

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District)	
)	
and)	Project No. 2299
)	
Modesto Irrigation District)	

2008 LOWER TUOLUMNE RIVER ANNUAL REPORT

Report 2008-2

Spawning Survey Summary Update

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SPAWNING SURVEY SUMMARY UPDATE

1. INTRODUCTION

The California Department of Fish and Game (CDFG) has conducted fall-run Chinook salmon spawning surveys on the Tuolumne River since 1971 as required under the cooperative fish study program for the Don Pedro Project FERC license. Turlock and Modesto Irrigation Districts (TID/MID) 1992 reviewed the 1971-1988 period and TID/MID 1997 summarized the 1989-1995 period. This report updates TID/MID 2008 and summarizes the 1971-2008 period. The 2008 information is based on preliminary data provided by CDFG.

2. SUMMARY UPDATE

2.1 Population Estimates, Sex Composition, and Potential Eggs

Population estimates for each year are in Table 1 and Figure 1. Estimates for the Tuolumne River and the San Joaquin basin are available since 1940 (Table 2). Tuolumne salmon runs for the 1971-2008 period have ranged from less than 100 salmon in 1990 and 1991 to 40,300 fish in 1985. The 2008 run estimate was 372 using the adjusted Peterson estimate (Tsao and O'Brien, 2009). The Tuolumne River estimates from 2003 to 2006 were based on CDFG, Region 4 modified Schaefer numbers which may differ from other reported estimates.

The percentage of females in the 1971-2008 runs has ranged from 25% in 1983 to 67% in 1978 (Figure 2). The years with less than 40% females usually had runs containing a large percentage of 2-year-old males. In 2008 there were about 57% females in the run.

Beginning in 1981, the potential egg deposition for each year has been estimated using the number and average size of females. This is based on a formula from CDFG Los Banos trap data collected in 1988 using a female size to egg number relationship. These potential egg deposition estimates have ranged from 145,000 in 1991 to 128.6 million in 1985 (Figure 3, Table 3). The estimated 2008 potential egg number was about 1.27 million based on approximately 212 females with an average fork length of 76.6 cm.

2.2 Spawning Distribution and Timing

The highest number of redds counted for each riffle was summarized each year for the 1981-2008 period (Table 4). The patterns from redd counts shows the most heavily used riffles are usually found in the upper river, upstream of Basso Bridge River Mile (RM) 47.5. For the 1981-2008 period, this upper reach of river (4.5 miles) averaged 44.7% of the total number of redds. In 2008 about 49% of the total number of redds counted were in this reach. Sections 2-4 (see map), averaged about 24%, 23%, and 8% respectively for the same period of years and section 5 was only surveyed in 1988 and 1989. In 2008 about 19% of the redds counted were in Section A, upstream of the Old La Grange Bridge. This section averaged about 11% during the 28-year period. Changes in survey personnel, survey methods and variable survey conditions could account for some uncertainty in yearly comparisons of redd count data.

The earliest date of peak weekly live count for the 1971-2008 period was 31Oct1996 and the latest peak was 27Nov1972 with a median date of 12Nov (Table 5). The 2008 run had a peak live count of 200 salmon during the week of 04Nov.

2.3 Length Frequency Distribution and Age Class Composition

Fork length measurements have been recorded for carcasses since 1981. Males are typically longer than females of the same age. Generally, the average length of all males is longer than of all females with the exception of years that have a high proportion of 2-year-olds, which are mostly males (Figure 4, Table 6). Estimation of age-class composition based on visual examination of the length frequency distribution of fresh measured carcasses was made for the 1981-2008 surveys (Table 7). These initial estimates are made for comparative purposes and may be modified when age analysis of scale/otolith samples and lengths of known age hatchery fish is utilized. The estimated female maximum fork lengths for ages two, three, and four were typically about 65, 83, and 95 cm respectively. Male fork length maximums for ages two, three, and four were 70, 90-95, and 105 cm, respectively. The most notable exceptions to the age/length estimates occurred in 1983-1984 and 1997-2000 when ocean growth of salmon may have been reduced due to El Niño (warm water) conditions that affected food resources.

Runs are mainly dominated by either 2 or 3-year-old salmon as shown in Figure 5. The 1998, 1999, and 2004 runs were estimated to have fairly equal numbers of two and three-year-old salmon. The 2008 run was dominated by 3-year-old salmon. Four-year-olds were estimated to be the most abundant age class only in 2001, but were estimated to be more than 10% of the 1986, 1989, 1990, and 1997-2008 runs. 2001 and 2007 had the highest estimated percentage of four-year-old salmon in the 1981-2008 study period. Five-year-olds are estimated to have comprised from 0-5% of the runs.

2.4 Linear Regression Analysis of 2-year old salmon vs. following year 3-year olds

A linear regression analysis of the logarithmic values for all estimated 2-year old salmon and the following year estimated 3-year olds resulted in an $r^2 = .83$ for the 1981-2007 period (excluding the 1984 outlier). A similar analysis for estimated 2-year old female salmon only and the following year estimated 3-year old females resulted in an $r^2 = .77$ (Figure 6). These analyses indicate a high degree of correlation for both all 2-year old salmon and for 2-year old females returning the following year as 3-year olds of that brood year.

2.5 Coded Wire Tagged Salmon

Large numbers of coded wire tagged (CWT) hatchery salmon have been released into the Tuolumne River or nearby San Joaquin River since 1986 as part of the Tuolumne River smolt survival evaluations; CWT salmon were last released in 2005. A small percentage of these fish shed their tags but still have the external mark of a clipped adipose fin. In addition, smaller numbers of untagged salmon have been released since 1995 as part of the rotary screw trap evaluations (and other survival evaluations in 1998). Nearly all of these artificially reared salmon have been from the Merced River Hatchery. Other large releases of CWT salmon are made at times by CDFG in the Merced, Stanislaus, and San Joaquin Rivers, and in the Delta. In addition, CDFG releases large numbers of unmarked hatchery salmon in some years in the Merced River.

From 1981 to 1986, the estimated proportion of adult CWT salmon in the run was less than 2%. That proportion began increasing with the first return of 1986 CWT study fish in the 1987 run. For the period of years from 1987 to 2005, the proportion of CWT salmon in the runs has generally ranged from 10-25% with the exception of a higher percentage in 1990 and 1991 with runs of less than 100 salmon and with a lesser percentage in the 1988 and 2000 runs. In 2008, the estimated percent of CWT salmon in the run was 5.7% based on 6 CWT's recovered.

Most of the Tuolumne River CWT's are of Merced River Hatchery origin and those mostly from Tuolumne River and south delta smolt study releases (Table 8).

2.6 Estimated Cohort Returns

The number of returns from a given cohort (spawning run) to the Tuolumne River was estimated using the age class composition values previously described. This enables cohort return estimates from the 1979 run, which first returned as 2-year olds in 1981; up to the 2005 run with 3-year olds returning in 2008 (the 2005 cohort was almost complete with 4-year olds still to return in the 2009 run). Runs since 1987 have had higher percentage contributions of known hatchery origin fish but no attempt was made here to separately consider their influence on the cohort returns.

The cohort return for a given year was determined by adding the estimated age 2 through age 5 returning fish from the subsequent runs. For example, the 1979 spawning run cohort returned as 2-year olds in 1981, 3-year olds in 1982, 4-year olds in 1983, and 5-year olds in 1984. Table 9 contains the age-class percentage estimates for each run, the corresponding number estimates that were added to result in the estimated cohort returns, and the estimated age composition of the cohorts. Figure 7 depicts the estimated runs with their estimated cohort returns, showing a wide range of variability.

3. REFERENCES

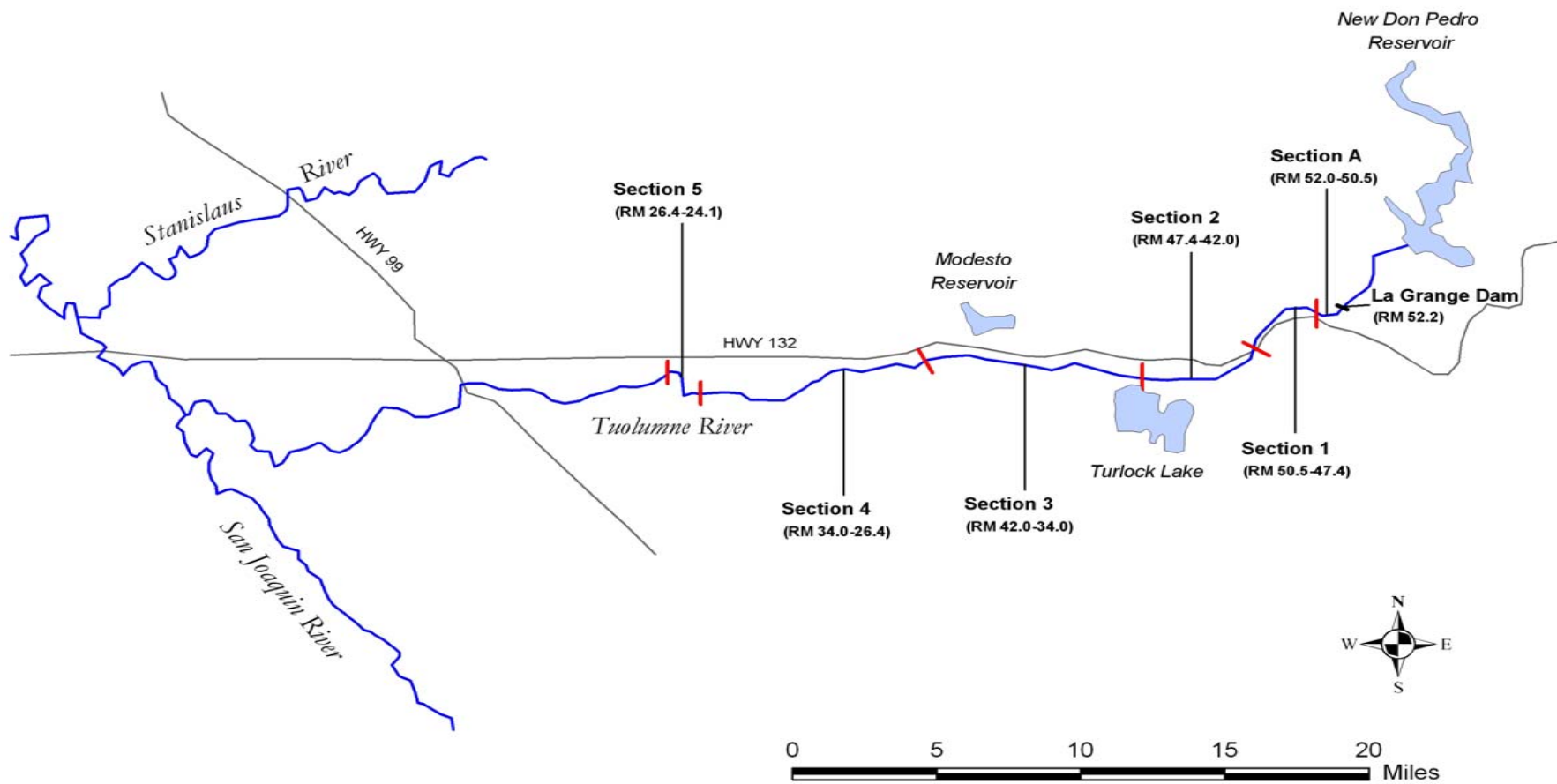
Tsao, S. and O'Brien, J., 2009. Preliminary 2008 Tuolumne River Chinook Salmon Spawning Escapement Survey Data. California Department of Fish and Game, La Grange, California.

CDFG (California Department of Fish and Game) [1971-2007]. San Joaquin River Chinook salmon Enhancement Project. Annual Reports and preliminary data, Region 4, Fresno.

TID/MID (Turlock Irrigation District and Modesto Irrigation District). 1992. Tuolumne River Salmon Spawning Surveys 1971-1988. 1991 Federal Energy Regulatory Commission Article 39 Report, Appendix 3.

TID/MID (Turlock Irrigation District and Modesto Irrigation District). 1997. Tuolumne River Salmon Spawning Summary, Supplement to 1992 FERC Report Appendix 3. 1996 Federal Energy Regulatory Commission Report 1996-1.

TID/MID (Turlock Irrigation District and Modesto Irrigation District). 2008. Spawning Survey Summary Update. Report 2007-2 to the Federal Energy Regulatory Commission.



Map of the Tuolumne River salmon spawning survey areas.

TUOLUMNE RIVER SALMON RUN (1971 to 2008)

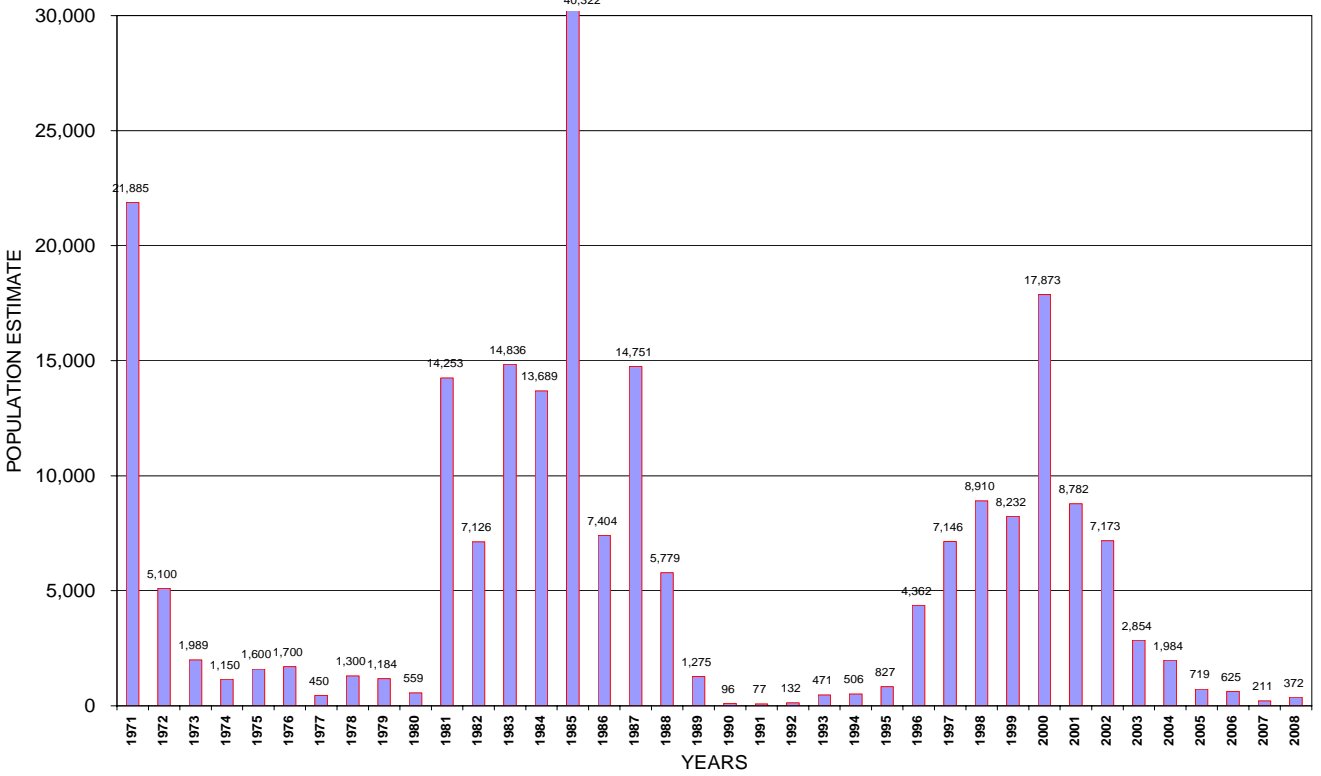


Figure 1. Estimated population of adult Chinook salmon for the Tuolumne River.

TUOLUMNE RIVER SALMON RUN
PERCENT FEMALE IN THE RUN (1971 to 2008)

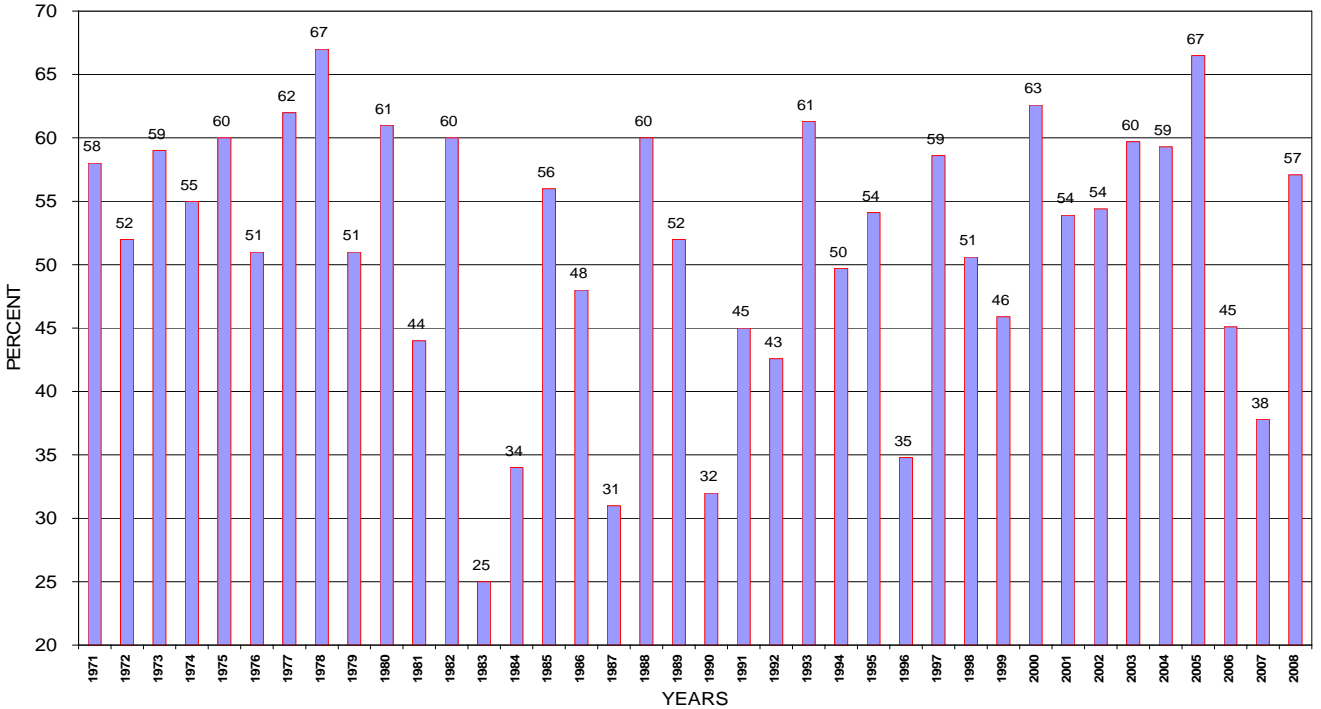


Figure 2. Percent female salmon in the Tuolumne River runs.

TUOLUMNE SALMON EGG POTENTIAL
 BASED ON LOS BANOS TRAP FECUNDITY DATA (1988)

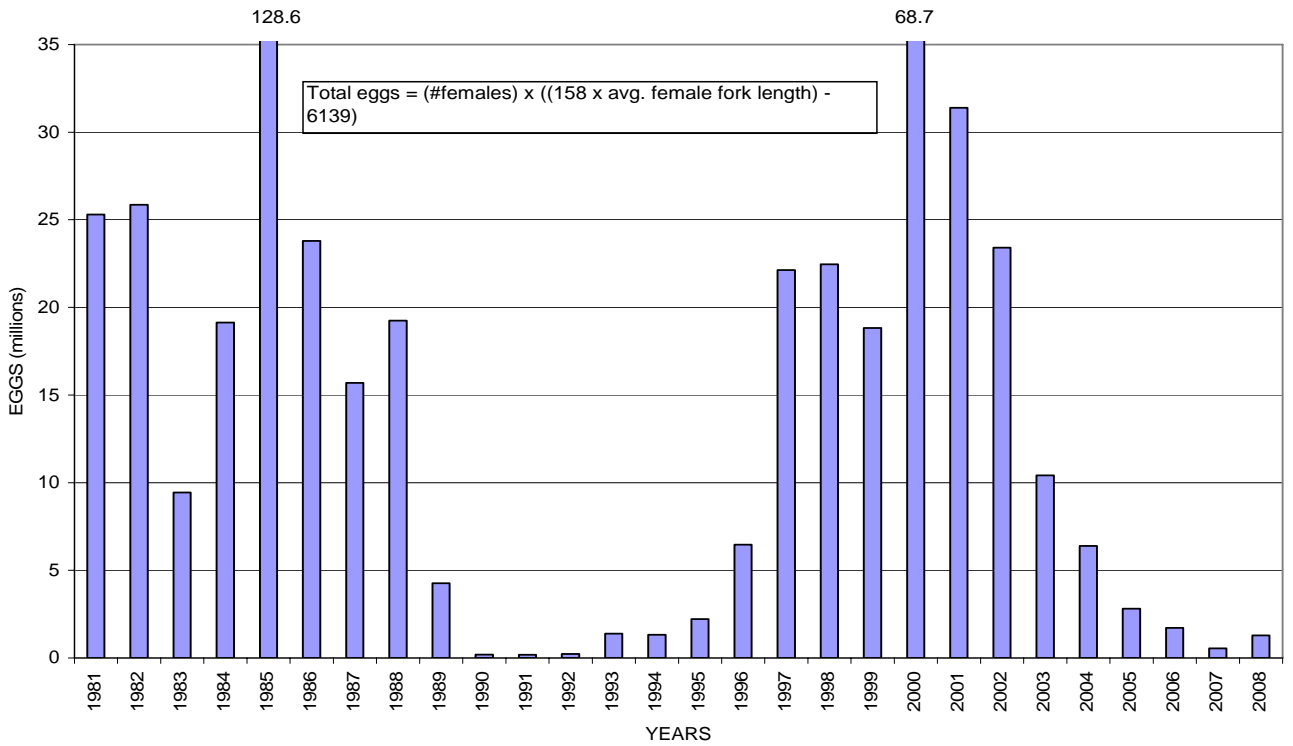


Figure 3. Potential egg deposition for Tuolumne River Chinook salmon, 1981-2008

TUOLUMNE RIVER CHINOOK SALMON
 AVERAGE FORK LENGTH OF FRESH CARCASSES

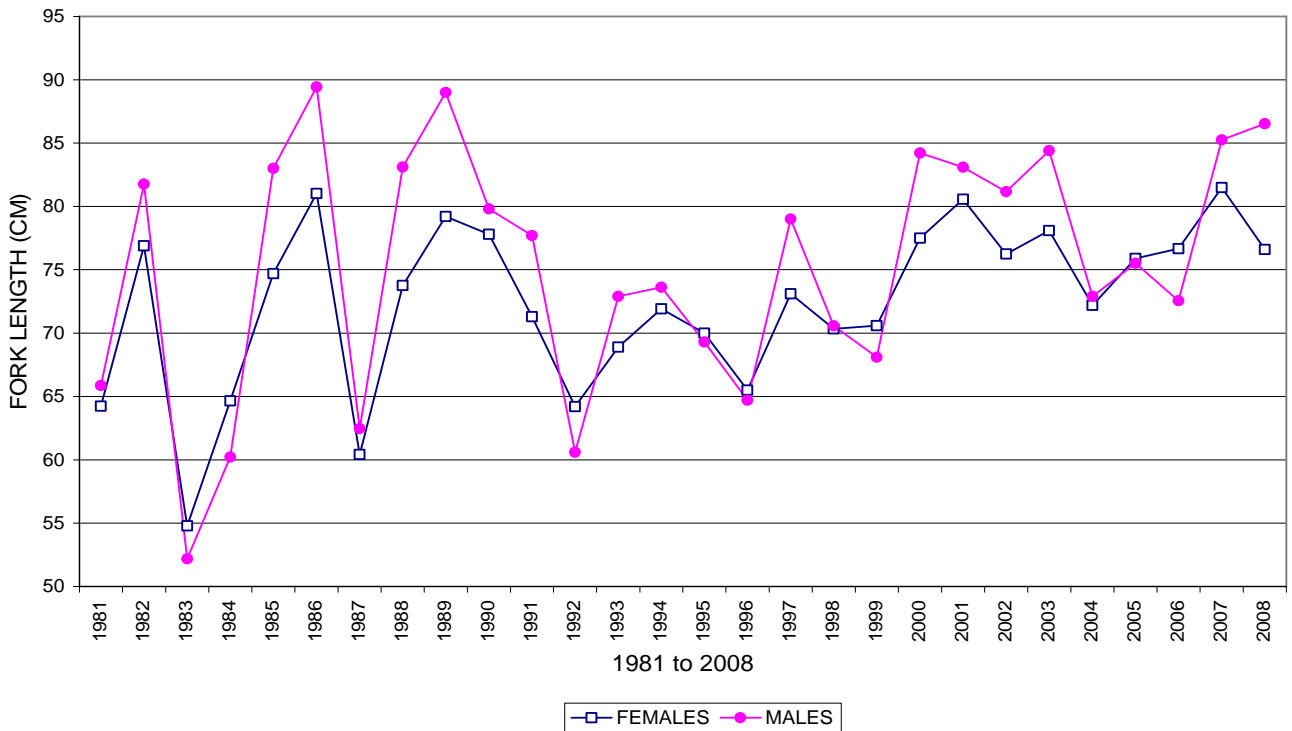
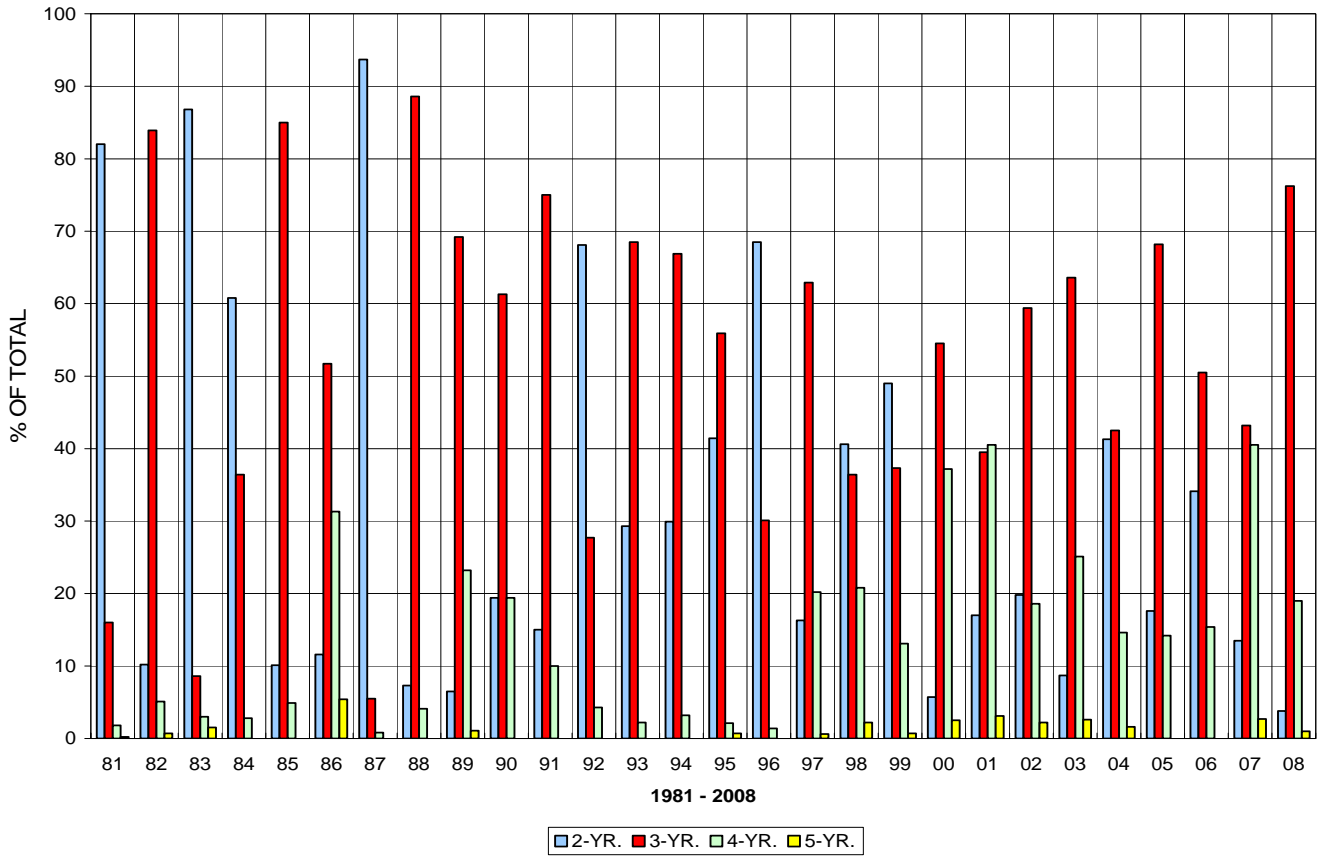


Figure 4. Average fork length of Tuolumne River salmon based on measured carcasses

TUOLUMNE RIVER SALMON ESTIMATED AGE CLASS COMPOSITION



TUOLUMNE RIVER SALMON ESTIMATED AGE CLASS COMPOSITION

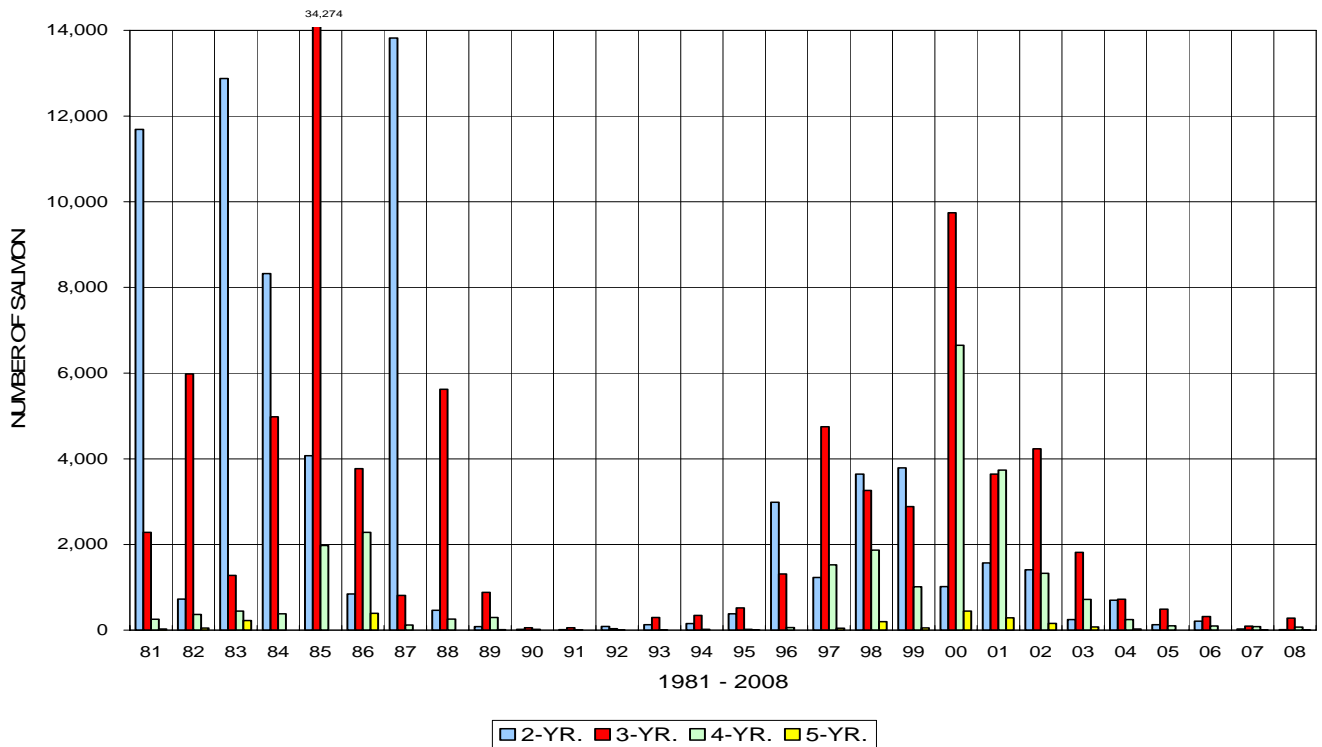
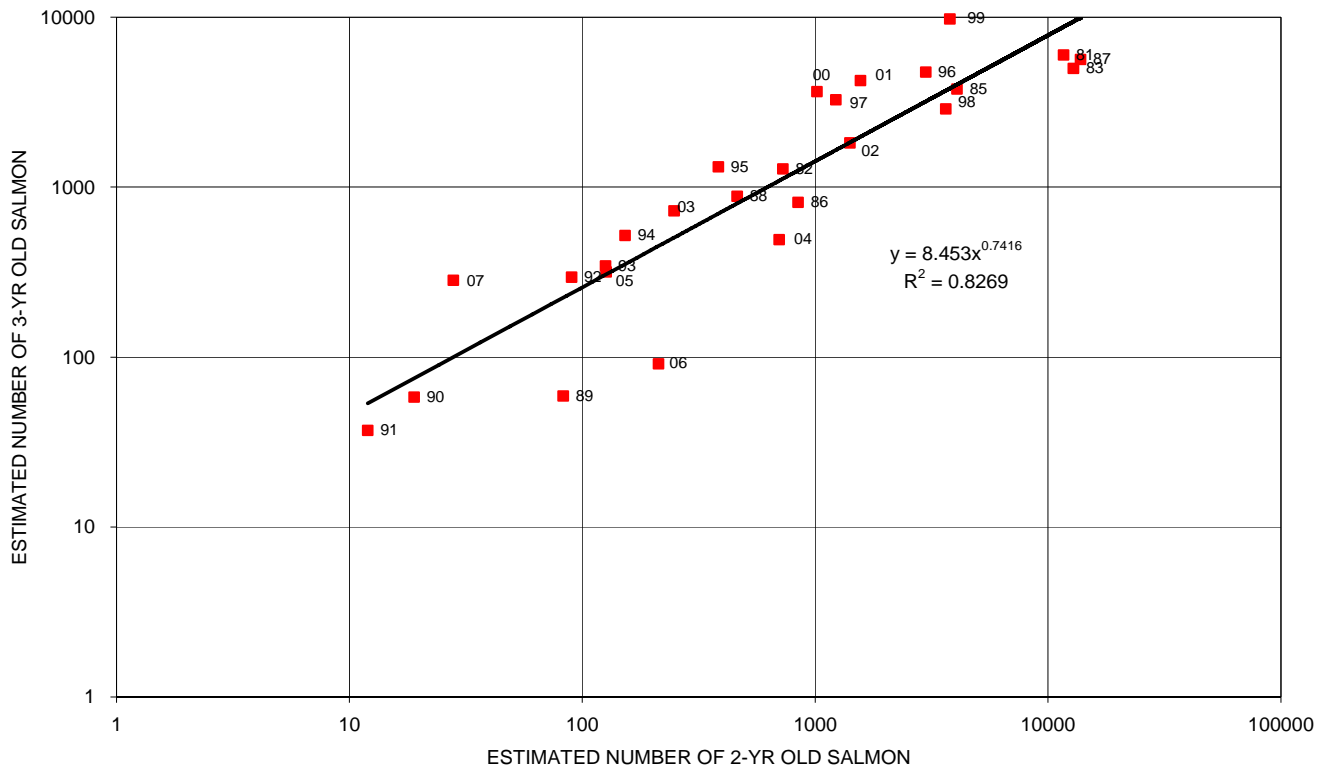


Figure 5. Estimated percent and number by age class for Tuolumne River salmon.

2-YR OLD VS following year 3-YR OLD
MALE AND FEMALE SALMON



2-YR OLD VS following year 3-YR OLD
FEMALE SALMON

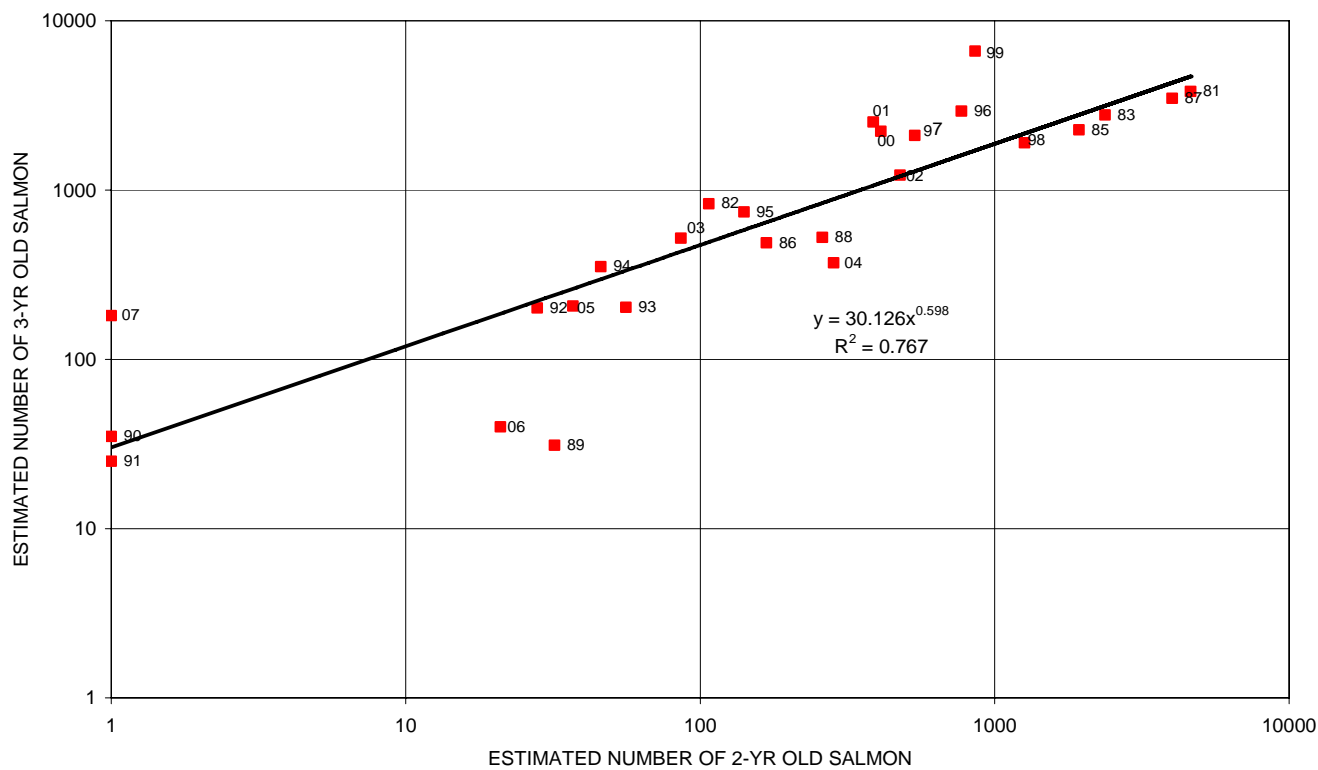


Figure 6. Estimated 2-yr-old salmon VS following year 3-yr-old (1981-2007 Tuolumne River runs) excluding 1984 outlier, run years are for the 2-yr-olds

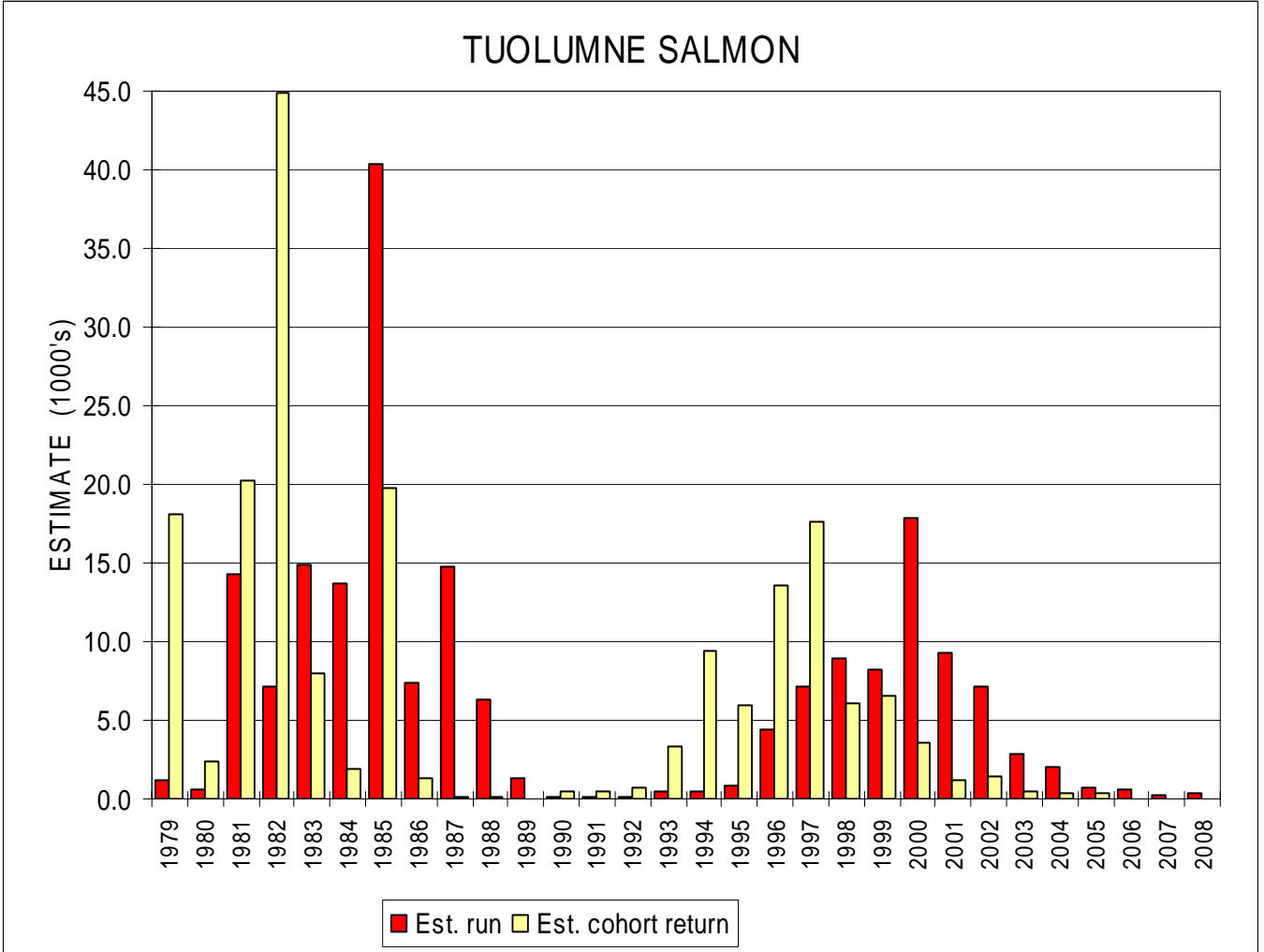


Figure 7. Estimated Tuolumne run numbers and spawner cohort returns

TABLE 1. TUOLUMNE RIVER SPAWNING SALMON SURVEY COUNTS AND ESTIMATES, 1971-2008.

YEAR	TOTAL CARCASSES	% FEMALE	TAGGED CARCASSES			(WEEKLY) MAXIMUM LIVE COUNT	(1) (WEEKLY) MAXIMUM REDD COUNT	ESTIMATED RUN
			NUMBER TAGGED	NUMBER RECOVERED	% RECOVERED			
1971	2,283	58.0			10.4 e	2,128	1,598	21,885
1972	537	52.0			10.5 e	349	423	5,100
1973	351	59.0	270	35	13.0			1,989
1974	90	55.0	84	7	8.3			1,150
1975	130	60.0	125	8	6.4	154	212	1,600
1976	336	51.0	330	61	18.5	241	312	1,700
1977	45	62.0						450
1978	116	67.0	35	2	9.0 e	81	119	1,300
1979	305	51.0	75	22	29.3	153	204	1,184
1980	248	61.0	74	30	40.5	112	117	559
1981	5,819	44.0	664	334	50.3	1,646	1,650	14,253
1982	2,135	60.0	293	123	42.0	530	1,111	7,126
1983	1,280	25.0	270	25	9.3	263	465	14,836
1984	3,841	34.0	693	201	29.0	1,084	1,143	13,689
1985	11,651	56.0	895	273	30.5	2,986	3,034	40,322
1986	2,463	48.0	456	172	37.7	1,123	1,250	7,288
1987	5,280	31.0	1,069	461	43.1	2,155	850	14,751
1988	3,011	60.0	2,171	1,316	60.6	1,066	1,936	6,349
1989	625	52.0	491	318	64.8	291	461	1,274
1990	37	32.0	30	14	46.7	44	42	96
1991	30	45.0	12	7	58.3	24	51	77
1992	55	42.6	47	26	55.3	49	38	132
1993	187	61.3	169	96	56.8	94	215	431
1994	215	49.7	185	110	59.5	226	264	513
1995	461	54.1	415	175	42.2	270	174	928
1996	1,301	34.9	1,186	369	31.1	636	216	4,362
1997	1,520	58.6	1,056	253	24.0	1,258	716	7,548
1998	2,712	50.6	2,170	679	31.3	1,058	448	8,967
1999	3,980	45.9	2,375	1,398	58.9	1,403	404	7,730
2000	6,884	62.6	2,162	870	40.2	3,269	2,104	17,873
2001	5,400	53.9	1,170	717	61.3	1,865	1,251	9,222
2002	4,702	54.4	1,283	826	64.4	1,366	478	7,125
2003	1,489	59.7	585	328	56.1	463	349	2,961
2004	1,224	59.3	529	344	65.0	718	455	1,700
2005	312	66.5	176	58	33.0	129	124	719
2006	152	45.1	91	21	23.1	114	115	625
2007	87	37.8	37	15	40.5	92	107	211
2008	161	57.1	105	46	43.8	200	165	372

(1) Redd counts were taken from TID/MID summary tables after 1980; redd counts for 1986 partially based on aerial photographs taken on 26 November 1986.

e - estimated

Table 2. SAN JOAQUIN BASIN CHINOOK SALMON SPAWNING STOCK ESTIMATES (in 1000's of fish)

Year	Stan.	Tuol.	Merced (river)	Merced (hatchery)	Merced (total)	Trib. Total	SJR abv. MR	Basin Total	Event
1939							5.00		No tributary estimates
1940	3.00	122.00	1.00		1.00	126.00		126.00	
1941	1.00	27.00	1.00		1.00	29.00	9.00	38.00	
1942		44.00				44.00		44.00	No Stan. or Merced estimates
1943							35.00		No tributary estimates
1944		130.00				130.00	5.00	135.00	No Stan. or Merced estimates
1945							56.00		No tributary estimates
1946		61.00				61.00	30.00	91.00	Friant Dam on San Joaquin River
1947	13.00	50.00				63.00	6.00	69.00	
1948	15.00	40.00				55.00	2.00	57.00	
1949	8.00	30.00				38.00	8.00	46.00	
1950							0.50		Last SJ run; Early flood - no trib. estimates
1951	4.00	3.00				7.00		7.00	Tracy Pumping Plant, No Merced estimate
1952	10.00	10.00				20.00		20.00	
1953	35.00	45.00	0.50		0.50	80.50		80.50	
1954	22.00	40.00	4.00		4.00	66.00		66.00	
1955	7.00	20.00				27.00		27.00	No Merced estimate
1956	5.00	6.00	0.00		0.00	11.00		11.00	
1957	4.00	8.00	0.40		0.40	12.40		12.40	Inland gill-netting banned
1958	6.00	32.00	0.50		0.50	38.50		38.50	
1959	4.00	46.00	0.40		0.40	50.40		50.40	Drought
1960	8.00	45.00	0.40		0.40	53.40		53.40	Drought
1961	2.00	0.50	0.05		0.05	2.55		2.55	Drought
1962	0.30	0.20	0.06		0.06	0.56		0.56	
1963	0.20	0.10	0.02		0.02	0.32		0.32	Lowest total of record
1964	4.00	2.10	0.04		0.04	6.14		6.14	First Old River fall rock barrier
1965	2.00	3.20	0.09		0.09	5.29		5.29	
1966	3.00	5.10	0.04		0.04	8.14		8.14	New Exchequer Dam on Merced
1967	11.89	6.80	0.60		0.60	19.29		19.29	
1968	6.39	8.60	0.60		0.60	15.59		15.59	State Pumping Plant
1969	12.33	32.20	0.60		0.60	45.13		45.13	
1970	9.30	18.40	4.70	0.10	4.80	32.50		32.50	Merced River Hatchery
1971	13.62	21.89	3.45	0.10	3.55	39.06		39.06	New Don Pedro Dam on Tuolumne
1972	4.30	5.10	2.53	0.12	2.65	12.05		12.05	
1973	1.23	1.99	0.80	0.20	1.00	4.22		4.22	
1974	0.75	1.15	1.00	0.40	1.40	3.30		3.30	
1975	1.20	1.60	1.70	0.40	2.10	4.90		4.90	
1976	0.60	1.70	1.20	0.30	1.50	3.80		3.80	Drought
1977	0.00	0.45	0.35	0.20	0.55	1.00		1.00	Drought
1978	0.05	1.30	0.53	0.10	0.63	1.98		1.98	New Melones Dam on Stanislaus
1979	0.10	1.18	1.92	0.30	2.22	3.50		3.50	
1980	0.10	0.56	2.85	0.16	3.01	3.67		3.67	
1981	1.00	14.25	9.49	0.92	10.42	25.67		25.67	
1982		7.13	3.07	0.19	3.26	10.39		10.39	No Stanislaus estimate
1983	0.50	14.84	16.45	1.80	18.25	33.58		33.58	
1984	11.44	13.69	27.64	2.11	29.75	54.88		54.88	
1985	13.47	40.32	14.84	1.21	16.05	69.85		69.85	
1986	6.50	7.40	6.79	0.65	7.44	21.34		21.34	
1987	6.29	14.75	3.17	0.96	4.13	25.17		25.17	Drought
1988	10.21	6.35	4.14	0.46	4.59	21.15	2.30	23.45	Drought
1989	1.51	1.28	0.35	0.08	0.43	3.21	0.33	3.54	Drought
1990	0.48	0.10	0.04	0.05	0.08	0.66	0.28	0.94	Drought
1991	0.39	0.08	0.08	0.04	0.12	0.59	0.18	0.77	Drought
1992	0.26	0.13	0.62	0.37	0.99	1.37	0.00	1.37	Drought; Electric barrier on SJR
1993	0.68	0.47	1.27	0.41	1.68	2.83		2.83	Start of Annual Physical barrier on SJR
1994	1.03	0.51	2.65	0.94	3.59	5.13		5.13	
1995	0.62	0.83	1.96	0.58	2.54	3.99		3.99	
1996	0.17	4.36	3.29	1.14	4.43	8.96		8.96	
1997	5.59	7.15	2.71	0.95	3.66	16.39		16.39	
1998	3.09	8.91	3.29	0.80	4.09	16.09		16.09	
1999	4.35	8.23	3.13	1.64	4.77	17.35		17.35	
2000	11.00	17.87	11.00	2.00	13.00	41.87		41.87	
2001	6.00	9.25	9.20	1.30	10.50	25.75		25.75	Drought
2002	6.90	7.17	7.90	1.80	9.70	23.77		23.77	Drought
2003	4.50	2.96	2.90	0.50	3.40	10.86		10.86	Drought
2004	4.02	1.98	3.27	1.05	4.32	10.32		10.32	Drought
2005	3.50	0.72	2.50	0.42	2.92	7.14		7.14	
2006	3.02	0.63	2.00	0.15	2.15	5.80		5.80	
2007	0.41	0.21	0.50	0.08	0.57	1.19		1.19	Drought
2008	1.09	0.37	0.40	0.07	0.46	1.92		1.92	Drought

(1940 Stan. and Merced, and 1941 Stan., Tuol., and Merced, are partial counts)

TABLE 3. NUMBER AND % OF FEMALES IN THE TUOLUMNE RIVER SALMON RUNS, 1971-2008.

Year	Estimate ^c Run	# of Female:	% females	Ave. FL females (cm)	(Y) Eggs per female	Potential egg deposition (millions)
1971	21,885	12,693	58			
1972	5,100	2,652	52			
1973	1,989	1,174	59			
1974	1,150	633	55			
1975	1,600	960	60			
1976	1,700	867	51			
1977	450	279	62			
1978	1,300	871	67			
1979	1,184	604	51			
1980	559	341	61			
1981	14,253	6,271	44	64.2	4034	25.30
1982	7,126	4,276	60	76.9	6046	25.85
1983	14,836	3,709	25	54.8	2544	9.44
1984	13,689	4,654	34	64.7	4113	19.14
1985	40,322	22,580	56	74.7	5697	128.65
1986	7,404	3,554	48	81.0	6696	23.80
1987	14,751	4,573	31	60.4	3431	15.69
1988	5,779	3,467	60	73.8	5548	19.24
1989	1,275	663	52	79.2	6410	4.25
1990	96	31	32	77.8	6189	0.19
1991	77	35	45	71.3	5159	0.18
1992	132	56	43	64.2	4034	0.23
1993	471	289	61	68.8	4762	1.38
1994	506	251	50	71.9	5254	1.32
1995	827	447	54	70.0	4953	2.22
1996	4,362	1,518	35	65.6	4255	6.46
1997	7,146	4,188	59	72.1	5285	22.13
1998	8,910	4,508	51	70.2	4983	22.46
1999	8,232	3,778	46	70.2	4983	18.83
2000	17,873	11,188	63	77.5	6141	68.71
2001	8,782	4,733	54	80.6	6632	31.39
2002	7,173	3,902	54	76.6	5998	23.41
2003	2,854	1,704	60	77.3	6109	10.41
2004	1,984	1,177	59	73.0	5428	6.39
2005	719	478	67	75.9	5887	2.81
2006	625	282	45	76.9	6046	1.70
2007	211	80	38	81.5	6775	0.54
2008	372	212	57	76.6	5998	1.27

$Y=158.45(\text{ave. FL females})-6138.91$ based on 1988 Los Banos trap data

TABLE 4 TUOLUMNE RIVER SPAWNING SURVEYS - MAXIMUM REDD COUNTS BY RIFFLE

SECTION A (La Grange Dam to OLGb)																														
Aerial																														
Riffle	1981	1982	1983 ^a	1984	1985 ^b	1986	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 ^c	1996 ^d	1997 ^e	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
A1																								1						
A2		1			1							1	0	0										3						
A3		20	13		8	33	40		17	40	15	0	0	4	8	12	7	10	11	8	14	22	29	7	5	10	5	6	4	7
A4		20	12		21	29	28		23	0	2	0	0	1	4	9	8	12	11	3	32	39	5	6	10	4	2	2	3	
A5		51	37	1	9	78	19		31	58	18	0	0	2	15	13	6	14	9	3	2	10	4		1	1	1	0	2	5
A6		1	11		4	14	8		14	5	5	0	1	0	1	4	5	9				1	0							
A7		35	33		13	30	21		17	38	8	0	4	6	20	12	12	16	76	46	41	122	189	26	28	17	10	26	25	32
Total:		128	106	2	55	185	116		102	141	48	0	6	12	45	45	39	57	108	68	60	187	261	38	44	38	20	34	33	47
Redd/Mile		98.5	81.5	1.5	42.3	142.3	89.2		78.5	108.5	36.9	0.0	4.6	9.2	34.6	34.6	30.0	43.8	83.1	52.3	46.2	143.8	200.8	29.2	33.8	29.2	15.4	26.2	25.4	36.2
Redd/1,000 ft ²		1.70	1.41	0.03	0.73	2.45	1.54		1.35	1.87	0.64	0.00	0.08	0.16	0.60	0.60	0.52	0.76	1.43	0.90	0.80	2.48	3.46	0.50	0.58	0.50	0.27	0.45	0.44	0.62
Percent of Total		8	10	0	5	6	12	0	12	7	8	0	12	23	18	14	17	17	11	11	9	7	12	5	9	8	11	21	17	19
SECTION 1 (OLGB to Basso Bridge)																														
Aerial																														
Riffle	1981	1982	1983 ^a	1984	1985 ^b	1986	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 ^c	1996 ^d	1997 ^e	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
1A	72	83	10	103	278	85	120	56	116	59	6	7	9	43	28	20	28	54	39	43	241	132	41	20	40	17	12	16	23	
1B,C	5	54	0	15	73	4	5	3	0	0	1	0	0	0	0	0	7	17	15	23	83	71	32	18	19	4	1	5	3	
2	77	63	6	77	150	47	100	35	138	47	1	5	1	16	15	13	37	126	35	54	212	187	35	16	46	8	5	21	7	
3A	31	10	0	6	38	7	13	8	50	5	0	0	0	9	5	0	1	3	2	15	40	10	3	0	0	1	0	0		
3B	10	36	0	33	102	14	25	32	19	9	0	0	1	0	4	4	9	53	41	72	240	254	44	40	46	7	9	13	13	
4A	102	57	7	56	238	48	60	42	106	22	1	2	2	0	7	3	17	56	44	45	260	168	35	22	30	6	8	12	13	
4B	40	38	1	36	219	36	65	44	72	24	1	1	3	8	8	4	16	52	37	43	319	174	38	29	36	5	3	5	0	
5A,B	173	126	2	32	132	19	40	26	51	15	0	1	1	2	12	4	10	43	30	46	108	80	13	14	7	2	3	7	13	
Total:	510	467	110	358	1230	260	428	246	552	181	10	16	17	78	79	48	125	404	243	341	1503	1076	241	159	224	50	41	79	72	
Redd/Mile	204	186.8	44	143.2	492	104	171.2	98.4	220.8	72.4	4	6.4	6.8	31.2	31.6	19.2	50	161.6	97.2	136.4	601.2	430.4	96.4	63.6	89.6	20	16.4	31.6	28.8	
Redd/1,000 ft ²	0.77	0.70	0.17	0.54	1.85	0.39	0.64	0.37	0.83	0.27	0.02	0.02	0.03	0.12	0.12	0.07	0.19	0.61	0.36	0.51	2.26	1.62	0.36	0.24	0.34	0.08	0.06	0.12	0.11	
Percent of Total	30	42	24	31	41	27	38	29	29	31	17	31	32	31	25	21	36	41	38	50	53	50	32	34	46	28	25	41	30	

TABLE 4 (CONTINUED)

SECTION 2 (Basso Bridge to TLSRA)																														
Riffle	Aerial																													
	1981	1982	1983 ^a	1984	1985 ^b	1986	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 ^c	1996 ^d	1997 ^e	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
6	28	27	8	30	46	12	15	13	15	9	0	0	1	7	12	7	12				5	0	0							
7	71	17	8	57	147	27	50	37	75	20	0	1	1	15	16	9	10	67	28	43	92	30	6	10	13	1	2	4	7	
8A,B	9	8	0	16	48	13	20	4	16	4	1	2	0	5	10	9	5	14	11	16	191	55	15	14	9	1	1	4	4	
9A,B	20	8	4	27	68	18	26	20	43	13	4	2	1	2	2	3	2					0								
10	47	17	1	14	^	^		0	0	0	0	0	0	2	1	1														
11A,B	6	3	1	12	41	10		6	19	6	0	0	0	0	1	0	0													
12A,B	11	0	0	5	8	13		1	8	4	5	1	0	3	4	1	2	19	19	14	75	24	9	8	5	2	2	3	0	
13A	7	3	1	4	16	6		4	44	6	0	0	2	1	2	1	3	10	11	13	50	17	7	6	2	1	3	6	5	
13B	22	9	1	42	77	4	12	26	^	^	1	0	1	2	3	2	2	3	3	6	16	12	7	4	1	2	1	1	1	
13C,D	4	17	1	8	7	2	11	3	3	2	1	0	0	0	0	0	0	2	1	3	15	4	1	3	1	0	1	1	0	
14	7	7	0	5	13	7		6	10	3	1	0	0	1	3	3	3	8	11	5	10	3	5	3	2	1	1	3	1	
15	8	12	0	4	41	7		8	13	6	0	0	0	0	2	0	2	6	8	4	10	20	6	7	4	0	2	0	5	
16N,S	8	2	0	17	8	9		9	18	9	0	0	0	2	5	1	2	15	10	12	49	42	19	8	3	1	2	2	4	
17A	15	26	0	10	18	12		7	20	5	0	0	0	4	3	1		4	5	8	8	6	6	2	3	1	0	1	2	
17B,C	14	6	4	15	26	10		11	14	7	4	0	0	3	4	6	6	9	11	12	18	24	22	8	10	3	1	6	3	
18A,B	9	15	5	24	40	7		5	7	5	0	2	0	4	4	5	11	12	10	17	43	33	14	6	8	2	4	1	2	
19	20	17	5	25	34	12		7	14	5	0	0	0	1	4	2	3	15	9	6	8	0						1	2	
20	27	9	0	8	5	6		3	11	5	0	0	0	2	2	0	1	(?)	0		3	1								
21	14	8	1	17	29	6		8	12	4	2	0	0	2	3	1	3	27	10	3	22	11	6	2	3	0	0	0	3	
22N, (A,B)	7	7	0	8	13	5		4	5	4	0	0	0	3	1	2	5	8	9	2	15	22	14	7	6	3	2	5	2	
22S	9	10	0	7	14	4		3	^	^	0	0	0	0		0	^	^												
23A	21	27	12	73	48	10		9	22	4	0	0	1	2	2	4	7	8	6	15										
23B	16	19	0	^	127	^		^	^	^	0	0	0	2	3	2	1	11	5	3	16	7	2	4	4	1	1	1	2	
23C	38	28	10	^	^	33		22	33	9	1	1	0	0	5	2	3	10	4	4	17	11	10	8	5	0	3	3	2	
23D	23	6	0	^	^	^		^	^	^	1	0	0	0	2	1	3	25	7	6	32	11	6	2	6	0	2	2	2	
Total:	461	308	180	428	874	233	271	216	402	130	21	9	7	61	95	61	84	272	180	183	710	333	155	102	85	21	28	44	47	
Redd/Mile	92.2	61.6	36	85.6	174.8	46.6	54.2	43.2	80.4	26	4.2	1.8	1.4	12.2	19	12.2	16.8	54.4	36	36.6	142	66.6	31	20.4	17	4.2	5.6	8.8	9.4	
Redd/1,000 ft ²	1.15	0.77	0.45	1.07	2.18	0.58	0.67	0.54	1.00	0.32	0.05	0.02	0.02	0.15	0.24	0.15	0.21	0.68	0.45	0.46	1.77	0.83	0.39	0.25	0.21	0.05	0.07	0.11	0.12	
Percent of Total	28	28	39	37	29	25	24	25	21	22	36	18	13	24	30	27	24	28	28	27	25	16	21	22	17	12	17	23	19	

TABLE 4 (CONTINUED)

Riffle	SECTION 3 (ILSRA TO Reed Gravel)																													
	1981	1982	1983 ^a	1984	1985 ^b	1986	Aerial 1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 ^c	1996 ^c	1997 ^c	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
24A N.S	38	21	10	28	16	28		24	22	14	2	0	0	8	1	3	8	37	13	8	7	29	18	8	9	3	2	0	0	
24B	12	0	0	7	39	^		2	4	2	0	0	0	0	0	3	3	(?)			20					0	1	5	3	
25	23	28	1	18	41	24		11	11	7	0	0	0	2	1	3	4	13	15	6	27	21	13	11	9	8	6	1	0	
26	21	17	6	21	31	20		18	17	12	3	1	2	3	5	5	5	11	12	6	30	19	9	6	5	8	2	3	6	
27	17	7	2	8	29	9		11	17	6	2	0	1	2	3	4	2	9	9	2	28	20	12	6	6	2	2	0	3	
28A,B	11	14	16	13	37	13		4	17	5	0	0	0	1	2	2	1		4	1	20	7	7	7	10	4	3	1	3	
29	28	21	18	26	36	19		14	22	5	1	0	1	4	8	5	5	6	7	3	11	14	4	3	5	3	5	2	3	
30A	24	22	7	28	39	12		12	38	16	2	1	0	0	3	2	3			5	10	8	10	5	5	6	4	5	3	
30B	18	21	18	14	19	10		13	^	^	2	3	1	3	4	2	3	6	5		5									
31	20	5	0	15	19	12		3	19	3	2	0	0	0	3	2	2	11	10	9	19	47	15	7	8	3	2	4	4	
32A,B	46	4	0	2	28	4		6	20	4	2	2	0	2	2	0		6	2	1	7	10	2	5	2	1	0	0	1	
33	15	1	2	11	33	11		7	16	7	0	1	0	0	1	2		12	5	2	16	24	9	11	3	2	6	1	3	
34	17	9	0	6	26	10		8	4	5	0	0	1	0	12	0		5	0		3	7	4	5	6	2	5	6	6	
35A,B	27	3	0	10	14	14		10	26	7	0	1	0	0	7	4		10	11	5	51	17	6	0	0	0	0		1	
36A	14	1	6	13	14	7		6	11	10	1	0	1	4	3	0	3	7	6	6	9	15	0	7	4	2	1	1	4	
36B	4	5	^	0	18	7		5	15	0	0	2	0	4	2	3	4	4	5	1	11	19	8	7	6	2	4	1	2	
37	12	0	0	1	4	9	15	3	4	2	0	0	0	0	1	1	3	4	3	1	7	8	10	2	1	1	1	0		
38N,S	6	9	15	13	9	8	6	7	11	4	0	0	0	1	2	4	2	10	3	7	20	19	31	10	10	3	0	0	2	
39N,S	8	7	^	7	14	11	20	6	14	6	2	1	0	1	3	0	3	6			1									
40N,S	14	0	^	9	39	25	20	9	14	12	0	0	0	1	4	0													2	6
41	7	4	^	5	11	5	20	9	33	4	0	1	0	2	3	1	2	6	6	2	5	12	7	5	3	3	1	2	4	
42A,B	34	7	^	2	56	58		15	59	12	0	0	0	0	2	2		3	2	1	8	35	15	6	8	1	0	0		
43A,B,C	6	5	0	1	33	4		0	2		0	0	0	7	6	3	2	3	2		10								1	
44	7	2	0	1	^	13		4	3	4	0	0	0	1	1	0					8	7	20	4	4	6	1	0	2	
45	9	5	2	6	^	^		^	^	^	0	0	0	1	2	3	2	(?)			5	13	4	2	0	1	2	0	1	
46	2	0	0	0	0	9		2	32	2	2	0	0	2	1	2	1	2	5	3	7	10	6	5	2	2	1	0	2	
Total:	440	218	155	265	605	342	365	209	431	149	21	13	7	49	82	56	58	171	125	69	345	361	210	122	106	63	49	34	59	
Redd/Mile	57.1	28.3	20.1	34.4	78.6	44.4	47.4	27.1	56.0	19.4	2.7	1.7	0.9	6.4	10.6	7.3	7.5	22.2	16.2	9.0	44.8	46.9	27.3	15.8	13.8	8.2	6.4	4.4	7.7	
Redd/1,000 ft ²	0.61	0.30	0.22	0.37	0.84	0.48	0.51	0.29	0.60	0.21	0.03	0.02	0.01	0.07	0.11	0.08	0.08	0.24	0.17	0.10	0.48	0.50	0.29	0.17	0.15	0.09	0.07	0.05	0.08	
Percent of Total	26	20	33	23	20	36	32	25	22	25	36	25	13	20	25	24	17	17	19	10	12	17	28	26	22	35	30	18	24	

TABLE 4 (CONTINUED)

SECTION 4 (Reed Gravel to Fox Grove)																														
Riffle	Aerial																													
	1981	1982	1983 ^a	1984	1985 ^b	1986	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 ^c	1996 ^d	1997 ^e	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
47A,B	8		11	13	12		6	6	28	3	0	1	0	1	2	5				10										
48A	17		^	1			2	2	17	2	0	0	0	0	1	0		4	6	3	4	7	7	5	2	2	0	0	1	
48B	0		^	0			2	3	^	^	0	1	0	2	3	2	1	4	5	3	9	19	17	3	2	1	0	0	2	
49A,B	4		^	1			0	4	0	1	0	0	0	1	0	1	0				1									
50	7		^	1			7	7	2	2	0	0	0	0	2	3	3	3	2	6	7	7	1	5	6	3	1	2	3	
51	2		^	0			2	10	3	0	0	0	0	0	2	0	2	1			8									
52A	9		^	3			3	74	16	0	0	1	3	1	2	6	4	2	4	8	3	4	1	0	0	0	0	0	2	
52B	13		^	0			2	^	^	^	1	0	1	1	1	3	1	2	2	3	4	2	0	4	4	4	4	2	2	3
53	4		^	3	8		5	3	12	7	1	0	1	0	0	0				4	1	13	2	3	0	0	0	0		
54	6		^	0	^		5	9	24	6	0	1	1	0	1	0	2				3	1	0	4	4	2	1	0	1	
55	5		^	0	6		20	9	17	4	0	0	0	0	1	3	1	2	2	3	11	16	8	9	5	3	3	0	1	
56	8		^	3	15		1	1	15	8	1	1	0	3	1	2	1	3	3	2	9	7	11	2	3	2	0	0		
57	8		^	0	^		4	3	17	7	0	0	0	0	0	0			3											
58	5		^	4			7	13	19	3	0	0	0	0	0	0						1	9		1	3	1	0		
59	13		^	4			3	2	2	2	0	1	0	0	0	1		(?)	1		3		0							
60N,S	7		^	1			6	8	62	2	0	1	5	4	3	0		2	1	3	7	11	12	4	2	1	0	0		
61	1		^	0			0	0	18	5	0	0	0	0	0	0		(?)			2	9	10	0	0	0	0	0		
62	2		^	0			0	0	3	2	0	0	0	0	0	0		1	0											
63	6		^	0			3	0	10	2	0	0	0	0	1	1			1		2	7	4	3	1	0	3	0	1	
64	9		^	0			4	0	15	0	0	0	0	0	0	0		(?)	1		1	3	4	0	0	1	0	0	1	
65	0		^	3			0	14	2	1	1	1	1	2	2	2	1	0	2	2	3	5	3	4	2	3	2	0	2	
66N,S	1		^	0			0	6	1	0	0	0	0	0	0	0		0	0	2	4	2	8	0	1	1	0	0	1	
67	2		^	0			0	5	0	2	0	0	0	0	0	0		0	0		2		0	0	0	0				
68	0		^	0			0	1	0	0	0	0	0	0	0	0		0	0				0	0	0	0				
Total:	137		18	37	-140		68	77	376	76	6	7	10	17	21	25	19	26	31	31	102	101	111	46	36	26	13	4	18	
Redd/Mile	22.5		3.0	6.1	23.0		11.1	12.6	61.6	12.5	1.0	1.1	1.6	2.8	3.4	4.1	3.1	4.3	5.1	5.1	16.7	16.6	18.2	7.5	5.9	4.3	2.1	0.7	3.0	
Redd/1,000 ft ²	0.17		0.02	0.05	0.17		0.08	0.09	0.46	0.09	0.01	0.01	0.01	0.02	0.03	0.03	0.02	0.03	0.04	0.04	0.12	0.12	0.14	0.06	0.04	0.03	0.02	0.00	0.02	
Percent of Total	8		4	3	5		6	9	20	13	10	14	19	7	7	11	6	3	5	5	4	5	15	10	7	14	8	2	7	

TABLE 4 (CONTINUED)

SECTION 5 (Below Fox Grove)																													
Riffle	Aerial																												
	1981	1982	1983 ^a	1984	1985 ^b	1986	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 ^c	1996 ^d	1997 ^e	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
69									1	0																			
70									0	0																			
71									0	0																			
72									5	0																			
73									9	3																			
74									2	0																			
75									9	0																			
76										1																			
77										0																			
78										0																			
Total:									26	4																			
Redd/Mile									9.6	1.5																			
Redd/1,000 ft ²									0.11	0.02																			
Percent of Total									1	1																			
	1981	1982	1983 ^a	1984	1985 ^b	1986	Aerial 1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 ^c	1996 ^d	1997 ^e	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Grand Total	1676	1099	465	1143	3034	951	1132	850	1928	588	58	51	53	250	322	229	343	981	647	684	2847	2132	755	473	489	180	165	194	243
# of Females	6300	4200	3700	4700	22600		3498	4600	3809	663	31	35	55	264	255	502	1518	4423	4537	3548	11188	4980	3876	1768	1007	478	282	80	212
Females/Redd	3.8	3.8	8.0	4.1	7.4		3.1	5.4	2.0	1.1	0.5	0.7	1.0	1.1	0.8	2.2	4.4	4.5	7.0	5.2	3.9	2.3	5.1	3.7	2.1	2.7	1.7	0.4	0.9
Flow (cfs)	230	420	620	500	350	230	230	210	100	220	130	130	160	270	175	300	400	350	320	390	370	180	193	252	190	470	388	160	167

Section A and 5 were not surveyed on a regular basis

Section riffle areas are estimated at 230 cfs.

^ = Included in preceding number

a = 1983 Redd counts were supplemented by aerial survey counts for sections 3 and 4.

In 1983, 261 stranded redds were also counted and are included in the totals for the sections.

b = 1985 Total redd count for section 4 was based on extrapolation of 1981 redd counts for the same riffles

c = 1995 Redd counts were unusually low considering the number of females.

d = 1996 surveys were terminated after first the week of December due to increase of flow to 5,000 cfs..

e = (?) Questionable counts that were omitted.

Poor visibility after Riffle 13C prevented a complete count after week 9.

TABLE 5. TUOLUMNE RIVER SALMON SURVEY PERIODS AND PEAK LIVE COUNTS.

Year	Survey Period		Peak Live Count		Tuolumne Estimate (x 1,000)	Peak Live / Pop.est. (%)
	Start Date	End Date	Date	Number		
1940	26-Sep	02-Dec	04-Nov	5,447	122.0	4.5%
1941	21-Sep	18-Nov	13-Nov	2,807	27.0	10.4%
1942	13-Sep	30-Nov	01-Nov	3,386	44.0	7.7%
1944	30-Sep	30-Nov	06-Nov	10,039	130.0	7.7%
1946	11-Oct	20-Nov	04-Nov	6,002	61.0	9.8%
1957	05-Nov	03-Jan			8.0	
1958	06-Nov	09-Jan			32.0	
1959	03-Nov	01-Jan			46.0	
1960	12-Nov	13-Jan			45.0	
1961					0.5	
1962	08-Nov	04-Jan			0.2	
1963	10-Feb				0.1	
1964	04-Nov	18-Dec			2.1	
1965	19-Nov	12-Jan			3.2	
1966	08-Nov	18-Jan	09-Nov	271	5.1	5.3%
1967	18-Oct	13-Jan	21-Nov	184	6.8	2.7%
1968	11-Nov	15-Dec	22-Nov	1,490	8.6	17.3%
1969	20-Nov	12-Jan			32.2	
1970	19-Nov	20-Jan	20-Nov	1,517	18.4	8.2%
1971	15-Nov	27-Dec	16-Nov	2,128	21.9	9.7%
1972	13-Nov	23-Jan	27-Nov	349	5.1	6.8%
1973	05-Nov	17-Jan			2.0	
1974					1.2	
1975	06-Nov	31-Dec	06-Nov	154	1.6	9.6%
1976	03-Nov	29-Dec	15-Nov	241	1.7	14.2%
1977	29-Nov	20-Dec			0.5	
1978	26-Oct	19-Dec	24-Nov	81	1.3	6.2%
1979	05-Nov	17-Dec	02-Nov	153	1.2	12.8%
1980	12-Nov	18-Dec	12-Nov	112	0.6	18.7%
1981	04-Nov	16-Dec			14.3	
1982	08-Nov	29-Nov	15-Nov	545	7.1	7.7%
1983	07-Nov	01-Dec	15-Nov	263	14.8	1.8%
1984	01-Nov	30-Nov	01-Nov	1,084	13.7	7.9%
1985	29-Oct	20-Dec	12-Nov	2,986	40.3	7.4%
1986	27-Oct	05-Dec	03-Nov	1,123	7.3	15.4%
1987	28-Oct	16-Dec	17-Nov	2,155	14.8	14.6%
1988	25-Oct	29-Dec	14-Nov	1,066	6.3	16.8%
1989	24-Oct	29-Dec	09-Nov	291	1.3	22.8%
1990	23-Oct	26-Dec	19-Nov	44	0.1	45.8%
1991	22-Oct	02-Jan	25-Nov	24	0.1	31.2%
1992	05-Nov	21-Dec	19-Nov	49	0.1	37.1%
1993	14-Oct	18-Dec	06-Nov	94	0.4	21.8%
1994	03-Nov	05-Jan	21-Nov	226	0.5	44.1%
1995	27-Oct	30-Dec	03-Nov	270	0.9	29.1%
1996	22-Oct	04-Dec	31-Oct	636	4.4	14.6%
1997	14-Oct	23-Dec	12-Nov	1,258	7.5	16.7%
1998	07-Oct	22-Dec	02-Nov	1,058	9.0	11.8%
1999	04-Oct	28-Dec	01-Nov	1,403	7.7	18.2%
2000	02-Oct	05-Jan	06-Nov	3,269	17.9	18.3%
2001	04-Oct	05-Jan	05-Nov	1,865	9.2	20.2%
2002	01-Oct	02-Jan	04-Nov	1,366	7.1	19.2%
2003	30-Sep	30-Dec	18-Nov	463	3.0	15.6%
2004	04-Oct	06-Jan	08-Nov	718	1.9	37.8%
2005	03-Oct	22-Dec	14-Nov	129	0.7	17.9%
2006	05-Oct	28-Dec	13-Nov	114	0.6	18.2%
2007	02-Oct	28-Dec	19-Nov	92	0.2	43.6%
2008	06-Oct	08-Jan	04-Nov	200	0.4	53.8%
<u>For period 1971-2008:</u>						
Minimum	30-Sep	29-Nov	31-Oct	---	---	---
Maximum	29-Nov	23-Jan	27-Nov	---	---	---
Median	26-Oct	27-Dec	12-Nov	---	---	---

TABLE 6. TUOLUMNE RIVER CHINOOK SALMON FORK LENGTHS (cm) OF CARCASSES MEASURED DURING SPAWNING SURVEYS, 1981-2008.

FEMALES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
NUMBER	289	153	92	286	524	251	349	222	193	11	9	20	56	78
MIN.	47	56	41	43	47	53	45	49	52	73	68	43	49.5	50
MAX.	86	97	85	77	90	99	93	90	99	89	74	88	87.5	88.5
AVG.	64.2	76.9	54.8	64.7	74.7	81.0	60.4	73.8	79.2	77.8	71.3	64.2	68.9	71.9
STD. DEV.	8.5	5.2	11.4	6.2	6.8	8.5	7.0	5.9	6.6	4.4	2.3	13.2	6.6	8.3
VARIANCE	72.5	27.0	130.9	38.0	46.7	72.0	48.6	35.4	43.8	19.4	5.1	173.6	44.0	69.2
MALES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
NUMBER	372	121	302	560	407	267	785	149	174	20	11	27	36	79
MIN.	37	29	34	30	54	35	39	50	46.5	44	52	46	47.5	52
MAX.	107	113	103	92	102	112	100	104	110.5	105	98	98	96	100.5
AVG.	65.9	81.8	52.2	60.2	83.0	89.4	62.5	83.1	89.0	79.8	77.7	60.6	72.9	73.6
STD. DEV.	10.0	14.5	11.7	10.5	9.6	16.1	7.3	9.6	12.2	17.2	15.5	12.3	12.6	12.6
VARIANCE	100.5	211.5	135.8	109.2	92.4	260.6	53.2	92.2	149.9	296.7	240.4	150.1	159.5	157.9

FEMALES	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
NUMBER	79	150	232	378	382	594	844	658	278	245	117	42	14	60
MIN.	51	48	51	46	43	53	48	50	54	51	46	56	73	60
MAX.	87	89	95	93	93	105	105	104	98	98	93	92	91	86
AVG.	70.0	65.5	73.1	70.3	70.6	77.5	80.6	76.2	78.1	72.2	75.9	76.7	81.5	76.6
STD. DEV.	9.0	8.9	6.5	10.7	9.3	6.1	9.1	8.7	7.6	10.5	7.1	7.2	5.3	5.1
VARIANCE	81.4	79.3	41.8	113.6	86.6	37.0	83.7	76.5	57.5	110.3	50.2	51.4	28.0	26.0
MALES	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
NUMBER	66	279	164	358	476	305	672	589	184	186	59	49	23	45
MIN.	49	41	45	46	43	46	47	31	30	43	46	56	59	59
MAX.	106	101	100	105	105	110	115	111	108	108	101	95	105	104
AVG.	69.3	64.7	79.0	70.6	68.1	84.2	83.1	81.2	84.4	72.9	75.5	72.6	85.3	86.5
STD. DEV.	13.6	11.3	11.7	15.1	12.4	10.5	15.6	14.5	13.7	14.2	14.3	10.8	14.1	9.2
VARIANCE	184.7	127.9	138.0	226.9	153.0	109.1	243.4	211.3	187.5	201.8	204.2	117.5	199.1	83.8

TABLE 7. ESTIMATED AGE CLASS COMPOSITION FROM LENGTH FREQUENCY DISTRIBUTIONS OF TUOLUMNE RIVER SALMON BASED ON FRESH MEASURED CARCASSES (1981-2008)

YEAR	SEX	2 YR. OLD			3 YR. OLD			4 YR. OLD			5 YR. OLD	
		MAX.	% OF TOT.	% OF SEX	MAX.	% OF TOT.	% OF SEX	MAX.	% OF TOT.	% OF SEX	% OF TOT.	% OF SEX
1981	FEMALE	68	32.5%	74.4%	85	10.4%	23.9%					
	MALE	75	49.5%	87.9%	95	5.6%	9.9%	105	1.1%	1.9%	0.2%	0.3%
	TOTAL		82.0%			16.0%			1.8%		0.2%	
1982	FEMALE	65	1.5%	2.6%	85	53.6%	96.1%					
	MALE	70	8.8%	19.8%	95	30.3%	68.6%	105	4.4%	9.9%	0.7%	1.7%
	TOTAL		10.2%			83.9%			5.1%		0.7%	
1983	FEMALE	60	16.0%	68.5%	74	5.6%	23.9%					
	MALE	65	70.8%	92.4%	87	3.0%	4.0%	83	1.3%	5.4%	0.5%	2.2%
	TOTAL		86.8%			8.6%			3.0%		1.0%	1.3%
1984	FEMALE	62	11.3%	33.6%	74	20.3%	60.1%					
	MALE	65	49.4%	74.6%	87	16.1%	24.3%					
	TOTAL		60.8%			36.4%			2.8%		0.0%	
1985	FEMALE	65	4.8%	8.6%	85	49.4%	87.8%					
	MALE	70	5.3%	12.0%	95	35.6%	81.3%					
	TOTAL		10.1%			85.0%			4.9%		0.0%	
1986	FEMALE	67	2.3%	4.8%	85	31.1%	64.1%	93	12.0%	24.7%	3.1%	6.4%
	MALE	75	9.3%	18.0%	95	20.7%	40.1%	107	19.3%	37.5%	2.3%	4.5%
	TOTAL		11.6%			51.7%			31.3%		5.4%	
1987	FEMALE	68	27.2%	88.5%	85	3.3%	10.6%					
	MALE	75	66.5%	96.1%	95	2.2%	3.2%					
	TOTAL		93.7%			5.5%			0.8%		0.0%	
1988	FEMALE	65	4.1%	6.8%	85	54.9%	91.9%					
	MALE	70	3.2%	8.1%	95	33.8%	83.9%					
	TOTAL		7.3%			88.6%			4.1%		0.0%	
1989	FEMALE	67	2.5%	4.7%	85	41.1%	78.2%	94	8.7%	16.6%	0.3%	0.5%
	MALE	70	4.1%	8.6%	95	28.1%	59.2%	107	14.4%	30.5%	0.8%	1.7%
	TOTAL		6.5%			69.2%			23.2%		1.1%	
1990	FEMALE	65	0.0%	0.0%	85	32.3%	90.9%					
	MALE	70	19.4%	30.0%	94	29.0%	45.0%					
	TOTAL		19.4%			61.3%			19.4%		0.0%	
(1) 1991	FEMALE	65	0.0%	0.0%	85	45.0%	100.0%					
	MALE	70	15.0%	27.3%	95	30.0%	54.5%					
	TOTAL		15.0%			75.0%			10.0%		0.0%	
(1) 1992	FEMALE	65	21.3%	50.0%	85	19.1%	45.0%					
	MALE	70	46.8%	81.5%	95	8.5%	14.8%					
	TOTAL		68.1%			27.7%			4.3%		0.0%	
1993	FEMALE	65	13.0%	21.4%	85	46.7%	76.8%					
	MALE	70	16.3%	41.7%	95	21.7%	55.6%					
	TOTAL		29.3%			68.5%			2.2%		0.0%	
1994	FEMALE	65	8.9%	17.9%	85	39.5%	79.5%					
	MALE	70	21.0%	41.8%	95	27.4%	54.4%					
	TOTAL		29.9%			66.9%			3.2%		0.0%	
1995	FEMALE	65	15.2%	27.8%	85	37.9%	69.6%					
	MALE	70	26.2%	57.6%	95	17.9%	39.4%	105	0.7%	1.5%	0.7%	1.5%
	TOTAL		41.4%			55.9%			2.1%		0.7%	
1996	FEMALE	65	17.7%	50.7%	85	17.0%	48.7%					
	MALE	70	50.8%	78.1%	95	13.1%	20.1%	105	1.2%	1.8%	0.7%	1.5%
	TOTAL		68.5%			30.1%			1.4%		0.0%	
(2) 1997	FEMALE	65	7.1%	12.2%	77	38.7%	66.7%	90	11.7%	20.1%	0.6%	1.1%
	MALE	70	9.2%	21.9%	88	24.2%	57.7%	100	8.6%	20.4%	0.6%	1.1%
	TOTAL		16.3%			62.9%			20.2%		0.6%	
(2) 1998	FEMALE	63	14.1%	27.5%	78	23.4%	45.5%	92	13.7%	26.7%	0.1%	0.3%
	MALE	68	26.5%	54.5%	87	13.0%	26.8%	99	7.1%	14.5%	2.0%	4.2%
	TOTAL		40.6%			36.4%			20.8%		2.2%	
(2) 1999	FEMALE	63	11.1%	24.9%	78	24.6%	55.2%	91	8.6%	19.4%	0.2%	0.5%
	MALE	70	37.9%	68.3%	87	12.7%	22.9%	99	4.4%	8.0%	0.5%	0.8%
	TOTAL		49.0%			37.3%			13.1%		0.7%	
(2) 2000	FEMALE	65	2.3%	3.5%	79	37.0%	56.1%	90	25.6%	38.7%	1.1%	1.7%
	MALE	70	3.4%	10.2%	88	17.5%	51.5%	99	11.6%	34.1%	1.4%	4.3%
	TOTAL		5.7%			54.5%			37.2%		2.5%	
(2) 2001	FEMALE	65	4.2%	7.5%	81	24.1%	43.2%	95	26.3%	47.3%	1.1%	2.0%
	MALE	70	12.8%	28.9%	90	15.4%	34.7%	105	14.2%	32.0%	2.0%	4.5%
	TOTAL		17.0%			39.5%			40.5%		3.1%	
(2) 2002	FEMALE	65	6.7%	12.8%	82	35.4%	67.0%	94	9.9%	18.7%	0.8%	1.5%
	MALE	70	13.1%	27.7%	92	24.1%	50.9%	104	8.7%	18.5%	1.4%	2.9%
	TOTAL		19.8%			59.4%			18.6%		2.2%	
(2) 2003	FEMALE	65	3.0%	5.0%	82	42.9%	71.2%	94	13.9%	23.0%	0.4%	0.7%
	MALE	70	5.6%	14.1%	90	20.8%	52.2%	103	11.3%	28.3%	2.2%	5.4%
	TOTAL		8.7%			63.6%			25.1%		2.6%	
(2) 2004	FEMALE	65	16.7%	29.4%	82	30.6%	53.9%	94	8.8%	15.5%	0.7%	1.2%
	MALE	70	24.6%	57.0%	90	11.8%	27.4%	102	5.8%	13.4%	0.9%	2.2%
	TOTAL		41.3%			42.5%			14.6%		1.6%	
(1) 2005	FEMALE	65	5.1%	7.7%	82	51.7%	77.8%	94	9.7%	14.5%		
	MALE	70	12.5%	37.3%	90	16.5%	49.2%	102	4.5%	13.6%		
	TOTAL		17.6%			68.2%			14.2%		0.0%	
(1) 2006	FEMALE	65	3.3%	7.1%	82	33.0%	71.4%	94	9.9%	21.4%		
	MALE	70	30.8%	57.1%	90	17.6%	37.7%	102	5.5%	10.2%		
	TOTAL		34.1%			50.5%			15.4%		0.0%	
(1) 2007	FEMALE	65	0.0%	0.0%	82	18.9%	50.0%	94	18.9%	50.0%		
	MALE	70	13.5%	21.7%	90	24.3%	39.1%	102	21.6%	34.8%	2.7%	4.3%
	TOTAL		13.5%			43.2%			40.5%		2.7%	
(1) 2008	FEMALE	65	1.9%	3.3%	82	48.6%	85.0%	94	6.7%	11.7%		
	MALE	70	1.9%	4.4%	90	27.6%	64.4%	102	12.4%	28.9%	1.0%	2.2%
	TOTAL		3.8%			76.2%			19.0%		1.0%	

(1) BASED ON ALL MEASURED CARCASSES
(2) EXCLUDES ADIPOSE FIN CLIPPED CARCASSES

TABLE 9. ESTIMATED TUOLUMNE SALMON RUN NUMBERS AND AGE COMPOSITION WITH ESTIMATED COHORT RETURNS AND COHORT AGE COMPOSITION

Year	Estimated Run (x 1000)	Age-class composition for salmon run					Cohort				Cohort Composition			
		2-yr (x 1000)	3-yr (x 1000)	4-yr (x 1000)	5-yr (x 1000)	2-yr (%)	3-yr (%)	4-yr (%)	5-yr (%)	Total (x 1000)	2-yr (%)	3-yr (%)	4-yr (%)	5-yr (%)
1978	1.30													
1979	1.18									18.11	64.5%	33.0%	2.5%	0.0%
1980	0.56									2.39	30.5%	53.5%	16.1%	0.0%
1981	14.25	11.69	2.28	0.26	0.03	82.0	16.0	1.8	0.2	20.24	63.6%	24.6%	9.8%	2.0%
1982	7.13	0.73	5.98	0.36	0.05	10.2	83.9	5.1	0.7	44.91	18.5%	76.3%	5.2%	0.0%
1983	14.84	12.88	1.28	0.45	0.22	86.8	8.6	3.0	1.5	8.02	50.8%	47.7%	1.5%	0.0%
1984	13.69	8.32	4.98	0.38	0.00	60.8	36.4	2.8	0.0	1.94	44.2%	41.7%	13.4%	0.7%
1985	40.32	4.07	34.27	1.98	0.00	10.1	85.0	4.9	0.0	19.74	70.0%	28.5%	1.5%	0.0%
1986	7.40	0.86	3.83	2.32	0.40	11.6	51.7	31.3	5.4	1.36	34.0%	64.7%	1.4%	0.0%
1987	14.75	13.82	0.81	0.12	0.00	93.7	5.5	0.8	0.0	0.15	55.5%	39.4%	5.2%	0.0%
1988	6.35	0.46	5.63	0.26	0.00	7.3	88.6	4.1	0.0	0.08	22.7%	70.4%	6.9%	0.0%
1989	1.28	0.08	0.88	0.30	0.01	6.5	69.2	23.2	1.1	0.06	19.8%	62.5%	17.7%	0.0%
1990	0.10	0.02	0.06	0.02	0.00	19.4	61.3	19.4	0.0	0.43	20.7%	74.3%	3.7%	1.3%
1991	0.08	0.01	0.06	0.01	0.00	15.0	75.0	10.0	0.0	0.49	27.9%	68.5%	3.5%	0.0%
1992	0.13	0.09	0.04	0.01	0.00	68.1	27.7	4.3	0.0	0.72	21.1%	64.4%	8.5%	6.0%
1993	0.47	0.14	0.32	0.01	0.00	29.3	68.5	2.2	0.0	3.29	10.4%	39.8%	43.8%	5.9%
1994	0.51	0.15	0.34	0.02	0.00	29.9	66.9	3.2	0.0	9.39	31.8%	47.8%	19.7%	0.6%
1995	0.83	0.34	0.46	0.02	0.01	41.4	55.9	2.1	0.7	5.93	19.6%	54.7%	18.2%	7.5%
1996	4.36	2.99	1.31	0.06	0.00	68.5	30.1	1.4	0.0	13.62	26.6%	22.5%	48.8%	2.1%
1997	7.15	1.16	4.49	1.44	0.04	16.3	62.9	20.2	0.6	17.68	22.8%	55.1%	21.2%	0.9%
1998	8.91	3.62	3.24	1.85	0.20	40.6	36.4	20.8	2.2	6.08	16.8%	60.1%	21.9%	1.2%
1999	8.23	4.03	3.07	1.08	0.06	49.0	37.3	13.1	0.7	6.58	23.9%	64.7%	10.9%	0.5%
2000	17.87	1.02	9.74	6.65	0.45	5.7	54.5	37.2	2.5	3.53	40.3%	51.5%	8.2%	0.0%
2001	9.25	1.57	3.65	3.75	0.29	17.0	39.5	40.5	3.1	1.19	20.8%	70.6%	8.6%	0.0%
2002	7.17	1.42	4.26	1.33	0.16	19.8	59.4	18.6	2.2	1.41	58.0%	34.7%	6.8%	0.4%
2003	2.85	0.25	1.82	0.72	0.07	8.7	63.6	25.1	2.6	0.53	23.9%	59.3%	16.1%	0.7%
2004	1.98	0.82	0.84	0.29	0.03	41.3	42.5	14.6	1.6	0.37	56.8%	24.3%	18.9%	
2005	0.72	0.13	0.49	0.10	0.00	17.7	68.2	14.2	0.0	0.31	9.1%	90.9%		
2006	0.63	0.21	0.32	0.10	0.00	34.1	50.5	15.4	0.0					
2007	0.21	0.03	0.09	0.09	0.01	13.5	43.2	40.5	2.7					
2008	0.37	0.01	0.28	0.07	0.00	3.8	76.2	19.0	1.0					