

Chinook Salmon Loss Estimation
for
Skinner Delta Fish Protective Facility and Tracy Fish Collection Facility

2/15/2013

I. Introduction

Estimates of salmon loss are based on fish salvage and operational data collected at the John E. Skinner Delta Fish Protective Facility (Skinner) and the Tracy Fish Collection Facility (Tracy). Loss calculations utilize estimates based on DFG studies of screening efficiency, handling and trucking mortality due to operation of the Skinner facility, and pre-screening losses occurring in Clifton Court Forebay (CCF) and the intake channel.

II. Loss Estimation

There are 4 essential components of loss estimation: salvage, pre-screen loss (predation), screen (louver) efficiency, and handling and trucking loss. Losses are estimated from the time salmon enter Clifton Court Forebay (at Skinner) or across the trash racks (at Tracy) to the time they are released back into the Delta. Salmon are lost in two ways before they are collected in the facility: 1) they might be eaten by predatory fish, or 2) they might pass through the louvers and then exported along with Delta water. Once collected, fish loss occurs when some fish die in the process of being handled or trucked.

A. Salvage Estimation

The first step in estimating loss is to estimate fish salvage. Salvage is estimated from samples (counts) of fish collected at least every two hours while water is being pumped.

$SALVAGE = \text{Observed number of fish} \times (\text{Total minutes pumping} \div \text{Count length})$

Exceptions: If the fish is observed in a predator removal, then $SALVAGE = \text{Observed number of fish} \times 1$.

If the fish is observed during a special study, then $SALVAGE = 0$.

Example: 1 salmon in count * (120 min. pumping / 10 min. count length) →
 $SALVAGE = 12$

B. Entrainment Estimation

The number of fish that are entrained into the facilities is estimated in two steps. First we estimate how many fish encountered the screens, the second step is to estimate how many fish entered the facility.

1. Encounter Estimation

We have already estimated how many salmon were collected (salvage), but since the screens are not 100% efficient, we know some fish passed through and were lost. Estimating the number of fish encountering the screens depends on fish size. Efficiency is generally higher for fish < 100 mm than for fish > 100 mm. The fish's ability to avoid the louvers and enter the bypass also depends on the water velocity through the louvers. For small fish, higher velocities will make it more difficult for them to avoid the louvers and will increase the likelihood that they will pass through the louvers and will be lost. The number of fish encountering the screens (ENCOUNT) is calculated by dividing the salvage (SALVAGE) by the screen efficiency (EFF).

If Length < 101 mm → ENCOUNT = SALVAGE/EFF1;

If Length > 100 mm → ENCOUNT = SALVAGE/EFF2;

$EFF1 = 0.630 + (0.0494 * (\text{Primary Channel Flow} / (\text{Primary Channel Depth} * \text{Width})))$

$EFF2 = 0.568 + (0.0579 * (\text{Primary Channel Flow} / (\text{Primary Channel Depth} * \text{Width})))$

Note: Channel width at Skinner depends on the number of bays open. As the pumping rate changes, bays are opened and closed to maintain primary channel approach velocities and bypass ratios within established criteria. Channel width at Tracy is fixed (84 ft).

2. Entrainment Estimation

The number of fish entrained (ENTRAIN) is calculated by dividing the number of fish encountering the screens (ENCOUNT) by the proportion of fish assumed to survive the journey to the louvers (1 – P). The pre-screen loss rate (P) is the rate of loss to entrained salmon during movement from the radial gates (Skinner) or trash racks (Tracy) to the louvers. The pre-screen loss at Skinner is based on an average of measured pre-screen loss rates in CCF for chinook salmon (75%). The pre-screen loss rate at Tracy is an agreed-upon value (15%).

$ENTRAIN = ENCOUNT / (1 - P)$

For Skinner: P = 0.75

For Tracy: P = 0.15

C. Live Release Estimation

We then estimate the number of salvaged fish that will survive the process of being transferred from the holding tanks to the truck and transported back to the Delta. This estimate is based on studies with salmon at the Skinner facility and depends on salmon length. Mortality during the transport process has been referred to as handling and trucking loss. For salmon less than or equal to 100 mm, mortality is assumed to be 2% and for salmon larger than 100 mm, mortality is assumed to be 0.

If length < 101 mm → RELEASE = SALVAGE x (1 – 0.02)

If length > 100 mm → RELEASE = SALVAGE

Note: Trucking and handling loss is combined into a single rate (2% for smaller fish).

D. System Loss Estimation

The final step in loss estimation is to subtract the estimated number of fish released alive from the estimated number of fish entrained.

LOSS = ENTRAIN – RELEASE

Exceptions:

If the fish is observed in a Skinner predator removal, then LOSS = SALVAGE x 4.33

If the fish is observed in a Tracy predator removal, then LOSS = SALVAGE x 0.569

If the fish is observed in a special study, then LOSS = 0

III. Loss Calculation Examples:

A. Skinner:

1 salmon observed in count * (120 min. pumping / 10 count length) → Salvage = 12, but some fish went through louvers and were not salvaged, so...

$$\text{If } < 101 \text{ mm, \# fish encountering screens} = 12 / (0.63 + (0.0494 * (2260 \text{ cfs} / 20 \text{ ft.} * 106 \text{ ft}))) = 17.6$$

But, most of the salmon were eaten before they got to the louvers, so... # fish entrained = 17.6 / (1-.75) = 70.4

But, we were able to release some of these fish back into the delta alive, so if fish < 100 mm... # fish released = 12 * (1 – .02) = 11.8

So, loss is the number of fish entrained minus the number of fish released alive... # fish lost = 70.4 - 11.8 = 58.6

B. Tracy:

1 salmon observed in count * (120 min. pumping / 10 count length) → Salvage = 12,

but some fish went through louvers and were not salvaged, so...

$$\text{If } < 101 \text{ mm, \# fish encountering screens} = 12 / (0.63 + (0.0494 * 2806 \text{ cfs} / (16.7 \text{ ft.} * 84 \text{ ft}))) = 16.4$$

But, most of the salmon were eaten before they got to the louvers, so... # fish entrained = $16.4 / (1 - .15) = 19.3$

But, we were able to release some of these fish back into the delta alive, so if fish < 100 mm... # fish released = $12 * (1 - .02) = 11.8$

So, loss is the number of fish entrained minus the number of fish released alive... # fish lost = $19.3 - 11.8 = 7.5$

NOTE: Loss for a 148 mm FL NON clipped Chinook salmon salvaged at SWP on 12/18/2012 has been preliminarily adjusted by +1 from 18.41 to 19.41 since it was accidentally killed as a mistaken clipped salmon and kept for coded wire tag processing.