

**Suisun Marsh Salinity Control Gates
Salmon Passage Evaluation Report
2002**

Department of Water Resources
and
Department of Fish and Game

May 2003

Adult Salmon Migration Monitoring, Suisun Marsh Salinity Control Gates, September – November 2002

Introduction

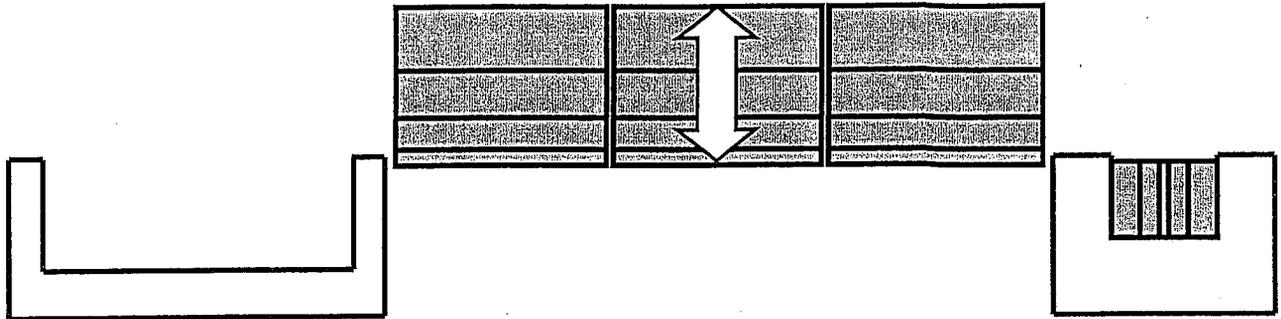
The 2002 adult salmon passage study is the second year of a planned 3 year program to continue monitoring the passage rate and passage times of migrating salmon past the Suisun Marsh Salinity Control Gates (SMSCG) in Montezuma Slough. Telemetry studies were started in 1993 (Tillman *et al* 1996; Edwards *et al* 1996) to assess the effects of the SMSCG on migrating adult salmon, particularly federally listed Winter-run, which may be present in Montezuma Slough during the peak operating times of the gates, October through May.

The 2001 study focused on the use of the existing boat lock as a fish passageway that was already a part of the SMSCG structure and could be held open during gate operations to allow unrestricted salmon passage when the flashboards were installed and the radial gates closed during flood tides (2001 Suisun Marsh Salinity Control Gates Salmon Passage Evaluation Report. <http://iep.water.ca.gov/suisun/dataReports/index.html>). Fish passage through the gates was monitored during three operational configurations (phases) including: flashboards installed, gates operating, boat lock closed (Full operation), flashboards out, gates held open, boat lock closed (Full open), and flashboards installed, gates operating, boat lock open (Modified operation) (Figure 1). These 3 gate configurations were used in the 2002 study with the order of the operation changed to determine if timing of the adult chinook migration had any affect on passage.

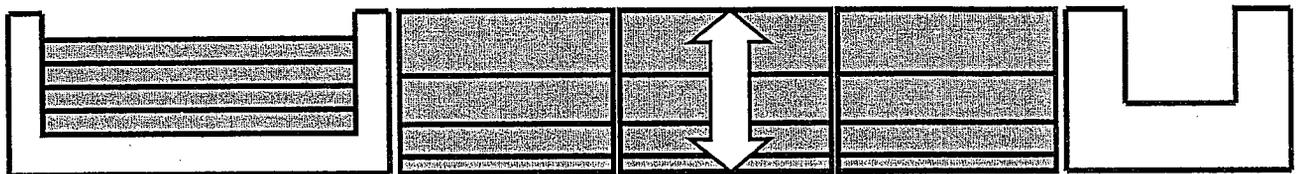
Sixty-six tagged salmon were released at the beginning of each 2-week operational phase and monitored for their passge rate and passage time through the SMSCG. Mobile monitoring was used to track fish movement in Montezuma Slough and find fish that may have died after tagging. Abundant adult Fall-run salmon were used as a surrogate for Winter-run. Salmon were captured using a large mesh gill net, measured to the nearest mm fork length, visually sexed and internally implanted with an ultrasonic transmitter. A Floy tag was attached externally just behind and below the dorsal fin to help identify any tagged fish that might be recaptured by the tagging crew. The address of the Stockton Fish and Game office was printed on each Floy tag to aid in the recovery of migration information from recreational anglers if the fish were caught.

Each ultrasonic tag was coded with a unique pulse interval and frequency to identify individual fish. The signals were picked up by stationary monitoring sites consisting of a hydrophone, receiver, and palmtop computer to detect the location of tagged fish. Monitoring sites were located upstream, downstream, and in the boat lock. (Figure 2). Mobile monitoring using a boat mounted hydrophone and portable receiver was conducted in Montezuma Slough.

Phase I: Flashboards out, gates up, boat lock closed. Sept 24 - Oct 7



Phase II: Flashboards in, gates operating, boat lock open. Oct 8 - 21



Phase III: Flashboards in, gates operating, boat lock closed Oct 22 - Nov 1

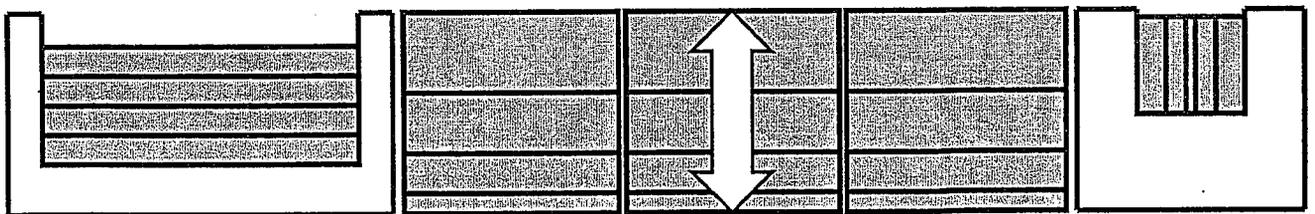


Figure 1. The 3 Operational Phases of the Salinity Control Gates for Sept – Nov 2001

A total of 198 adult Fall-run Chinook salmon were tagged and monitored during September 25 – November 6. Tagging was delayed 3 days due to problems with getting the flashboards installed to begin the full operation configuration of the Salinity Control Gates. Although the delay pushed monitoring time into the first week of November, tagging was completed on October 26 and did not overlap with the time designated for the presence of Winter-run Chinook salmon.

2002 Results

Eighty-four tagged salmon passed through the SMSCG during the 2002 tagging study, representing 42% of the 198 total tagged adult fish. Ninety-two tagged salmon did not pass the gates (47%) and 22 were removed from the sample population due to non-detection or having died after tagging (11%). The highest percentage of fish passed the gates during the full open operational phase, and the lowest percent of passage was during the full operation with the boat lock open phase (Figure 3). Tagged fish ranged in size from 600 – 1010mm with an average length of 705mm. Tagged fish were evenly distributed between male and female. A slightly higher percentage of tagged fish passed

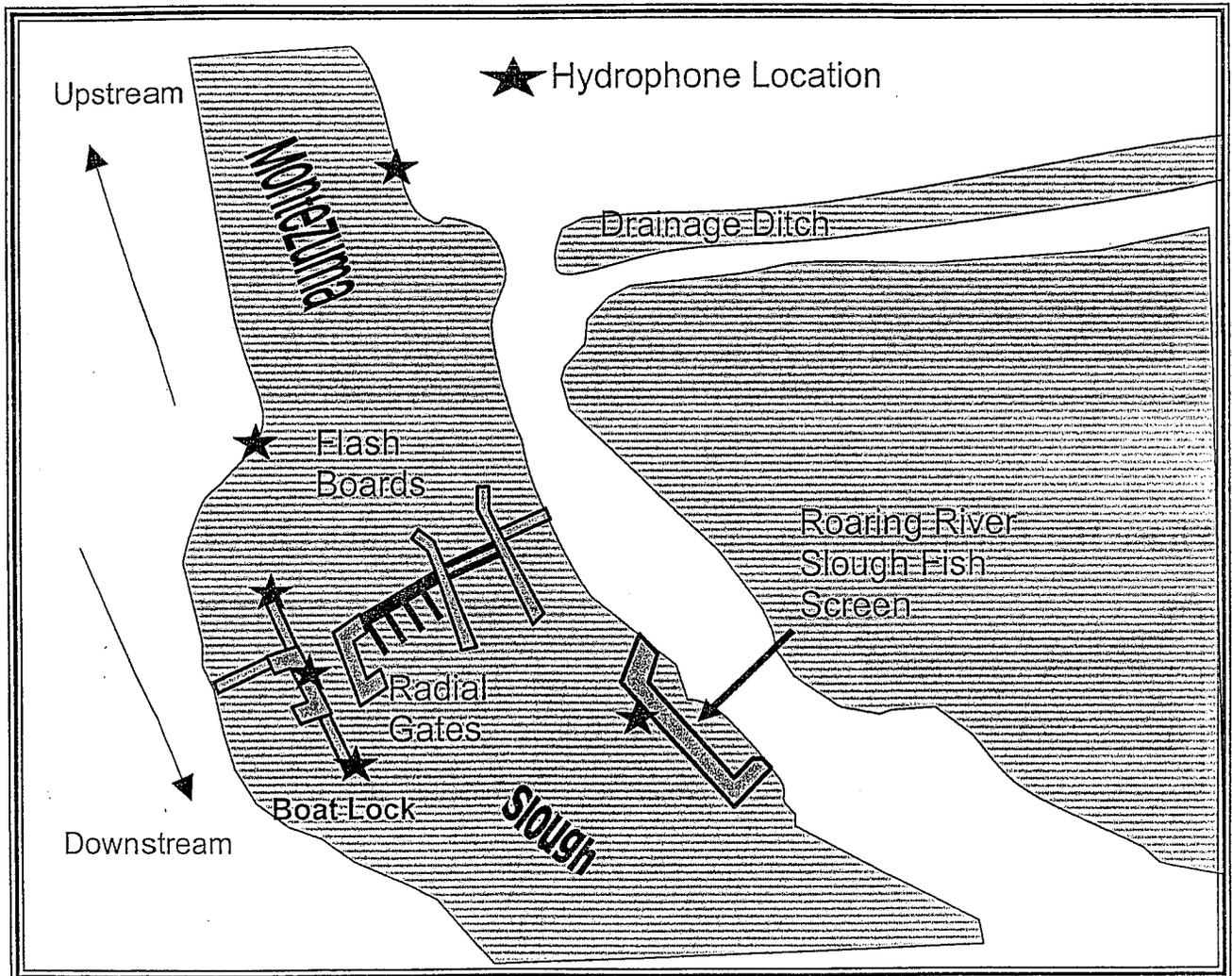


Figure 2. Hydrophone Locations at the SMSCG, Sept – Nov 2001

the gates during nighttime (54%). The average passage time for tagged fish ranged from 0.5 – 275.2 hours with Phase III (full operation, boat lock open) having the longest mean passage time (Figure 4.)

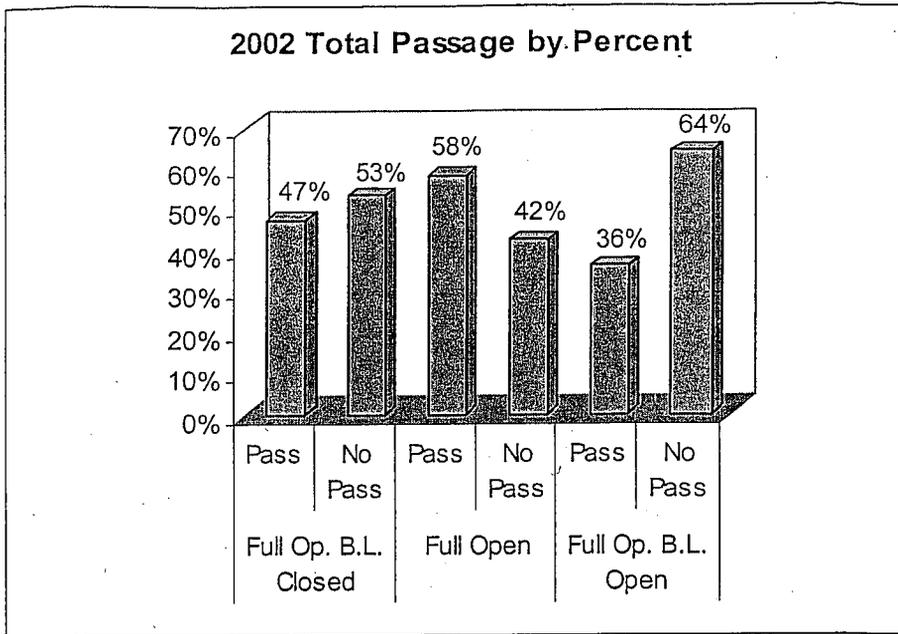


Figure 3. 2022 Total Passage by Percent

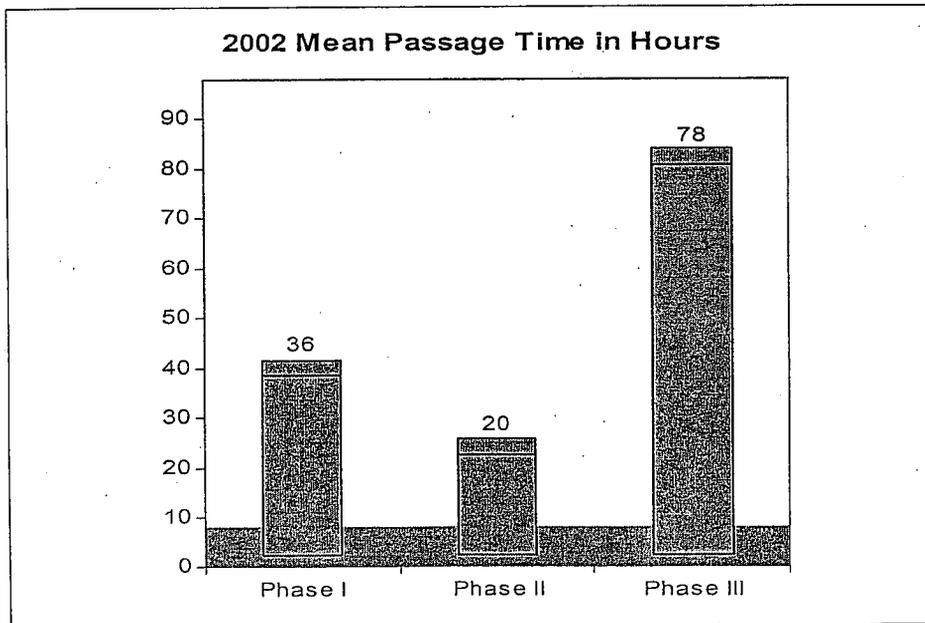


Figure 4. 2022 Mean Passage Time in Hours.

Passage by Phase

Phase I (Full operation boat lock closed) – 47% passed the gates (53% no pass) with an average time of 36 hours (3.6 to 105.8). Of these 31% passed and went upstream, 12% passed and moved back downstream, 45% moved downstream and 12% had no records.

Phase II (Full open) – 58% passed the gates (42% no pass) with an average time of 20 hours (0.5 to 143.6). Of these, 32% passed and went upstream, 21% passed and moved back downstream, 38% moved downstream and 9% had no records.

Phase III Full operation boat lock open) – 36% passed the gates (64% no pass) with an average passage time of 78 hours (2.8 to 275.2). Of these, 27% passed and went upstream, 5% passed and moved back downstream, 54% moved downstream and 14% had no records.

The full open phase had the best passage as expected but the real surprise was the significantly different poor passage results from the full operation with the boat lock open phase (Table 1). The boat lock open phase not only had the lowest passage percentage, but also the longest delay time (significantly longer) between phases (Table 2).

Table 1.
Chi-square and probability (one tailed) for passage rates.

Phase I vs. Phase II	$X^2 = 1.426$	$P = 0.232$
Phase I vs. Phase III	$X^2 = 1.53$	$P = 0.216$
Phase II vs. Phase III	$X^2 = 5.84$	$P = 0.016^*$

Tukey Test

Phase I vs. II vs. III	$P = 0.368$
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* Significant difference

Table 2.
Tukey test for probability on mean passage time

Phase I vs. Phase II	$P = 0.468$
Phase I vs. Phase III	$P = 0.019^*$
Phase II vs. Phase III	$P = 0.001^*$

T-test for probability on mean passage time

Phase I vs. Phase II	$P = 0.151$
Phase I vs. Phase III	$P = 0.019^*$
Phase II vs. Phase III	$P = 0.033^*$

*Significant difference

Salmon Usage of the Boat Lock

During the Phase III configuration (full operation, boat lock open), of the 21 tagged salmon to pass the gates 38% were recorded moving through the boat lock, compared with 32% passage in 2001 (Figure 5). The average time spent in the boat lock was 7 minutes for 2002 compared with 13 minute in 2001. All tagged fish recorded passing through the boat lock did so during an ebb tide (gates in the up position).

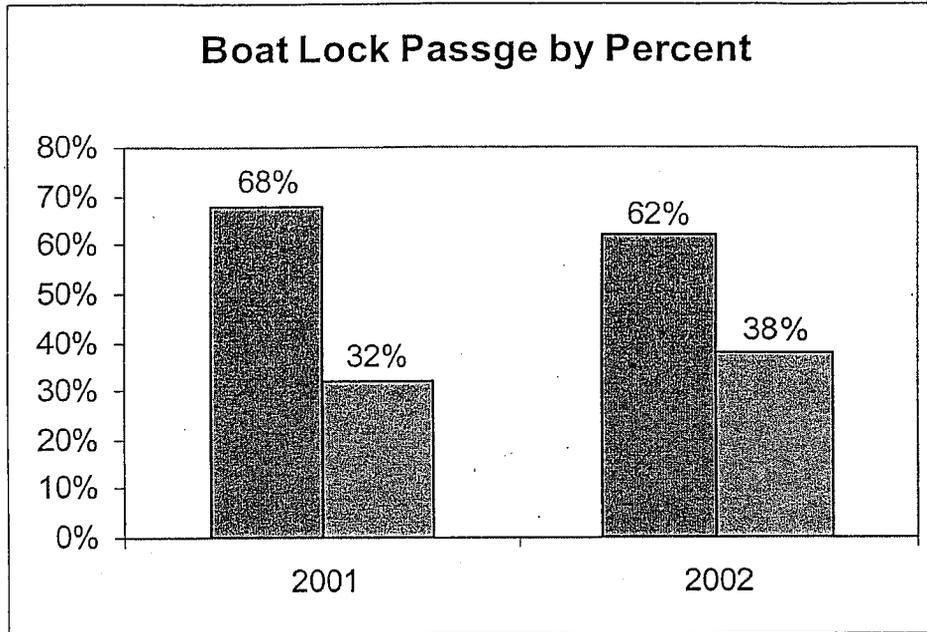


Figure 5. 2001 – 2002 Boat Lock Passage by Percent.

Discussion

There are a couple of events that may have influenced the differences between years in the 2 full operation phases with the boat lock open. In 2001, there was a delay in gate operation timing that would have created a stronger flow attraction in the boat lock, possibly bringing more fish through the locks. This was corrected during the 2002 study. In 2001, fish passage through the boat lock was equally divided between ebb and flood flows while in 2002 all tagged fish passed during an ebb tide (Table 3).

Study Year	Gate Open (Ebb)	Gate Closed (Flood)	Day	Night	Total
2001	43% (n=6)	57% (n=8)	50% (n=7)	50% (n=7)	n = 14
2002	100% (n=8)	0% (n=0)	25% (n=2)	75% (n=6)	n = 8

The feasibility of using the boat lock for fish passage looked promising based on the results of the 2001 study when compared with past studies (Vincik 2002). However, results from the 2002 study did not confirm these findings, in fact were almost exactly opposite when comparing passage rates and times of tagged adult salmon through the boat lock open phase. The question of the effect of the delayed gate operation was raised and with it the issue of how to proceed in future studies. Do we attempt to recreate the modified gate operations of 2001 to test the effect of increased attraction flow on migration through the boat lock or do we continue the study using the 2002 normal gate operations? These options are being considered by the SMSCG Steering Committee along with the possibility of continuing the study through 2005 to get 3 consistent study years at each option.

Also in 2002, records show that during the first couple of days of phase I (full operation, boat lock closed) one of the three gates was held open due to a mechanical problem while the other two were in the closed position giving more available passage time for salmon. Although this event only occurred during two tidal cycles it may have had an effect on passage rates and times.

References

- Edwards, G.W., K.A.F. Urquhart, and T.L. Tillman. 1996. *Adult salmon migration monitoring, Suisun Marsh Salinity Control Gates, September – November 1994*. Technical Report 50, Interagency Ecological Program for the San Francisco Bay/Delta Estuary. 27pp.
- Tillman, T.L., G.W. Edwards, and K.A.F. Urquhart. 1996. *Adult salmon migration during the various operational phases of the Suisun Marsh Salinity Control Gates in Montezuma Slough, August-October 1993*. Agreement to the Department of Water Resources, Ecological Services Office by Department of Fish and Game; Bay-Delta and Special Water Projects Division. 25 pp.
- Vincik, R.F. 2002 *Adult salmon migration monitoring at the Suisun Marsh Salinity Control Gates, Sept. – Nov. 2001*. Interagency Ecological Program for the San Francisco Estuary Newsletter 15:45-48.

Mr. Edward C. Anton, Chief
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Suisun Marsh Salinity Control Gates Salmon Passage Evaluation

Dear Mr. Anton:

This letter is to convey to you the 2002 Suisun Marsh Salinity Control Gates Salmon Passage Evaluation Report. You requested the report when approving the Department of Water Resources request for a variance from the electrical conductivity objectives at water quality compliance stations C-2, S-64, S-49, S-42 and S-2 in the Suisun Marsh for the purpose of conducting the study during the period of October 2001 through May 2004.

If you have any questions regarding this report or the project, please contact Heidi Rooks at (916) 445-6147 or by email at hrooks@water.ca.gov.

Sincerely,

Barbara McDonnell