

**LOWER MOKELUMNE RIVER
UPSTREAM FISH MIGRATION MONITORING
Conducted at Woodbridge Irrigation District Dam
August 2003 through July 2004**

August 2004

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Abstract: This report summarizes data collected below Woodbridge Irrigation District Dam (WIDD) on the lower Mokelumne River (LMR) from August 01, 2003 through July 31, 2004. An estimated 10,240 fall-run Chinook salmon (*Oncorhynchus tshawytscha*) passed the WIDD fish ladders between August 4, 2003 and January 14, 2004. Fifty percent of the run passed WIDD by November 13, 2003 as compared to November 7th of last year. Highest daily passage was 540 on November 7, 2003. The sex and life stage was positively determined for 9,997 salmon and included 4,112 (41%) adult females, 3,268 (33%) adult males, 617 (6%) grilse females and 2,000 (20%) grilse males. Thirty-nine adult steelhead (*O. mykiss*) passed WIDD between October 2003 and May 2004. Peak steelhead passage occurred in December (13). Other species using the WIDD fishways included: American shad, *Alosa sapidissima*; black bass, *Micropterus sp.*; common carp, *Cyprinus carpio*; goldfish, *Carassius auratus*; Hitch , *Lavinia exilicauda*; Pacific lamprey, *Lampetra tridentata*; Sacramento pikeminnow, *Ptychocheilus grandis*; Sacramento splittail, *Pogonichthys macrolepidotus*; Sacramento sucker, *Catostomus occidentalis*; and tule perch, *Hysterocarpus traski*.

INTRODUCTION

East Bay Municipal Utility District (EBMUD) has been monitoring adult fall-run Chinook salmon escapement in the lower Mokelumne River (LMR) using video surveillance and trapping at Woodbridge Irrigation District Dam (WIDD) since the fall of 1990. Initially, monitoring documented the timing and magnitude of the adult salmon escapement to the LMR with a secondary focus on steelhead. Monitoring has started between August and mid-October, and ended between December and April in previous years. Since 2001, 12 months of continuous video/trap monitoring has been conducted. Carcass surveys were initiated this year to provide a secondary count method. Due to reconstruction of WIDD it was deemed appropriate to investigate this as a secondary count method in case conditions at WIDD precluded video monitoring and trapping during the construction phase of the rebuild project.

OBJECTIVES

The objectives of this study are to 1) monitor fish passage of native and non-native fishes through the WIDD fish ladders, 2) describe the relationship of fall-run Chinook salmon

movements to environmental conditions on the LMR and 3) to assess the use of carcass surveys as a secondary method of escapement on the LMR.

METHODS

Video/live trap

EBMUD's monitoring of fall-run Chinook salmon migration began on August 01, 2003 with video monitoring in the high stage ladder at the WIDD. On November 4, Woodbridge Irrigation District (WID) began removing the boards in the dam, which necessitated operation of the low stage ladder. EBMUD began trapping and video monitoring in the low-stage ladder on November 6, 2003. Trapping and video monitoring continued until December 15, 2003 when trapping was discontinued. Video monitoring in the low stage ladder continued to April 13, 2004. Monitoring in the high stage was resumed on April 18, 2004, when the boards of WID were installed, and continued through July 31, 2004.

All other monitoring, and data collection and storage methods for video/live trap monitoring were consistent with prior year's monitoring efforts (Marine and Vogel 2000, Workman 2001).

Carcass surveys

Carcass surveys were conducted on a weekly basis from the last week in September to the second week in January. Each week a three-person crew in a drift boat, (one rower, one operating the trolling motor, and one at the bow of the boat to walk side channels) surveyed from the base of Camanche Dam to Elliott Road (Figure 1). In periods of low carcass abundance, one day was sufficient to cover the entire survey area. During periods of high carcass abundance the survey was conducted over two survey days. Split channels were surveyed with one person walking one arm and two surveyors in the boat drifting the other arm looking for carcasses. The river channel, as well as the banks, was scanned for carcasses.

The first survey section was just below the barrier fence adjacent to the hatchery ladder entrance. The crew walked out on the barrier fence to scan for carcasses above and below. Any carcasses encountered above the fence was marked and released below the barrier fence. The remainder of the river was surveyed from the boat or by foot. Surveys were conducted by drifting in the boat until a carcass was encountered. Each carcass was collected with a gaff, and then observed for sex, fork length, and the presence of an adipose fin clip.

Carcasses were given a designation of "fresh" (F), "decayed" (D), or "skeleton" (S). Fish with clear eyes and blood remaining in the gills were recorded as fresh, while fish with cloudy eyes and no blood in the gills were designated as decayed. Fish that were in an advanced state of decay (i.e. covered entirely or nearly entirely with fungus, falling apart, lacking substantial flesh on the bones) were recorded as skeleton. Skeletons were chopped and returned to the river. These were included in the tally for the section, but were not tagged, as carcasses in this condition may not have the same probability of recapture as that of fresher carcasses (Heyne 2001). Fresh and decayed carcasses were tagged with a uniquely numbered jaw tag applied to the lower jaw, and colored flagging to denote the week of survey, and then returned into the river current where they were collected. Each carcass

encountered was assessed for the presence of a numbered jaw tag from previous surveys. Jaw tag number from previously tagged carcasses was recorded and the carcass was released back to the water.

All fish were checked for an adipose fin clip. If clipped, the upper portion of the head was taken and data recorded on the head tag following the protocol supplied by the California Department of Fish and Game (CDFG) Ocean Salmon Project. By leaving the lower jaw the fish was still available for the mark-recapture portion of the survey and was tagged with a jaw tag for carcass sampling.

All fish were assessed as to sex, spawning condition and fork length (cm). Fish were measured to the nearest 5 centimeters, sexed, and females were assessed for spawning condition. Females were rated as unspawned (all or nearly all eggs intact), partially spawned (<50% of eggs intact), or spawned out (no eggs).

Tissue samples were collected from eight fresh carcasses for deposit in the “Central Valley Salmonid Tissue Archive”. Tissue were collected according to the “DNA Fin Clip Collection Protocol – Dry Method” (Navicky 2003).

Data analysis for carcass surveys can be conducted in a number of ways: One seasonal Peterson estimate can be developed from overall mark/recapture numbers for the entire survey; a Schaeffer estimate can be developed by summing weekly Peterson estimates; or a Jolly-Seber estimate can be developed which is an open population model and accounts for additions to and losses from the population throughout the duration of the survey. The Jolly-Seber model works better with populations of >3,000, so the Schaeffer methodology was used to analyze the Mokelumne carcass data (Glenn Szerlong, NOAA, pers.comm.).

RESULTS AND DISCUSSION

Native Anadromous Fish

Chinook Salmon (video/trapping)

The fall-run Chinook salmon escapement estimate in the LMR for 2003/2004 is 10,240 spawners entering the river between August 2003 and January 2003 (Figure 2). Fifty percent of the run passed WIDD by November 13, 2003 as compared to November 7th of last year (Table 1). Highest daily passage of 540 fish occurred on November 7, 2003. The sex and life stage was positively determined for 9,997 fish including 4,112 (41%) adult (>60 cm FL) females, 3,628 (33%) adult males, 617 (6%) grilse (\leq 60 cm FL) females and 2,000 (20%) grilse males (Figure 3). In addition there were 26 unknown sex adults, 188 unknown sex grilse, and 29 unknown sex and size fish. Data are in Appendix A.

Over the past twelve years we have observed a 1:3 grilse to adult ratio, and the same ratio exists for 2003. However, in 2003 we observed a larger number of very small grilse fish (< 55 cm) than has been observed in past years (Figure 4).

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
8/4/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
8/5/2003	0	2	0	0	1	0	0	0	0	3	0	0	-1	0
8/6/2003	0	0	0	0	0	0	0	0	0	0	0	0	-1	0
8/7/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/8/2003	0	1	0	0	1	0	0	0	0	2	0	0	0	0
8/9/2003	0	4	0	0	0	0	0	0	0	4	0	0	0	0
8/10/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/11/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/12/2003	0	3	0	0	0	0	0	0	0	3	0	0	-1	0
8/13/2003	2	2	0	0	0	0	0	0	0	4	0	0	0	0
8/14/2003	1	2	0	0	0	0	0	0	0	3	0	0	0	0
8/15/2003	0	0	0	0	0	1	0	0	0	1	0	0	0	0
8/16/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
8/17/2003	0	3	0	0	0	0	0	0	0	3	0	0	0	0
8/18/2003	2	1	1	0	0	0	0	0	0	4	0	0	0	0
8/19/2003	1	5	0	0	0	1	0	0	0	7	0	0	0	0
8/20/2003	0	4	0	0	0	0	0	0	0	4	0	0	0	0
8/21/2003	0	0	0	0	0	0	0	0	0	0	0	0	-1	0
8/22/2003	5	15	0	1	1	0	0	0	0	22	0	0	-1	0
8/23/2003	3	1	0	0	0	0	0	0	0	4	0	0	0	0
8/24/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/25/2003	1	7	0	0	0	0	0	0	0	8	0	0	0	0
8/26/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
8/27/2003	3	1	1	2	1	0	0	0	0	8	0	0	0	0
8/28/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
8/29/2003	3	0	0	0	0	0	0	0	0	3	0	0	0	0
8/30/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/31/2003	2	1	0	0	0	0	0	0	0	3	0	0	0	0
9/1/2003	0	3	0	0	0	0	0	0	3	6	0	0	0	0
9/2/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/3/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
9/4/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
9/5/2003	0	0	1	1	0	0	0	0	0	2	0	0	0	0
9/6/2003	0	0	0	1	0	0	0	0	0	1	0	0	0	0
9/7/2003	1	0	0	0	0	0	0	0	0	1	0	0	0	0
9/8/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
9/9/2003	1	3	0	0	1	0	0	0	0	5	0	0	0	0
9/10/2003	1	0	0	0	0	0	0	0	0	1	0	0	0	0
9/11/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/12/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/13/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/14/2003	1	1	0	1	0	0	0	0	0	3	0	0	0	0
9/15/2003	0	0	0	0	0	0	0	0	0	0	0	0	1	1
9/16/2003	0	0	0	1	0	0	0	0	0	1	0	0	0	0
9/17/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/19/2003	0	1	0	0	0	0	0	0	0	1	0	0	0	0
9/20/2003	1	0	0	0	0	1	0	0	0	2	0	0	0	0
9/21/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
9/22/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
9/23/2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/24/2003	0	2	0	0	0	0	0	0	0	2	0	0	0	0
9/25/2003	0	2	0	0	0	0	0	0	0	2	0	0	-1	-1
9/26/2003	4	1	0	0	0	0	0	0	0	5	0	0	1	1
9/27/2003	4	6	0	0	0	0	0	0	0	10	0	0	0	0
9/28/2003	1	3	0	0	0	0	0	0	0	4	0	0	0	0
9/29/2003	0	2	0	0	2	0	0	0	0	4	0	0	0	0
9/30/2003	0	2	0	2	0	0	0	0	0	4	0	0	0	0
10/1/2003	0	1	0	0	0	0	0	0	0	1	0	0	1	1
10/2/2003	1	6	0	0	1	0	0	0	0	8	0	0	1	1
10/3/2003	0	4	0	0	1	0	0	0	0	5	0	0	0	0
10/4/2003	3	5	0	4	0	0	0	0	0	12	0	0	0	0
10/5/2003	1	1	0	3	1	0	0	0	0	6	0	0	0	0
10/6/2003	2	2	0	2	0	0	0	0	0	6	0	0	0	0

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
10/7/2003	3	6	0	2	1	0	0	0	0	12	0	0	0	0
10/8/2003	4	7	0	3		0	0	0	0	14	0	0	1	1
10/9/2003	7	20	0	5	4	2	0	0	0	38	0	0	0	0
10/10/2003	3	3	0	7	3	1	0	0	0	17	0	0	0	0
10/11/2003	16	17	0	22	4	0	0	0	0	59	0	0	1	1
10/12/2003	4	10	0	7	1	0	0	0	0	22	0	0	0	0
10/13/2003	3	5	0	9	1	1	0	0	0	19	0	0	0	0
10/14/2003	4	2	0	9	1	0	0	0	22	38	0	0	0	0
10/15/2003	2	1	0	0	1	0	0	0	6	10	0	0	0	0
10/16/2003	5	5	0	0	1	0	0	0	0	11	0	0	0	0
10/17/2003	3	4	0	10	1	0	-2	0	0	16	0	0	0	0
10/18/2003	6	10	0	16	3	2	0	0	0	37	0	0	0	0
10/19/2003	5	17	0	8	5	1	0	0	0	36	0	0	0	0
10/20/2003	3	13	0	9	3	4	0	0	0	32	0	0	0	0
10/21/2003	3	3	0	8	2	0	0	0	0	16	0	0	0	0
10/22/2003	5	9	0	4	3	4	0	0	1	26	0	0	0	0
10/23/2003	14	13	0	20	3	4	0	0	0	54	0	0	0	0
10/24/2003	20	26	0	21	11	4	0	0	0	82	-1	0	1	0
10/25/2003	40	32	3	30	13	4	1	0	-2	121	0	0	0	0
10/26/2003	15	13	1	21	3	6	0	0	0	59	0	0	0	0
10/27/2003	7	8	0	14	4	4	0	0	0	37	0	0	0	0
10/28/2003	13	6	0	21	2	4	0	0	0	46	0	0	0	0
10/29/2003	9	10	0	27	8	4	-1	0	1	58	0	0	0	0
10/30/2003	74	75	1	67	28	9	1	0	0	255	0	0	0	0
10/31/2003	65	77	0	75	30	7	0	0	0	254	0	0	0	0
11/1/2003	35	27	0	29	11	6	0	0	0	108	0	0	0	0
11/2/2003	18	15	0	12	8	4	0	0	0	57	0	0	0	0
11/3/2003	27	51	0	60	12	11	0	0	1	162	0	0	0	0
11/4/2003	62	60	3	115	27	19	-1	0	0	285	0	0	0	0
11/5/2003	86	84	0	43	16	0	0	0	0	229	0	2	0	2
11/6/2003	151	142	0	78	10	0	0	0	0	381	0	0	0	0
11/7/2003	204	195	0	125	16	0	0	0	0	540	0	0	0	0

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
11/8/2003	151	133	0	86	13	0	0	0	0	383	0	1	0	1
11/9/2003	194	189	0	101	13	0	0	0	0	497	0	1	0	1
11/10/2003	94	108	0	54	10	0	0	0	0	266	0	0	2	2
11/11/2003	90	119	0	60	14	0	0	0	0	283	0	1	0	1
11/12/2003	108	119	0	41	8	0	0	0	0	276	0	0	0	0
11/13/2003	97	121	0	62	12	0	0	0	0	292	0	0	0	0
11/14/2003	99	113	0	59	8	0	0	0	0	279	0	0	0	0
11/15/2003	107	125	0	46	14	0	0	0	0	292	0	0	0	0
11/16/2003	79	70	0	35	3	0	0	0	0	187	0	0	0	0
11/17/2003	35	36	0	28	7	0	0	0	0	106	0	0	0	0
11/18/2003	64	75	0	33	8	0	0	0	0	180	0	0	0	0
11/19/2003	64	71	0	38	5	0	0	0	0	178	0	0	0	0
11/20/2003	54	54	0	19	12	0	0	0	0	139	0	0	0	0
11/21/2003	69	63	0	14		0	0	0	0	146	0	0	0	0
11/22/2003	41	61	0	19	5	0	0	0	0	126	0	0	0	0
11/23/2003	54	48	0	29	4	0	0	0	0	135	0	0	0	0
11/24/2003	65	61	0	18	4	0	0	0	0	148	0	0	0	0
11/25/2003	86	93	0	37	18	4	0	0	0	238	0	2	0	2
11/26/2003	72	76	0	51	23	8	0	0	0	230	0	0	0	0
11/27/2003	46	81	-1	18	21	4	0	0	0	169	0	0	1	1
11/28/2003	54	70	9	16	16	0	0	0	0	165	0	0	1	1
11/29/2003	66	127	3	43	21	12	0	-1	0	271	0	0	0	0
11/30/2003	44	83	3	37	19	17	0	0	1	204	0	0	1	1
12/1/2003	26	71	0	12	10	8	0	0	-2	125	0	1	1	2
12/2/2003	45	62	0	17	9	7	0	0	0	140	0	0	-2	-2
12/3/2003	59	104	1	33	30	6	0	0	0	233	0	0	1	1
12/4/2003	87	137	0	20	15	3	0	0	1	263	0	0	0	0
12/5/2003	22	81	0	6	6	1	0	0	0	116	0	0	0	0
12/6/2003	47	96	0	9	6	0	0	0	0	158	0	0	0	0
12/7/2003	32	76	0	11	4	0	0	0	0	123	0	0	0	0
12/8/2003	31	54	0	7	9	0	0	0	0	101	0	1	0	1
12/9/2003	18	30	0	9	3	0	0	0	0	60	0	0	0	0

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
12/10/2003	16	49	0	8	0	0	0	0	0	73	0	1	0	1
12/11/2003	14	17	0	5	2	0	0	0	0	38	0	0	0	0
12/12/2003	10	26	0	4	3	0	0	0	0	43	1	1	0	2
12/13/2003	3	6	0	4	2	0	0	0	0	15	0	0	0	0
12/14/2003	2	4	0	0	0	0	0	0	0	6	0	0	0	0
12/15/2003	9	27	0	4	3	1	0	0	0	44	0	0	1	1
12/16/2003	8	14	0	0	0	1	0	0	0	23	1	0	0	1
12/17/2003	15	11	1	3	3	1	0	0	0	34	1	0	0	1
12/18/2003	5	12	0	1	1	0	0	0	0	19	0	0	-1	-1
12/19/2003	2	13	0	1	1	0	0	0	0	17	0	0	0	0
12/20/2003	10	4	0	0	0	0	0	0	0	14	0	0	-1	-1
12/21/2003	1	7	0	1	0	0	0	0	0	9	0	0	0	0
12/22/2003	4	7	0	2	3	0	0	0	0	16	-1	0	1	0
12/23/2003	-1	4	0	0	0	0	0	0	0	3	0	0	-1	-1
12/24/2003	2	1	0	2	0	0	0	0	0	5	0	0	0	0
12/25/2003	1	5	4	0	0	0	0	0	0	10	0	0	0	0
12/26/2003	0	5	0	0	0	0	0	0	0	5	1	0	1	2
12/27/2003	0	2	0	0	0	0	0	0	0	2	0	0	2	2
12/28/2003	1	1	0	1	1	1	0	0	0	5	1	0	-2	-1
12/29/2003	0	2	0	1	0	0	0	0	0	3	0	0	1	1
12/30/2003	2	2	2	0	1	0	0	0	0	7	0	0	-1	-1
12/31/2003	1	2	0	0	1	0	0	0	0	4	0	0	0	0
1/1/2004	1	0	0	0	0	0	0	0	0	1	0	0	0	0
1/2/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/3/2004	0	1	1	0	0	0	0	0	0	2	0	0	0	0
1/4/2004	0	0	0	0	0	0	0	0	0	0	0	0	1	1
1/5/2004	0	1	0	0	0	0	0	0	0	1	0	0	0	0
1/6/2004	1	2	0	0	0	0	0	0	0	3	0	0	0	0
1/7/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/8/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/9/2004	0	1	0	0	0	0	0	0	0	1	0	1	0	1
1/10/2004	1	0	0	0	0	0	0	0	0	1	1	0	0	1

Appendix A. Daily passage of Chinook and steelhead at Woodbridge Dam. (cont.)

August 04, 2003-July 31, 2004.

Date	Chinook Salmon										Steelhead			
	Adult Male	Adult Female	Unknown adult	Grilse Male	Grilse Female	Unknown grilse	Unknown Male	Unknown Female	Unknown sex and size	Total	Male	Female	Unknown	Total
7/27/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/28/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/29/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/30/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/31/2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	3,268	4,111	36	2,000	617	178	-2	-1	32	10,240	8	12	19	39

* -1 values indicate a net downstream migration for the day in question