

SUMMARY

In 2011, higher summer flows in June and July prevented safe river access for conducting the early summer Reference count survey within the 20-mile reach of the Tuolumne River below La Grange Dam. The 3-day survey was conducted on September 16th – 19th and again on November 1st – 3rd. Preliminary USGS flow at La Grange was about 336 cfs and water temperature ranged from 13.5°C (56.3 F) to 18.6°C (65.5 F) in September and flow was about 356 cfs with water temperatures from 12.7°C (54.9 °F) to 14.7°C (58.5 °F) in November. A total of 66 juvenile Chinook salmon and 1,179 rainbow trout were observed in various habitats in September and 25 Chinook salmon (including adults) and 148 rainbow trout were observed in November. Chinook salmon were observed downstream to Riffle 57 (River Mile [RM] 31.5) and rainbow trout downstream to Riffle 41A (RM 35.3) in September and Chinook salmon were observed to Riffle 31 (RM 38) and rainbow trout to Riffle 57 (RM 31.5) in November. Other native fish species observed were Sacramento sucker, Sacramento pikeminnow, hardhead, and riffle sculpin with the non-native species recorded being largemouth bass, smallmouth bass, and striped bass during the two surveys. 2011 represents the second consecutive year in which striped bass were observed in the lower Tuolumne River.

Early summer surveys conducted in June/July have been completed in most years since 1986 except in years with extended high flows into the summer survey period (i.e., 1995, 1998, 2005, 2006, 2010, and 2011) that precluded the surveys.

Late summer surveys have been conducted in September of most years during the recent 2001–2011 period with the exception of 2008 and 2009. Rainbow trout were observed in all years surveyed with the highest counts seen in 2011 and the second highest counts seen in 2006. Chinook salmon were seen in much lower numbers or not at all for the same period of years with the highest counts observed in 2010.

The river-wide distribution of non-salmonid species (species other than trout or salmon) encountered in Reference count surveys shifted beginning in the summer of 1996. In surveys from 1982–1996, warmwater species (e.g. common carp, goldfish, catfish species, and sunfish species) were commonly observed, even upstream to Riffle 2 (RM 49.9). After 1996, these species were observed less frequently and typically only farther downstream. The change in species distribution coincided with higher required summer flows implemented with the 1996 FERC Order and lower upstream water temperatures associated with these flows.

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1 INTRODUCTION

Annual snorkel surveys have been conducted by the Turlock and Modesto Irrigation Districts (Districts) at locations along the lower Tuolumne River since 1982, with standard “Reference” locations established since 2001. The location, area sampled by site and season have varied over the years prior to 2001. The surveys completed from 1982–1987 were in limited locations and in varying seasons. A June/July snorkel survey has often been conducted since 1986 to evaluate the abundance, size, and distribution of salmonids and other fish species in “early summer” when required flow releases are less than in other seasons and is after the primary outmigration period of juvenile salmon. Summer surveys during June through September have been conducted in most years since 1988, although very wet years with high summer flows were not sampled for safety reasons. The surveys in 1988–1994 were part of the Districts’ “summer flow” studies examining conditions affecting Chinook salmon (*Oncorhynchus tshawytscha*) while those since 1996 were part of the Tuolumne River fish management program implemented under the current FERC license for the Don Pedro Project. A total of 12 sites per survey have been done since 2001 and a comparable September snorkel survey was done in 2001–2007 and again in 2010–2011. In 2011 the survey was conducted in September and was repeated in November. The 2011 surveys were implemented as required studies under the FERC order issued 10 May 2010 regarding *O.mykiss*.

Locations were selected to include a range of habitat types (i.e., riffles, runs, pools) at sites where salmonids may occur and are spaced at intervals down the river in general areas of suitable access. The overall river section examined is limited to the reach with suitable underwater visibility, this generally being about a 20-mile section from La Grange Dam (RM 52.2) downstream to near the city of Waterford (RM 31.5), although one site near RM 25 was sampled in 1988–1993.

1.1 2011 STUDY SITES

The area studied was the Tuolumne River from La Grange Dam (RM 52.2) to Hickman Bridge (RM 31.5) (Figure 1). Sites were selected based upon historical observations of fish habitat use, with presence/absence of fish at these sites and relative numbers used as indicators of river conditions such as flow and temperature. A total of twelve sites sampled are listed below. Riffle names are interchangeably designated with an “R” in this report (i.e. R21 = Riffle 21).

Site	Location	River Mile ^a
1	Old La Grange Bridge (Riffle A7)	50.7
2	Riffle 2	49.9
3	Riffle 3B	49.1
4	Basso Bridge (R5B)	47.9
5	Riffle 7	46.9
6	Zanker Farm (R13B)	45.5
7	Bobcat Flat (R21)	42.9
8	Tuolumne River Resort (R23C)	42.3
9	7/11 Gravel (R31)	38.0
10	Santa Fe Gravel (R35A)	37.1
11	Deardorff Farm (R41A)	35.3
12	Hickman Bridge (R57)	31.5

^a derived from topographic maps as distance from confluence with the San Joaquin River

1.2 2011 SAMPLING CONDITIONS

The flow at La Grange during 16–19 September was approximately 336 cfs and approximately 356 cfs during the 01–03 November survey (Figure 2). Water temperature ranged from 13.5 °C (56.3 °F) at Riffle A7 on 16 September to 18.6 °C (65.5 °F) at Riffle 57 on 18 September and 12.7°C (54.9 °F) at Riffle 7 on 02 November to 14.7°C (58.5 °F) at Riffle 57 on 03 November. The higher flows sampled this year required some modification to the survey methods as noted in the methods section.

2 METHODS

Underwater observations were conducted using an effort-based method where a snorkeler examined within a specified area for a given period of time and recorded the species, numbers, and size estimates of fish observed. A combination of different habitat types was observed, including riffles, runs, and pools. The overall river section examined is limited to the reach with suitable underwater visibility, this generally being a 20-mile section below La Grange Dam downstream to Waterford. The snorkeling method provided an index of species abundance and these surveys can be referred to as “Reference count” surveys.

Each habitat type sampled usually involved one observer who snorkeled the specified habitat area for a certain time period. Whenever feasible, the surveys were conducted moving upstream against the current. A side-to-side (zigzag) pattern was used as the width of the survey section required. Occasionally, two snorkelers moved upstream in tandem, with each person counting fish on their side of the center of the survey section. Whenever possible, the entire width of the habitat section selected was carefully surveyed. The only exceptions were the habitat areas that were too wide to effectively cover. If high water velocity precluded upstream movement, snorkelers would float downstream with the current, remaining as motionless as possible through the study area, although stream margins at those sites would still be viewed in an upstream direction. The 2011 surveys required more areas to be searched utilizing the downstream float method.

Usually the total length of an observed fish was estimated using a ruler outlined on the diving slate and recorded to the nearest 10 mm. For some larger fish, the lengths may be estimated by viewing the fish in reference to adjacent objects and then measuring that estimated length. In cases where larger numbers of fish are observed, the observer estimated the length range and number of fish in the group. Care was taken to observe and count each fish just once in the survey area.

Other data recorded for each location included water temperature, electrical conductivity, turbidity, dissolved oxygen, and horizontal visibility. Site-specific data that was recorded included area sampled, average depth, sample time, general habitat type, and substrate type.

3 RESULTS AND DISCUSSION

Survey conditions and fish observations from the snorkel survey conducted on 16–19 September and 01–03 November are summarized in Tables 1 and 2, respectively. The six native fish species observed were characteristic of the lower elevation zone adjacent to the Sierra foothills.

These species were Chinook salmon, rainbow trout, Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis*), hardhead (*Mylopharodon conocephalus*), and riffle sculpin (*Cottus gulosus*). The introduced (non-native) species observed were largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), redear sunfish (*Lepomis microlophus*), and striped bass (*Morone saxatilis*).

Chinook salmon were observed downstream to R57 (RM 31.5) and rainbow trout to R41A (RM 35.3) in September and Chinook salmon were observed to R31 (RM 38) and rainbow trout to R57 (RM 31.5) in November.

During the September surveys, there were 66 juvenile Chinook salmon observed in riffle, run, and run-pool habitats from RA7 (RM 50.7) near La Grange Dam downstream to R57 (RM 31.5), ranging in size from 70–140 mm total length (TL). There were 1,179 rainbow trout observed ranging in size from 70–520 mm TL and seen in riffle, run, and run-pool habitats. A total of 836 juvenile (<150 mm TL) and 343 adult rainbow trout were observed between RA7 (RM 50.7) and R41A (RM 35.3). Fish were observed in riffle, run, and run-pool habitats. Water temperature at those locations ranged from 13.5 °C (56.3 F) to 18.0 °C (64.4 F). Sacramento sucker, along with Sacramento pikeminnow and hardhead were often co-occurring, while riffle sculpin were observed at 3 locations in low numbers usually hidden under cobble/boulder substrate. Striped bass were observed at R2 (RM 49.9), R21 (R42.9), and R31 (RM 38.0) for only the second time during the Reference count surveys. The other year when striped bass were observed was in 2010.

During the November surveys, there were 25 Chinook salmon including 14 adult spawners observed in riffle, run and pool habitats from RA7 (RM 50.7) to R31 (RM 38.0) ranging in size from 60–90 mm TL for the juveniles and 320–650 mm TL for the adult spawners. The 148 rainbow trout observed ranged in size from 70–500 mm FL and were also observed in the similar combinations of riffle, run and pool habitats as the salmon. A total of 34 juvenile (<150 mm TL) and 114 adult rainbow trout were observed between RA7 (RM 50.7) and R57 (RM 31.5). Water temperature ranged from 12.7°C (54.9 °F) to 14.7°C (58.5 °F) at those locations. In comparison to other fish species observed in September, no striped bass were observed in November and only one hardhead was seen.

4 COMPARISON WITH OTHER YEARS

4.1 Rainbow trout and Chinook salmon: 1982-2011

Tables 3 and 4 summarize rainbow trout and Chinook salmon observations for all snorkel surveys conducted between 1982 and 2011. Low numbers of rainbow trout were observed downstream of La Grange Dam to Riffle 5 (RM 48.0) in limited surveys from 1982 to 1986. Rainbow trout were almost entirely absent from the lower Tuolumne River in surveys from 1987 to 1995 surveys. Beginning with the increased summer base flows implemented under the 1996 FERC Order, the number and distribution of rainbow trout increased and since 1999 these fish have been regularly observed at locations downstream to RM 42.9 or RM 42.3. For the 1982–2011 period, Chinook salmon were recorded in all years except 1991 and 1992 although in some years there counts were very low after May. Chinook salmon were also commonly seen downstream to about RM 42.9. Figures 3 and 4 graphically represent Tables 3 and 4 for the

June-September period, only. Dates and locations where rainbow trout and Chinook salmon were observed for the 2001-2011 period are in Figures 5 and 6.

4.2 Recent surveys: 2001-2011

Since the early summer snorkel survey could not be completed due to high flows in some years (2005, 2006, 2010, 2011), the comparative discussion will focus on the late summer (September) surveys. The number of rainbow trout and Chinook salmon observed for the 2001 to 2011 period were graphed by location for the September surveys (Figures 7 and 8). Rainbow trout were commonly observed in the upper 10 miles of river below the La Grange Dam. This is similar to the distribution of Chinook salmon although Chinook were occasionally seen as far downstream as Hickman Bridge (RM 31.5).

The locations sampled since 2001 were the same each year and these surveys were the most comparable showing presence or absence along the lower Tuolumne River by year and generally indicating abundance from observed counts. September surveys show Rainbow trout counts increased from 2001 to 2005 and were much higher beginning in 2006 (Figure 9). The observed increases in counts of rainbow trout in 2006 and 2011, especially of fish less than 250 mm TL, may be the result of increased spawning and rearing habitat downstream of the La Grange Dam combined with the potential introduction of trout from overflows of the La Grange reservoir during flood control releases during the spring of those years. Chinook salmon counts (Figure 10) in September were comparatively low.

In both 2010 and 2011, an additional Reference count survey was also conducted in November pursuant to the May 2010 FERC Order. Although observations of *O. mykiss* were generally similar in both November surveys (Table 3), the November 2011 observations represented an apparent reduction from the September 2011 counts. This pattern was not seen in the 2010 data and was possibly due to density dependent factors following the reduction in flows in September 2011. The density indices for the 2010 and 2011 surveys are shown in Figure 11.

4.3 Other species observed: 1986-2011

The distribution and abundance of non-salmonid fish species observed during the summer snorkel surveys has changed over time. Prior to 1996, more introduced warmwater species were commonly seen with goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), brown bullhead (*Ameiurus nebulosus*), white catfish (*Ameiurus catus*), and various sunfish species usually observed (Table 5). After 1996 these species were often absent at upstream sites or observed in lower numbers. The change in species distribution of warmwater species appears to be associated with higher minimum summer flow releases. In addition to *O. mykiss* and Chinook salmon, other native fish species observed in 2011 were Sacramento sucker, Sacramento pikeminnow, hardhead, and riffle sculpin with the non-native species recorded being largemouth bass, smallmouth bass, and striped bass. The observance of striped bass at R2, R21, and R31 during the September surveys was somewhat unusual. The only other year when striped bass were observed was 2010.

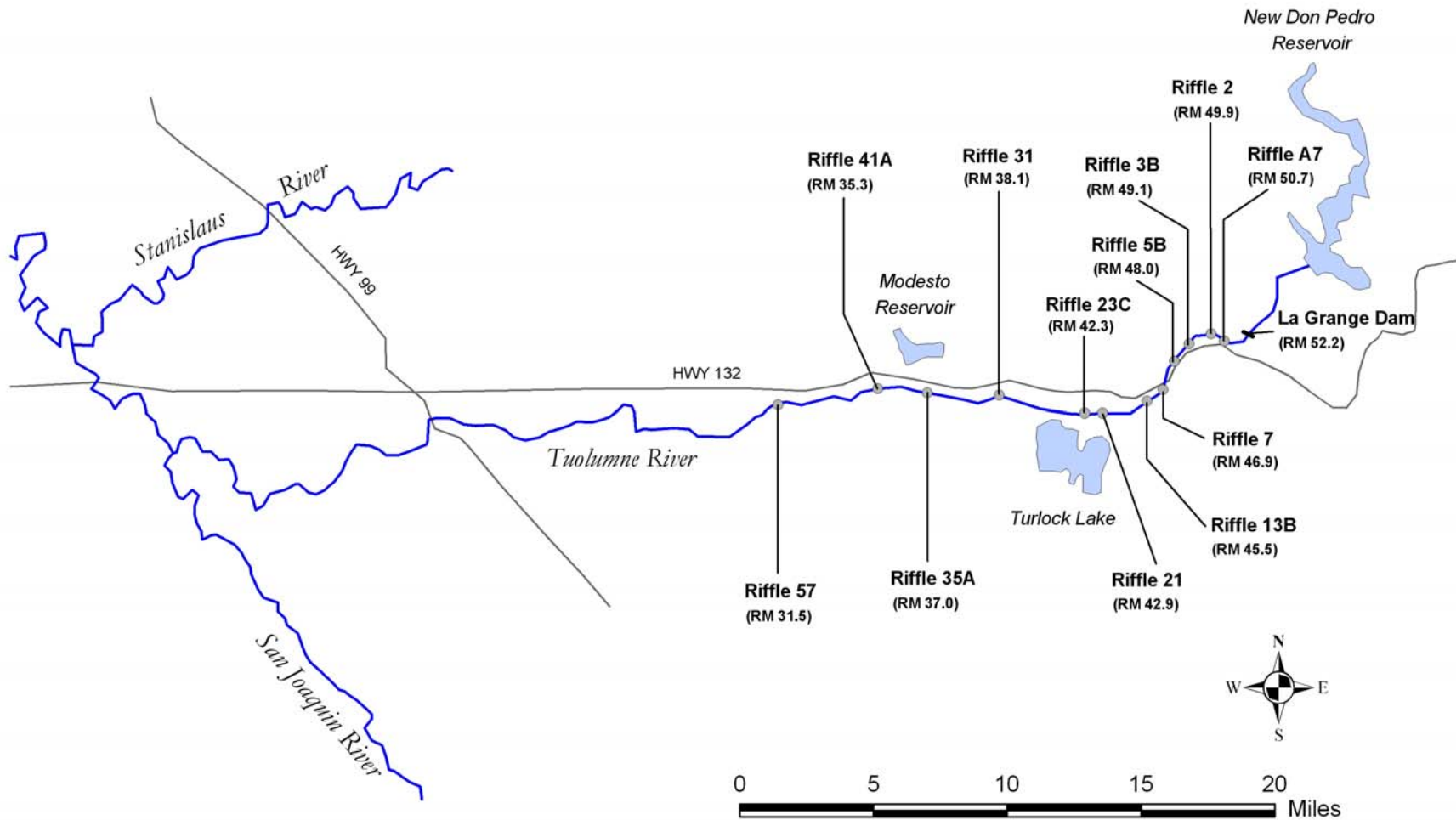


Figure 1. Locations of snorkel survey sites on the lower Tuolumne River, 2011.

2011 Tuolumne River daily mean flow
Provisional USGS data

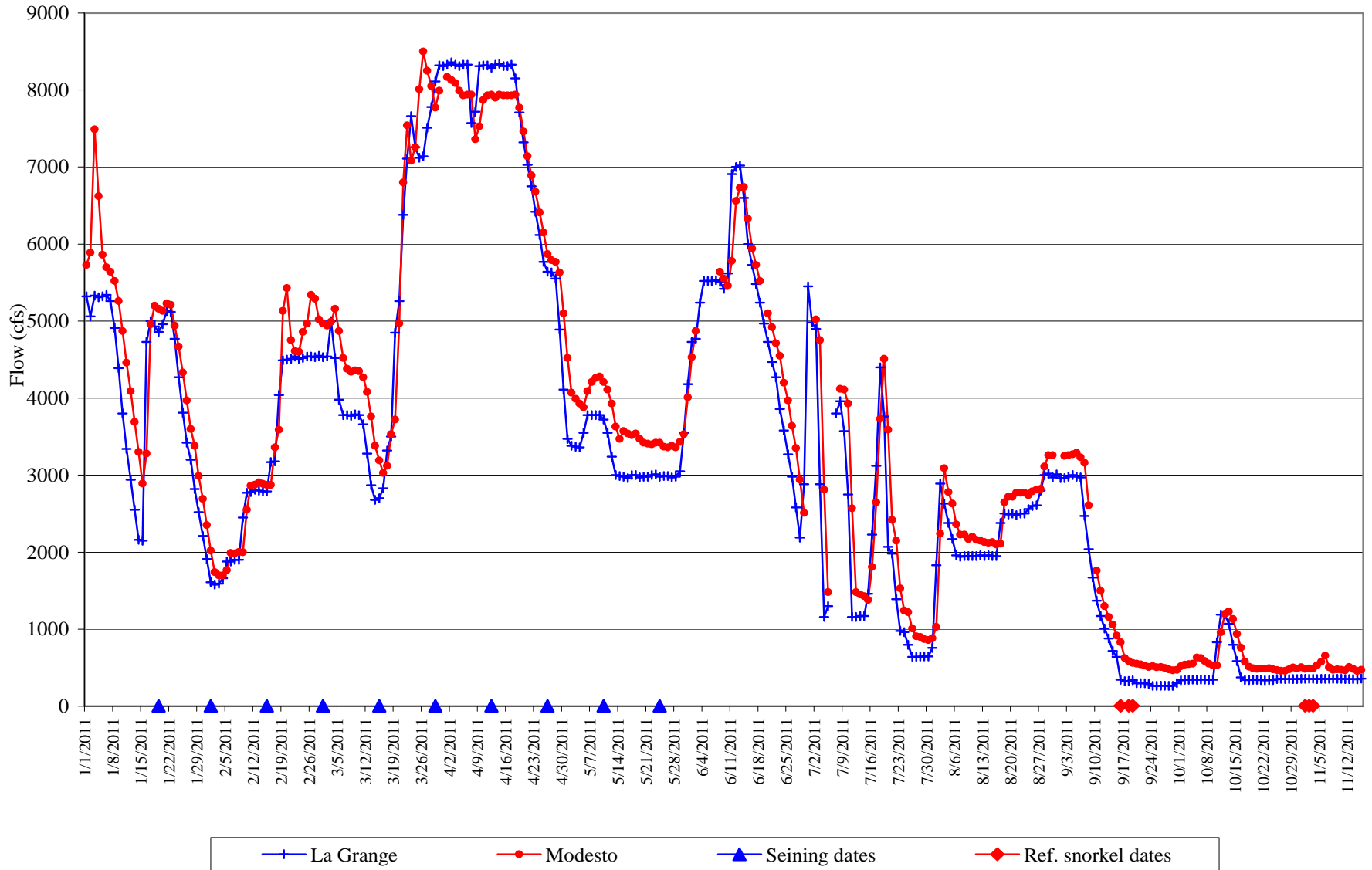


Figure 2. 2011 Tuolumne River flows at La Grange and Modesto

Locations where *O. mykiss* were observed during
the 1982 to 2011 Tuolumne River snorkel surveys (June-September)

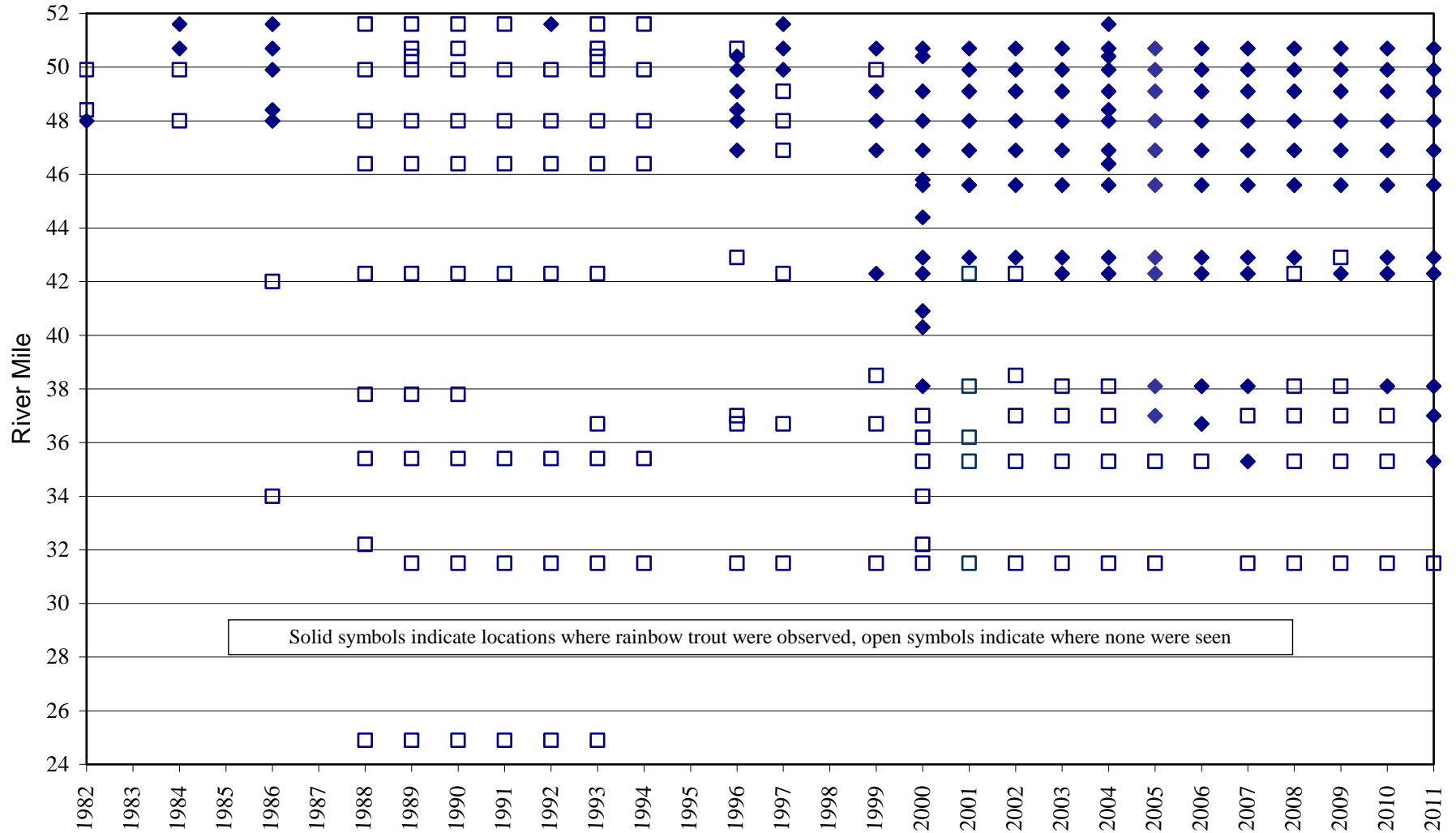


Figure 3. Locations where *O. mykiss* were observed

Locations where Chinook Salmon were observed during
the 1982 to 2011 Tuolumne River snorkel surveys (June-September)

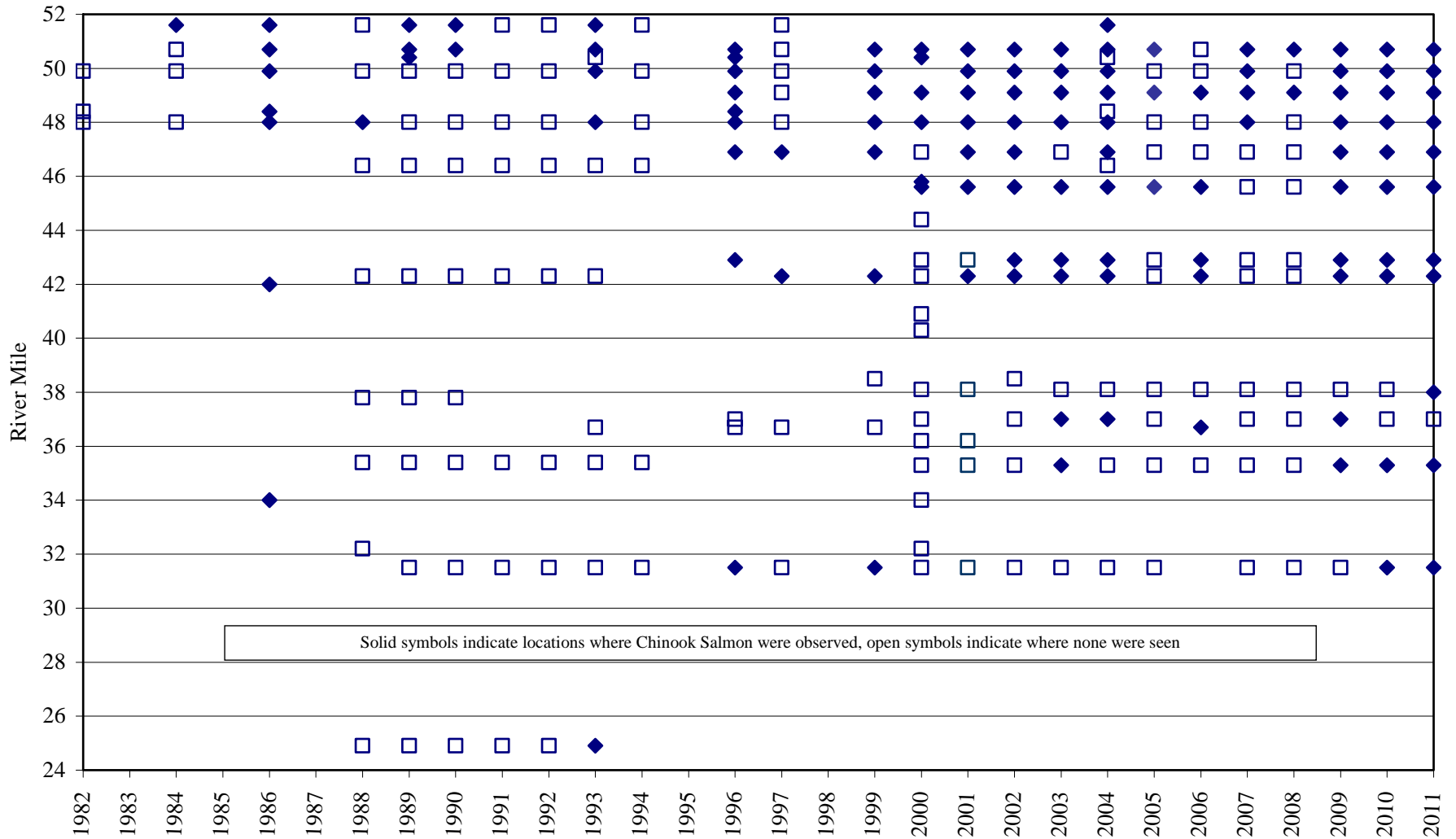


Figure 4. Locations where Chinook salmon were observed

Dates and locations when *O.mykiss* were observed during the 2001 to 2011 Tuolumne River snorkel surveys

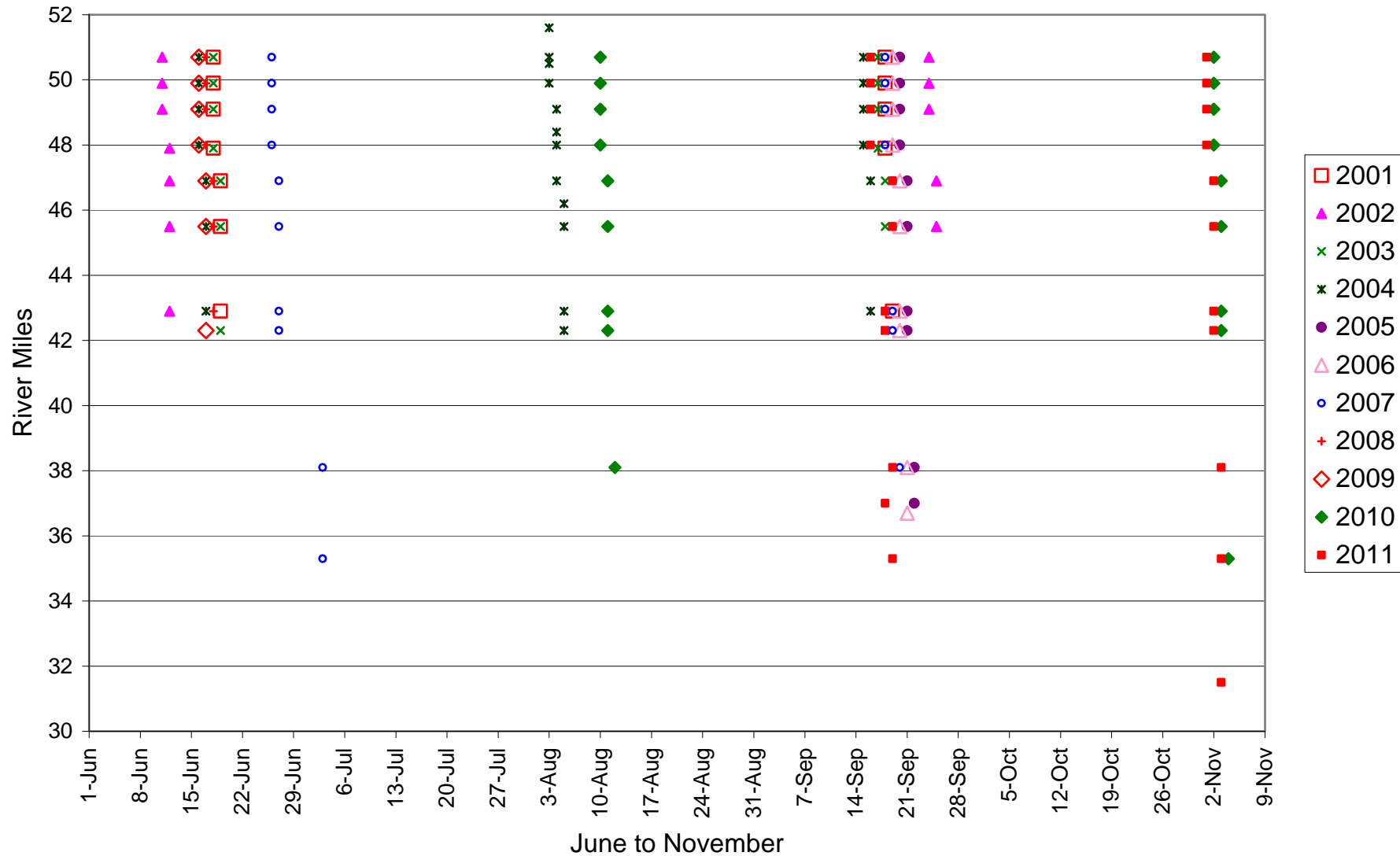


Figure 5. Dates and locations where *O. mykiss* were observed during the snorkel surveys

Dates and locations when Chinook Salmon were observed during the 2001 to 2011 Tuolumne River snorkel surveys

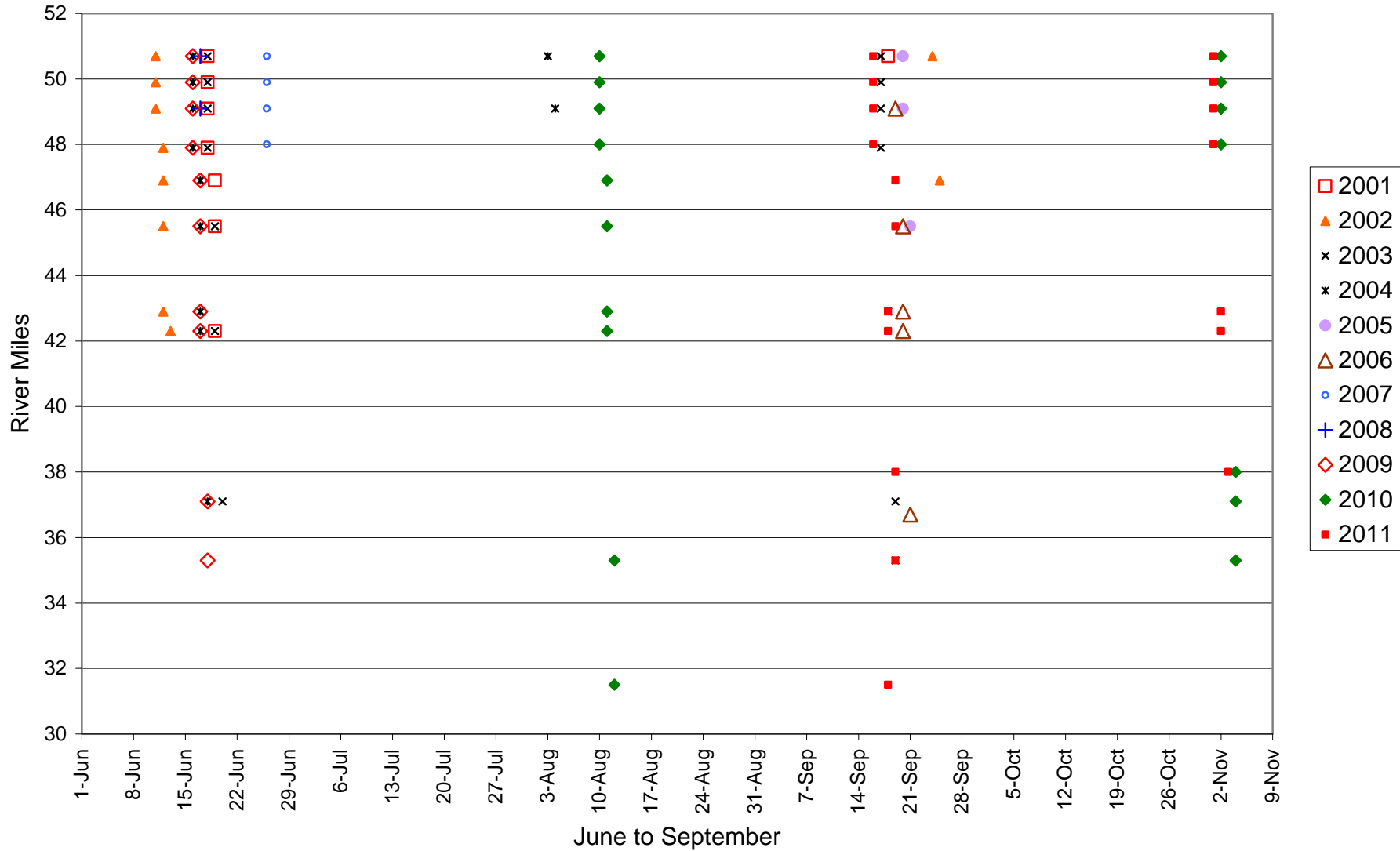


Figure 6. Dates and locations where Chinook Salmon were observed during the snorkel surveys.

Number of *O. mykiss* observed, by location, during the 2001 to 2011 Tuolumne River September snorkel surveys

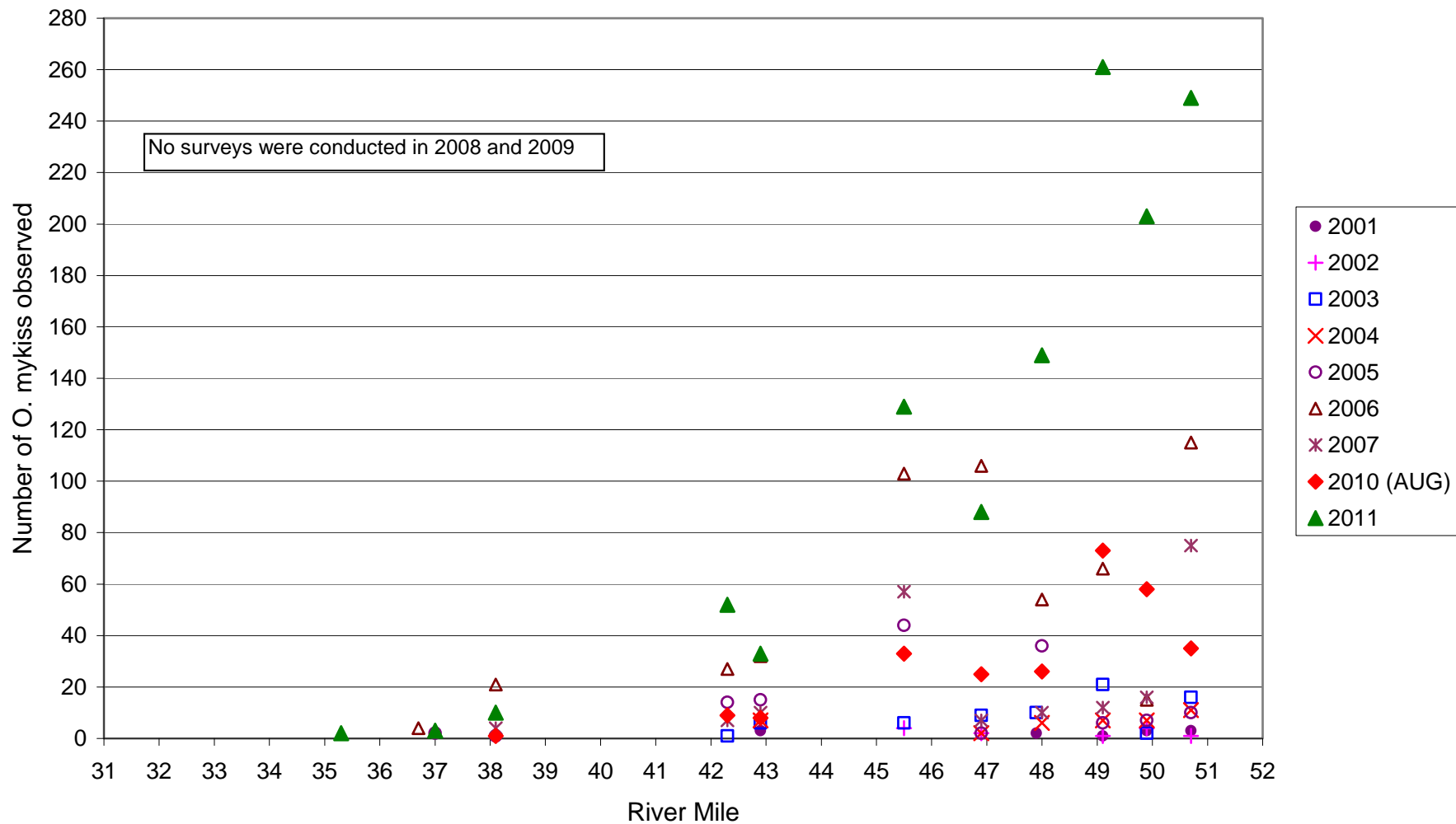


Figure 7. *O. mykiss* observations during the September snorkel surveys

Number of Chinook Salmon observed, by location, during the 2001 to 2011 Tuolumne River September snorkel surveys

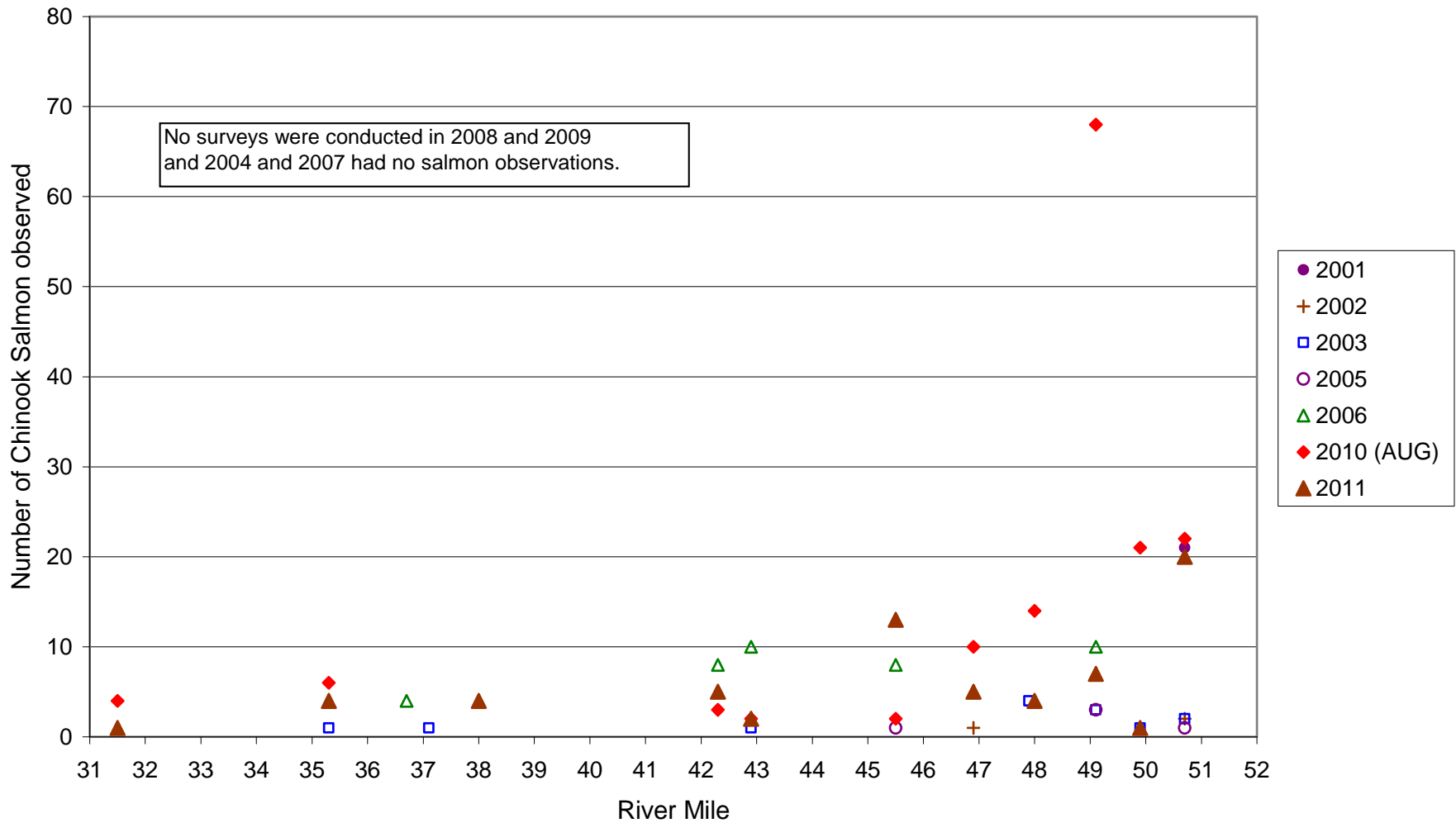


Figure 8. Chinook salmon observations during the September snorkel surveys

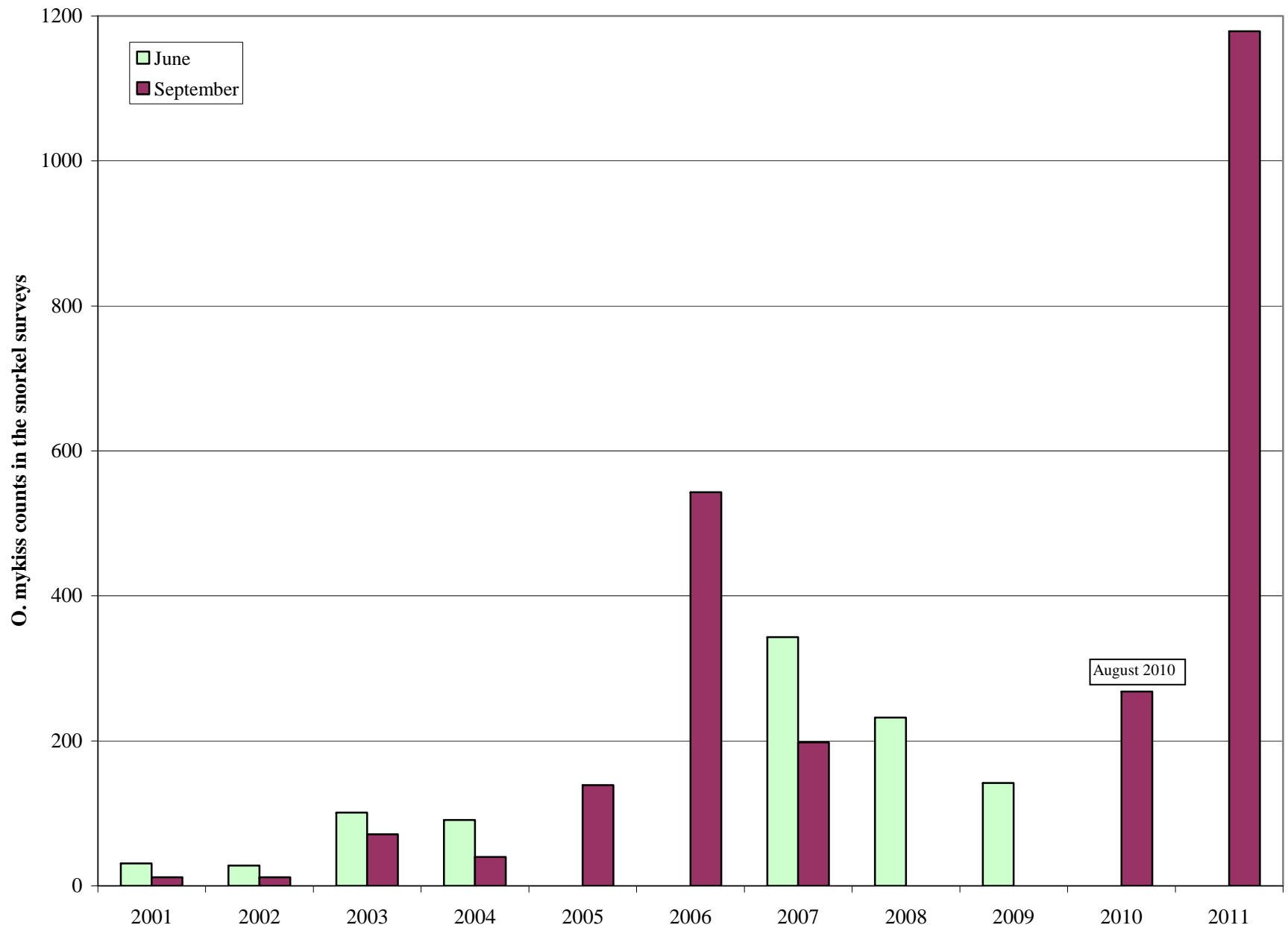


Figure 9. *O. mykiss* counts during the June and September snorkel surveys

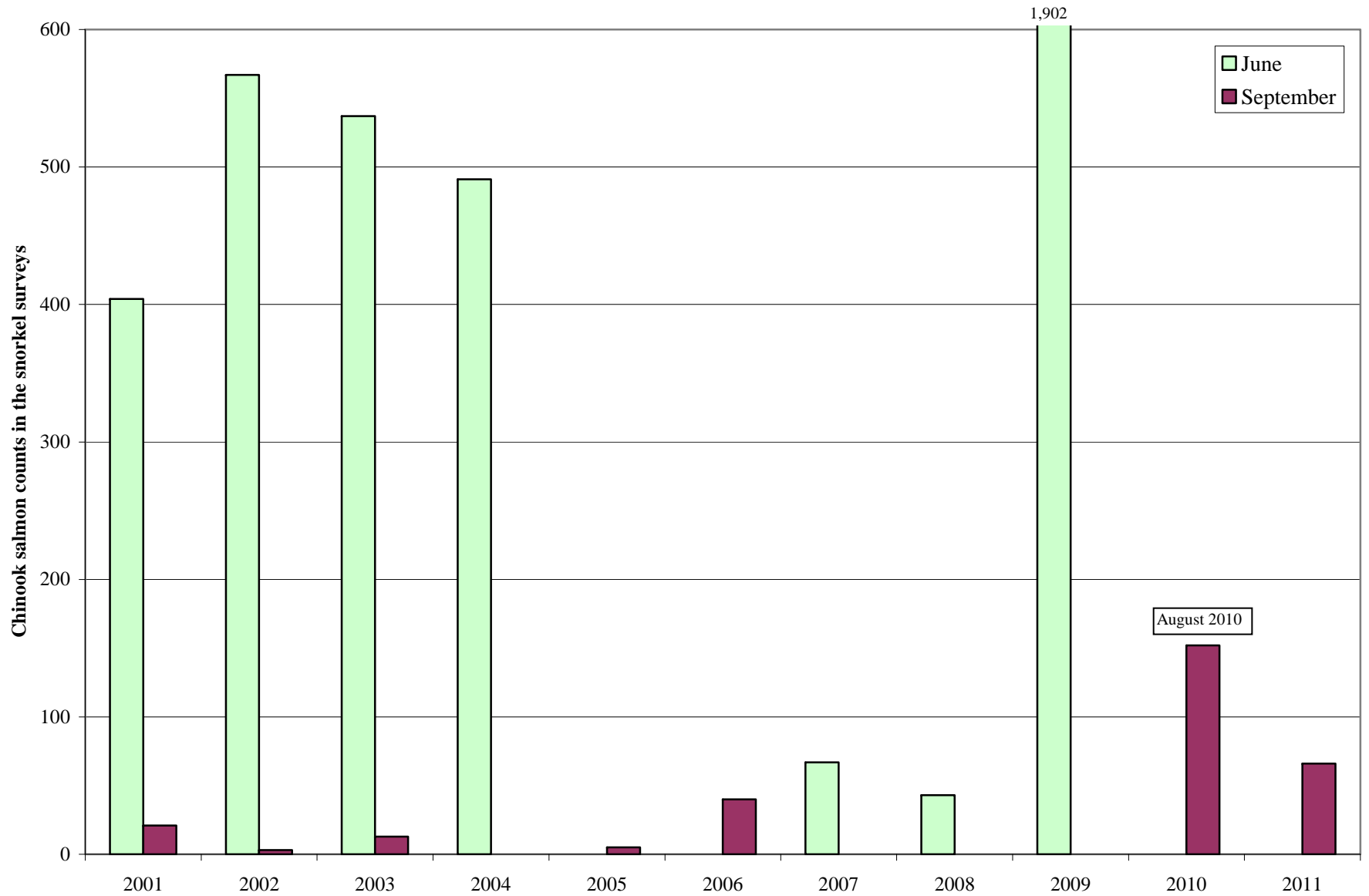


Figure 10. Chinook salmon counts during the June and September snorkel surveys

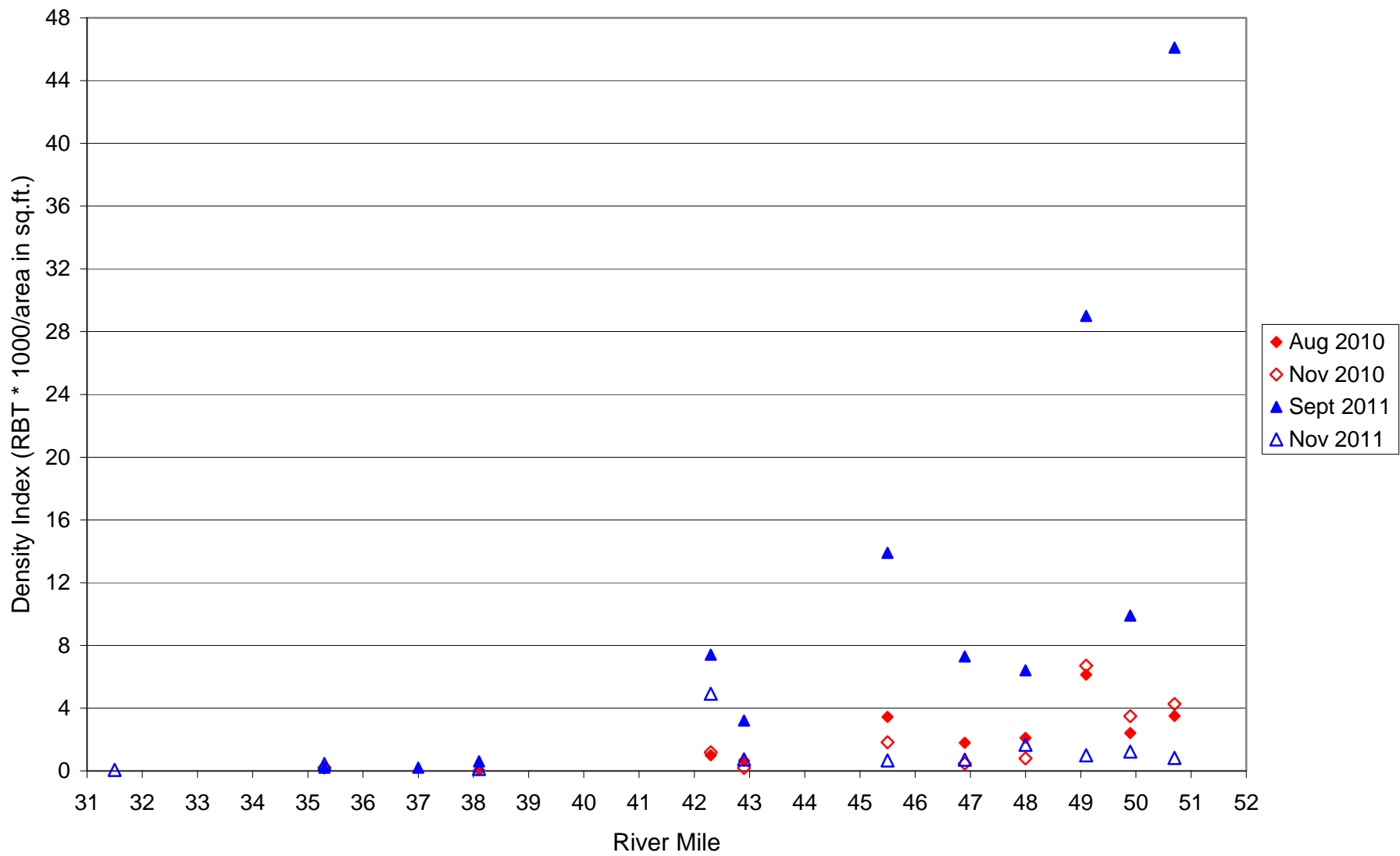


Figure 11. *O. mykiss* density indices for 2010 and 2011 snorkel surveys.

TABLE 1. 2011 TUOLUMNE RIVER SNORKEL SUMMARY (TID/MID)

DATE	START TIME	LOCATION	RIVER MILE	SITE	AREA (Sq. Ft.)	AVG. DEPTH (FEET)	TIME (Min.)	HABITAT	SUBSTRATE	WATER TEMP. (C)	DO (mg/l)	EC	TURB. (NTU)	HORIZ. VISIB. (FEET)	NUMBER COUNTED (ESTIMATED TOTAL LENGTH OR SIZE RANGE IN MM)										
															CHINOOK count/est.	CHINOOK size	RAINBOW count/est.	RAINBOW size	SACRAMENTO SUCKER	SACRAMENTO PIKEMINNOW	RIFFLE SCULPIN	LARGEMOUTH BASS	SMALLMOUTH BASS	STRIPED BASS	
16SEP	1023	Riffle A7	50.7	1	3,000	3.3	13.0	Riffle-Run	cobble,boulder,bedrock	13.5	12.5	20	0.9	23.0	10	(70-100)	50 110	(70-140) (160-400)			(80)				
	1027			2	2,400	3.5	22.0	Run	gravel,cobble,sand						10	(90-110)	82 7	(70-140) (200-320)							
16SEP	1148	Riffle 2	49.9	1	6,000	1.5	20.0	Riffle	cobble,gravel,boulder	15.0	11.0	25	0.9	18.0	1	(110)	44 10	(80-140) (160-240)			(50,60,70)				
	1203			2	4,500	7.0	18.0	Pool-Run	bedrock,cobble,boulder								52 7	(80-140) (280-500)					(400)		
	1205			3	10,000	5.0	17.0	Run-Pool	cobble,gravel,bedrock								57 33	(70-140) (160-450)							
16SEP	1400	Riffle 3B	49.1	1	4,000	2.2	15.0	Riffle	cobble,gravel,sand	15.8	9.9	20	0.9	20.0			81 13	(80-140) (160-425)							
	1358			2	5,000	2.4	13.0	Run-Riffle	cobble,gravel,boulder						7	(70-130)	110 57	(70-140) (160-380)							
16SEP	1505	Riffle 5B	47.9	1	2,000	2.5	12.0	Riffle	cobble,gravel,sand	16.2	9.8	24	0.8	18.0			12 6	(80-140) (160-425)							
	1524			2	11,250	4.5	32.0	Run	cobble,bedrock,gravel						4	100-110)	59 20	(90-140) (160-460)							
	1500			3	10,000	4.5	15.0	Run-Pool	cobble,bedrock,boulder								35 17	(70-140) (160-380)			(420,440)				
					58,150	177.0																			
									Subtotal						32		862			2	4			1	
19SEP	1420	Riffle 7	46.9	1	5,000	1.5	20.0	Riffle	cobble,gravel,sand	15.5	9.6	21	1.0	18.0			40 4	(100-140) (360-420)							
	1425			2	7,000	5.5	18.0	Run	bedrock,cobble,sand						5	(90-110)	26 18	(110-140) (150-520)	(80)		(500)				
19SEP	1318	Riffle 13B	45.5	1	5,250	3.0	16.0	Run	cobble,gravel,sand	14.9	9.2	24	1.0	20.0	3	80-100)	60 7	(70-140) (160-240)							
	1323			2	4,000	2.5	16.0	Riffle	gravel,cobble,sand						10	(80-110)	62	(80-140)	(80)						
18SEP	1059	Riffle 21	42.9	1	4,375	2.5	18.0	Riffle	cobble,gravel,boulder	14.8	8.8	28	1.2	15.0	2	(80,80)	13 8	(110-140) (160-200)							
	1105			2	6,000	6.0	17.0	Run-Pool	cobble,gravel,sand								6 6	(100-140) (160-520)	(450)				(500)		
18SEP	0950	Riffle 23C	42.3	1	3,000	2.5	13.0	Run-Riffle	cobble,gravel,bedrock	15.0	9.7	24	1.3	14.0	2	(80,90)	23 12	(100-140) (160-460)							
	0949			2	4,000	2.0	14.0	Riffle	cobble,gravel,bedrock						3	(80-100)	14 3	(90-140) (160,180,340)							
					38,625	132.0			Subtotal						25		302			3	1			1	
19SEP	0916	Riffle 31	38.0	1	6,000	1.8	18.0	Riffle	cobble,gravel,boulder	16.3	8.8	34	1.2	16.0	1	(100)	2	(120,320)	(700)						
	0918			2	12,000	4.0	17.0	Run-Pool	cobble,gravel,sand						3	(90,90,100)	6 2	(110-140) (240,260)	65(400-800)		(140)			(480)	
18SEP	1316	Riffle 35A	37.1	1	4,500	1.8	18.0	Riffle	cobble,gravel,sand	18.0	8.0	34	2.4	14.0			2	(130,400)			7(70-80)				
	1317			2	11,250	3.0	18.0	Run	cobble,gravel,sand								1	(180)	9(60-100)		7(60-100),(240,260,280)	(70,80)			
19SEP	1106	Riffle 41A	35.3	1	3,000	2.0	17.0	Run-Riffle	cobble,gravel,sand	17.1	9.0	35	1.1	13.0	1	(140)	2	(120,140)			5(60-90)			(160)	
	1106			2	2,500	4.5	7.0	Run-Pool	sand,gravel,bedrock						3	(100-120)									
	1113			3	6,000	2.0	13.0	Riffle	cobble,gravel,sand										12(80-110)		32(60-90)				
18SEP	1432	Riffle 57	31.5	1	13,125	1.8	18.0	Riffle	cobble,gravel,boulder	18.6	9.2	37	1.5	13.0	1	(110)			25(360-500)		(140)		(160)		
	1434			2	7,000	2.8	16.0	Run	cobble,gravel,bedrock										(600)		(360,450)		6(160-280)		
					65,375	142.0			Subtotal						9		15			113	56	2	2	8	1
									TOTAL#						66		1179			116	59	6	2	8	3

TABLE 2. 2011 TUOLUMNE RIVER SNORKEL SUMMARY (TID/MID)

DATE	START TIME	LOCATION	RIVER MILE	SITE	AREA (Sq. Ft.)	AVG.		HABITAT	SUBSTRATE	WATER TEMP. (C)	DO (mg/l)	EC	TURB. (NTU)	HORIZ. VISIB. (FEET)	NUMBER COUNTED (ESTIMATED TOTAL LENGTH OR SIZE RANGE IN MM)									
						DEPTH (FEET)	TIME (Min.)								CHINOOK count/est.	CHINOOK size	RAINBOW count/est.	RAINBOW size	SACRAMENTO SUCKER	SACRAMENTO PIKEMINNOW	RIFFLE SCULPIN	HARDHEAD		
01NOV	1006 1008	Riffle A7	50.7	1 2	5,000 2,250	3.3 3.5	23.0 20.0	Riffle-Run Run	cobble,boulder,gravel gravel,cobble,sand	13.0	12.6	20	0.9	22.0	4 2	(380-550) (500,600)	6	(160-340)			(70,80)			
01NOV	1132 1147 1150	Riffle 2	49.9	1 2 3	6,000 6,000 10,000	1.5 7.0 5.0	20.0 20.0 16.0	Riffle Pool-Run Run-Pool	cobble,gravel,boulder bedrock,cobble,boulder cobble,gravel,bedrock	13.7	12.3	26	1.1	16.0	No fish observed 2 1	(320,360) (480)	4 23	(300-360) (220-350)		(420)				
01NOV	1336 1338	Riffle 3B	49.1	1 2	3,000 5,000	2.2 2.4	14.0 17.0	Riffle Run-Riffle	cobble,gravel,sand cobble,gravel,boulder	14.2	10.7	31	1.0	15.0	2 2	(470,490)	5 3	(160-360) (240,240,320)			(30)			
01NOV	1447 1515 1445	Riffle 5B	47.9	1 2 3	2,000 12,000 10,500	2.5 4.5 4.5	11.0 26.0 16.0	Riffle Run Run-Pool	cobble,gravel,sand cobble,bedrock,gravel cobble,bedrock,boulder	14.5	10.7	21	0.8	15.0	2 2 2	(490,500)	4 4 2	(360,380) (380-500) (130,140)						
					61,750	183.0		Subtotal							13		82			1	3			
02NOV	1004 1002	Riffle 7	46.9	1 2	5,000 7,500	1.5 5.5	15.0 16.0	Riffle Run	cobble,gravel,sand bedrock,cobble,sand	12.7	12.7	25	1.0	18.0			1 8	(280) (300-480)			(380,420)			
02NOV	1108 1102	Riffle 13B	45.5	1 2	7,000 5,000	2.5 2.5	18.0 15.0	Run Riffle	cobble,gravel,sand gravel,cobble,sand	13.0	9.8	24	0.9	18.0	No fish observed		1 7	(140) (160-210)						
02NOV*	1253 1300	Riffle 21	42.9	1 2	7,000 4,000	2.5 7.0	20.0 11.0	Riffle Pool	cobble,gravel,sand cobble,gravel,sand	13.4	10.9	27	0.9	15.0	1	(70)	7 1	(130-140) (120)	(70,70,80)					
02NOV	1428 1430	Riffle 23C	42.3	1 2	2,500 4,000	2.0 2.0	17.0 15.0	Run-Riffle Riffle	cobble,gravel,bedrock cobble,gravel,bedrock	14.2	N.A.	25	1.1	14.0	8 2	(60-80) (80,90)	11 10 10 1	(100-140) (150-230) (70-140) (150)						
					42,000	127.0		Subtotal							11		57		3	2				
03NOV	0938 0940	Riffle 31	38.0	1 2	6,000 10,000	2.5 4.0	16.0 18.0	Riffle Run-Pool	cobble,gravel,boulder cobble,gravel,sand	13.3	11.6	34	1.6	14.0	1	(650)	1 1	(140) (330)						
03NOV	1052 1050	Riffle 35A	37.1	1 2	4,000 8,750	1.5 3.3	17.0 16.0	Riffle Run	cobble,gravel,sand cobble,gravel,sand	14.1	10.7	31	1.3	14.0					60(50-90)	70(50-80) (70), 6(300-350)				
03NOV	1245 1243 1250	Riffle 41A	35.3	1 2 3	3,000 2,500 8,000	2.0 4.5 2.0	15.0 7.0 10.0	Run-Riffle Run-Pool Riffle	cobble,gravel,sand sand,gravel,bedrock cobble,gravel,sand	14.2	10.9	32	1.3	14.0	No fish observed			4 2	(180-420) (130,280)					
03NOV	1352 1353	Riffle 57	31.5	1 2	7,500 7,000	2.0 2.8	14.0 15.0	Riffle Run	cobble,gravel,boulder cobble,gravel,bedrock	14.7	10.6	38	1.3	12.0			1	(280)	20(400-600) 40(300-550)	(380) 4(180-280)		(300)		
					56,750	128.0		Subtotal							1		9		120	82		1		
TOTAL#															25		148		123		85		3	1

Table 3. Tuolumne River snorkel survey locations (1982-2010) with number of O. mykiss observed, otherwise none were seen.

	1982	1984		1985	1986		1987			1988					1989				1990				1991		1992	
	AUG	APR	AUG	MAR	JUL	AUG	JAN	APR	OCT	MAY	JUN	JUL	AUG	SEP	MAY	JUN	JUL	SEP	MAY	JUN	JUL	SEP	JUN	SEP	JUN	SEP
LOCATIONS																										
Riffle A3/A4 (RM 51.6)			27	2		6			X	X				X	X	X	X	X	X	X	X	X	X	X	1	X
Riffle A7 (RM 50.7)			26			13			X					X	X		X		X							
Riffle 1A (RM 50.4)									X							X										
Riffle 2 (RM 49.9)	X		X			25	X	X		X				X			X		X	X		X	X	X	X	X
Riffle 3B (RM 49.1)																										
Riffle 4B (RM 48.4)	X	12		X	5	10																				
Riffle 5B (RM 48.0)	2	X	X	X		10	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Riffle 7 (RM 46.9)																										
Riffle 9 (RM 46.4)										X				X			X		X		X	X	X	X	X	X
Riffle 12 (RM 45.8)																										
Riffle 13A-B (RM 45.6)																										
Riffle 17A2 (RM 44.4)																										
Riffle 21 (RM 42.9)																										
Riffle 23B-C (RM 42.3)										X				X			X		X		X	X	X	X	X	X
Riffle 24 (RM 42.0)					X																					
Riffle 26 (RM 40.9)																										
Riffle 27(RM 40.3)																										
Riffle 30B (RM 38.5)																										
Riffle 31 (RM 38.1)																										
Riffle 33 (RM 37.8)										X				X			X		X		X					
Riffle 35A (RM 37.0)																										
Riffle 36A (RM 36.7)																										
Riffle 37 (RM 36.2)									X																	
Riffle 39-40 (RM 35.4)										X				X			X		X		X	X	X	X	X	X
Riffle 41A (RM 35.3)																										
Riffle 46 (RM 34.0)					X		X																			
Riffle 52B (RM 32.2)										X				X												
Riffle 57-58 (RM 31.5)		X		X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Charles (RM 24.9)										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Total O.mykiss	2	12	53	2	5	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	

Table 3 (cont). Tuolumne River snorkel survey locations (1982-2010) with number of O. mykiss observed, otherwise none were seen.

LOCATIONS	1993				1994			1995	1996	1997	1999	2000		2001		2002		2003		2004			2005	2006	2007		2008	2009	2010		2011		
	MAY	JUN	JUL	OCT	MAY	JUL	OCT	NOV	JUL	JUN	JUN	JUN	JUN	SEP	JUN	SEP	JUN	SEP	JUN	AUG	SEP	SEP	SEP	JUN	SEP	JUN	JUN	AUG	NOV	SEP	NOV		
Riffle A3/A4 (RM 51.6)	X	X	X	X		X	X	X					4								5												
Riffle A7 (RM 50.7)	X	X	X	X	X			1	X	2	14	14	7	3	5	1	66	16	12	6	11	10	115	106	75	76	80	35	33	249	6		
Riffle 1A (RM 50.4)	X	X		X				51				3							4														
Riffle 2 (RM 49.9)	X	X		X		X	X		91	2	X		3	3	1	4	8	2	23	2	7	7	15	34	16	9	12	58	67	203	27		
Riffle 3B (RM 49.1)									138	X	31	14	8	1	11	1	5	21	22	5	7	6	66	45	12	78	27	73	67	261	8		
Riffle 4B (RM 48.4)	X								55										8														
Riffle 5B (RM 48.0)	X		X		X	X	X	2	45	X	10	19	4	2	3	X	6	10	11	15	6	36	54	92	10	21	11	26	16	149	41		
Riffle 7 (RM 46.9)									4	X	15	52	4	X	5	2	14	9	13	5	2	2	106	22	7	13	6	25	6	88	9		
Riffle 9 (RM 46.4)	X	X		X		X	X												3														
Riffle 12 (RM 45.8)												5																					
Riffle 13A-B (RM 45.6)	X											20	3	X	2	4	1	6	5	13	X	46	103	15	57	24	4	33	14	129	8		
Riffle 17A2 (RM 44.4)												14																					
Riffle 21 (RM 42.9)									X			27	2	3	1	X	X	6	5	9	7	15	32	10	10	11	X	8	2	33	8		
Riffle 23B-C (RM 42.3)			X		X					X	9	4	X	X	X	X	1	1	X	1	X	14	27	5	7	X	2	9	10	52	32		
Riffle 24 (RM 42.0)	X						X																										
Riffle 26 (RM 40.9)												4																					
Riffle 27(RM 40.3)												2																					
Riffle 30B (RM 38.5)										X					X	X																	
Riffle 31 (RM 38.1)												2	X	X			X	X	X	X	X	1	21	12	4	X	X	1	X	10	2		
Riffle 33 (RM 37.8)																																	
Riffle 35A (RM 37.0)								X				X			X	X	X	X	X	X	X	2		X	X	X	X	X	X	3	X		
Riffle 36A (RM 36.7)	X		X		X			X	X	X												4											
Riffle 37 (RM 36.2)												X	X	X																			
Riffle 39-40 (RM 35.4)		X		X		X	X																										
Riffle 41A (RM 35.3)												X	X	X	X	X	X	X	X	X	X	X	X	2	X	X	X	X	3	2	6		
Riffle 46 (RM 34.0)												X																					
Riffle 52B (RM 32.2)												X																					
Riffle 57-58 (RM 31.5)	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1		
Charles (RM 24.9)		X		X		X																											
Total O.mykiss	0	0	0	0	0	0	0	3	384	8	79	180	31	12	28	12	101	71	91	76	40	139	543	343	198	232	142	268	218	1179	148		

Data in bold type (JUL96, RA7 to R5B) was collected by CDFG using different survey methods that are not comparabl

Table 4. Tuolumne River snorkel survey locations (1982-2010) with number of Chinook Salmon observed, otherwise none were seen.

	1982		1984		1985	1986		1987			1988					1989				1990				1991		1992			
	AUG		APR	AUG	MAR	JUL	AUG	JAN	APR	OCT	MAY	JUN	JUL	AUG	SEP	MAY	JUN	JUL	SEP	MAY	JUN	JUL	SEP	JUN	SEP	JUN	SEP		
LOCATIONS																													
Riffle A3/A4 (RM 51.6)				7	X		75			X	3				X	127	56	18	X		135	12	X	X		X	X	X	X
Riffle A7 (RM 50.7)				X			20			X					X	11			X		144		3						
Riffle 1A (RM 50.4)										150	22							25											
Riffle 2 (RM 49.9)	?			X			50	100+	100+		1				X				X		11	X		X		X	X	X	X
Riffle 3B (RM 49.1)											1																		
Riffle 4B (RM 48.4)	?	?			60	30	25				1																		
Riffle 5B (RM 48.0)	?	?	X	X			40	130	400		129	1	X	X	X	X			X	X	X	X		X	X	X	X	X	X
Riffle 7 (RM 46.9)																													
Riffle 9 (RM 46.4)											3				X	X			X				X	X		X	X	X	X
Riffle 12 (RM 45.8)																													
Riffle 13A-B (RM 45.6)																													
Riffle 17A2 (RM 44.4)																													
Riffle 21 (RM 42.9)																													
Riffle 23B-C (RM 42.3)											X				X				X		X		X	X		X	X	X	X
Riffle 24 (RM 42.0)						10																							
Riffle 26 (RM 40.9)																													
Riffle 27(RM 40.3)																													
Riffle 30B (RM 38.5)																													
Riffle 31 (RM 38.1)																													
Riffle 33 (RM 37.8)											1				X	X			X		X		X						
Riffle 35A (RM 37.0)																													
Riffle 36A (RM 36.7)																													
Riffle 37 (RM 36.2)																													
Riffle 39-40 (RM 35.4)															X				X		X		X	X		X	X	X	X
Riffle 41A (RM 35.3)																													
Riffle 46 (RM 34.0)							8				800+																		
Riffle 52B (RM 32.2)											X				X														
Riffle 57-58 (RM 31.5)			?		40										X				X		X		X	X		X	X	X	X
Charles (RM 24.9)											X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Total Chinook Salmon	0	0	7	100	48	210	1030+	690+	0	161	1	0	0	0	127	67	43	0	294	12	3	0	0	0	0	0	0	0	

Table 4 (cont). Tuolumne River snorkel survey locations (1982-2010) with number of Chinook Salmon observed, otherwise none were seen.

LOCATIONS	1993				1994			1995	1996	1997	1999	2000	2001		2002		2003		2004			2005	2006	2007		2008	2009		2010		2011			
	MAY	JUN	JUL	OCT	MAY	JUL	OCT	NOV	JUL	JUN	JUN	JUN	JUN	SEP	JUN	SEP	JUN	SEP	JUN	AUG	SEP	SEP	SEP	JUN	SEP	JUN	JUN	AUG	NOV	SEP	NOV			
Riffle A3/A4 (RM 51.6)	9	35	X	10		X	X	2		X									X															
Riffle A7 (RM 50.7)	54	X	2	7	X			17	20	X	23	211	277	21	429	2	426	2	390	77	X	1	X	13	X	26	1401	22	51	20	6			
Riffle 1A (RM 50.4)	14	X		7					29										X															
Riffle 2 (RM 49.9)	6	2		11		X	X		16	X	3		4	X	10	X	72	1	16	X	X	X	X	18	X	X	43	21	32	1	3			
Riffle 3B (RM 49.1)									4	X	108	34	52	X	83	X	16	3	59	3	X	3	10	32	X	17	333	68	35	7	2			
Riffle 4B (RM 48.4)	5								43										X															
Riffle 5B (RM 48.0)	33		3	3	29	X	X	3	154	X	20	35	47	X	17	X	4	4	4	X	X	X	X	4	X	X	92	14	20	4	2			
Riffle 7 (RM 46.9)									20	1	57	X	17	X	15	1	X	X	4	X	X	X	X	X	X	X	9	10	X	5	X			
Riffle 9 (RM 46.4)	3	X		7		X	X												X															
Riffle 12 (RM 45.8)												6																						
Riffle 13A-B (RM 45.6)	X	X		X									5	6	X	10	X	9	X	3	X	X	1	8	X	X	X	2	2	X	13	X		
Riffle 17A2 (RM 44.4)												X																						
Riffle 21 (RM 42.9)												X	X	X	1	X	X	1	7	X	X	X	10	X	X	X	7	2	X	2	1			
Riffle 23B-C (RM 42.3)			X	X	2			1		2	1	X	1	X	2	X	8	X	1	X	X	X	8	X	X	X	12	3	X	5	10			
Riffle 24 (RM 42.0)	X	X						1																										
Riffle 26 (RM 40.9)												X																						
Riffle 27(RM 40.3)												X																						
Riffle 30B (RM 38.5)											X				X	X																		
Riffle 31 (RM 38.1)												X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	30	4	1
Riffle 33 (RM 37.8)																																		
Riffle 35A (RM 37.0)					X							X			X	X	2	1	7	X	X	X			X	X	X	1	X	1	X	X		
Riffle 36A (RM 36.7)	8		X	X	X					X	X	X											4											
Riffle 37 (RM 36.2)												X	X	X																				
Riffle 39-40 (RM 35.4)		X		X		X	X																											
Riffle 41A (RM 35.3)												X	X	X	X	X	X	1	X	X	X	X	X	X	X	X	2	6	1	4	X			
Riffle 46 (RM 34.0)												X																						
Riffle 52B (RM 32.2)												X																						
Riffle 57-58 (RM 31.5)	X	X		X	5	X	X			1	X	1	X	X	X	X	X	X	X	X	X	X			X	X	X	X	4	X	1	X		
Charles (RM 24.9)		1		X																														
Total Chinook Salmon	132	38	5	45	36	0	0	24	289	3	213	338	404	21	567	3	537	13	491	80	0	5	40	67	0	43	1902	152	170	66	25			

Data in bold type (JUL96, RA7 to R5B) was collected by CDFG using different survey methods that are not comparable

Table 5. Fish species observed in the Tuolumne River snorkel surveys during the June-September period.

Summary table of fish species observed in the Tuolumne River snorkel studies 1986 to 2010, June to September survey period.

FAMILY	COMMON NAME	NATIVE SPECIES	ABBREV.	1986	1988	1989	1990	1991	1992	1993	1994	1996	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Petromyzontidae	Pacific lamprey	N	LP	X										X					X						X	
Salmonidae	Chinook salmon	N	CS	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Salmonidae	rainbow trout	N	RT	X					X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cyprinidae	goldfish		GF		X	X	X	X	X	X	X															
Cyprinidae	carp		CP	X	X	X	X	X	X	X	X						X	X								
Cyprinidae	hardhead	N	HH	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X		X	X	X	X	
Cyprinidae	Sacramento pikeminnow	N	PM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Catostomidae	Sacramento sucker	N	SKR	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ictaluridae	brown bullhead		BBH				X	X	X																	
Ictaluridae	white catfish		WCF		X	X	X	X	X	X	X								X			X		X		
Centrarchidae	green sunfish		GSF		X	X	X	X	X		X															
Centrarchidae	bluegill		BG	X	X	X	X	X	X		X						X	X	X			X	X	X		
Centrarchidae	redecor sunfish		RSF		X	X	X	X	X	X	X		X				X	X	X				X	X	X	
Centrarchidae	warmouth		WM						X														X	X	X	
Centrarchidae	largemouth bass		LMB	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Centrarchidae	smallmouth bass		SMB	X	X	X	X	X	X	X	X						X	X	X	X		X	X	X	X	X
Cottidae	rifle sculpin	N	RSCP	X	X		X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X
Morionidae	striped bass		SB																						X	X

(List includes all species observed during 1986-2010 snorkel studies)