000	0.00000000	0.00000000	0.00012298

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9704, 1.0154)	(0.9704, 1.0154)
95 percent:	(0.9661, 1.0197)	(0.9661, 1.0197)
99 percent:	(0.9577, 1.0281)	(0.9577, 1.0281)

==========

Likelihood ratio statistic for equality of recovery probabilities: 0.0192

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

Appendix B

One hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at 75 kcfs, Bonneville Dam, August 2002. Pooled controls.

Control fish: released – 447, recovered alive – 377, dead – 65.
Spillbay 14 fish: released – 208, recovered alive – 167, dead – 31.
Spillbay 16 fish: released – 185, recovered alive – 156, dead – 23.

RESULTS FOR FULL MODEL (UNEQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.8434	(0.0172)	Control group survival
Pa =	1.0	N/A	Live recovery probability*
Pd =	0.8500	(0.0302)	Dead recovery probability
S2 =	0.8029	(0.0276)	Spillbay 14 survival
S3 =	0.8432	(0.0267)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -436.7551

Tau =	0.9520 (0.0380)	Spillbay 14/Control ratio
Tau =	0.9998 (0.0377)	Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.8939

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00029547	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00091071	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00076087	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00071451

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.8894, 1.0145)	(0.9378, 1.0618)
95 percent:	(0.8774, 1.0265)	(0.9260, 1.0737)
99 percent:	(0.8540, 1.0499)	(0.9028, 1.0968)

Continued.

Appendix B

One hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at 75 kcfs, Bonneville Dam, August 2002. Pooled controls.

Control fish: released – 447, recovered alive – 377, dead – 65.
Spillbay 14 fish: released – 208, recovered alive – 167, dead – 31.
Spillbay 16 fish: released – 185, recovered alive – 156, dead – 23.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.8529	(0.0168)	Control group survival
Pa = Pd	0.9750	(0.0054)	Recovery probability
S2 =	0.8434	(0.0258)	Spillbay 14 survival
S3 =	0.8715	(0.0250)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -437.3356

Tau =	0.9889	(0.0360)	Spillbay 14/Control ratio
Tau =	1.0218	(0.0356)	Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.6499

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00028378	0.00000000	0.00000000	0.00000000
0.00000000	0.00002902	0.00000000	0.00000000
0.00000000	0.00000000	0.00066693	0.00000000
0.00000000	0.00000000	0.00000000	0.00062560

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9296, 1.0481)	(0.9632, 1.0803)
95 percent:	(0.9182, 1.0595)	(0.9520, 1.0915)
99 percent:	(0.8961, 1.0816)	(0.9301, 1.1134)

==========

Likelihood ratio statistic for equality of recovery probabilities: 1.1610

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

Appendix B

One hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at Gas Cap, Bonneville Dam, August 2002. Pooled controls.

Control fish: released – 447, recovered alive – 377, dead – 65.
Spillbay 14 fish: released – 250, recovered alive – 211, dead – 30.
Spillbay 16 fish: released – 250, recovered alive – 221, dead – 25.

RESULTS FOR FULL MODEL (UNEQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.8546	(0.0167)	Control group survival
Pa =	0.9782	(0.0051)	Live recovery probability
Pd =	1.0	N/A	Dead recovery probability*
S2 =	0.8800	(0.0206)	Spillbay 14 survival
S3 =	0.9000	(0.0190)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -445.0563

Tau = 1.0297 (0.0313) Spillbay 14/Control ratio
Tau = 1.0531 (0.0303) Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.5373

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00027801	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00002575	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00042240	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00036000

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9782, 1.0813)	(1.0034, 1.1029)
95 percent:	(0.9683, 1.0912)	(0.9938, 1.1124)
99 percent:	(0.9490, 1.1104)	(0.9752, 1.1310)

Continued.

Appendix B

One hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at Gas Cap, Bonneville Dam, August 2002. Pooled controls.

Control fish: released – 447, recovered alive – 377, dead – 65.
Spillbay 14 fish: released – 250, recovered alive – 211, dead – 30.
Spillbay 16 fish: released – 250, recovered alive – 221, dead – 25.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.8529	(0.0168)	Control group survival
Pa = Pd	0.9810	(0.0044)	Recovery probability
S2 =	0.8755	(0.0213)	Spillbay 14 survival
S3 =	0.8984	(0.0193)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -445.1317

Tau = 1.0265 (0.0321) Spillbay 14/Control ratio
Tau = 1.0533 (0.0307) Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.6029

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00028378	0.00000000	0.00000000	0.00000000
0.00000000	0.00001969	0.00000000	0.00000000
0.00000000	0.00000000	0.00045222	0.00000000
0.00000000	0.00000000	0.00000000	0.00037113

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9736, 1.0793)	(1.0028, 1.1038)
95 percent:	(0.9635, 1.0895)	(0.9931, 1.1135)
99 percent:	(0.9437, 1.1092)	(0.9742, 1.1323)

==========

Likelihood ratio statistic for equality of recovery probabilities: 0.1507

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

Appendix B

Forty-eight hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at 75 kcfs, Bonneville Dam, August 2002. Pooled controls.

Control fish: released – 447, recovered alive – 365, dead – 77.
Spillbay 14 fish: released – 208, recovered alive – 148, dead – 50.
Spillbay 16 fish: released – 185, recovered alive – 131, dead – 48.

RESULTS FOR FULL MODEL (UNEQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.8166	(0.0183)	Control group survival
Pa =	1.0	N/A	Live recovery probability*
Pd =	0.8929	(0.0221)	Dead recovery probability
S2 =	0.7115	(0.0314)	Spillbay 14 survival
S3 =	0.7081	(0.0334)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -516.4378

Tau =	0.8714 (0.0431)	Spillbay 14/Control ratio
Tau =	0.8672 (0.0453)	Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.0671

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00033511	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00048808	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00098679	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00111725

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.8004, 0.9424)	(0.7926, 0.9417)
95 percent:	(0.7868, 0.9560)	(0.7784, 0.9560)
99 percent:	(0.7603, 0.9825)	(0.7505, 0.9839)

Continued.

Appendix B

Forty-eight hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at 75 kcfs, Bonneville Dam, August 2002. Pooled controls.

Control fish: released – 447, recovered alive – 365, dead – 77.
Spillbay 14 fish: released – 208, recovered alive – 148, dead – 50.
Spillbay 16 fish: released – 185, recovered alive – 131, dead – 48.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.8258	(0.0180)	Control group survival
Pa = Pd	0.9750	(0.0054)	Recovery probability
S2 =	0.7475	(0.0309)	Spillbay 14 survival
S3 =	0.7318	(0.0331)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -518.5870

Tau =	0.9052	(0.0423)	Spillbay 14/Control ratio
Tau =	0.8862	(0.0445)	Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.3082

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00032547	0.00000000	0.00000000	0.00000000
0.00000000	0.00002902	0.00000000	0.00000000
0.00000000	0.00000000	0.00095331	0.00000000
0.00000000	0.00000000	0.00000000	0.00109636

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.8356, 0.9747)	(0.8130, 0.9595)
95 percent:	(0.8223, 0.9881)	(0.7990, 0.9735)
99 percent:	(0.7962, 1.0141)	(0.7716, 1.0009)

==========

Likelihood ratio statistic for equality of recovery probabilities: 4.2985

Compare with quantiles of the chi-squared distribution with 1 d.f.:

For significance level 0.10:	2.706
For significance level 0.05:	3.841
For significance level 0.01:	6.635

Appendix B

Forty-eight hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at Gas Cap, Bonneville Dam, August 2002. Pooled controls.

Control fish: released – 447, recovered alive – 365, dead – 77.
Spillbay 14 fish: released – 250, recovered alive – 201, dead – 40.
Spillbay 16 fish: released – 250, recovered alive – 213, dead – 33.

RESULTS FOR FULL MODEL (UNEQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.8166	(0.0183)	Control group survival
Pa =	1.0	N/A	Live recovery probability*
Pd =	0.8929	(0.0239)	Dead recovery probability
S2 =	0.8040	(0.0251)	Spillbay 14 survival
S3 =	0.8520	(0.0225)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -498.7419

Tau =	0.9846 (0.0379)	Spillbay 14/Control ratio
Tau =	1.0434 (0.0361)	Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 1.1238

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00033511	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
0.00000000	0.00000000	0.00056942	0.00000000	0.00000000
0.00000000	0.00000000	0.00000000	0.00063034	0.00000000
0.00000000	0.00000000	0.00000000	0.00000000	0.00050438

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9224, 1.0469)	(0.9840, 1.1028)
95 percent:	(0.9104, 1.0588)	(0.9726, 1.1142)
99 percent:	(0.8872, 1.0821)	(0.9504, 1.1364)

Continued.

Appendix B

Forty-eight hour survival estimates for juvenile chinook salmon released through Spillbays 14 and 16 at Gas Cap, Bonneville Dam, August 2002. Pooled controls.

Control fish: released – 447, recovered alive – 365, dead – 77.
Spillbay 14 fish: released – 250, recovered alive – 201, dead – 40.
Spillbay 16 fish: released – 250, recovered alive – 213, dead – 33.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S1 =	0.8258	(0.0180)	Control group survival
Pa = Pd	0.9810	(0.0044)	Recovery probability
S2 =	0.8340	(0.0240)	Spillbay 14 survival
S3 =	0.8659	(0.0217)	Spillbay 16 survival

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -498.8721

Tau = 1.0100 (0.0365) Spillbay 14/Control ratio
Tau = 1.0485 (0.0349) Spillbay 16/Control ratio

Z statistic for the equality of equal turbine survivals: 0.7638

Compare with quantiles of the normal distribution:

	1-tailed	2-tailed
For significance level 0.10:	1.2816	1.6449
For significance level 0.05:	1.6449	1.9600
For significance level 0.01:	2.3263	2.5758

Variance-Covariance matrix for estimated probabilities:

0.00032547	0.00000000	0.00000000	0.00000000
0.00000000	0.00001969	0.00000000	0.00000000
0.00000000	0.00000000	0.00057439	0.00000000
0.00000000	0.00000000	0.00000000	0.00047216

Confidence intervals:

	Spillbay 14 Tau	Spillbay 16 Tau
90 percent:	(0.9500, 1.0699)	(0.9911, 1.1059)
95 percent:	(0.9385, 1.0814)	(0.9801, 1.1169)
99 percent:	(0.9161, 1.1038)	(0.9587, 1.1383)

==========

Likelihood ratio statistic for equality of recovery probabilities: 0.2604

Compare with quantiles of the chi-squared distribution with 1 d.f.:
For significance level 0.10: 2.706
For significance level 0.05: 3.841
For significance level 0.01: 6.635

Appendix B

Malady/clean fish rates for chinook salmon released through Spillbay 14 at 75 kcfs spill in May, 2002.

Controls: 393 released, 385 without passage related maladies, 8 with passage related maladies.
Test fish: 127 released, 121 without passage related maladies, 6 with passage related maladies.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S =	0.9796	(0.0071)	Control group not injured
Pa = Pd	1.0	N/A	Recovery probability*
Tau =	0.9726	(0.0205)	Spillbay 14 clean fish
1-Tau =	0.0274	(0.0205)	Spillbay 14 with maladies

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -63.243509

Variance-Covariance matrix for estimated probabilities:
0.00005 -0.00005
-0.00005 0.00042

Profile likelihood intervals:

	Spillbay 14 clean fish	Spillbay 14 with maladies
90 percent:	(0.9330, 1.0000)	(0.0000, 0.0670)
95 percent:	(0.9240, 1.0000)	(0.0000, 0.0760)
99 percent:	(0.9051, 1.0000)	(0.0000, 0.0949)

Appendix B

Malady/clean fish rates for chinook salmon released through Spillbay 14 at gas saturation cap spill in May, 2002.

Controls: 393 released, 385 without passage related maladies, 8 with passage related maladies.
Test fish: 234 released, 225 without passage related maladies, 9 with passage related maladies.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S =	0.9796	(0.0071)	Control group not injured
Pa = Pd	1.0	N/A	Recovery probability*
Tau =	0.9815	(0.0147)	Spillbay 14 clean fish
1-Tau =	0.0185	(0.0147)	Spillbay 14 with maladies

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -77.220491

Variance-Covariance matrix for estimated probabilities:
0.00005 -0.00005
-0.00005 0.00022

Profile likelihood intervals:

Spillbay 14 clean fish	Spillbay 14 with maladies
90 percent: (0.9548, 1.0000)	(0.0000, 0.0452)
95 percent: (0.9489, 1.0000)	(0.0000, 0.0511)
99 percent: (0.9369, 1.0000)	(0.0000, 0.0631)

Appendix B

Malady/clean fish rates for chinook salmon released through Spillbay 16 at 75 kcfs spill in May, 2002.

Controls: 393 released, 385 without passage related maladies, 8 with passage related maladies.
Test fish: 159 released, 145 without passage related maladies, 14 with passage related maladies.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S =	0.9796	(0.0071)	Control group not injured
Pa = Pd	1.0	N/A	Recovery probability*
Tau =	0.9309	(0.0239)	Spillbay 16 clean fish
1-Tau =	0.0691	(0.0239)	Spillbay 16 with maladies

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -86.455534

Variance-Covariance matrix for estimated probabilities:
0.00005 -0.00005
-0.00005 0.00057

Profile likelihood intervals:

	Spillbay 16 clean fish	Spillbay 16 with maladies
90 percent:	(0.8873, 0.9665)	(0.0335, 0.1127)
95 percent:	(0.8780, 0.9726)	(0.0274, 0.1220)
99 percent:	(0.8589, 0.9840)	(0.0160, 0.1411)

Appendix B

Malady/clean fish rates for chinook salmon released through Spillbay 16 at gas saturation cap spill in May, 2002.

Controls: 393 released, 385 without passage related maladies, 8 with passage related maladies.
Test fish: 234 released, 226 without passage related maladies, 8 with passage related maladies.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S =	0.9796	(0.0071)	Control group not injured
Pa = Pd	1.0	N/A	Recovery probability*
Tau =	0.9859	(0.0141)	Spillbay 16 clean fish
1-Tau =	0.0141	(0.0141)	Spillbay 16 with maladies

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -73.941660

Variance-Covariance matrix for estimated probabilities:
0.00005 -0.00005
-0.00005 0.00020

Profile likelihood intervals:

	Spillbay 16 clean fish	Spillbay 16 with maladies
90 percent:	(0.9602, 1.0000)	(0.0000, 0.0398)
95 percent:	(0.9545, 1.0000)	(0.0000, 0.0455)
99 percent:	(0.9428, 1.0000)	(0.0000, 0.0572)

Appendix B

Malady/clean fish rates for chinook salmon released through Spillbay 14 at 75 kcfs in August, 2002.

Controls: 392 released, 387 without passage related maladies, 5 with passage related maladies.
Test fish: 174 released, 151 without passage related maladies, 23 with passage related maladies.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S =	0.9872	(0.0057)	Control group not injured
Pa = Pd	1.0	N/A	Recovery probability*
Tau =	0.8790	(0.0265)	Spillbay 14 clean fish
1-Tau =	0.1210	(0.0265)	Spillbay 14 with maladies

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -94.727095

Variance-Covariance matrix for estimated probabilities:
0.00003 -0.00003
-0.00003 0.00070

Profile likelihood intervals:

	Spillbay 14 clean fish	Spillbay 14 with maladies
90 percent:	(0.8319, 0.9191)	(0.0809, 0.1681)
95 percent:	(0.8221, 0.9260)	(0.0740, 0.1779)
99 percent:	(0.8022, 0.9388)	(0.0612, 0.1978)

Appendix B

Malady/clean fish rates for chinook salmon released through Spillbay 14 at gas saturation cap spills in August, 2002.

Controls: 392 released, 387 without passage related maladies, 5 with passage related maladies.
Test fish: 219 released, 211 without passage related maladies, 8 with passage related maladies.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S =	0.9872	(0.0057)	Control group not injured
Pa = Pd	1.0	N/A	Recovery probability*
Tau =	0.9759	(0.0140)	Spillbay 14 clean fish
1-Tau =	0.0241	(0.0140)	Spillbay 14 with maladies

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -61.106206

Variance-Covariance matrix for estimated probabilities:
0.00003 -0.00003
-0.00003 0.00020

Profile likelihood intervals:

	Spillbay 14 clean fish	Spillbay 14 with maladies
90 percent:	(0.9497, 0.9969)	(0.0031, 0.0503)
95 percent:	(0.9438, 1.0000)	(0.0000, 0.0562)
99 percent:	(0.9316, 1.0000)	(0.0000, 0.0684)

Appendix B

Malady/clean fish rates for chinook salmon released through Spillbay 16 at 75 kcfs in August, 2002.

Controls: 392 released, 387 without passage related maladies, 5 with passage related maladies.
Test fish: 163 released, 146 without passage related maladies, 17 with passage related maladies.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S =	0.9872	(0.0057)	Control group not injured
Pa = Pd	1.0	N/A	Recovery probability*
Tau =	0.9073	(0.0248)	Spillbay 16 clean fish
1-Tau =	0.0927	(0.0248)	Spillbay 16 with maladies

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -81.287185

Variance-Covariance matrix for estimated probabilities:
0.00003 -0.00003
-0.00003 0.00062

Profile likelihood intervals:

	Spillbay 16 clean fish	Spillbay 16 with maladies
90 percent:	(0.8624, 0.9441)	(0.0559, 0.1376)
95 percent:	(0.8529, 0.9504)	(0.0496, 0.1471)
99 percent:	(0.8334, 0.9620)	(0.0380, 0.1666)

Appendix B

Malady\clean fish rates for chinook salmon released through Spillbay 16 at gas saturation cap spill in August, 2002.

Controls: 392 released, 387 without passage related maladies, 5 with passage related maladies.
Test fish: 224 released, 216 without passage related maladies, 8 with passage related maladies.

RESULTS FOR REDUCED MODEL (EQUAL LIVE/DEAD RECOVERY)

	estim.	std. err.	
S =	0.9872	(0.0057)	Control group not injured
Pa = Pd	1.0	N/A	Recovery probability*
Tau =	0.9767	(0.0138)	Spillbay 16 clean fish
1-Tau =	0.0233	(0.0138)	Spillbay 16 with maladies

* -- Because of constraints in the data set, this probability is assumed equal to 1.0; not estimated.

log-likelihood : -61.290143

Variance-Covariance matrix for estimated probabilities:
0.00003 -0.00003
-0.00003 0.00019

Profile likelihood intervals:

Spillbay 16 clean fish	Spillbay 16 with maladies
90 percent: (0.9510, 0.9974)	(0.0026, 0.0490)
95 percent: (0.9453, 1.0000)	(0.0000, 0.0547)
99 percent: (0.9333, 1.0000)	(0.0000, 0.0667)

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbays 14 and 16 at 75 kcfs and gas cap spill at Bonneville Dam, May-June 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency, Expected, Cell Chi-Square	maladies	no maladies	Total
SB14_75	6 6.2321 0.0086	121 120.77 0.0004	127
SB14_gc	9 11.483 0.5368	225 222.52 0.0277	234
SB16_75	14 7.8024 4.9229	145 151.2 0.254	159
SB16_gc	8 11.483 1.0563	226 222.52 0.0545	234
Total	37	717	754

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	3	6.8614	0.0764
Likelihood Ratio Chi-Square	3	6.0863	0.1075
Mantel-Haenszel Chi-Square	1	0.0069	0.9338
Phi Coefficient		0.0954	
Contingency Coefficient		0.0950	
Cramer's V		0.0954	

Sample Size = 754

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbay 14 at 75 kcfs and gas cap spill at Bonneville Dam, May-June 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency, Expected, Cell Chi-Square	maladies	no maladies	Total
SB14_75	6 5.277 0.0991	121 121.72 0.0043	127
SB14_gc	9 9.723 0.0538	225 224.28 0.0023	234
Total	15	346	361

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	1	0.1594	0.6897
Likelihood Ratio Chi-Square	1	0.1566	0.6923
Continuity Adj. Chi-Square	1	0.0152	0.9020
Mantel-Haenszel Chi-Square	1	0.1590	0.6901
Phi Coefficient		0.0210	
Contingency Coefficient		0.0210	
Cramer's V		0.0210	

Fisher's Exact Test

Cell (1,1) Frequency (F)	6
Left-sided Pr <= F	0.7542
Right-sided Pr >= F	0.4412
Table Probability (P)	0.1954
Two-sided Pr <= P	0.7838

Sample Size = 361

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbay 16 at 75 kcfs and gas cap spill at Bonneville Dam, May-June 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency, Expected, Cell Chi-Square	maladies	no maladies	Total
SB16_75	14 8.9008 2.9213	145 150.1 0.1732	159
SB16_gc	8 13.099 1.985	226 220.9 0.1177	234
Total	22	371	393

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	1	5.1973	0.0226
Likelihood Ratio Chi-Square	1	5.0840	0.0241
Continuity Adj. Chi-Square	1	4.2280	0.0398
Mantel-Haenszel Chi-Square	1	5.1841	0.0228
Phi Coefficient		0.1150	
Contingency Coefficient		0.1142	
Cramer's V		0.1150	

Fisher's Exact Test

Cell (1,1) Frequency (F)	14
Left-sided Pr <= F	0.9935
Right-sided Pr >= F	0.0208
Table Probability (P)	0.0142
Two-sided Pr <= P	0.0264

Sample Size = 393

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbays 14 and 16 at 75 kcfs at Bonneville Dam, May-June 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency, Expected, Cell Chi-Square	maladies	no maladies	Total
SB14_75	6 8.8811 0.9347	121 118.12 0.0703	127
SB16_75	14 11.119 0.7466	145 147.88 0.0561	159
Total	20	266	286

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	1	1.8076	0.1788
Likelihood Ratio Chi-Square	1	1.8717	0.1713
Continuity Adj. Chi-Square	1	1.2347	0.2665
Mantel-Haenszel Chi-Square	1	1.8013	0.1796
Phi Coefficient		-0.0795	
Contingency Coefficient		0.0793	
Cramer's V		-0.0795	

Fisher's Exact Test

Cell (1,1) Frequency (F)	6
Left-sided Pr <= F	0.1327
Right-sided Pr >= F	0.9451
Table Probability (P)	0.0778
Two-sided Pr <= P	0.2439

Sample Size = 286

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbays 14 and 16 at gas cap spill at Bonneville Dam, May-June 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency, Expected, Cell Chi-Square	maladies	no maladies	Total
SB14_gc	9 8.5 0.0294	225 225.5 0.0011	234
SB16_gc	8 8.5 0.0294	226 225.5 0.0011	234
Total	17	451	468

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	1	0.0610	0.8049
Likelihood Ratio Chi-Square	1	0.0611	0.8048
Continuity Adj. Chi-Square	1	0.0000	1.0000
Mantel-Haenszel Chi-Square	1	0.0609	0.8051
Phi Coefficient		0.0114	
Contingency Coefficient		0.0114	
Cramer's V		0.0114	

Fisher's Exact Test

Cell (1,1) Frequency (F)	9
Left-sided Pr <= F	0.6887
Right-sided Pr >= F	0.5000
Table Probability (P)	0.1887
Two-sided Pr <= P	1.0000

Sample Size = 468

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbays 14 and 16 at 75 kcfs and gas cap spill at Bonneville Dam, August 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency , Expected , Cell Chi-Square	maladies	no maladies	Total
SB14_75	23 12.492 8.8384	151 161.51 0.6836	174
SB14_gc	8 15.723 3.7935	211 203.28 0.2934	219
SB16_75	17 11.703 2.398	146 151.3 0.1855	163
SB16_gc	8 16.082 4.0616	216 207.92 0.3142	224
Total	56	724	780

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	3	20.5682	0.0001
Likelihood Ratio Chi-Square	3	20.2767	0.0001
Mantel-Haenszel Chi-Square	1	6.9288	0.0085
Phi Coefficient		0.1624	
Contingency Coefficient		0.1603	
Cramer's V		0.1624	

Sample Size = 780

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbay 14 at 75 kcfs and gas cap spill at Bonneville Dam, August 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency, Expected, Cell Chi-Square	maladies	no maladies	Total
SB14_75	23 13.725 6.2675	151 160.27 0.5367	174
SB14_gc	8 17.275 4.9796	211 201.73 0.4264	219
Total	31	362	393

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	1	12.2102	0.0005
Likelihood Ratio Chi-Square	1	12.3985	0.0004
Continuity Adj. Chi-Square	1	10.9292	0.0009
Mantel-Haenszel Chi-Square	1	12.1792	0.0005
Phi Coefficient		0.1763	
Contingency Coefficient		0.1736	
Cramer's V		0.1763	

Fisher's Exact Test

Cell (1,1) Frequency (F)	23
Left-sided Pr <= F	0.9999
Right-sided Pr >= F	4.462E-04
Table Probability (P)	3.451E-04
Two-sided Pr <= P	5.676E-04

Sample Size = 393

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbay 16 at 75 kcfs and gas cap spill at Bonneville Dam, August 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency, Expected, Cell Chi-Square	maladies	no maladies	Total
SB16_75	17 10.53 3.9759	146 152.47 0.2746	163
SB16_gc	8 14.47 2.8931	216 209.53 0.1998	224
Total	25	362	387

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	1	7.3434	0.0067
Likelihood Ratio Chi-Square	1	7.2802	0.0070
Continuity Adj. Chi-Square	1	6.2523	0.0124
Mantel-Haenszel Chi-Square	1	7.3244	0.0068
Phi Coefficient		0.1378	
Contingency Coefficient		0.1365	
Cramer's V		0.1378	

Fisher's Exact Test

Cell (1,1) Frequency (F)	17
Left-sided Pr <= F	0.9982
Right-sided Pr >= F	0.0064
Table Probability (P)	0.0046
Two-sided Pr <= P	0.0106

Sample Size = 387

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbays 14 and 16 at 75 kcfs at Bonneville Dam, August 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency, Expected, Cell Chi-Square	maladies	no maladies	Total
SB14_75	23 20.653 0.2668	151 153.35 0.0359	174
SB16_75	17 19.347 0.2848	146 143.65 0.0384	163
Total	40	297	337

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	1	0.6258	0.4289
Likelihood Ratio Chi-Square	1	0.6285	0.4279
Continuity Adj. Chi-Square	1	0.3876	0.5336
Mantel-Haenszel Chi-Square	1	0.6239	0.4296
Phi Coefficient		0.0431	
Contingency Coefficient		0.0431	
Cramer's V		0.0431	

Fisher's Exact Test

Cell (1,1) Frequency (F)	23
Left-sided Pr <= F	0.8313
Right-sided Pr >= F	0.2673
Table Probability (P)	0.0986
Two-sided Pr <= P	0.5013

Sample Size = 337

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbays 14 and 16 at gas cap spill at Bonneville Dam, August 2002.

The FREQ Procedure

Table of desc by cond

desc	cond		
Frequency , Expected , Cell Chi-Square	maladies	no maladies	Total
SB14_gc	8 7.9097 0.001	211 211.09 386E-7	219
SB16_gc	8 8.0903 0.001	216 215.91 378E-7	224
Total	16	427	443

Statistics for Table of desc by cond

Statistic	DF	Value	Prob
Chi-Square	1	0.0021	0.9633
Likelihood Ratio Chi-Square	1	0.0021	0.9633
Continuity Adj. Chi-Square	1	0.0000	1.0000
Mantel-Haenszel Chi-Square	1	0.0021	0.9634
Phi Coefficient		0.0022	
Contingency Coefficient		0.0022	
Cramer's V		0.0022	

Fisher's Exact Test

Cell (1,1) Frequency (F)	8
Left-sided Pr <= F	0.6179
Right-sided Pr >= F	0.5819
Table Probability (P)	0.1998
Two-sided Pr <= P	1.0000

Sample Size = 443

Appendix B

Chi square tests of homogeneity of fish with maladies released through Spillbays 14 and 16 (pooled) at 75 kcfs and gas cap spill at Bonneville Dam, August 2002.

The FREQ Procedure

Table of release by cond

release	cond		
Frequency , Expected , Cell Chi-Square	maladies	no maladies	Total
75 kcfs	40 24.195 10.325	297 312.81 0.7986	337
Gas cap	16 31.805 7.8541	427 411.19 0.6075	443
Total	56	724	780

Statistics for Table of release by cond

Statistic	DF	Value	Prob
Chi-Square	1	19.5848	<.0001
Likelihood Ratio Chi-Square	1	19.6461	<.0001
Continuity Adj. Chi-Square	1	18.3653	<.0001
Mantel-Haenszel Chi-Square	1	19.5597	<.0001
Phi Coefficient		0.1585	
Contingency Coefficient		0.1565	
Cramer's V		0.1585	

Fisher's Exact Test

Cell (1,1) Frequency (F)	40
Left-sided Pr <= F	1.0000
Right-sided Pr >= F	9.012E-06
Table Probability (P)	6.646E-06
Two-sided Pr <= P	1.680E-05

Sample Size = 780

APPENDIX C

HYDRAULIC/PHYSICAL CONDITIONS DURING TESTING

Appendix Table C-1

Physical conditions at Bonneville Dam during the juvenile chinook salmon releases through Spillbays 14 (shallow flow deflector) and 16 (deep flow deflector), downstream of Spillbay 17 (control), and through the sluice at two spill volumes (75 kcfs and gas cap), May/June (spring) and August (summer) 2002.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
				May/June (Spring, High Tailwater)					
20 May	1700	4.1	5.1	75.3	31	242.9	75.7	18.7	57.0
20 May	1800	4.1	5.1	75.3	31	240.5	75.7	18.6	57.1
20 May	1900	4.1	5.1	75.3	32	238.7	75.7	18.5	57.2
21 May	0800	4.1	5.1	75.4	28	272.6	75.8	20.2	55.6
21 May	0900	4.1	5.1	75.5	28	271.8	75.9	20.2	55.7
21 May	1000	4.1	5.1	75.6	28	272.2	75.8	20.2	55.6
21 May	1100	4.1	5.1	75.6	28	270.1	75.9	20.2	55.7
21 May	1200	4.1	5.1	75.6	28	269.2	76.0	20.1	55.9
21 May	1300	4.2	5.1	75.8	28	269.0	76.0	20.1	55.9
21 May	1400	4.2	5.1	75.8	28	268.9	76.0	20.1	55.9
21 May	1500	4.2	5.1	75.9	28	267.1	76.1	20.0	56.1
21 May	1600	4.2	5.1	75.9	28	267.5	76.0	20.1	55.9
21 May	1700	4.2	5.1	75.9	28	268.1	76.1	20.1	56.0
21 May	1800	4.2	5.1	75.9	28	266.6	76.2	19.9	56.3
21 May	1900	4.8	6.4	91.5	34	267.1	76.1	20.5	55.6
22 May	0900	5.1	7.1	100.0	35	289.8	76.0	21.5	54.5
22 May	1000	5.1	7.1	100.2	35	288.9	76.1	21.5	54.6
22 May	1100	5.1	7.1	100.2	35	289.2	76.1	21.4	54.7
22 May	1200	5.1	7.1	100.2	35	289.4	76.0	21.5	54.5
22 May	1300	5.1	7.1	100.1	35	289.4	76.0	21.5	54.5
22 May	1400	5.1	7.1	100.0	35	289.4	76.0	21.5	54.5
22 May	1500	5.1	7.1	99.9	34	289.9	75.9	21.5	54.4
22 May	1600	7.1	8.9	135.5	48	280.8	75.8	21.8	54.0
23 May	0700	7.9	9.7	149.2	55	273.2	75.6	21.3	54.3
23 May	0800	7.9	9.7	149.2	55	273.0	75.6	21.3	54.3

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
23 May	0900	7.9	9.7	149.1	55	272.5	75.6	21.4	54.2
23 May	1000	7.9	9.7	148.9	54	277.1	75.5	21.5	54.0
23 May	1100	7.9	9.7	149.0	54	273.5	75.5	21.4	54.1
23 May	1200	7.9	9.7	148.9	54	273.3	75.5	21.4	54.1
23 May	1300	7.9	9.7	148.9	54	274.2	75.5	21.4	54.1
23 May	1400	7.9	9.6	148.8	54	274.8	75.5	21.3	54.2
23 May	1500	7.9	9.6	152.7	55	279.7	75.4	21.5	53.9
23 May	1600	7.9	9.6	153.9	55	280.3	75.4	21.5	53.9
23 May	1700	7.9	9.6	153.9	57	271.9	75.4	21.3	54.1
23 May	1800	7.9	9.6	153.8	57	269.5	75.4	21.3	54.1
24 May	0700	7.9	9.6	154.0	54	284.3	75.4	21.7	53.7
24 May	0800	7.9	9.6	154.0	55	280.4	75.5	21.6	53.9
24 May	900	7.9	9.6	154.2	55	279.9	75.5	21.5	54.0
24 May	1000	7.9	9.7	154.2	55	278.3	75.5	21.5	54.0
24 May	1100	7.9	9.7	154.2	55	278.5	75.4	21.5	53.9
24 May	1200	7.9	9.6	154.1	55	278.6	75.5	21.6	53.9
24 May	1300	7.9	9.6	154.1	55	278.1	75.5	21.5	54.0
24 May	1400	7.9	9.6	154.2	55	278.1	75.5	21.4	54.1
24 May	1500	7.9	9.8	151.5	55	276.0	75.6	21.2	54.4
24 May	1600	7.9	8.8	146.4	54	271.2	75.6	21.2	54.4
24 May	1700	7.9	8.8	146.3	53	276.9	75.5	21.7	53.8
25 May	0700	7.9	8.8	146.9	56	260.4	75.7	20.8	54.9
25 May	0800	7.9	8.8	146.8	56	262.1	75.8	20.8	55.0
25 May	0900	7.9	8.8	146.9	56	261.6	75.8	20.8	55.0
25 May	1000	7.9	8.8	146.9	56	261.8	75.8	20.8	55.0
25 May	1100	7.9	8.8	145.8	56	260.8	75.8	20.8	55.0
25 May	1200	7.0	7.9	129.1	51	253.2	75.8	20.5	55.3
25 May	1300	7.0	7.9	128.9	50	256.6	75.7	20.7	55.0
25 May	1400	7.0	7.9	128.5	47	270.9	75.5	21.1	54.4

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
25 May	1500	7.0	7.9	128.4	47	270.6	75.4	21.1	54.3
25 May	1600	7.0	7.9	128.3	47	270.3	75.5	21.1	54.4
25 May	1700	7.0	7.9	128.4	50	257.6	75.5	20.6	54.9
25 May	1800	7.0	7.9	128.3	50	257.0	75.5	20.5	55.0
26 May	0700	3.2	3.2	77.2	31	248.6	75.5	19.5	56.0
26 May	0800	3.2	3.2	78.3	31	252.0	75.6	19.6	56.0
26 May	0900	3.2	3.2	79.3	31	252.1	75.6	19.5	56.1
26 May	1000	3.2	3.2	80.3	32	251.7	75.8	19.5	56.3
26 May	1100	3.2	3.2	81.3	32	251.7	75.8	19.4	56.4
26 May	1200	3.2	3.2	82.3	33	253.2	75.8	19.5	56.3
26 May	1300	3.2	3.2	83.3	30	280.5	75.7	20.6	55.1
26 May	1400	3.2	3.2	84.3	29	286.8	75.7	20.6	55.1
26 May	1500	3.2	3.2	85.3	30	286.1	75.7	20.5	55.2
26 May	1600	3.2	3.2	86.3	33	259.3	75.9	19.5	56.4
26 May	1700	3.2	3.2	87.3	30	286.7	75.6	20.7	54.9
27 May	0700	4.2	5.1	75.9	33	229.3	76.0	18.2	57.8
27 May	0800	4.2	5.1	75.8	33	232.5	76.0	18.3	57.7
27 May	0900	4.2	5.1	75.8	32	233.6	75.9	18.5	57.4
27 May	1000	4.1	5.1	75.7	30	248.8	75.8	19.3	56.5
27 May	1100	4.1	5.1	75.4	29	259.0	75.7	19.7	56.0
27 May	1200	4.1	5.1	75.4	29	257.0	75.7	19.5	56.2
27 May	1300	4.1	5.1	75.4	30	253.0	75.7	19.4	56.3
27 May	1400	4.1	5.1	75.4	30	252.9	75.7	19.6	56.1
27 May	1500	4.1	5.1	75.4	30	252.1	75.7	19.4	56.3
27 May	1600	4.1	5.1	75.2	28	269.5	75.6	20.1	55.5
27 May	1700	4.1	5.1	75.2	28	271.8	75.6	20.5	55.1
28 May	0700	4.1	5.1	75.6	27	281.1	75.8	21.2	54.6
28 May	0800	4.1	5.1	75.6	26	285.3	75.9	21.2	54.7

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
28 May	0900	4.2	5.1	75.8	27	284.9	76.0	21.2	54.8
28 May	1000	4.2	5.1	75.8	27	285.0	76.0	21.3	54.7
28 May	1100	4.2	5.9	83.1	29	291.4	75.9	21.7	54.2
28 May	1200	4.2	6.1	84.5	29	292.8	75.9	21.7	54.2
28 May	1300	4.2	5.6	80.2	28	288.7	76.0	21.5	54.5
28 May	1400	4.2	5.1	75.9	27	282.1	76.1	21.3	54.8
28 May	1500	4.2	5.7	81.2	28	288.1	76.0	21.7	54.3
29 May	0800	7.0	7.9	137.3	41	333.7	75.3	23.8	51.5
29 May	0900	7.0	7.9	138.3	41	333.5	75.4	23.9	51.5
29 May	1000	7.0	7.9	139.4	42	333.4	75.4	24.0	51.4
29 May	1100	7.0	7.9	140.4	42	335.0	75.4	24.0	51.4
29 May	1200	7.0	7.9	141.4	42	334.2	75.4	24.1	51.3
29 May	1300	7.0	7.9	142.4	43	334.2	75.4	24.0	51.4
29 May	1400	7.0	7.9	143.4	42	339.2	75.4	24.2	51.2
29 May	1500	7.0	7.9	144.4	43	338.7	75.4	24.1	51.3
29 May	1600	7.0	7.9	145.4	43	339.0	75.3	24.1	51.2
29 May	1700	7.0	7.9	146.4	44	334.4	75.5	23.4	52.1
29 May	1800	7.0	7.9	147.4	45	330.9	75.5	23.4	52.1
30 May	0700	7.0	7.9	129.1	40	324.8	75.5	21.6	53.9
30 May	0800	7.0	7.9	129.1	40	325.5	75.5	21.5	54.0
30 May	0900	7.0	7.9	129.2	40	324.4	75.4	21.7	53.7
30 May	1000	7.0	7.8	128.7	40	322.7	75.3	22.8	52.5
30 May	1100	7.0	7.8	128.5	40	323.1	75.0	23.1	51.9
30 May	1200	6.9	7.8	127.9	40	320.7	75.0	23.6	51.4
30 May	1300	6.9	7.8	128.4	40	320.2	75.2	23.3	51.9
30 May	1400	6.9	7.8	128.4	40	324.3	75.2	23.4	51.8
30 May	1500	6.3	7.8	121.0	38	315.3	75.3	23.0	52.3
30 May	1600	6.0	7.9	118.6	38	312.2	75.3	22.9	52.4
30 May	1700	6.0	7.9	118.6	39	306.6	75.3	22.9	52.4
30 May	1800	6.0	7.9	118.7	39	302.2	75.4	22.8	52.6

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
31 May	0700	6.0	7.8	118.4	38	314.1	75.3	23.4	51.9
31 May	0800	6.0	7.8	118.4	38	314.8	75.3	23.4	51.9
31 May	0900	6.0	7.9	118.7	38	313.9	75.4	23.5	51.9
31 May	1000	6.0	7.9	118.8	38	312.8	75.4	23.4	52.0
31 May	1100	6.0	7.9	118.9	38	313.5	75.5	23.5	52.0
31 May	1200	6.1	7.9	119.1	38	311.9	75.6	23.3	52.3
31 May	1300	6.1	7.9	119.3	38	311.1	75.6	23.4	52.2
31 May	1400	6.1	7.9	119.2	38	315.1	75.6	23.4	52.2
31 May	1500	6.1	7.9	119.4	38	313.7	75.7	23.4	52.3
31 May	1600	6.1	7.9	119.5	38	313.1	75.7	23.4	52.3
31 May	1700	6.1	7.9	119.6	39	307.6	75.8	23.1	52.7
01 Jun	0800	6.0	7.9	118.9	34	349.3	75.3	24.9	50.4
01 Jun	0900	6.0	7.9	118.6	34	352.4	75.4	25.0	50.4
01 Jun	1000	6.0	7.9	118.9	34	346.2	75.5	24.8	50.7
01 Jun	1100	6.0	7.9	118.9	35	343.5	75.4	24.8	50.6
01 Jun	1200	6.0	7.9	118.8	35	342.6	75.4	24.7	50.7
May/June Average						**285.8**	**75.6**	**21.5**	**54.2**
Minimum		**3.2**	**3.2**	**75.2**	**26**	**229.3**	**75.0**	**18.2**	**50.4**
Maximum		**7.9**	**9.8**	**154.2**	**57**	**352.4**	**76.2**	**25.0**	**57.8**

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
				August (Summer, Low Tailwater)					
18 Aug	0800	5.0	6.9	99.8	73	135.8	74.0	11.9	62.1
18 Aug	0900	5.0	6.9	99.7	73	135.8	74.0	11.8	62.2
18 Aug	1000	5.0	6.9	99.6	73	135.7	74.0	11.9	62.1
18 Aug	1100	5.0	6.9	99.5	72	137.3	73.9	11.9	62.0
18 Aug	1200	5.0	6.9	99.4	72	138.5	73.9	11.8	62.1
18 Aug	1300	5.0	6.9	99.5	72	138.6	73.9	11.7	62.2
18 Aug	1400	5.0	6.9	99.6	72	138.7	74.0	11.8	62.2
18 Aug	1500	5.0	6.9	99.6	72	138.6	74.0	11.6	62.4
18 Aug	1600	5.0	6.9	99.6	72	138.6	74.0	11.8	62.2
18 Aug	1700	5.0	6.9	99.6	72	138.6	74.0	11.7	62.3
18 Aug	1800	5.0	6.9	99.7	72	138.5	74.0	11.6	62.4
19 Aug	0800	5.8	7.3	109.3	74	146.8	74.1	12.5	61.6
19 Aug	0900	5.0	6.9	98.0	72	137.0	74.1	12.5	61.6
19 Aug	1000	5.0	6.9	98.0	72	136.6	74.1	12.3	61.8
19 Aug	1100	5.0	6.9	98.1	72	136.3	74.1	12.2	61.9
19 Aug	1200	5.0	6.9	98.0	72	136.3	74.1	12.1	62.0
19 Aug	1300	5.0	6.9	98.0	72	136.3	74.1	12.0	62.1
19 Aug	1400	5.0	6.9	98.0	72	136.2	74.1	11.9	62.2
19 Aug	1500	5.0	6.9	98.0	72	136.2	74.1	11.8	62.3
19 Aug	1600	5.0	6.9	98.0	72	136.1	74.1	11.7	62.4
19 Aug	1700	5.0	6.9	98.0	72	136.0	74.1	11.6	62.5
19 Aug	1800	5.0	6.9	98.1	72	135.9	74.1	11.6	62.5
19 Aug	1900	5.0	6.9	98.1	72	135.9	74.1	11.7	62.4
20 Aug	0800	5.9	7.7	118.7	76	156.3	73.7	13.5	60.2
20 Aug	0900	5.9	7.7	118.7	76	156.3	73.7	13.5	60.2
20 Aug	1000	5.9	7.7	118.7	76	156.3	73.7	13.5	60.2
20 Aug	1100	5.9	7.7	118.7	76	156.3	73.7	13.4	60.3
20 Aug	1200	5.9	7.7	118.7	76	156.3	73.7	13.5	60.2

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
20 Aug	1300	5.9	7.7	118.7	76	156.3	73.7	13.4	60.3
20 Aug	1400	5.9	7.7	118.7	76	156.2	73.7	13.4	60.3
20 Aug	1500	5.9	7.7	118.7	76	156.2	73.7	13.3	60.4
20 Aug	1600	5.9	7.7	118.7	76	156.1	73.8	13.2	60.6
20 Aug	1700	5.9	7.7	118.7	76	156.1	73.8	13.3	60.5
21 Aug	0800	6.0	7.8	120.4	76	158.6	74.1	13.8	60.3
21 Aug	0900	6.0	7.8	120.4	76	158.3	74.0	13.9	60.1
21 Aug	1000	6.0	7.8	120.3	76	158.3	74.0	13.8	60.2
21 Aug	1100	6.0	7.8	120.4	76	158.3	74.0	13.8	60.2
21 Aug	1200	6.0	7.8	120.4	76	158.2	74.0	13.7	60.3
21 Aug	1300	6.0	7.8	120.4	76	158.2	74.0	13.8	60.2
21 Aug	1400	6.0	7.8	120.4	76	157.6	74.1	13.5	60.6
21 Aug	1500	6.0	7.8	120.4	77	157.3	74.1	13.5	60.6
21 Aug	1600	6.0	7.8	120.5	77	157.3	74.0	13.5	60.5
21 Aug	1700	6.0	7.8	120.5	77	157.3	74.1	13.4	60.7
22 Aug	0800	4.1	5.0	76.0	52	146.5	74.1	12.7	61.4
22 Aug	0900	4.1	5.0	76.0	52	147.0	74.1	12.8	61.3
22 Aug	1000	4.1	5.0	76.0	51	149.3	74.1	13.1	61.0
22 Aug	1100	4.1	5.0	76.1	51	150.4	74.1	12.9	61.2
22 Aug	1200	4.1	5.0	76.1	51	150.5	74.2	12.9	61.3
22 Aug	1300	4.1	5.0	76.2	51	150.3	74.2	12.8	61.4
22 Aug	1400	4.1	5.0	76.3	49	156.8	74.3	13.1	61.2
22 Aug	1500	4.1	5.0	76.4	49	157.2	74.3	13.0	61.3
22 Aug	1600	4.1	5.0	76.4	47	162.6	74.3	13.4	60.9
22 Aug	1700	4.1	5.1	76.5	47	162.3	74.4	13.1	61.3
22 Aug	1800	4.1	5.1	76.7	52	148.9	74.5	12.5	62.0
22 Aug	1900	4.1	5.1	76.9	52	147.3	74.6	12.4	62.2

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
23 Aug	0700	4.1	5.1	74.6	49	152.2	74.3	12.7	61.6
23 Aug	0800	4.1	5.0	75.3	46	163.7	74.2	13.3	60.9
23 Aug	0900	4.1	5.0	75.2	46	164.9	74.1	13.5	60.6
23 Aug	1000	4.1	5.0	75.1	46	164.1	74.1	13.6	60.5
23 Aug	1100	4.1	5.0	75.0	46	163.7	74.0	13.5	60.5
23 Aug	1200	4.1	5.0	74.9	46	162.6	73.9	13.5	60.4
23 Aug	1300	4.0	5.0	74.7	46	162.3	73.9	13.5	60.4
23 Aug	1400	4.1	5.0	74.9	51	148.3	74.0	12.8	61.2
23 Aug	1500	4.1	5.0	74.9	51	147.2	74.0	12.7	61.3
23 Aug	1600	4.1	5.0	74.8	49	154.2	73.9	12.9	61.0
24 Aug	0800	4.1	5.0	75.3	50	152.0	74.2	12.5	61.7
24 Aug	0900	4.1	5.0	75.4	49	152.5	74.2	12.8	61.4
24 Aug	1000	4.1	5.0	75.3	45	167.1	74.2	13.5	60.7
24 Aug	1100	4.1	5.0	75.2	45	168.6	74.1	13.6	60.5
24 Aug	1200	4.1	5.0	75.1	45	168.6	74.1	13.7	60.4
24 Aug	1300	4.1	5.0	75.1	45	168.5	74.1	13.7	60.4
24 Aug	1400	4.1	5.0	75.1	45	168.6	74.1	13.6	60.5
24 Aug	1500	4.1	5.0	75.0	44	168.6	74.0	13.6	60.4
24 Aug	1600	4.1	5.0	74.9	44	168.5	74.0	13.6	60.4
25 Aug	0700	4.0	6.0	74.7	58	129.2	73.8	11.6	62.2
25 Aug	0800	4.0	5.9	74.7	58	129.2	73.8	11.5	62.3
25 Aug	0900	4.0	5.9	74.6	55	135.1	73.8	11.7	62.1
25 Aug	1000	4.0	5.9	74.7	55	135.5	73.9	11.9	62.0
25 Aug	1100	4.0	6.0	74.8	55	135.4	73.9	11.8	62.1
25 Aug	1200	4.0	6.0	74.8	55	134.8	73.9	11.7	62.2
25 Aug	1300	4.1	6.0	75.0	66	112.8	74.0	10.6	63.4
25 Aug	1400	4.1	6.0	75.0	65	114.7	74.0	10.6	63.4
25 Aug	1500	4.1	6.0	74.9	65	115.5	74.0	10.4	63.6
25 Aug	1600	4.1	6.0	74.9	61	123.0	73.9	10.6	63.3

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
25 Aug	1700	4.1	6.0	74.9	61	123.4	74.0	10.5	63.5
25 Aug	1800	4.1	6.0	75.0	61	123.3	74.0	10.4	63.6
26 Aug	0700	5.9	7.8	117.0	75	155.3	73.8	12.1	61.7
26 Aug	0800	5.9	7.8	117.0	75	155.4	73.8	12.2	61.6
26 Aug	0900	5.9	7.8	117.0	75	155.5	73.9	12.3	61.6
26 Aug	1000	6.0	7.8	117.1	75	155.6	73.8	12.5	61.3
26 Aug	1100	5.9	7.8	118.3	75	156.9	73.8	12.8	61.0
26 Aug	1200	5.9	7.8	118.9	75	157.9	73.8	12.9	60.9
26 Aug	1300	5.9	7.8	119.0	75	158.1	73.9	12.9	61.0
26 Aug	1400	5.5	7.4	105.8	73	144.3	74.0	11.4	62.6
26 Aug	1500	5.0	6.9	99.8	73	137.5	74.0	11.1	62.9
26 Aug	1600	5.0	6.9	99.8	73	137.5	74.1	11.2	62.9
27 Aug	0700	5.1	7.0	97.6	73	133.9	74.6	11.2	63.4
27 Aug	0800	5.1	7.0	97.6	73	133.8	74.5	11.2	63.3
27 Aug	0900	5.1	7.0	97.7	73	133.5	74.5	11.2	63.3
27 Aug	1000	5.1	7.0	97.6	73	133.2	74.5	11.2	63.3
27 Aug	1100	5.1	7.0	97.5	73	132.8	74.5	11.2	63.3
27 Aug	1200	5.1	7.0	97.7	73	133.0	75.6	11.3	64.3
27 Aug	1300	5.1	7.0	99.0	74	134.3	75.6	11.4	64.2
27 Aug	1400	5.1	7.0	99.4	74	134.6	74.5	11.5	63.0
27 Aug	1500	5.9	7.8	114.2	76	149.7	74.5	12.3	62.2
27 Aug	1600	5.9	7.8	114.5	76	150.0	75.5	12.6	62.9
27 Aug	1700	6.0	7.9	115.2	77	150.3	75.5	12.4	63.1
28 Aug	0800	4.1	5.1	76.3	51	148.5	75.7	11.6	64.1
28 Aug	0900	4.1	5.1	76.0	54	141.5	75.9	11.4	64.5
28 Aug	1000	4.1	5.1	76.5	55	139.8	75.8	11.7	64.1
28 Aug	1100	4.1	5.1	76.4	53	145.5	75.8	11.7	64.1
28 Aug	1200	4.1	5.1	76.3	52	145.8	75.8	11.9	63.9

Appendix Table C-1

Continued.

Date	Hour	Spill (kcfs)		Total Spill (kcfs)	% Spill of Total Flow	River Flow (kcfs)	Elevation (ft)		Total Head (ft)
		Spillbay 14	Spillbay 16				Forebay	Tailwater	
28 Aug	1300	4.1	5.1	76.4	52	146.2	75.7	12.3	63.4
28 Aug	1400	4.1	5.1	76.3	49	155.3	75.7	12.4	63.3
28 Aug	1500	4.1	5.1	76.3	48	157.4	75.7	12.9	62.8
28 Aug	1600	4.1	5.1	76.3	45	167.7	75.7	13.5	62.2
28 Aug	1700	4.1	5.1	76.2	43	178.8	75.8	12.3	63.5
28 Aug	1800	4.1	5.1	76.4	46	165.7	75.7	13.3	62.4
28 Aug	1900	4.1	5.1	76.4	47	163.8	75.9	13.4	62.5
29 Aug	0700	4.1	5.1	75.5	55	138.4	75.8	11.7	64.1
29 Aug	0800	4.1	5.1	75.5	53	143.8	75.8	11.9	63.9
29 Aug	0900	4.1	5.1	75.5	52	144.8	75.7	11.9	63.8
29 Aug	1000	4.1	5.1	75.4	52	144.8	75.7	12.0	63.7
29 Aug	1100	4.1	5.1	75.4	52	144.7	75.7	12.0	63.7
29 Aug	1200	4.1	5.1	75.3	52	144.7	75.6	11.9	63.7
29 Aug	1300	4.1	5.1	75.3	52	145.1	75.7	12.1	63.6
30 Aug	0800	5.1	7.0	99.3	72	137.4	75.7	11.2	64.5
30 Aug	0900	5.1	7.0	99.6	72	137.5	75.7	11.1	64.6
30 Aug	1000	5.1	7.0	99.5	72	137.4	75.7	11.4	64.3
30 Aug	1100	5.1	7.0	99.6	72	137.4	75.8	11.1	64.7
30 Aug	1200	5.1	7.0	99.6	72	137.4	75.8	11.1	64.7
30 Aug	1300	5.1	7.0	99.7	73	137.4	75.8	11.1	64.7
30 Aug	1400	5.4	7.0	102.5	73	140.1	75.8	11.5	64.3
August Average						**147.3**	**74.4**	**12.4**	**62.1**
Minimum		**4.0**	**5.0**	**74.6**	**43**	**112.8**	**73.7**	**10.4**	**60.1**
Maximum		**6.0**	**7.9**	**120.5**	**77**	**178.8**	**75.9**	**13.9**	**64.7**