

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

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

2010 LOWER TUOLUMNE RIVER ANNUAL REPORT

Report 2010-5

2010 Snorkel Report and Summary Update

Prepared for

Turlock and Modesto Irrigation Districts

By

Steve Kiriara
Stillwater Sciences
Berkeley, CA

November 2010

SUMMARY

In 2010, higher summer flows in June and July precluded conducting the early summer reference count snorkel survey within the 20-mile reach of the Tuolumne River below La Grange Dam. The 3-day survey was instead conducted on 10-12 August, with an additional survey conducted on 02-04 November. Preliminary USGS flow at La Grange was about 315 cfs and water temperature ranged from 11.1°C (52.0 F) to 20.1°C (68.2 F) in August and flow was about 360 cfs with water temperatures from 11.7°C (53.1 F) to 14.3°C (57.7 F) in November. A total of 152 juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and 268 rainbow trout (*Oncorhynchus mykiss*) were observed in various habitats in August and 170 Chinook salmon (including adult spawners) and 218 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 31 (RM 38.0) in August and Chinook salmon and rainbow trout were both observed downstream to Riffle 41A (RM 35.3) in November. Other native fish species observed were Sacramento sucker, Sacramento pikeminnow, hardhead, Pacific lamprey, and riffle sculpin with the non-native species recorded being largemouth bass, smallmouth bass, redear sunfish, and striped bass during the two surveys.

Early summer surveys in June/July have been conducted in most years since 1986 except in years with high flows (1995, 1998, 2005, 2006, and 2010) that precluded the surveys.

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

Summer distribution of non-salmonid species (species other than trout or salmon) shifted beginning in 1996. Prior to then, 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 further downstream. The change in species distribution coincided with higher required summer flows and associated cooler water temperatures occurring in non-flood release years.

CONTENTS

	Page
1. INTRODUCTION	1
1.1 2010 STUDY AREAS	1
1.2 2010 SAMPLING CONDITIONS.....	2
2. METHODS	2
3. RESULTS AND DISCUSSION	2
4. COMPARISON WITH OTHER YEARS.....	3
4.1 Rainbow trout and Chinook salmon: 1982-2010	3
4.2 Recent surveys: 2001-2010.....	3
4.3 Other species observed: 1986-2010.....	4
5. FIGURES	# 1-10
6. TABLES	# 1 - 5

1 INTRODUCTION

The Turlock and Modesto irrigation districts (Districts) Tuolumne River snorkel surveys began in 1982 and the number, location, area sampled by site and season having varied over the years. 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 subsequent to 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 (*O. 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 included since 2001 and a comparable September snorkel survey was included in 2001–2007 and again in 2010. In 2010 the survey was conducted in August and was repeated in November. The 2010 surveys were implemented as required studies under the FERC order issued 10 May 2010 regarding *Oncorhynchus 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 2010 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 a “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 2010 SAMPLING CONDITIONS

The flow at La Grange during 10–12 August was approximately 315 cfs and approximately 360 cfs during the 02–04 November survey (Figure. 2). Water temperature ranged from 11.1 °C (52.0 °F) at Riffle A7 on 10 August to 20.1 °C (68.2 °F) at Riffle 57 on 12 August and 11.7 °C (53.1 °F) on 02 November to 14.3 °C (57.7 °F) on 04 November at these same locations. 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 near the city of Waterford. The snorkeling method provided an index of species abundance and these surveys are currently referred to as “reference counts”.

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 2010 surveys required more areas to be searched utilizing the downstream float method.

Usually the total length of an observed fish was estimated using scale markings 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 10–12 August and 02–04 November are summarized in Tables 1 and 2, respectively. The seven 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*), Pacific lamprey (*Lampetra tridentata*) 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 R31 (RM 38.0) in August and both species were observed downstream to R41A (RM 35.3) in November.

During the August surveys, there were 152 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 50–170 mm total length (TL). There were 268 rainbow trout observed ranging in size from 40–480 mm TL and were seen in riffle, run, and run-pool habitats. A total of 195 juvenile (<150 mm TL) and 73 adult rainbow trout were observed between RA7 (RM 50.7) and R31 (RM 38.0). Fish were observed in riffle, run, and run-pool habitats. Water temperature at those locations ranged from 11.1 °C (52.0 F) to 16.3 °C (61.3 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 R21 (RM 42.9) for the first time during the reference snorkel surveys.

During the November surveys, there were 170 Chinook salmon including 13 adult spawners observed in riffle, run and pool habitats from RA7 (RM 50.7) to R41A (RM 35.3). The juveniles ranged in size from 70–120 mm TL and the adults ranged in size from 650–920 mm TL. There were a total 218 rainbow trout observed ranging in size from 70–400 mm FL also observed in similar combinations of riffle, run and pool habitats, with 155 juvenile (<150 mm TL) and 63 adults observed between RA7 (RM 50.7) and R 41A (RM 35.3). Water temperature ranged from 11.7 °C (53.1 °F) to 14.2 °C (57.6 °F) at those locations. Similar to the August survey, Sacramento sucker along with Sacramento pikeminnow and hardhead were often co-occurring, while riffle sculpin were observed at 4 locations in low numbers usually hidden under cobble/boulder substrate. Striped bass were again observed at R21 (RM 42.9).

4 COMPARISON WITH OTHER YEARS

4.1 Rainbow trout and Chinook salmon: 1982-2010

Tables 3 and 4 summarize rainbow trout and Chinook salmon observations for all snorkel surveys conducted between 1982 and 2010. Some rainbow trout were observed downstream to R5 (RM 48.0) in limited surveys from 1982 to 1986. Rainbow trout were almost entirely absent during 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 1982–2010 period, Chinook salmon were recorded in all years except 1991 and 1992 although in some years their 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 2000–2010 period are shown in Figures 5 and 6.

4.2 Recent surveys: 2001-2010

Since the early summer snorkel survey could not be completed due to high flows in some years (2005, 2006, 2010), the comparative discussion will focus on the September surveys. The number of rainbow trout and Chinook salmon observed for the 2001 to 2010 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 Br. (RM 31.5). During the August 10-12 and November 2-4 surveys conducted in 2010, the total numbers of both Chinook and rainbow trout increased from 2007, the last year the late summer surveys were conducted.

The locations sampled since 2001 were the same each year and these surveys were the most comparable. September surveys show rainbow trout counts increased from 2001 to 2005 and were much higher beginning in 2006 (Figure 9). The increase in 2006 and 2010 may be the result of more trout being introduced into the lower river from the upstream reservoirs at La Grange and Don Pedro during the flood control releases occurring during the spring of those years. Chinook salmon counts (Figure 10) in September were comparatively low. Salmon counts were highest in 2010 when 152 and 170 were observed in August and November, respectively.

4.3 Other species observed: 1986-2010

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 2010 were Sacramento sucker, Sacramento pikeminnow, hardhead, Pacific lamprey and riffle sculpin with the non-native species recorded being largemouth bass, smallmouth bass, redear sunfish, and striped bass. The observance of striped bass at R21 (RM 42.9) was unusual. It was the first time this species was seen during the reference snorkel surveys.

TABLE 1. AUGUST 2010 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	(1) SACRAMENTO SUCKER	SACRAMENTO PIKEMINNOW	HARDHEAD	RIFLE SCULPIN	LARGEMOUTH BASS	SMALLMOUTH BASS	REDEAR SUNFISH	STRIPED BASS and other	
10AUG	1000	Riffle A7	50.7	1	6,000	1.5	25	Riffle	cobble,gravel,bedrock	11.1	11.5	21	0.6	25.0	20	(50-75)	4	(40-50)	(70)								
	1006			2	4,000	4.0	21	Run-Riffle	cobble,gravel,sand						2	(110,120)	12	(100-140)	(550)								
10AUG	1140	Riffle 2	49.9	1	6,000	1.3	24	Riffle	cobble,gravel,sand	14.2	11.3	25	0.6	23.0			6	(100-140)				(70,90)					
	1157			2	6,000	6.5	22	Pool-Run	bedrock,cobble,boulder						16	(70-90)	17	(150-250)									
	1200			3	12,000	5.0	18	Run-Pool	cobble,sand,boulder						5	(70-90)	13	(80-140)				(120,130)					
10AUG	1407	Riffle 3B	49.1	1	4,400	2.5	21	Riffle	cobble,gravel,sand	15.5	12.3	25	0.6	23.0	10	(80-90)	55	(80-140)									
	1406			2	7,500	2.5	18	Run-Riffle	cobble,gravel,bedrock						50	(50-90)	4	(160,160,170,200)									
															8	(100-120)	11	(120-140)									
10AUG	1523	Riffle 5B	47.9	1	3,000	2.5	16	Riffle	cobble,gravel,sand	16.0	11.7	23	0.8	18.0	7	(80-110)	9	(110-140)	(700)			(60)					
	Not done			2				Run									5	(160-280)									
	1515			3	9,375	4.0	20	Run-Pool	bedrock,cobble,gravel						7	(50-70)	11	(110-140)	(400,450)	4(250-300)					2(60,80)		
					58,275		185								125		192		5	4		3	2		2		
11AUG	0936	Riffle 7	46.9	1	6,000	1.5	19	Riffle	cobble,gravel,boulder	12.0	10.6	22	0.8	22.0	4	(50-70)	7	(110-140)									
	0933			2	8,000	4.5	22	Run	bedrock,cobble,sand						6	(70-90)	4	(160-160)		2(360,420)							
																	8	(70-120)									
11AUG	1125	Riffle 13B	45.5	1	6,000	2.0	18	Riffle-Run	cobble,gravel,sand	13.4	11.4	24	0.7	18.0	2	(60,100)	27	(50-140)									
	1130			2	3,600	2.0	16	Riffle	cobble,gravel,sand								1	(170)		30(130-200)							
																	4	(110-140)									
11AUG	1327	Riffle 21	42.9	1	4,800	1.5	20	Riffle	cobble,gravel,sand	15.3	10.8	27	1.0	17.0	2	(70,100)	4	(110-140)									
	1328			2	7,500	5.0	18	Run-Pool	cobble,sand,vegetation								4	(110,140,150,160)		(120)	(140)					15(300-500)	
11AUG	1452	Riffle 23C	42.3	1	3,000	2.5	23	Run	gravel,sand,bedrock	16.4	10.7	30	1.1	15.0	3	(60,70,90)	3	(120,140,160)									
	1454			2	6,000	2.0	15	Riffle	cobble,gravel,bedrock								4	(80-140)		7(140-200)	(130,140)						
					44,900		151								17		75		40	3						SB(15)	
12AUG	0944	Riffle 31	38.0	1	7,200	2.0	20	Riffle	cobble,gravel,sand	16.3	10.1	36	1.2	15.0			1	(140)	14(700-800)	(230)							
	0945			2	12,500	4.0	18	Run-Pool	cobble,gravel,sand										(600)	3(250-350)	4(300-350)	(80)				LP(100)	
12AUG	1126	Riffle 35A	37.1	1	6,000	2.0	20	Riffle	cobble,gravel,sand	17.5	9.8	36	1.0	14.0						(120,150)							
	1124			2	15,000	2.5	19	Run	cobble,gravel,sand											5(250-350)			(130)	(220)			
12AUG	1342	Riffle 41A	35.3	1	2,500	2.2	22	Run-Riffle	cobble,gravel,sand	18.5	10.6	36	1.2	12.0	4	(70-90)			4(200-250)	8(200-300)	5(300-350)				(140,240)		
	1342			2	2,400	4.5	8	Pool-Run	gravel,sand,cobble						2	(160,170)					5(220-400)				4(120-400)		
	1350			3	4,000	2.5	10	Riffle-Run	cobble,gravel,sand										30(60-70)	3(650-800)							
12AUG	1515	Riffle 57	31.5	1	3,750	1.5	22	Riffle	cobble,gravel,sand	20.1	10.5	36	1.1	11.0	4	(60-90)			14(400-600)	5(200-300)							
	1515			2	10,000	2.5	20	Run-Riffle	cobble,bedrock,sand										3(650-800)	3(260-360)	(240)		11(70-160)	(90,130)	3(90,140,320)	6(70-160)	
					63,350		159								10		1		80	32	10	1	13	11	6	LP(1)	
					166,525		495								152		268		85	76	13	4	15	11	8	SB(15) LP(1)	

(1) YOY Sacramento sucker were common below R13B

TABLE 2. NOVEMBER 2010 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/test	CHINOOK size	RAINBOW count/test	RAINBOW size	(1) SACRAMENTO SUCKER	SACRAMENTO PIKEMINNOW	HARDHEAD	RIFFLE SCULPIN	SMALLMOUTH BASS	STRIPED BASS	
02NOV	0948 0950	Riffle A7	50.7	1 2	3,750 4,000	1.8 4.0	24 22	Riffle Run-Riffle	cobble,gravel,boulder cobble,gravel,sand	11.7	10.2	20	0.8	18.0	4 4 43	(700-900) (750-920) (70-100)	11 22	(180-500) (70-140)							
02NOV	1104 1122 1120	Riffle 2	49.9	1 2 3	6,000 6,000 7,200	1.5 6.5 5.0	24 24 16	Riffle Pool-Run Run-Pool	cobble,gravel,sand bedrock,cobble,boulder cobble,sand,boulder	12.6	9.0	27	0.9	18.0	32	(70-90)	1 4 54 8	(340) (180-420) (70-130) (160-320)	(700)			(90)			
02NOV	1317 1320	Riffle 3B	49.1	1 2	4,000 6,000	2.2 2.5	19 18	Riffle Run-Riffle	cobble,gravel,sand cobble,gravel,bedrock	13.3	9.8	25	0.8	15.0	1 4 30	(700) (650-750) (70-110)	4 3 60	(120,300,360,450) (140,160,160) (70-90)				(60)			
02NOV	1432 1447 1425	Riffle 5B	47.9	1 2 3	2,000 12,000 6,000	2.5 4.5 4.0	10 22 16	Riffle Run-Pool Run-Pool	cobble,gravel,sand gravel,cobble,bedrock bedrock,cobble,gravel	13.8	10.1	21	0.8	15.0	20	(70-90)	1 10 4 1	(160) (70-90) (70-140) (320)	3(350-500) 5(350-500)			(60)			
Subtotal															138		183		9				3		
03NOV	1005 1004	Riffle 7	46.9	1 2	5,000 8,000	1.0 4.5	16 20	Riffle Run	cobble,gravel,sand bedrock,cobble,sand	11.7	9.0	23	0.8	18.0			1 5	(160) (220-450)							
03NOV	1110 1114	Riffle 13B	45.5	1 2	4,500 3,200	2.3 2.0	15 12	Riffle-Run Riffle	cobble,gravel,sand cobble,gravel,sand	12.1	9.5	24	0.9	15.0			7 7	(160-180) 160-240							
03NOV	1255 1256	Riffle 21	42.9	1 2	3,000 8,000	1.7 5.0	15 18	Riffle Run-Pool	cobble,gravel,sand cobble,sand,vegetation	12.7	10.1	26	0.8	15.0	No fish observed		2	(280,300)	(600)				6(300-500)		
03NOV	1406 1408	Riffle 23C	42.3	1 2	2,500 6,000	2.3 2.0	12 10	Run Riffle	cobble,sand,bedrock cobble,gravel,bedrock	13.1	10.0	30	1.1	13.0			5 3 2	(160-180) (90-120) (160,220)							
Subtotal															0		32		1					6	
04NOV	0950 0955	Riffle 31	38.0	1 2	7,500 12,000	1.5 4.0	21 18	Riffle Run-Pool	cobble,gravel,sand cobble,gravel,sand	13.1	10.3	30	1.0	15.0	30	(70-90)		25(50-70)				(100) ? Scp.			
04NOV	1114 1115	Riffle 35A	37.1	1 2	2,200 12,000	2.0 2.3	15 16	Riffle Run	cobble,gravel,sand cobble,gravel,sand	13.7	10.7	33	1.2	15.0	1	(80)		200(50-70)	300(30-60)						
04NOV	1300 1257 1303	Riffle 41A	35.3	1 2 3	4,800 3,000 6,000	2.3 4.5 2.0	15 6 10	Run-Riffle Pool-Run Riffle-Run	cobble,gravel,sand gravel,sand,cobble cobble,gravel,sand	14.2	11.1	35	1.2	14.0	1	(120)	3	(160,170,180)	(400,400,450) (600) 20(30-50)	(240) 100(30-50)	(350) (300)		(150)		
04NOV	1423 1424	Riffle 57	31.5	1 2	7,200 10,000	1.7 2.3	16 18	Riffle Run-Riffle	cobble,gravel,sand cobble,bedrock,sand	14.3	11.4	35	1.1	13.0				12(500-700)	(200,240) (180,200,320)	(200,240)					
Subtotal															32		3		261	406	4	1	1	6	
TOTAL#															170		218		271	406	4	4	1	6	
					64,700	135									32		3		261	406	4	1	1	6	
					161,850	448									170		218		271	406	4	4	1	6	

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

	1993				1994			1995	1996	1997	1999	2000		2001		2002		2003		2004			2005	2006	2007		2008	2009	2010			
	MAY	JUN	JUL	OCT	MAY	JUL	OCT	NOV	JUL	JUN	JUN	JUN	JUN	SEP	JUN	SEP	JUN	SEP	JUN	SEP	JUN	AUG	SEP	SEP	SEP	JUN	SEP	JUN	JUN	AUG	NOV	
LOCATIONS																																
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			
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			
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			
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			
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			
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			
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			
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			
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	1	21	12	4	X	X	1	X			
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	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	X	3		
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		
Charles (RM 24.9)		X		X			X																									
Total <i>O. mykiss</i>	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			

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

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			X		11	X		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	4	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	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	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	X					
Riffle 35A (RM 37.0)																											
Riffle 36A (RM 36.7)																											
Riffle 37 (RM 36.2)									40																		
Riffle 39-40 (RM 35.4)										X				X	X		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	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 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

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

	1993				1994			1995	1996	1997	1999	2000	2001		2002		2003			2004			2005	2006	2007		2008	2009		2010	
	MAY	JUN	JUL	OCT	MAY	JUL	OCT	NOV	JUL	JUN	JUN	JUN	JUN	JUN	SEP	JUN	SEP	JUN	SEP	JUN	AUG	SEP	SEP	SEP	JUN	SEP	JUN	JUN	AUG	NOV	
LOCATIONS																															
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	
Riffle 1A (RM 50.4)	14	X		7					29			47							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	
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	
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	X	4	X	X	92	14	20	
Riffle 7 (RM 46.9)									20	1	57	X	17	X	15	1	X	X	4	X	X	X	X	X	X	X	X	9	10	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	
Riffle 17A2 (RM 44.4)												X																			
Riffle 21 (RM 42.9)									2			X	X	X	1	X	X	1	7	X	X	X	10		X	X	X	7	2	X	
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	
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	30	
Riffle 33 (RM 37.8)																															
Riffle 35A (RM 37.0)					X				X			X			X	X	2	1	7	X	X	X	X		X	X	X	1	X	1	
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	X	2	6	1	
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	X	X	4	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		

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

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
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
Salmonidae	rainbow trout	N	RT	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
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
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	redeer sunfish		RSF		X	X	X	X	X	X	X		X				X	X	X				X	X	X
Centrarchidae	warmouth		WM						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
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
Moronidae	striped bass		SB																						X

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

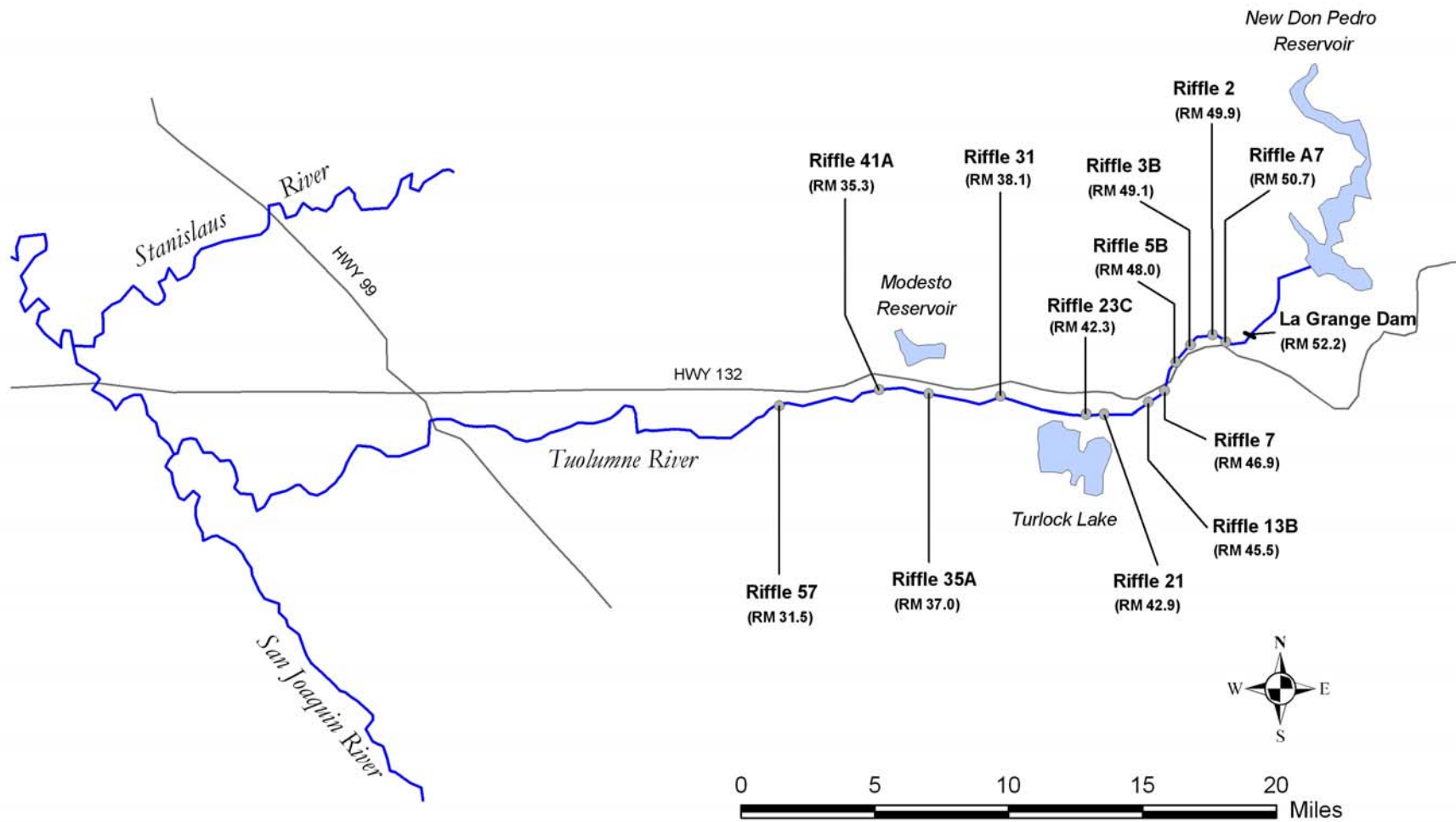


Figure 1. Locations of snorkel survey sites on the lower Tuolumne River, 2010.

2010 Tuolumne River daily mean flow
Provisional USGS data

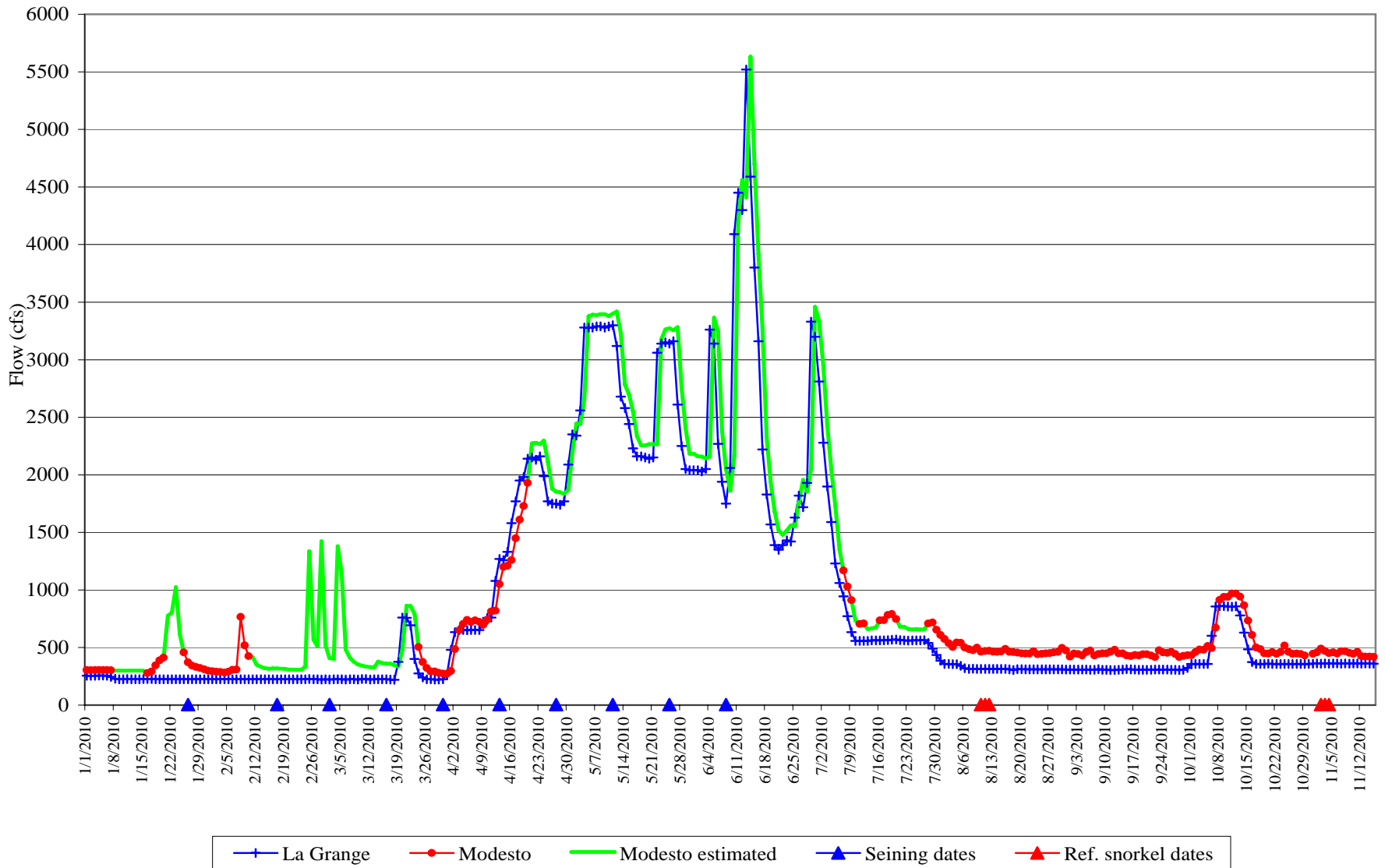


Figure 2. 2010 Tuolumne River flows at La Grange and Modesto

Locations where *O. mykiss* were observed during the 1982 to 2010 Tuolumne River snorkel surveys (June-September)

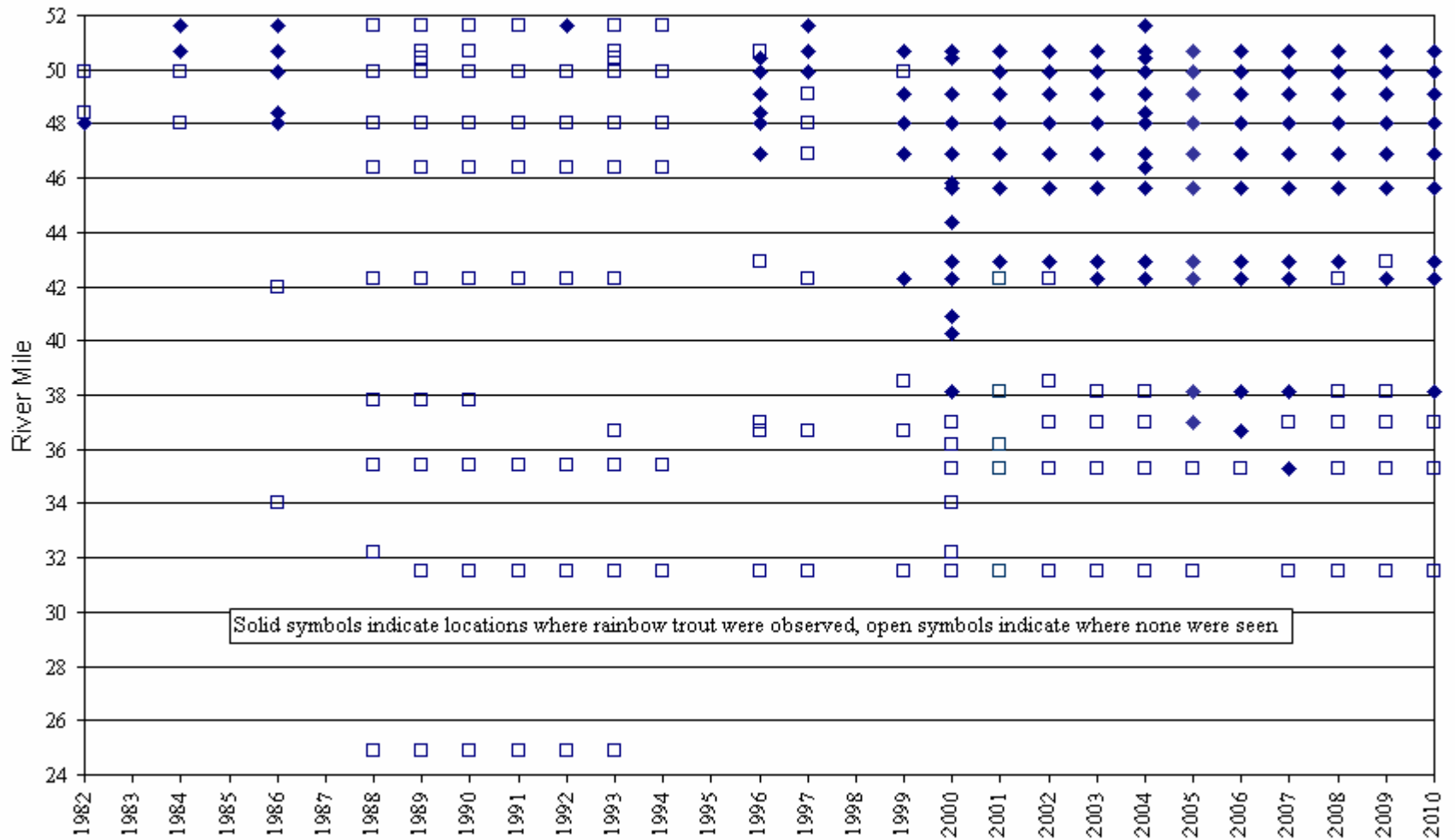


Figure 3. Locations where *O. mykiss* were observed

Locations where Chinook Salmon were observed during the 1982 to 2010 Tuolumne River snorkel surveys (June-September)

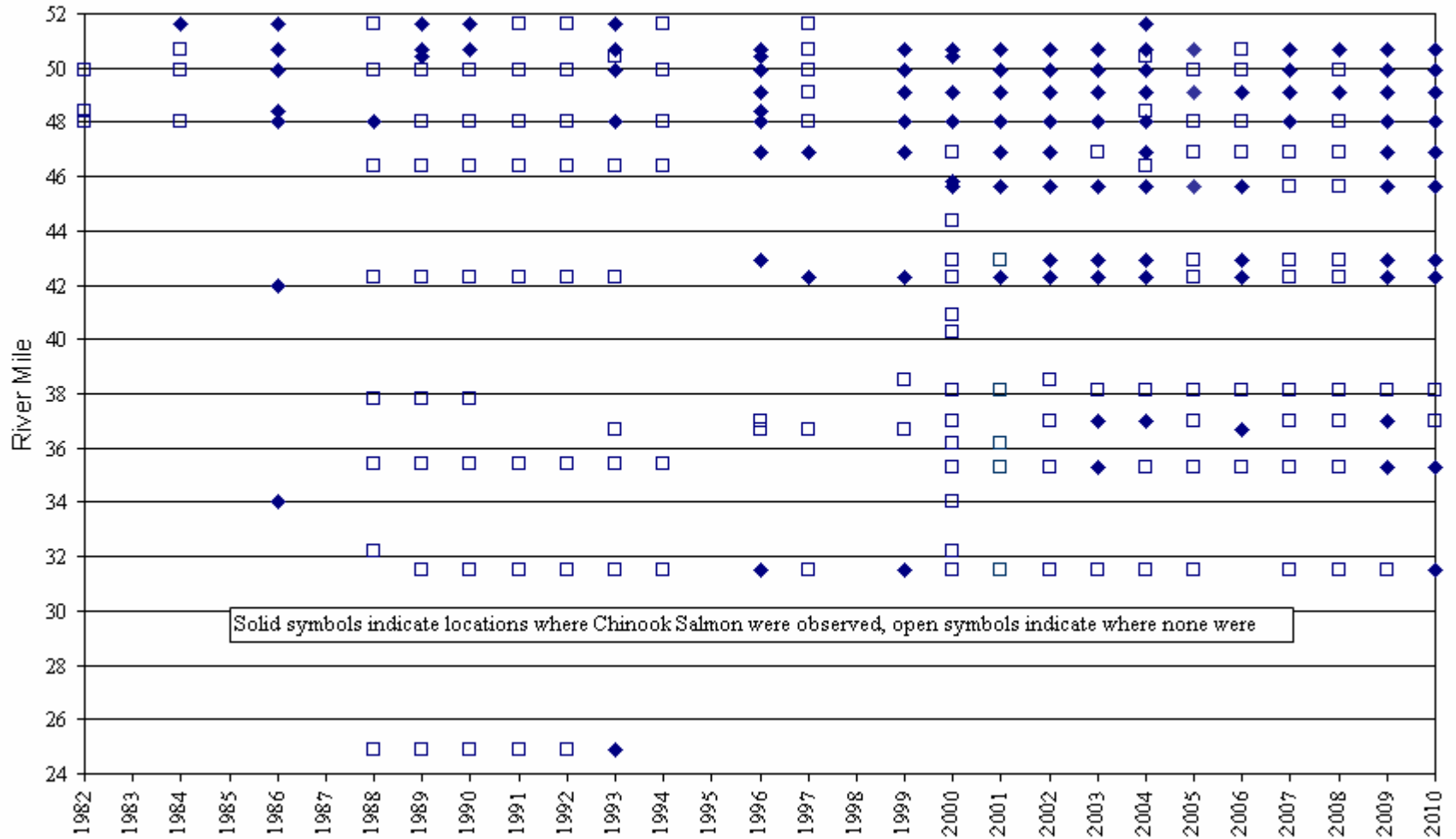


Figure 4. Locations where Chinook salmon were observed

Dates and locations when *O. mykiss* were observed during the 2000 to 2010 Tuolumne River snorkel surveys

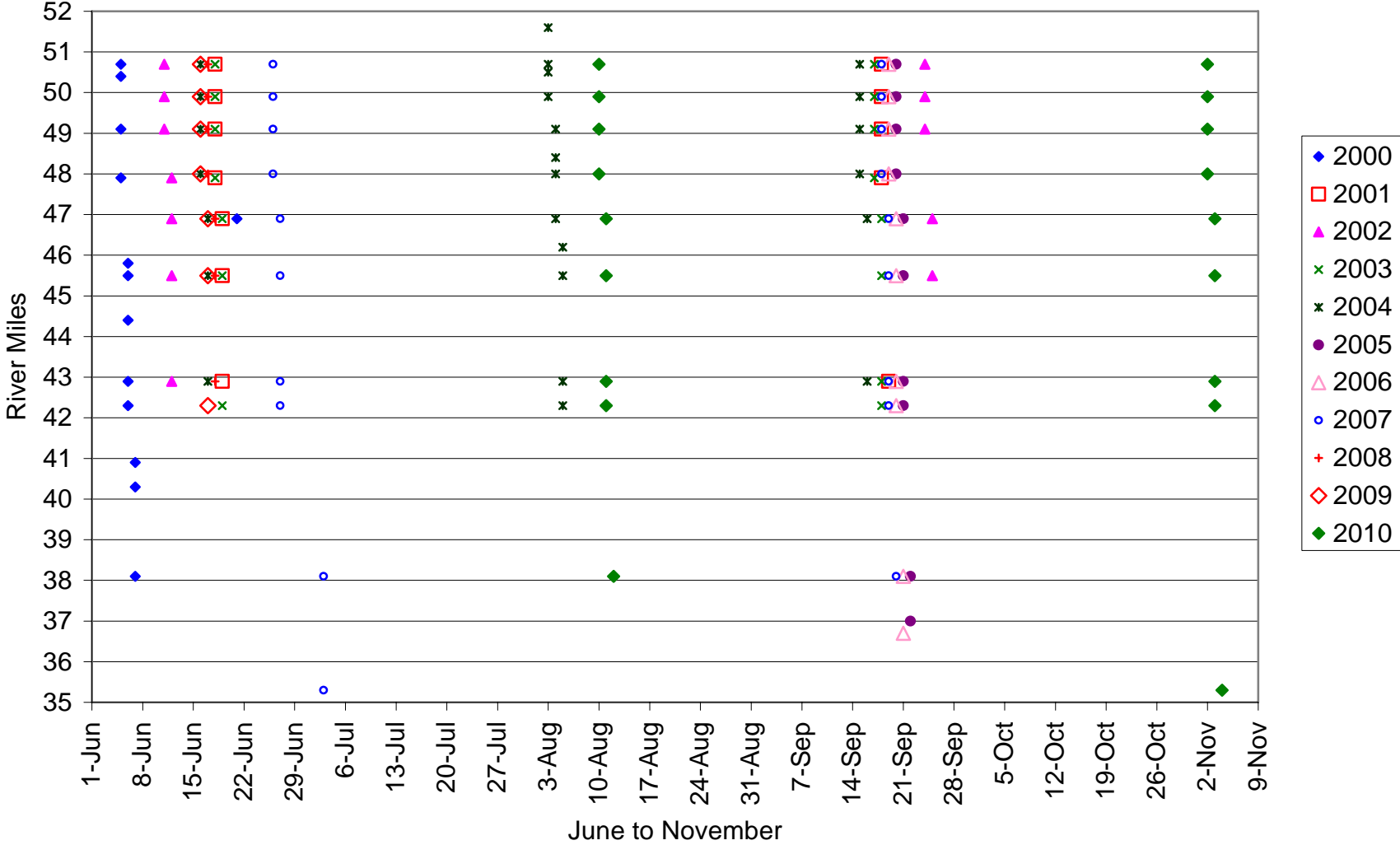


Figure 5. Dates and locations where *O. mykiss* were observed during the snorkel surveys

Dates and locations when Chinook Salmon were observed during the 2000 to 2010 Tuolumne River snorkel surveys

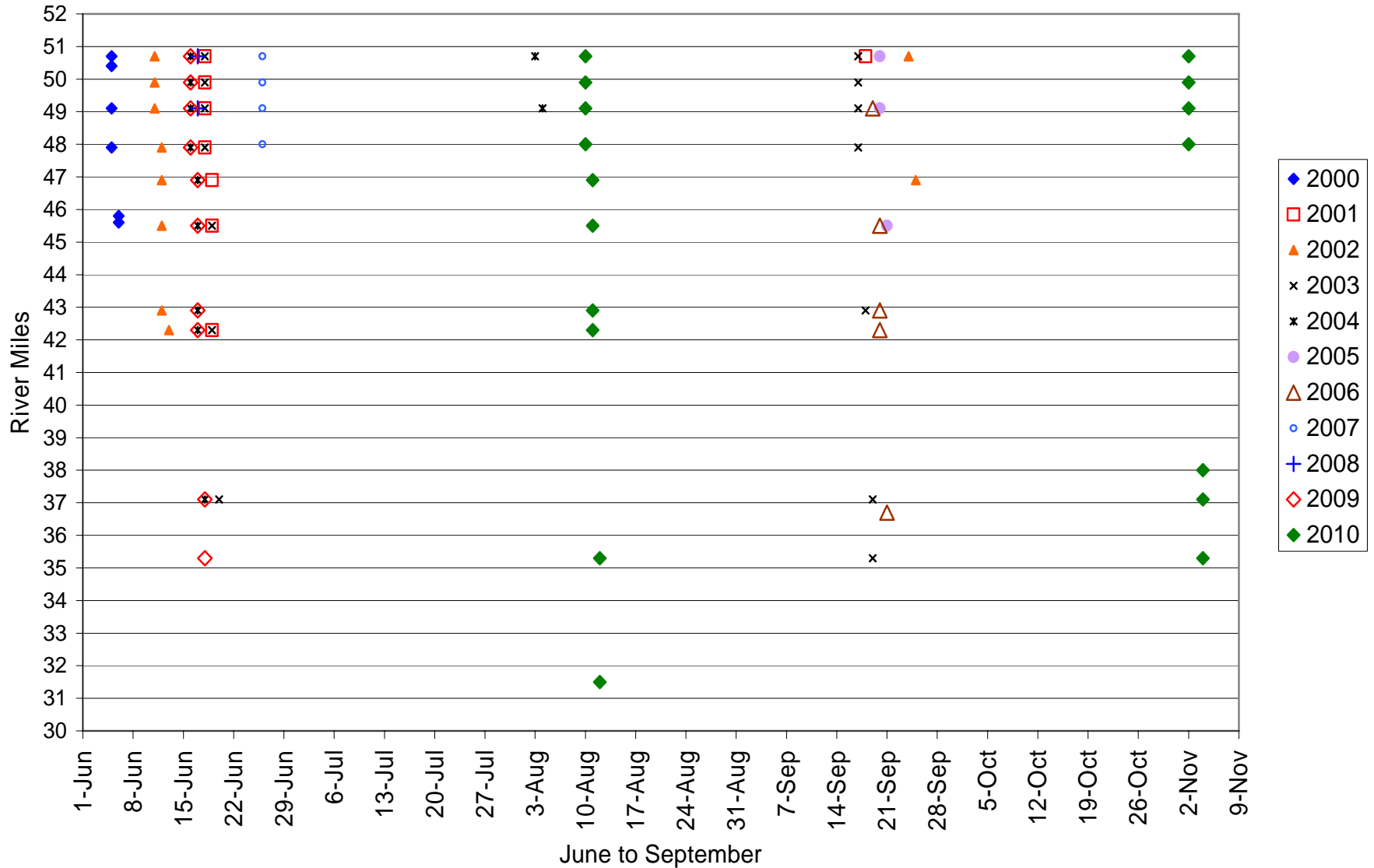


Figure 6. Dates and locations where Chinook Salmon were observed during the snorkel surveys.

Number of *O. mykiss* observed, by location, during
the 2001 to 2010 Tuolumne River September snorkel surveys

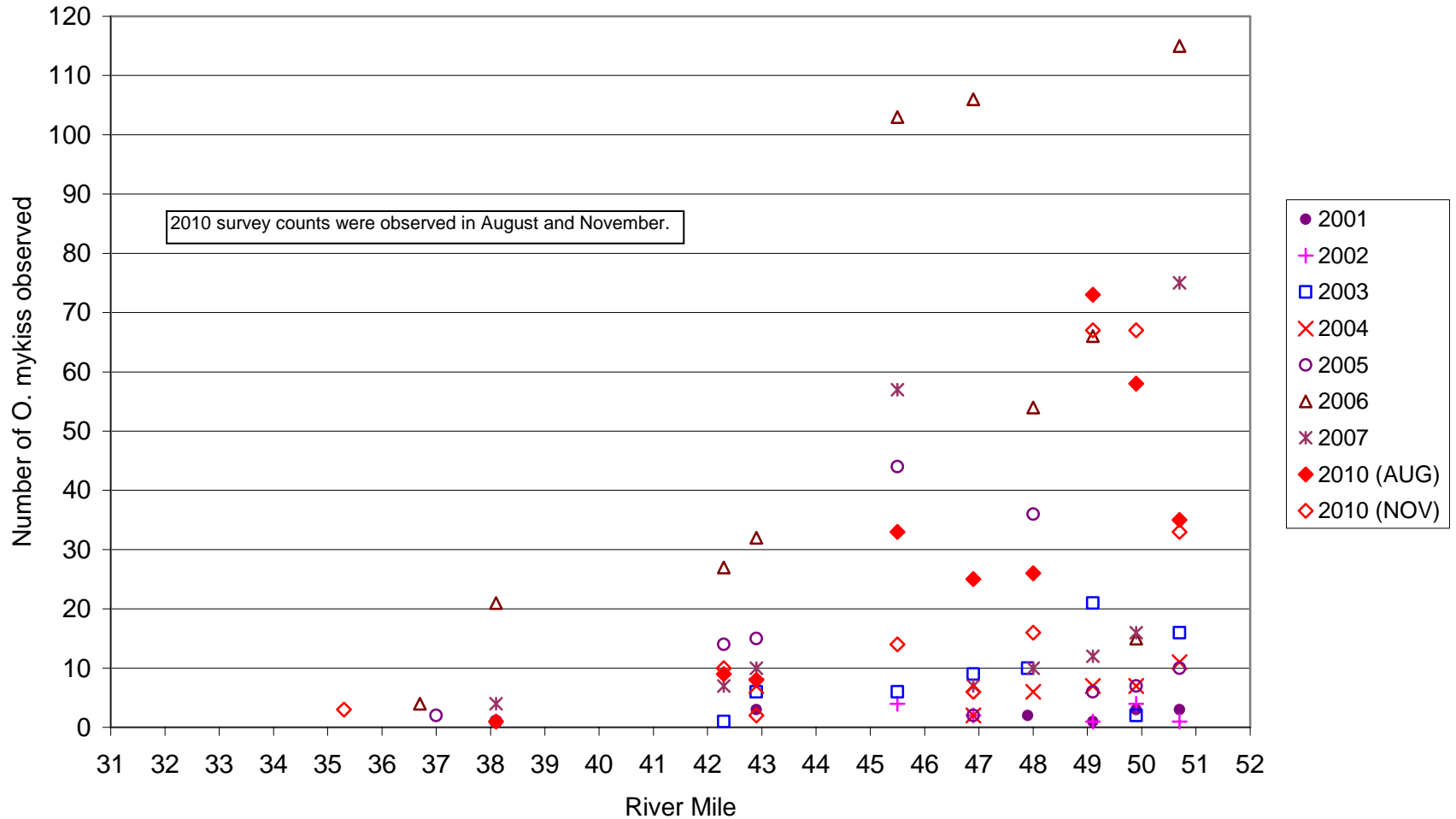


Figure 7. *O. mykiss* observations during the September snorkel surveys

Number of Chinook Salmon observed, by location, during the 2001 to 2010 Tuolumne River September snorkel surveys

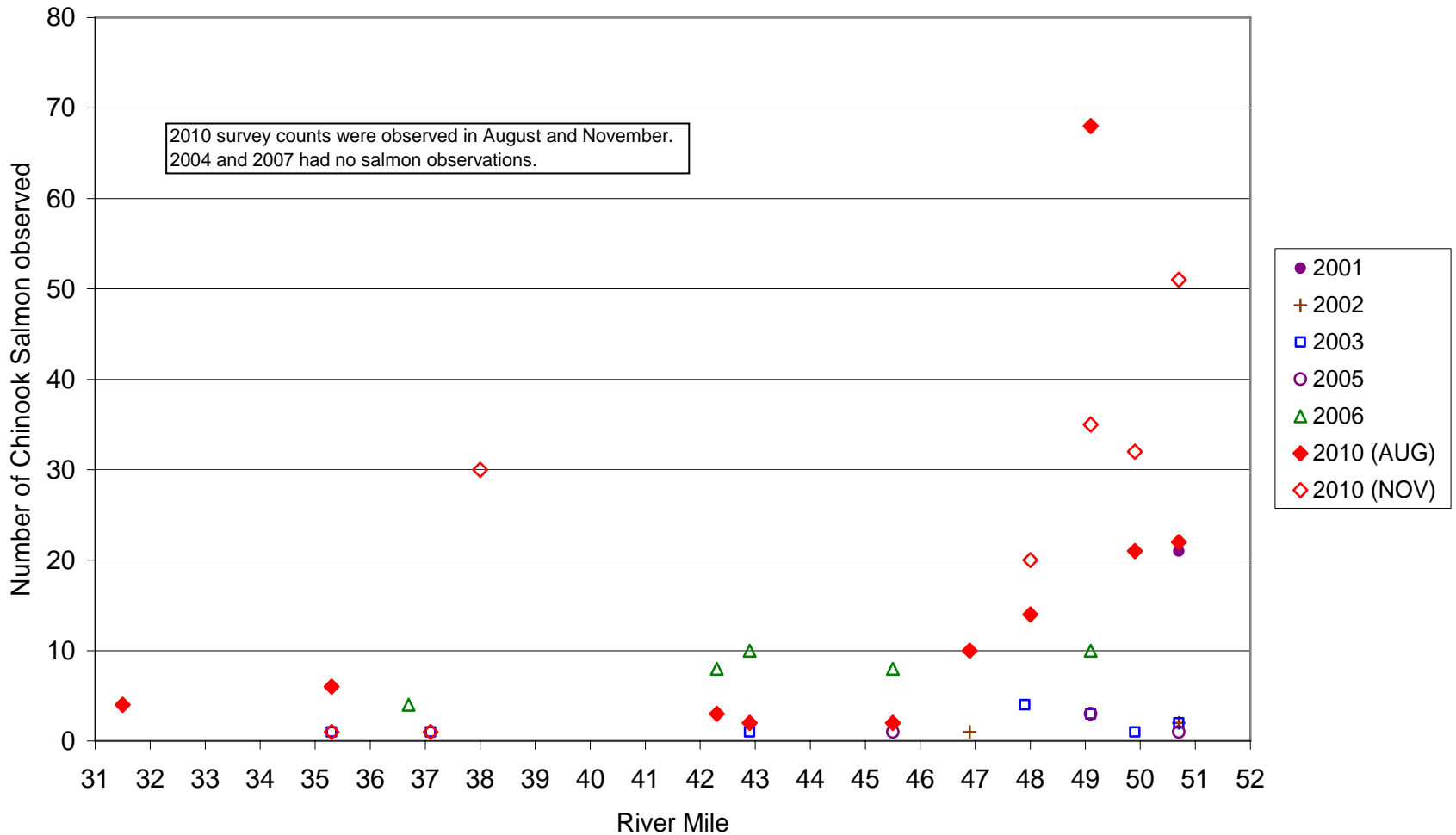


Figure 8. Chinook salmon observations during the September snorkel surveys

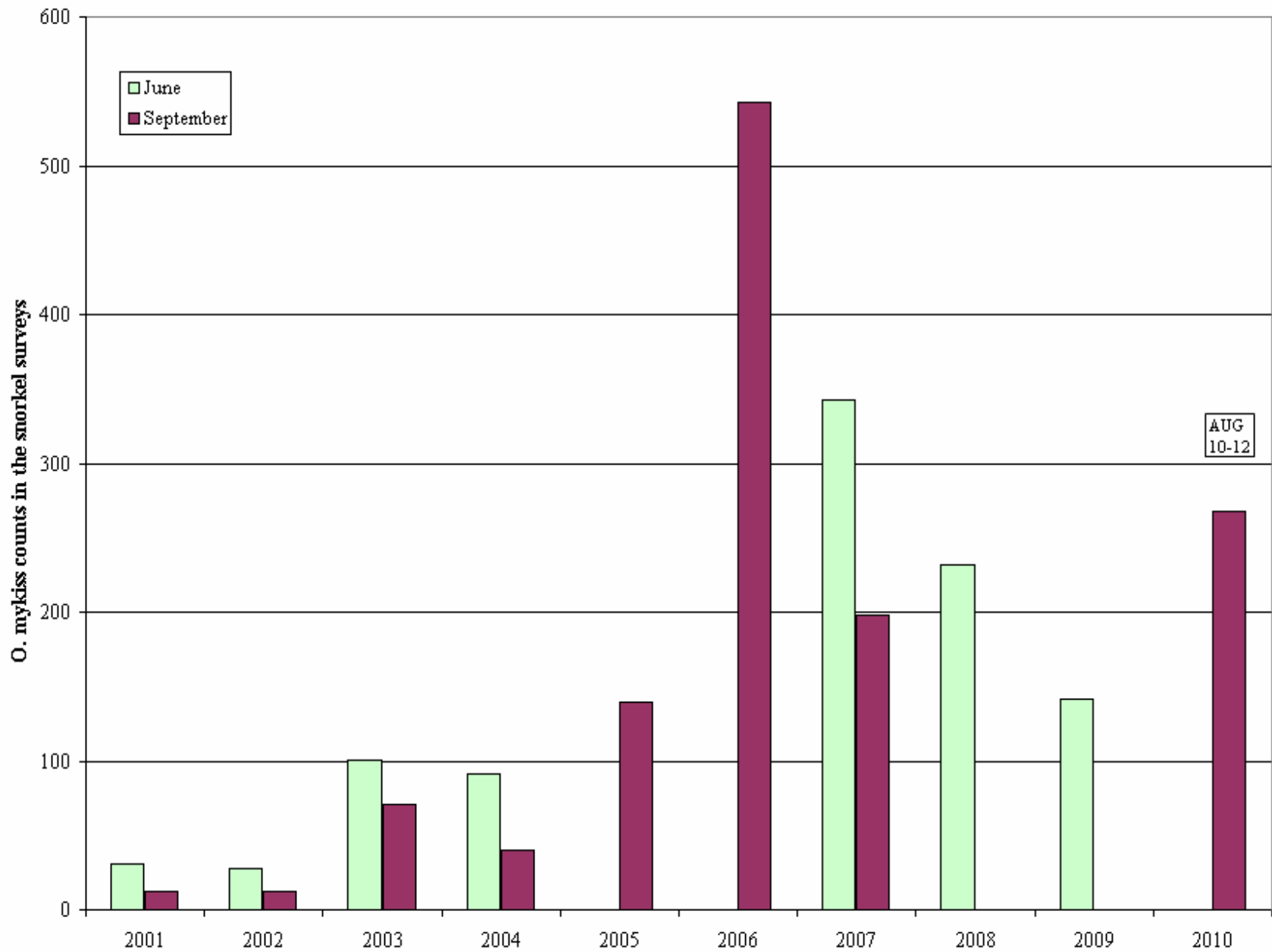


Figure 9. *O. mykiss* counts during the June and September snorkel surveys

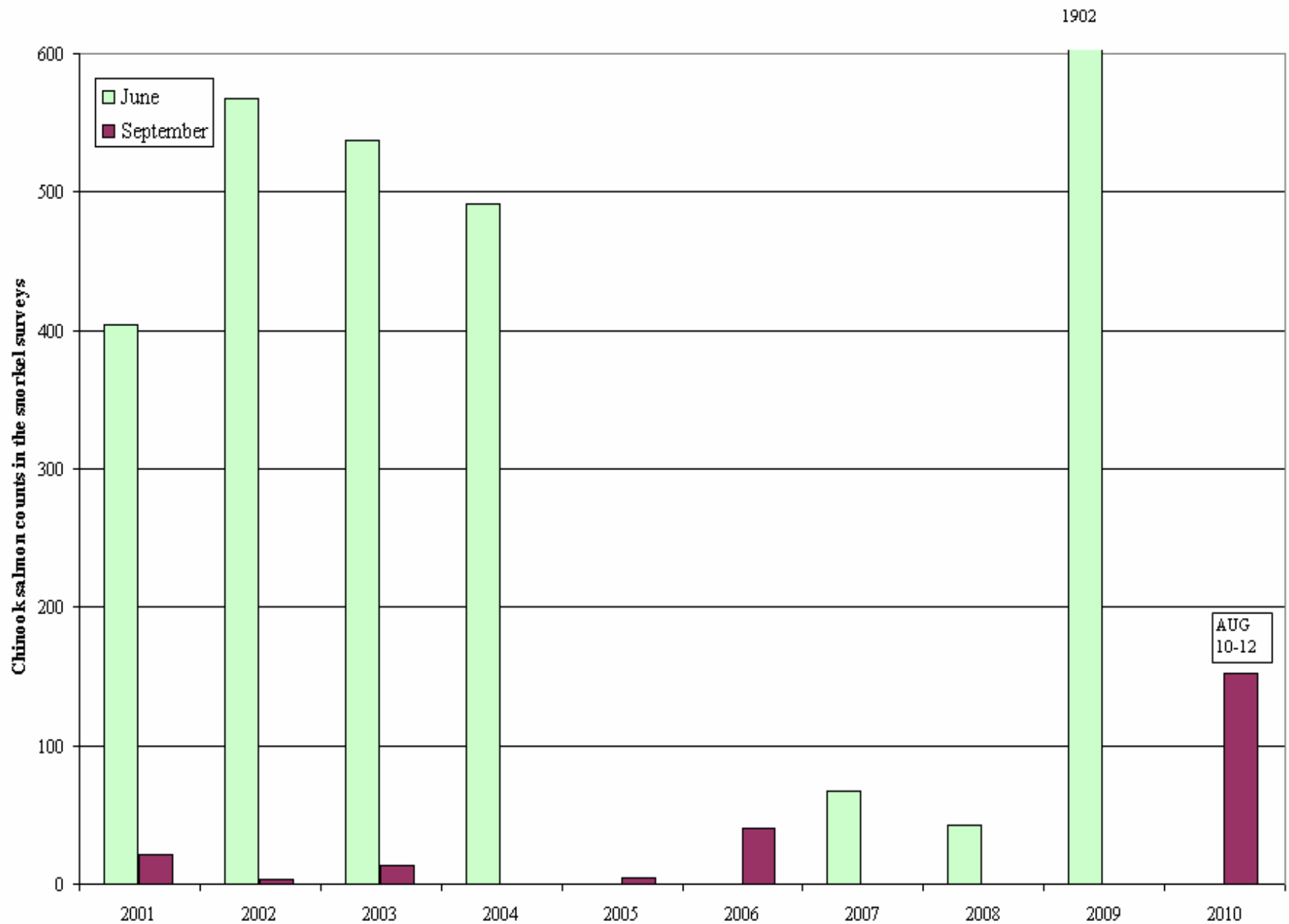


Figure 10. Chinook salmon counts during the June and September snorkel surveys