Evaluation of Fish Entrainment in Seven Unscreened Sacramento River Diversions 2010

Annual Report

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Executive Summary

The CVPIA Anadromous Fish Screen Program and the CALFED Ecosystem Restoration Program initiated a four-year effort in 2009 to screen 12 diversions on the Sacramento River while obtaining fish entrainment monitoring data at each diversion site. The intent is to collect fish entrainment monitoring data at each diversion site for two diversion seasons (typically April through September) prior to fish screen installation which will occur at the end of the second irrigation season. The monitoring sites are located on the Sacramento River between Knights Landing (RM 91) and Colusa (RM 143) (plus one site in Steamboat Slough) where the majority of the remaining unscreened diversions on the Sacramento River are located. The diversions sites to be monitored and screened were selected based on relevant information including the size and location of the diversion, suitability for entrainment monitoring, and the voluntary participation of the diverter. A range of diversion sizes and locations were chosen in order to obtain the most useful scientific data. Selected diversion sizes to be monitored and screened were between 5 cfs and 150 cfs. These biological assessments will analyze the effect of site-specific physical, hydraulic, and habitat characteristics of diversions on fish entrainment and are intended to lead to a better understanding of the benefits of fish screening, and to help prioritize which irrigation diversions are most important to screen.

This 2010 fish entrainment study represents the second-year effort to obtain monitoring data at seven agricultural diversions. For three of the sites, fish sampling was initiated during the 2009 irrigation season and continued during the 2010 season. For the remaining four sites, sampling began during the 2010 season and will again be monitored in 2011. This annual technical report describes the methods and results, including all summarized data, for the seven agricultural diversion sites (ranging in capacity from 9 cfs to 128 cfs) monitored in 2010.

Fewer juvenile salmon were sampled during 2010 compared to 2009. The hydrologic conditions and the seasonal timing of salmon emigration played significant roles in the low salmonid entrainment observed during the 2010 sampling program. The spring of 2010 was unusually wet due to frequent late-season storms saturating the agricultural lands served by the irrigation canals sampled during this study. Additionally, the early spring was cooler than normal. These circumstances resulted in a very late onset of irrigation diversions from the Sacramento River. Additionally, and importantly, the late start of irrigation occurred after the predicted emigration of juvenile salmonids from the upper Sacramento River. Because most of the irrigation diversions did not increase substantially until well into May, the fish sampling in the irrigation canals undoubtedly missed the seasonal presence of salmon. Each of the sites is located in the lower Sacramento River, which, during the primary summer-time irrigation season, possesses unfavorable water temperatures for juvenile salmon. These conditions may partially explain the low numbers of juvenile salmon sampled, although other factors such as the naturally low seasonal presence of each of the four runs of salmon and steelhead and the late timing of irrigation diversions likely had an overriding influence.

As observed during the 2009 sampling program, among those salmon captured in 2010, very few were fry-sized (< 60 mm) fish. This circumstance may be attributable to low fry-sized salmon presence in the river during the time periods sampled. Also, the lower

river likely serves primarily as a migratory corridor for fish emigrating to salt water and not so much as a rearing area, at least during the period sampled. Because fish sampling could not occur until irrigation diversion operations were initiated, this sampling, by itself, cannot estimate the proportional presence of the various life stages present in the river. However, as data becomes available from other fish sampling programs in the upper and lower river, further examination of this subject will be addressed in the 2012 final report on the four-year program. Some of the sites chosen for sampling during 2011 and 2012 divert water during the river prior and after the principal irrigation season; data acquired during those years will likely provide further insight into the topic.

Sacramento sucker, Tule perch, Sacramento pikeminnow, and prickly sculpin dominated the species sampled and was consistent with the types of habitats and seasonable presence expected for those species. Among those species sampled, the fish sizes were small indicating entrainment of younger life stages which could be explained by lesser swimming capabilities for avoiding entrainment or different habitat preferences based on life stage.

Although data are limited for providing definitive conclusions, the 2010 sampling program suggests that there may be features at the seven sites creating conditions for disproportional fish entrainment rates between sites. It's premature to determine causal circumstances at this time but riverine habitat conditions in the immediate vicinity of the pipe intakes may be a factor. For example, it's hypothesized that the South Steiner site may have entrained a disproportionally higher number of non-salmonid fish compared to other sites due to the back eddy and slow-water characteristics near the river intake. However, results of the survey of the seven diversions sampled during the 2010 irrigation season are too limited to provide empirical evidence of the primary factors affecting fish entrainment. As more data are acquired from additional sites in 2011 and 2012, more detailed comparisons will be possible and will be discussed in detail in the final report on the four-year sampling program. It is anticipated that results of this study, upon completion over the next two years when 12 separate diversions have been sampled and when integrated with the 2008 in-river surveys (including knowledge derived from other past studies), will lead to a significantly improved understanding of those factors which are most important determinants of fish entrainment.

Introduction

Screening of agricultural diversions has been a common practice in recent years in order to conserve and restore populations of anadromous fishes (including Chinook salmon, *Oncorhynchus tshawytscha*, and steelhead, *Oncorhynchus mykiss*) in the Central Valley of California. Fish screens contribute to the overall restoration of anadromous fisheries by protecting juvenile fish from entrainment at these diversions. Protecting fish from entrainment enhances anadromous fish out-migrant success, thereby indirectly enhancing the sport and commercial harvest of these species and the number of returning fish to the rivers.

Fish screening efforts have been focused on protecting winter, spring, fall and late-fall runs of Chinook salmon and steelhead, as they migrate down the Sacramento River. Traditionally, some of the largest runs of Chinook salmon of any west coast river system

have been produced in the Sacramento River. However, over recent years there has been a significant decline in winter-run, spring-run, and fall-run Chinook salmon and Central Valley steelhead stocks to the point that under state and federal law the winter-run has been listed as Endangered, the spring-run Chinook salmon and the Central Valley steelhead have been listed as Threatened, and the fall run is currently a Candidate species for listing.

Under both the Central Valley Project Improvement Act (CVPIA) and the CALFED Bay-Delta Program (CALFED) there have been significant efforts to screen agricultural diversions in the Central Valley of California, particularly the larger unscreened diversions (over 150 cfs) on the Sacramento River. There are many small and moderate sized agricultural diversions (under 150 cfs) on the Sacramento River that remain unscreened. However, there is a general lack of data available about the potential effects of these agricultural diversions on existing fish populations.

In 2009, the CVPIA Anadromous Fish Screen Program (AFSP) and the CALFED Ecosystem Restoration Program initiated a four-year effort to screen up to 15 diversions on the Sacramento River while obtaining critical fish entrainment monitoring data at each diversion site. Fish entrainment monitoring data will be collected at each diversion site for two diversion seasons (typically April through September) prior to fish screen installation which will occur at the end of the second irrigation season. These biological assessments will analyze the effect of site-specific physical, hydraulic, and habitat characteristics of diversions on fish entrainment and are intended to lead to a better understanding of the benefits of fish screening, and to help prioritize which irrigation diversions are most important to screen.

This 2010 fish entrainment study represents the second-year effort to obtain monitoring data at seven agricultural diversions. For three of the sites, fish sampling was initiated during the 2009 irrigation season and continued during the 2010 season. For the remaining four sites, sampling began during the 2010 season and will again be monitored in 2011. Fish screens will be installed at these locations at the end of the 2010 and 2011 diversion seasons, respectively. Five additional diversion sites will be monitoring in 2011 and 2012 with additional fish screens installed in 2012. The monitoring data from these subsequent efforts will be also published in annual reports using the same format as this report. The monitoring sites are located on the Sacramento River between Knights Landing (RM 91) and Colusa (RM 143) (plus one site in Steamboat Slough) where the majority of the remaining unscreened diversions on the Sacramento River are located. The diversions sites to be monitored and screened were selected based on relevant information including the size and location of the diversion, suitability for entrainment monitoring, and the voluntary participation of the diverter. A range of diversion sizes and locations were chosen in order to obtain the most useful scientific data. Selected diversion sizes to be monitored and screened were between 5 cfs and 150 cfs.

This annual technical report describes the methods and results, including all summarized data, for the seven agricultural diversion sites monitored in 2010. Results of the 2009 fish monitoring program are provided in a separate annual report (Vogel 2010). A comprehensive assessment comparing sampling data for all sites and all years will be provided in a final report on the project at its conclusion in 2012.

Study Sites

Three sites on the Sacramento River were selected by members of the Anadromous Fish Screen Program Technical Committee to evaluate daily fish entrainment during the 2009 and 2010 irrigation seasons (Year 1 Sites) and four different sites were selected for monitoring during the 2010 and 2011 seasons (Year 2 Sites) (Figure 1):

Year 1 Sites

Sycamore Mutual Water Corporation
River Mile 132.5
Latitude: 39°08'12.9"
Longitude: 121°56'23.1"
Diversion Capacity: 65 cfs

River Garden Farms No. 2
River Mile 96.7
Latitude: 38°51'52.70"N
Longitude: 121°45'28.50"W
Diversion Capacity: 32 cfs

Sutter Mutual – State Ranch
River Mile 96.25
Latitude: 38°52'13.31"N
Longitude: 121°45'11.93"W
Diversion Capacity: 128 cfs

Year 2 Sites

RD 108 South Steiner
River Mile 114.3
Latitude: 38°59'21.87"N
Longitude: 121°48'59.71"W
Diversion Capacity: 30 cfs

Oji Brothers
River Mile 103.3
Latitude: 38°53'56.00"N
Longitude: 121°48'8.00"W
Diversion Capacity: 25 cfs

Windswept Land & Livestock #3
River Mile 102.5
Latitude: 38°53'15.00"N
Longitude: 121°48'30.00"W
Diversion Capacity: 9 cfs

Sutter Mutual Portuguese Bend
River Mile 88.2
Latitude: 38°47'53.00"N
Longitude: 121°41'47.00"W
Diversion Capacity: 106 cfs

For the remainder of this report, these locations are referred to as Sycamore, River Garden Farms No. 2, State Ranch, South Steiner, Oji, Windswept, and Portuguese Bend, respectively.

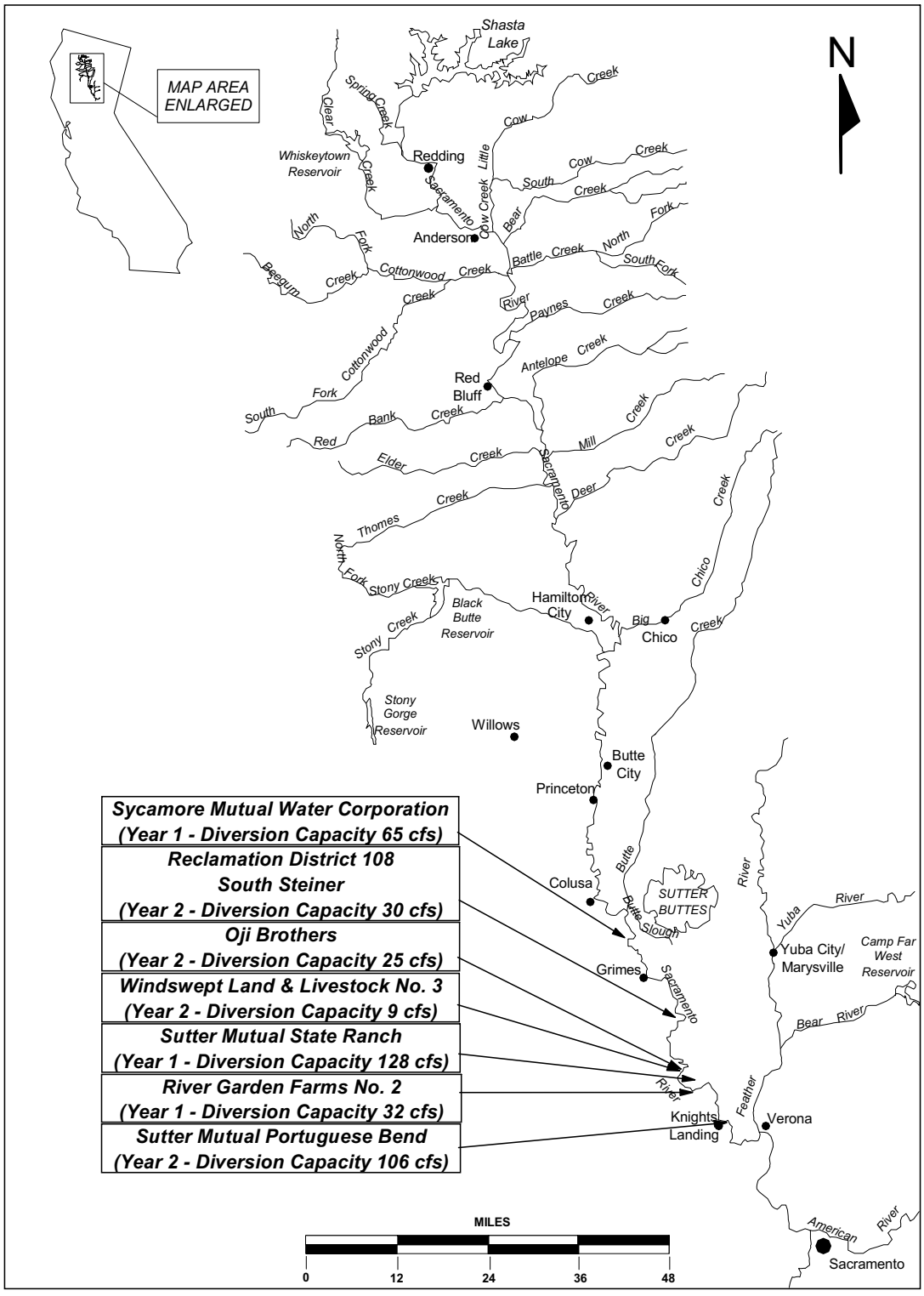

Figure 1. The Sacramento River basin showing the location of seven water diversion sites sampled during the 2010 study

Methods

Fish Entrainment

The study was designed to sample fish that have already been diverted out of the river through irrigation pumps. Sampling equipment and methods were similar to recent entrainment sampling at other irrigation canals (Vogel 2008a). Rectangular, ¼-inch knotless nylon mesh fyke nets[1] were used to collect the fish in irrigation canals. Past experience has demonstrated that these nets would capture all salmonids of the size anticipated at the diversion sites (e.g., Bigelow and Johnson 1996; Vogel and Marine 1997, Vogel 2008b). The larval life stages of other fish species could filter through the mesh, but the sampling program focused on salmonids. However, some of the smaller life stages of non-salmonids were nevertheless sampled (e.g., suckers). Field crews ensured that the fyke frames were properly positioned directly over the culvert or in the canal each day through visual observation. Due to water depth, the nets at Sycamore could not be directly observed so the field crews determined net frame position by measuring the depth with a 10-foot-long wooden pole.

Fish collected were identified as to species, enumerated, measured for fork length, and the carcasses put back into the canals. In some instances, fish carcasses were sufficiently damaged (presumably due to passage through the pumps) that species identification and length measurements were not possible. Water velocity entering the mid-point of each fyke net was measured with a General Oceanics® flow meter continuously positioned in the flow when each net was in the water. These flow meters have a propeller (rotor) directly coupled with a digital counter. Using the vendor's formulae for conversions from counts to velocity provide computed average water velocity for the elapsed time between fyke trap checks. Flow filtered through each fyke net was computed by multiplying the average daily water velocity between fyke trap checks times the submerged cross-sectional area of the culvert or canal (based on culvert or canal and water elevation measurements). Additionally, where available, water district records on flows diverted were obtained. Water elevations were recorded daily and assumed to be representative of the prior 24-hour period. Day-to-day fluctuations in flow were minimal during the study. Fyke nets were checked once daily seven days a week. An Onset® Computer Corporation thermograph was placed in the irrigation canals at Sycamore, State Ranch, South Steiner, Oji, Windswept, and Portuguese Bend to record hourly water temperatures. Water temperatures at River Garden Farms No. 2 were assumed to be similar to temperatures at State Ranch because of the close proximity between sites. All fish species sampled during the 2010 entrainment monitoring project are provided in Appendix A, including the scientific names and if the species are native or non-native.

Sycamore

The fyke apparatus at Sycamore consisted of two 29-in by 45-in rectangular metal frames and two 29-in by 45-in by 15-ft long ¼-inch knotless nylon mesh fyke nets. The end of each fyke net tapered to a 1-ft by 1-ft. by 2-ft long 3/16-inch knotless nylon mesh bag and

[1] Manufactured by Christensen Nets, Inc., Minnesota

a Velcro® zippered end to remove fish and debris. The fyke nets were positioned over culverts exiting into the irrigation canal. We estimated that the two fyke nets filtered 100% of the flow pumped from the river. The fyke frames and nets were raised and lowered within a 3-inch metal channel frame using winches to check for fish entrainment each day (Figure 2).

Figure 2. Fyke apparatus and nets used to sample for fish entrainment at the Sycamore canal.

River Garden Farms No. 2

The fyke apparatus at River Garden Farms No. 2 consisted of two 31-in by 36-in rectangular metal frames and two 31-in by 36-in by 15-ft long ¼-inch knotless nylon mesh fyke nets. The end of each fyke net tapered to a 1-ft by 1-ft. by 2-ft long 3/16-inch knotless nylon mesh bag and a Velcro® zippered end to remove fish and debris. The fyke nets were positioned over culverts exiting into the two irrigation canals. We estimated that the fyke nets filtered 100% of the flow pumped from the river. The fyke frames and nets were raised and lowered within a 3-inch metal channel frame using winches to check for fish entrainment each day (Figure 3).

Figure 3. Fyke apparatus and net used to sample for fish entrainment in one of two canals at River Garden Farms No. 2.

State Ranch

The fyke apparatus at State Ranch consisted of a 5-ft by 5-ft 10-in rectangular metal frame and a 5-ft by 5-ft 10-in by 20-ft long ¼-inch knotless nylon mesh fyke net. The end of the fyke net tapered to a 1-ft by 1-ft. by 3-ft long 3/16-inch knotless nylon mesh bag and a Velcro® zippered end to remove fish and debris. The fyke frame and net were raised and lowered within a 3-inch metal channel frame using a winch to check for fish entrainment each day (Figure 4). We estimated that the fyke net filtered 100% of the flow pumped from the river when the net frame fully covered the culvert opening. In some instances early in the season when debris loads were exceptionally high, the net frame covered approximately half the submerged opening of the culvert and an estimated 50% of the flow was sampled. In these latter instances, fish catches were expanded two-fold to account for the un-sampled flow.

Figure 4. Fyke apparatus, fyke net, and sampling platform used to sample for fish entrainment in the State Ranch canal.

South Steiner

One earth-lined canal was sampled at South Steiner. Efforts were made to sample in a second concrete canal which would have allowed 100% sampling efficiency but was abandoned after the equipment was vandalized and local growers ditched a bypass channel around the concrete canal after the onset of the irrigation season. Because of this circumstance, we plan to sample the newly created bypass channel during the 2011 season which will increase sampling efficiency. Strong turbulence in the concrete manifold distribution box into the canals likely distributed the fish in proportion to flow although this assumption was not empirically tested. USBR monthly pumping flow records were obtained to compare with total flow filtered by the one fyke net. These comparisons were used to estimate the portion of the total flow sampled each month. Based on the flow records, the following proportions of total pump flow sampled by month were: May 67%, June 33%, July 33%, August 50%, and September 100%. These proportions were used to estimate the daily numbers of fish entrained during each of the respective months. The fyke apparatus in the earth canal consisted of a 30-in by 30-in rectangular metal frame and a 30-in by 30-in by 12-ft long ¼-inch knotless nylon mesh fyke net (Figure 5). The end of the fyke net tapered to a 1-ft by 1-ft. by 2-ft long 3/16-inch knotless nylon mesh bag and a Velcro® zippered end to remove fish and debris. The fyke frame and net were raised and lowered within a 3-inch metal channel frame using a winch to check for fish entrainment each day (Figure 6).

Figure 5. Fyke apparatus, fyke net, and sampling platform used to sample for fish entrainment in the South Steiner earth canal.

Oji

The fyke apparatus in the Oji concrete canal consisted of a trapezoidal (78-in by 42-in by 14-in by 42-in) metal frame and a 14-ft long ¼-inch knotless nylon mesh trapezoidal fyke net with the same opening dimensions tapered to a 1-ft by 1-ft. by 2-ft long 3/16-inch knotless nylon mesh bag and a Velcro® zippered end to remove fish and debris. The fyke frame and net were raised and lowered using a winch to check for fish entrainment (Figure 6). We estimated that the fyke net filtered 100% of the flow in the concrete canal when the net was fully in the water. In some instances early in the season when debris loads and pumping were exceptionally high, the net frame was positioned to cover approximately half the submerged portion of the canal and an estimated 50% of the flow was sampled. In these latter instances, fish catches were expanded two-fold to account for the un-sampled flow.

Figure 6. Fyke apparatus, fyke net, and sampling platform used to sample for fish entrainment in the Oji canal.

Windswept

The fyke apparatus at Windswept consisted of a 56-in by 36-in rectangular metal frame and a 56-in by 36-in by 14-ft long ¼-inch knotless nylon mesh fyke net. The end of the fyke net tapered to a 1-ft by 1-ft. by 2-ft long 3/16-inch knotless nylon mesh bag and a Velcro® zippered end to remove fish and debris. The fyke frame and net were raised and lowered within a 3-inch metal channel frame using a winch to check for fish entrainment each day (Figure 7). We estimated that the fyke net filtered 100% of the flow exiting into the main canal. A very small culvert exiting into small ditch was rarely used and was not sampled.

Figure 7. Fyke apparatus, fyke net, and sampling platform used to sample for fish entrainment in the Windswept canal.

Portuguese Bend

The fish sampling apparatus at Portuguese Bend consisted of three fyke nets fished side-by-side. The center fyke apparatus consisted of a 46-in by 46-in rectangular metal frame and a 46-in by 46-in by 20-ft long ¼-inch knotless nylon mesh fyke net. The two side nets each consisted of a trapezoidal (57-in by 44-in by 48-in by 12-in) metal frame and a 20-ft long ¼-inch knotless nylon mesh trapezoidal fyke net with the same opening dimensions. Each of the three nets tapered to a 1-ft by 1-ft. by 3-ft long 3/16-inch knotless nylon mesh bag and a Velcro® zippered end to remove fish and debris. The fyke frames and nets were raised and lowered within a 3-inch metal channel frame using a winch to check for fish entrainment each day (Figure 8). We estimated that the three fyke nets filtered 98% of the canal flow when all three nets were positioned in the canal. There were instances when one or two of the three nets had to be raised (e.g., net repair or very high pumping/high debris loads) and the numbers of fish sampled with nets remaining in the water were extrapolated based on the approximate portion of the canal flow sampled (e.g., one- or two-thirds).

Figure 8. Three fyke nets, sampling platform, and associated apparatus used to sample for fish entrainment in the Portuguese Bend canal.

Results

Sycamore

Fish Entrainment

Fish entrainment monitoring at the Sycamore outfall was initiated on April 26, 2010 (the onset of pumping operations at that location) (first net pull on April 27th) and continued until September 30, 2010. Tables 1A, 1B, and 1C provide the total numbers of fish sampled and sizes by species. Appendix B at the end of this report provides daily data on fish entrainment.

Sacramento sucker was the dominant species among 24 identifiable species sampled at Sycamore, followed by Tule perch, prickly sculpin, and Sacramento pikeminnow (Figures 9 and 10). No Chinook salmon were observed. The daily numbers of all fish species sampled at the outfalls were highly variable over the irrigation season (Figure 11).

Table 1A. Grand total of fish sampled and sizes by species at Sycamore pump station, April 27 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)								
Sacramento Sucker ***(Catostomus occidentalis)***	**Tule Perch** ***(Hysterocarpus traski)***	**Prickly Sculpin** ***(Cottus asper)***	**Sacramento Pikeminnow** ***(Ptychocheilus grandis)***	**Unknown Sculpin**	**Golden Shiner** ***(Notemigonus crysoleucas)***	**Hardhead** ***(Mylopharodon conocephalus)***	**Pacific Lamprey** ***(Lampetra tridentate)***	**Sacramento Splittail** ***(Pogonichthys macrolepidotu)***
N=1,099	N=432	N=130	N=99	N=21	N=34	N=25	N=20	N=17
61.2 mm	65.5 mm	45.6 mm	91.7 mm	46.1 mm	95.6 mm	83.6 mm	171.8 mm	70.9 mm
29 – 160 mm	31 – 130 mm	32 – 94 mm	33 – 131 mm	30 – 65 mm	79 – 134 mm	59 – 111 mm	39 – 232 mm	42 – 124 mm
(17.1 mm)	(19.1 mm)	(8.6 mm)	(20.2 mm)	(8.1 mm)	(13.8 mm)	(13.2 mm)	(50.9 mm)	(30.9 mm)

Table 1B. Grand total of fish sampled and sizes by species at Sycamore pump station, April 27 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)								
Black Bullhead ***(Ictalurus melas)***	**Bluegill** ***(Lepomis macrochirus)***	**Black Crappie** ***(Pomoxis nigromaculatus)***	**California Roach** ***(Livinia symmetricus)***	**White Catfish** ***(Ameiurus catus)***	**River Lamprey** ***(Lampetra ayresi)***	**Largemouth Bass** ***(Micropterus salmoides)***	**Brown Bullhead** ***(Ameiurus nebulosus)***	**Wakasagi** ***(Hypomesus nipponensis)***
N=12	N=12	N=10	N=9	N=8	N=6	N=6	N=4	N=2
235 mm	43 mm	80.3 mm	87.7 mm	95.7 mm	80 mm	73.8 mm	105 mm	48 mm
235 – 235 mm	30 – 68 mm	65 – 91 mm	79 – 97 mm	29 – 225 mm	65 – 95 mm	32 – 142 mm	105 – 105 mm	46 – 52 mm
(0 mm)	(15 mm)	(7.8 mm)	(6.9 mm)	(112 mm)	(21.2 mm)	(43.7 mm)	(0 mm)	(3.5 mm)

Table 1C. Grand total of fish sampled and sizes by species at Sycamore pump station, April 27 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)							
Yellow Bullhead ***(Ictalurus natalis)***	**Threespine Stickleback** ***(Gasterostreus aculeatus)***	**Riffle Sculpin** ***(Cottus gulosus)***	**American Shad** ***(Alosa sapidissima)***	**Green Sunfish** ***(Lepomis cyanellus)***	**Carp** ***(Cyprinus carpio)***	**Unknown Lamprey** ***(Lampetra)***	**Unknown Bass**
N=3	N=1	N=1	N=1	N=1	N=1	N=1	N=1
Not Measured	44 mm	70 mm	39 mm	48 mm	Not Measured	Not Measured	41 mm
(N.A.)	(N.A.)	(N.A.)	(N.A.)	(N.A.)	(N.A.)	(N.A.)	(N.A.)

An additional 31 fish were sampled that could not be identified

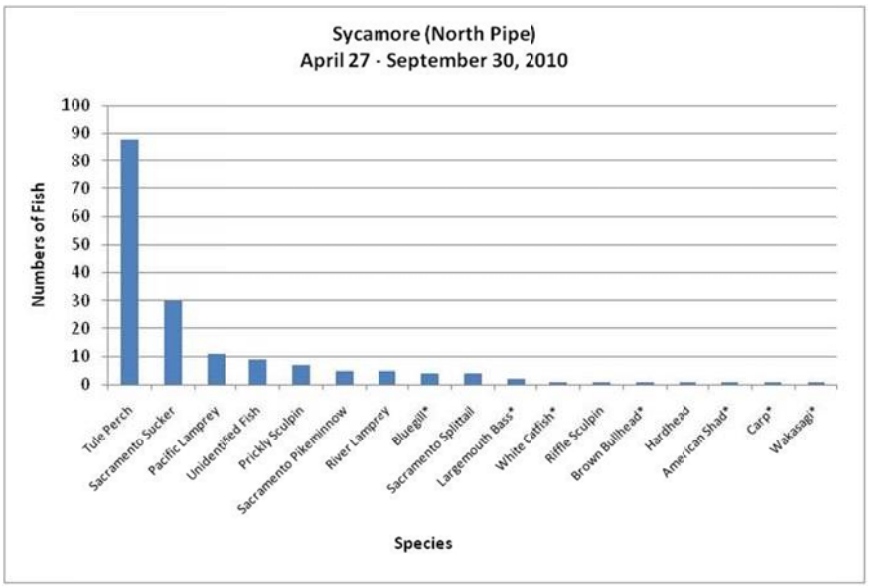

Figure 9. Fish species sampled during entrainment monitoring at the Sycamore pump station north pipe outlet (April 27 – September 30, 2010. Asterisks indicate non-native fish species.

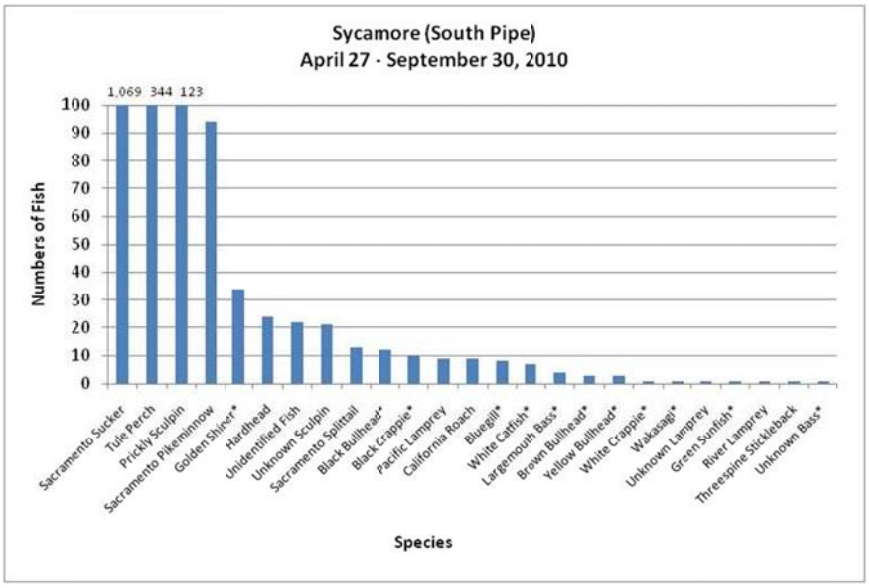

Figure 10. Fish species sampled during entrainment monitoring at the Sycamore pump station south pipe outlet (April 27 – September 30, 2010. Asterisks indicate non-native fish species.

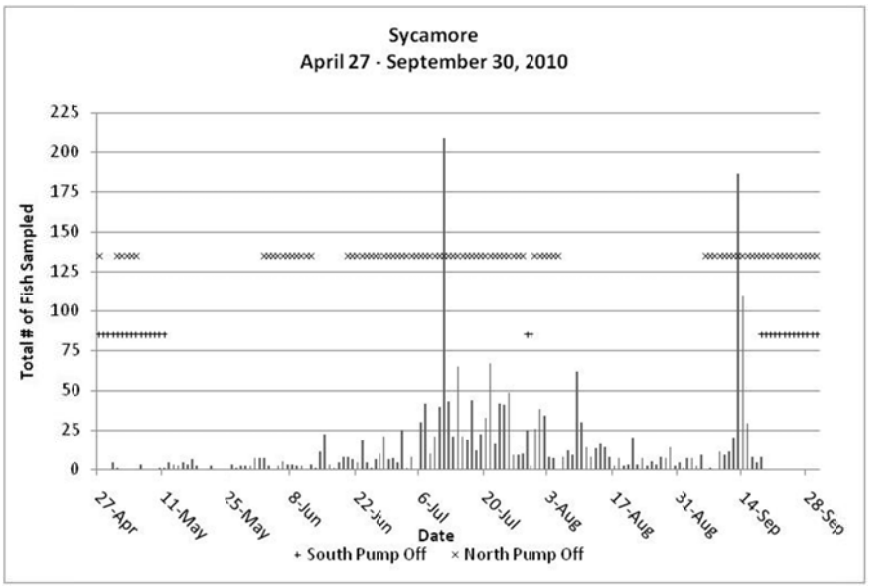

Figure 11. Daily numbers of fish (all species combined) sampled during entrainment monitoring at Sycamore canal (April 27 – September 30, 2010).

Based on data collected by a thermograph placed at the site, water temperatures rapidly increased during the spring reaching the high 60's degrees Fahrenheit by early July through early September (Figure12). Water temperatures observed at the Sycamore diversion site early in the season were tolerable for juvenile salmon. However, the high, sustained river flows likely resulted in most juvenile salmon emigrating from the upper river prior to water diversions and could partially explain why no salmonids were sampled (discussed later in this report). Periods of elevated temperatures occurred with minimal or no pumping late in the season resulting in warming of canal water (Figure 12). All of the species entrained would normally be expected to be present at this river location during the sampling period.

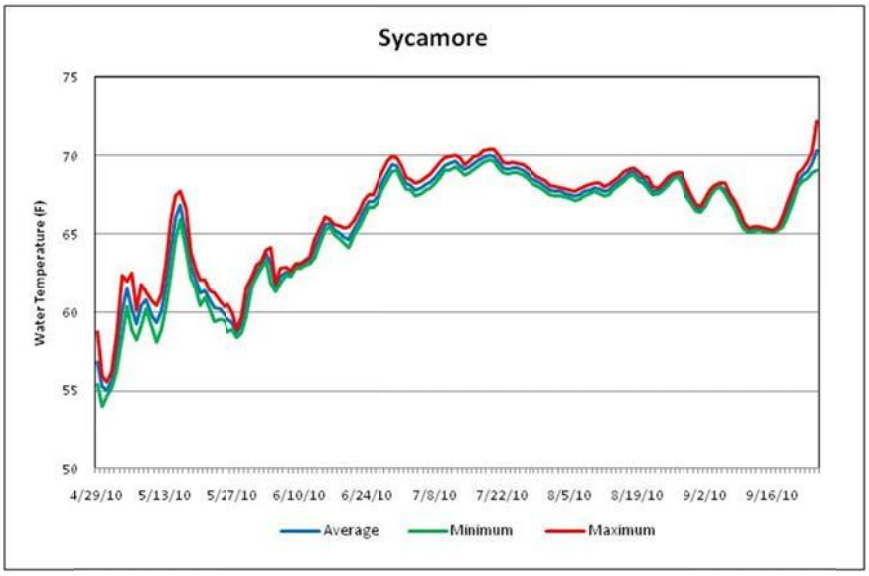

Figure 12. Daily water temperatures recorded at Sycamore canal.

Based on the flow meters installed in the fyke nets, daily flow in the canal was highly variable (Figure 13) but provides a relative indication of the timing of water diversions into the canal. No correlations between flow and numbers of fish entrained were evident.

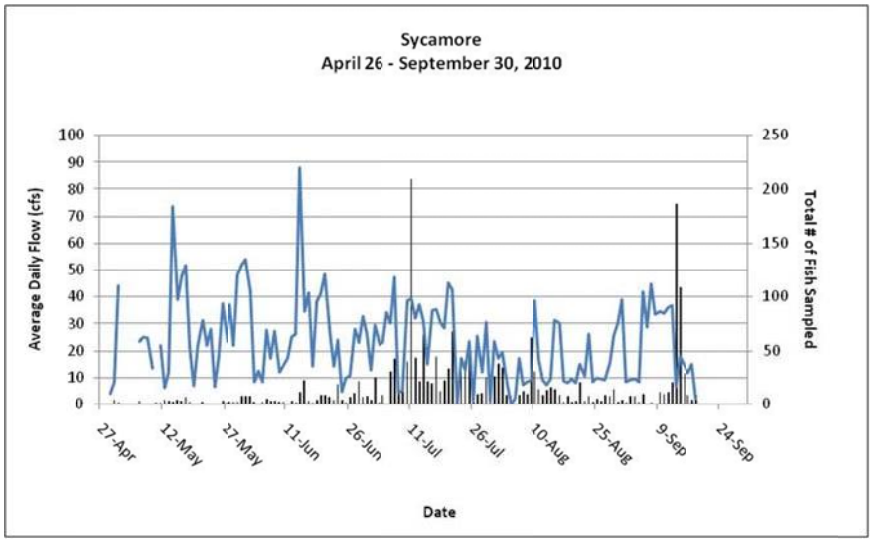

Figure 13. Estimated daily flows (cfs) in the irrigation canal at Sycamore and daily total number of fish (all species) sampled during the 2010 study period.

Physical Features of the Pump Station Intakes

The Sycamore pump station intakes are located on the right side of the river (facing downstream) in a relatively straight portion or very slight inside bend of the river channel (Figure 14).

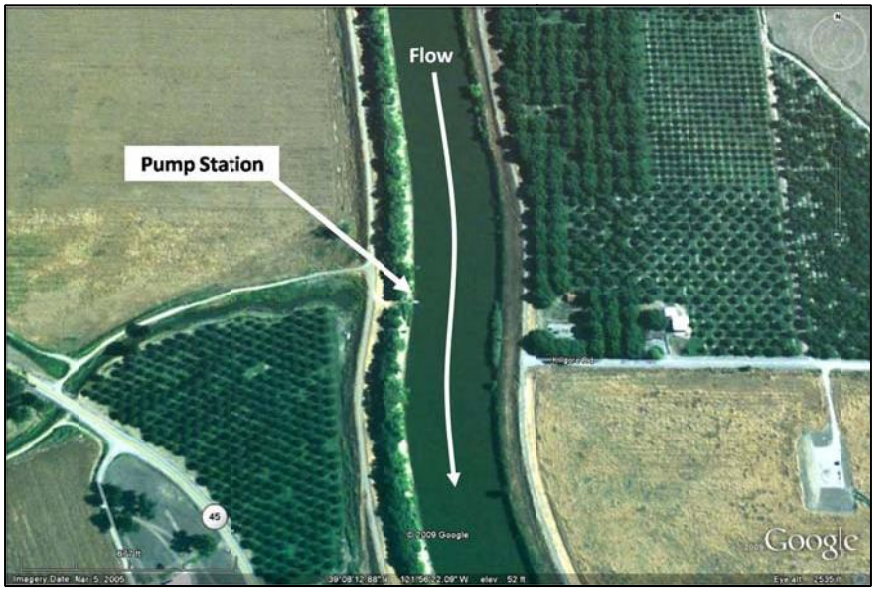

Figure 14. Location of the Sycamore pump station on the Sacramento River.

Based on in-river surveys conducted during the summer of 2008, the two Sycamore 30-inch diameter pipe intakes enter the water at a 30-degree angle (Figure 15) (Table 2). At the time of the survey on July 16, 2008, the water depth at the pipe intakes was 11 feet with the intakes positioned one foot above the cobble riverbed, 30 feet from the river's edge, and flow was unidirectional. Rearing habitat for juvenile salmon was characterized as poor and predatory fish habitat was classified as fair (Vogel 2008c). Additional features of the site are provided in Table 2.

Figure 15. The Sycamore pump intakes looking in a downstream direction.

Site Number: 111		TABLE 2. DIVERSION CHARACTERISTICS OF THE SYCAMORE PUMP STATION INTAKE (RIVER MILE 132.5) (DATA FROM VOGEL 2008c) 7/16/08								
Location Facing Downstream	**Channel Configuration at Diversion**	**# of Intake(s) (Upstream to Downstream)**	**Intake Opening Size (Outside Diameter in Inches)**	**Distance Between Intakes (Feet)**	**Intake Angle into Water (Degrees)**	**Estimated Distance from Intake Opening to Bank (Feet)**	**Estimated Riverbed Depth Near Intake (Feet)**	**Estimated Distance of Intake Off River Bottom (Feet)**	**Type of Posts In Water for Support Structure**	**# of Support Posts**
Right	Straight	2	30"	2'	30°	30'	11'	1'	I-Beam	2
			30"		30°	30'	11'	1'		
Hydraulic Characteristics	**Riverbank Material**	**Riparian Overstory (Type)**	**Riparian Understory (Type)**	**Estimated Time In Shade (Percent)**	**Debris Near Diversion Intake**	**Natural Instream Structure in General Vicinity of Diversion**	**Estimated Riverbed Substrate Near Diversion Intake**	**Juvenile Salmonid Habitat (Overall Quality)**	**Potential Predator Habitat (Overall Quality)**	
Unidirectional	Co, We	TrC	Sh	5%	WD-L	None	Co	1	2	

RIPARIAN IDENTIFICATION		**RIVERBED SUBSTRATE IDENTIFICATION**		**DEBRIS NEAR DIVERSION INTAKE**			**JUVENILE SALMON REARING/PREDATOR HABITAT**	
Code	Type	Code	Type	**Code**	**Type**		Code	Quality
Gr	Grasses	Si	Silt	WD-L	Woody Debris - Low Density		1	Poor
Sh	Shrubs	Sa	Sand	WD-M	Woody Debris - Medium Density		2	Fair
So	Soil	Co	Cobble	WD-H	Woody Debris - High Density		3	Good
Mu	Mulberry	RR	Rip-Rap					
TrA	Ash Tree	HP	Hardpan					
TrC	Cottonwood Tree							
TrO	Oak Tree							
TrUn	Unidentified Tree							
TrW	Walnut Tree	Code	Detail		8/21/08	7/16/08		
TrWi	Willow Tree	Non-Op	Non-Operational	Water Temperature:	71°F	66°F		
Ve	Vegetation	NA	Not Applicable	Secchi Depth:	5.5'			
We	Weeds	NE	No Estimates	Turbidity (NTUs):	4.4			

DIDSON™ imaging revealed minimal submerged woody debris around the pipe intakes and a cobble riverbed substrate at the intake location. Figure 16 shows a DIDSON™ still image taken at the Sycamore pumping station. Motion images (.avi files) were recorded on August 21, 2008 and are provided in a separate report on in-river surveys of Sacramento River water diversions (Vogel 2008c).

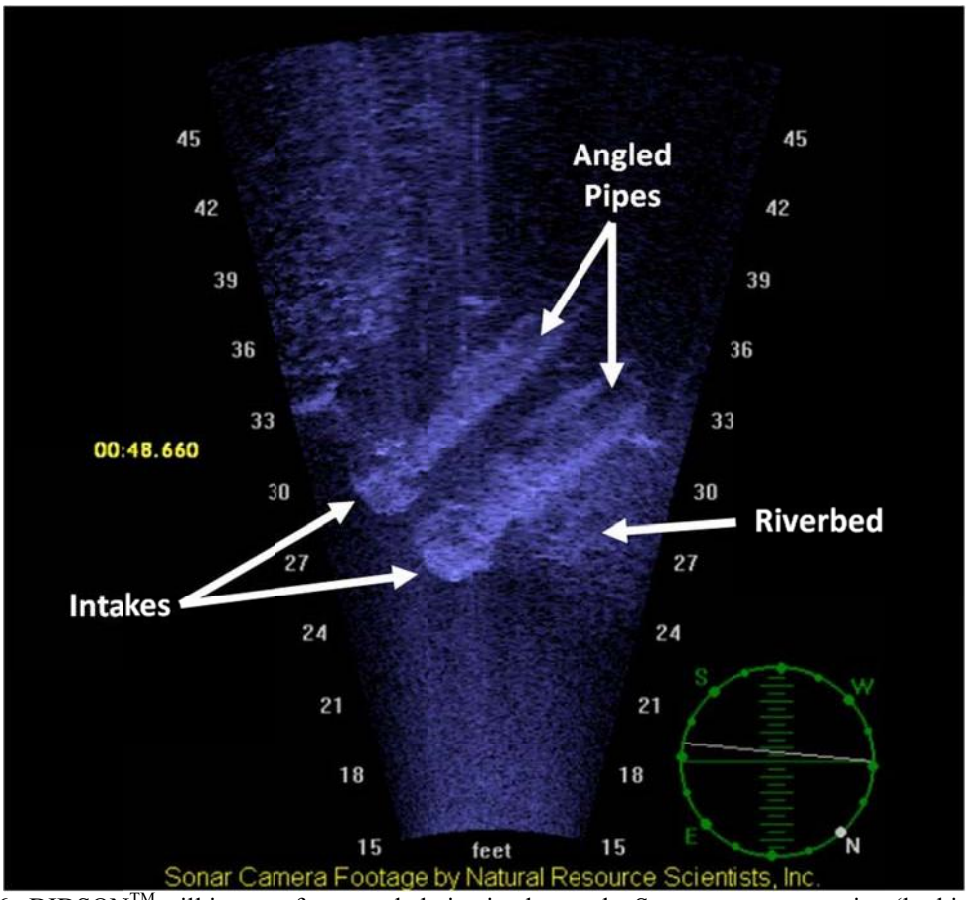

Figure 16. DIDSON™ still image of two angled pipe intakes at the Sycamore pump station (looking in a downstream direction). Image taken on August 21, 2008.

Figures 17 – 20 show Acoustic Doppler Current Profiler (ADCP) bathymetry profiles and water velocity distributions across the river channel just upstream and downstream of the Sycamore pump station as measured on August 21, 2008. The thalweg is on the left side of the river channel, the opposite side as the pump station. The highest concentration of flow is in the center portion of the channel.

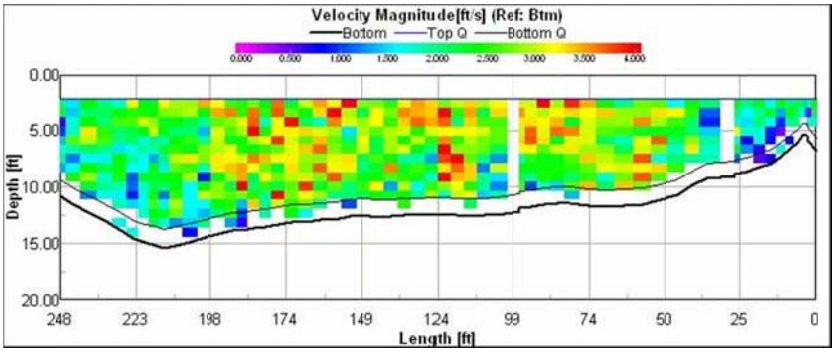

Figure 17. ADCP transect 1 (facing downstream) measured just downstream of Sycamore pump station (located on right bank). Right bank is ~7' from start of transect and left bank is ~6' from end of transect.

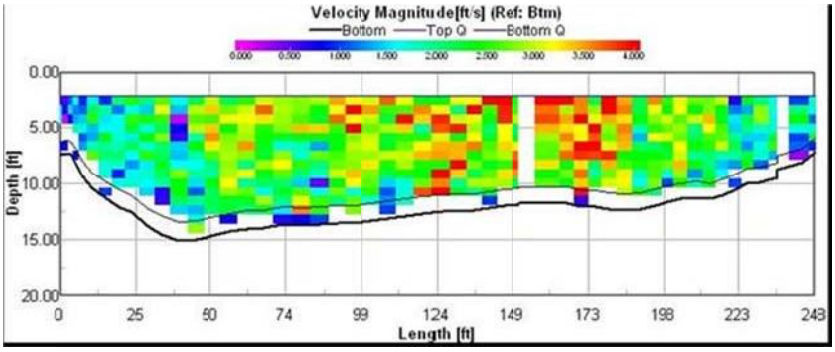

Figure 18. ADCP transect 2 (facing downstream) measured just downstream of Sycamore pump station (located on right bank). Left bank is ~6' from start of transect and right bank is ~5' from end of transect.

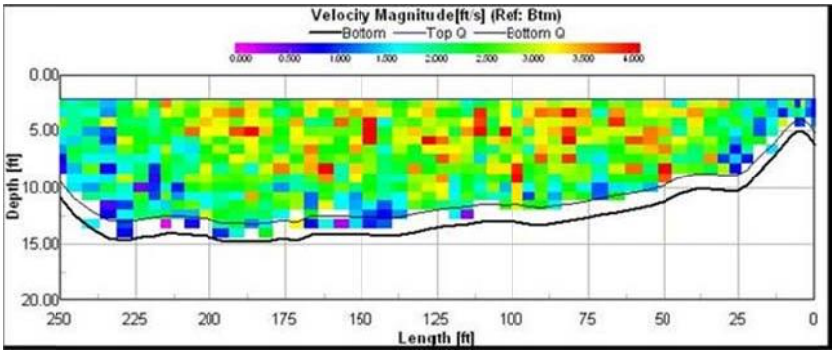

Figure 19. ADCP transect 3 (facing downstream) measured just upstream of Sycamore pump station (located on right bank). Right bank is ~9' from start of transect and left bank is ~10' from end of transect.

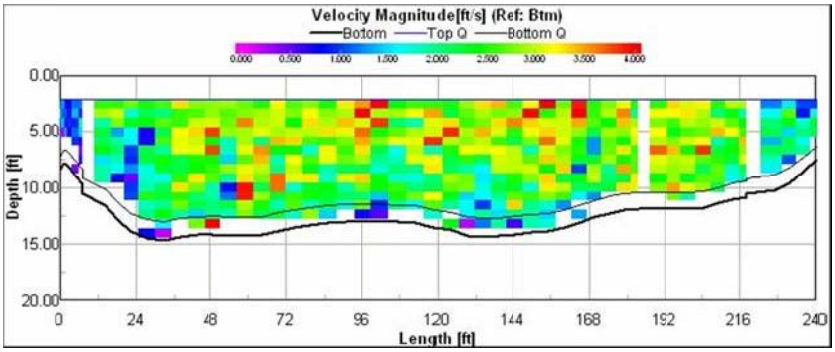

Figure 20. ADCP transect 4 (facing downstream) measured just upstream of Sycamore pump station (located on right bank). Left bank is ~10' from start of transect and right bank is ~6' from end of transect.

River Garden Farms No. 2

Fish Entrainment

Fish entrainment monitoring at the outfall for the River Garden Farms No. 2 was initiated on May 23, 2010 (the onset of irrigation diversion) (first net pull on May 24th) and continued until September 30, 2010. Tables 3A and 3B provide the total numbers of fish sampled and fish sizes by species. Appendix C at the end of this report provides daily data on fish entrainment.

Tule perch was the dominant fish species among 14 identifiable species sampled at River Garden Farms No. 2, followed by Chinook salmon, and Wakasagi (Figure 21). Sixteen juvenile Chinook salmon were observed (Table 4). One Chinook salmon fry was sampled which was a size indicating that the fish was a late-fall-run Chinook; all other fish were fall-run Chinook. No winter-run fry were observed during late summer or fall when the species is present in the upper portions of the Sacramento River[2]. The daily numbers of all fish species sampled was consistently low throughout the irrigation season (Figure 22).

[2] Based on: Vogel, D.A. and K.R. Marine. 1991. Guide to upper Sacramento River Chinook salmon life history. U.S. Bureau of Reclamation, Central Valley Project. July 1991.

Table 3A. Grand total of fish sampled and sizes by species at River Garden Farms pump station, May 24 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Tule Perch *(Hysterocarpus traski)*	**Chinook Salmon** *(Oncorhynchus tshawytscha)*	**Wakasagi** *(Hypomesus nipponensis)*	**Sacramento Sucker** *(Catostomus occidentalis)*	**Brown Bullhead** *(Ameiurus nebulosus)*	**White Crappie** *(Pomoxis annularis)*	**White Catfish** *(Ameiurus catus)*
N=23 72.4 mm 31 – 100 mm (21.3 mm)	N=16 81.8 mm 31 – 109 mm (17.4 mm)	N=11 45.1 mm 39 – 54 mm (5.2 mm)	N=4 85 mm 20 – 150 mm (91.9 mm)	N=4 215 mm 185 – 260 mm (39.7 mm)	N=3 39.3 mm 38 – 41 mm (1.5 mm)	N=3 150 mm 30 – 270 mm (169.7 mm)

Table 3B. Grand total of fish sampled and sizes by species at River Garden Farms pump station, May 24 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Fathead Minnow *(Pimephales promelas)*	**Golden Shiner** *(Notemigonus crysoleucas)*	**Bluegill** *(Lepomis macrochirus)*	**Yellow Bullhead** *(Ictalurus natalis)*	**Sacramento Pikeminnow** *(Ptychocheilus grandis)*	**Carp** *(Cyprinus carpio)*	**River Lamprey** *(Lampetra ayresi)*
N=2 48.5 mm 46 – 51 mm (3.5 mm)	N=2 47 mm 41 – 53 mm (8.5 mm)	N=2 39 mm 28 – 50 mm (15.6 mm)	N=2 179 mm 179 –179 mm (0 mm)	N=1 197 mm (N.A.)	N=1 54 mm (N.A.)	N=1 Not Measured (N.A.)

An additional 10 fish were sampled that could not be identified

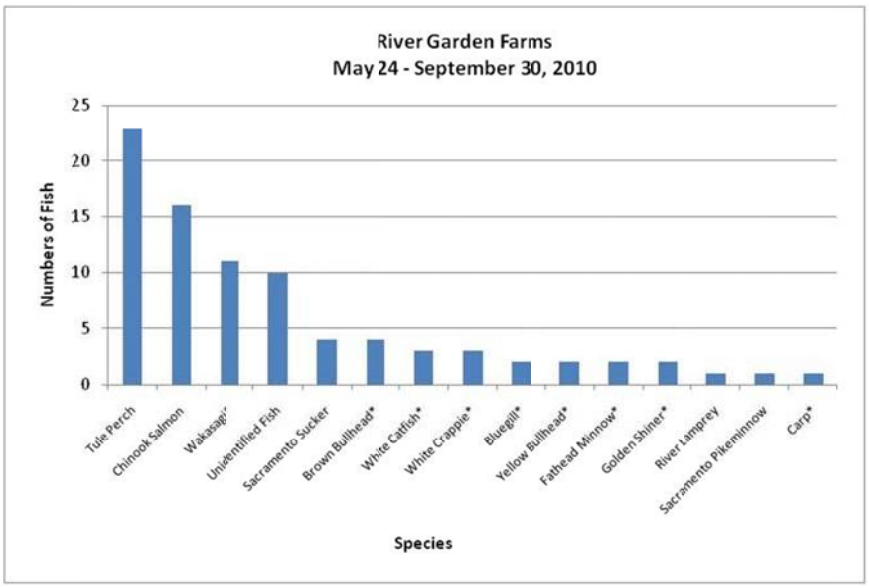

Figure 21. Fish species sampled during entrainment monitoring at the River Garden Farms No. 2 canal (May 24 – September 30, 2010). Asterisks indicate non-native fish species.

Table 4. Number of juvenile Chinook salmon sampled at River Garden Farms No. 2 (May 24 – September 30, 2010).	
May 29, 2010	2
May 30, 2010	1
May 31, 2010	6
June 1, 2010	3
June 2, 2010	3
June 3, 2010	1
Total	**16**

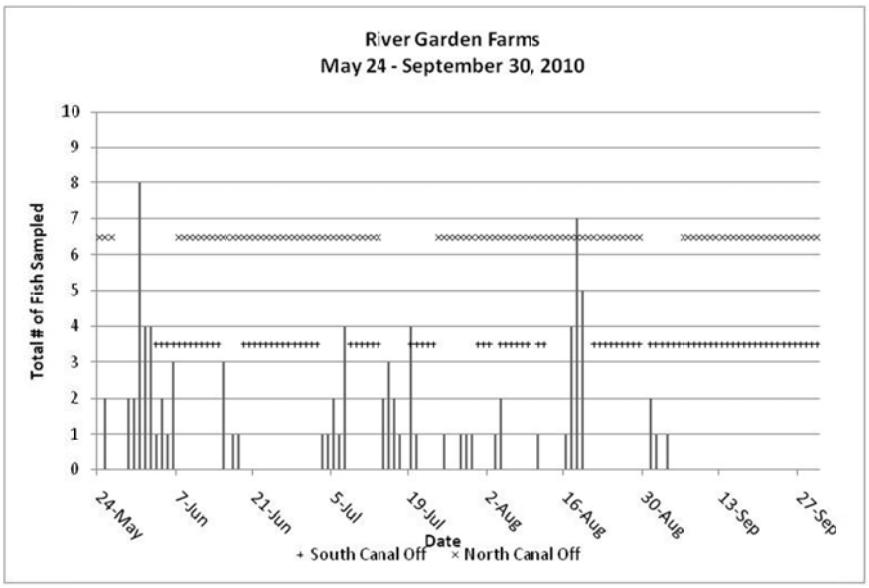

Figure 22. Daily numbers of fish (all species combined) sampled during entrainment monitoring at River Garden Farms No. 2 (May 24 – September 30, 2010)

Based on data from a thermograph at nearby State Ranch canal, water temperatures were cool early in the season, rose rapidly in the spring, reaching the high 60's to low 70's degrees Fahrenheit from late June to mid-September (Figure 23). All of the fish species entrained would normally be expected to be present at this river location during the sampling period.

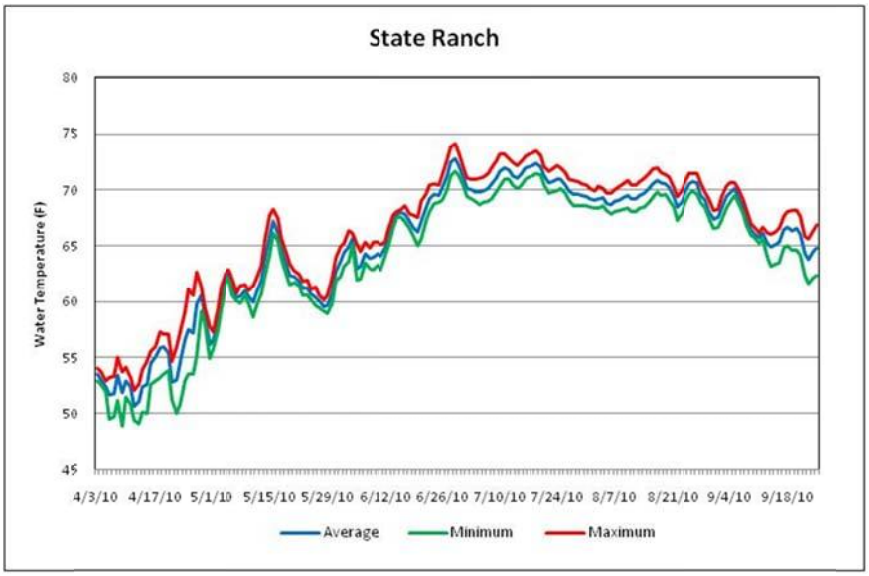

Figure 23. Water temperatures recorded at State Ranch canal (just downstream from River Garden Farms No. 2).

Based on the flow meters installed in the fyke nets, daily flow in the canals was highly variable (Figure 24) but provides a relative indication of the timing of water diversions into the canal. No correlations between flow and numbers of fish entrained were evident.

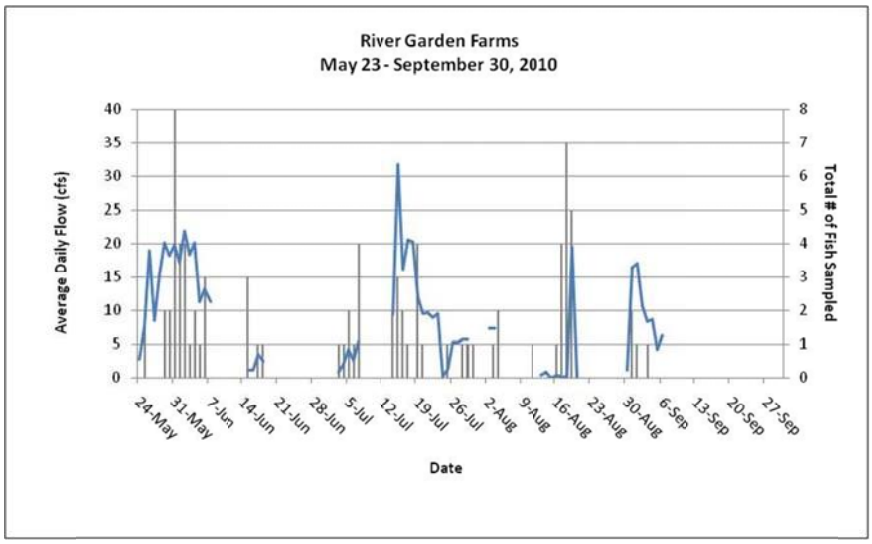

Figure 24. Estimated daily flows (cfs) in the irrigation canal at River Garden Farms and daily total number of fish (all species) sampled during the 2010 study period.

Physical Features of the Pump Station Intakes

The River Garden Farms No. 2 pump station intakes are located on a sharp outside bend of the river channel (Figure 25).

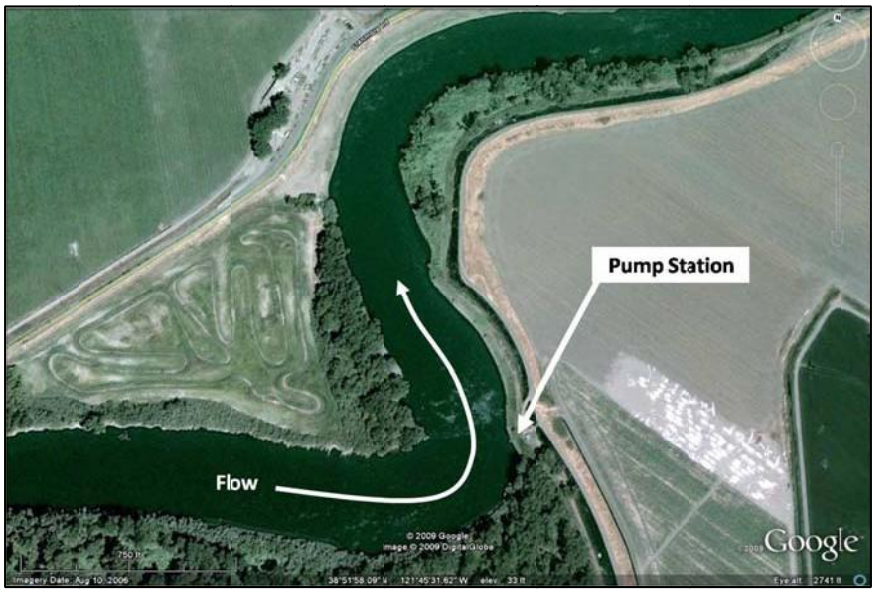

Figure 25. Location of the River Garden Farms No. 2 pump station on the Sacramento River

Based on in-river surveys conducted during the summer of 2008, the 24-inch and 30-inch diameter River Garden Farms No. 2 pipe intakes enter the water at a 28-degree angle (Figure 26) (Table 5). At the time of the survey on June 25, 2008, the water depth at the pipe intakes was 14 feet with the intakes positioned five feet above the riprap riverbed, 22 feet from the river's edge, and flow was swift and unidirectional. Rearing habitat for

juvenile salmon was characterized as poor and predatory fish habitat was classified as fair (Vogel 2008c). Additional features of the site are provided in Table 5.

Figure 26. The River Garden Farms No. 2 pump intakes looking in a downstream direction.

Site Number: 042		TABLE 5. DIVERSION CHARACTERISTICS OF THE RIVER GARDEN FARMS NO. 2 PUMP STATION INTAKE (RIVER MILE 96.7) (DATA FROM VOGEL 2008c) 6/25/08								
Location Facing Downstream	**Channel Configuration at Diversion**	**# of Intake(s) (Upstream to Downstream)**	**Intake Opening Size (Outside Diameter in Inches)**	**Distance Between Intakes (Feet)**	**Intake Angle into Water (Degrees)**	**Estimated Distance from Intake Opening to Bank (Feet)**	**Estimated Riverbed Depth Near Intake (Feet)**	**Estimated Distance of Intake Off River Bottom (Feet)**	**Type of Posts In Water for Support Structure**	**# of Support Posts**
Right	Outside Bend	2	24"	2'	28°	22'	14'	5'	Round Post	2
			30"		28°	22'	14'	5'		
Hydraulic Characteristics	**Riverbank Material**	**Riparian Overstory (Type)**	**Riparian Understory (Type)**	**Estimated Time In Shade (Percent)**	**Debris Near Diversion Intake**	**Natural Instream Structure in General Vicinity of Diversion**	**Estimated Riverbed Substrate Near Diversion Intake**	**Juvenile Salmonid Habitat (Overall Quality)**	**Potential Predator Habitat (Overall Quality)**	
Swift Unidirectional	RR, Gr	None	RR, Gr	15%	None	None	RR	1	2	
RIPARIAN IDENTIFICATION			**RIVERBED SUBSTRATE IDENTIFICATION**			**DEBRIS NEAR DIVERSION INTAKE**			**JUVENILE SALMON REARING/PREDATOR HABITAT**	
Code	Type		Code	Type		**Code**	**Type**		Code	Quality
Gr	Grasses		Si	Silt		WD-L	Woody Debris - Low Density		1	Poor
Sh	Shrubs		Sa	Sand		WD-M	Woody Debris - Medium Density		2	Fair
So	Soil		Co	Cobble		WD-H	Woody Debris - High Density		3	Good
Mu	Mulberry		RR	Rip-Rap						
TrA	Ash Tree		HP	Hardpan						
TrC	Cottonwood Tree									
TrO	Oak Tree									
TrUn	Unidentified Tree									
TrW	Walnut Tree		Code	Detail			7/16/08	6/25/08		
TrWi	Willow Tree		Non-Op	Non-Operational		Water Temperature:	70°F	66°F		
Ve	Vegetation		NA	Not Applicable		Secchi Depth:	4'			
We	Weeds		NE	No Estimates		Turbidity (NTUs):	6.68			

DIDSON™ imaging revealed no woody debris around the pipe intakes and a riprap riverbed substrate at the intake location. Figure 27 shows a DIDSON™ still image taken at the River Garden Farms No. 2 pumping station. Motion images (.avi files) were recorded on July 16, 2008 and are provided in a separate report on in-river surveys of Sacramento River water diversions (Vogel 2008c).

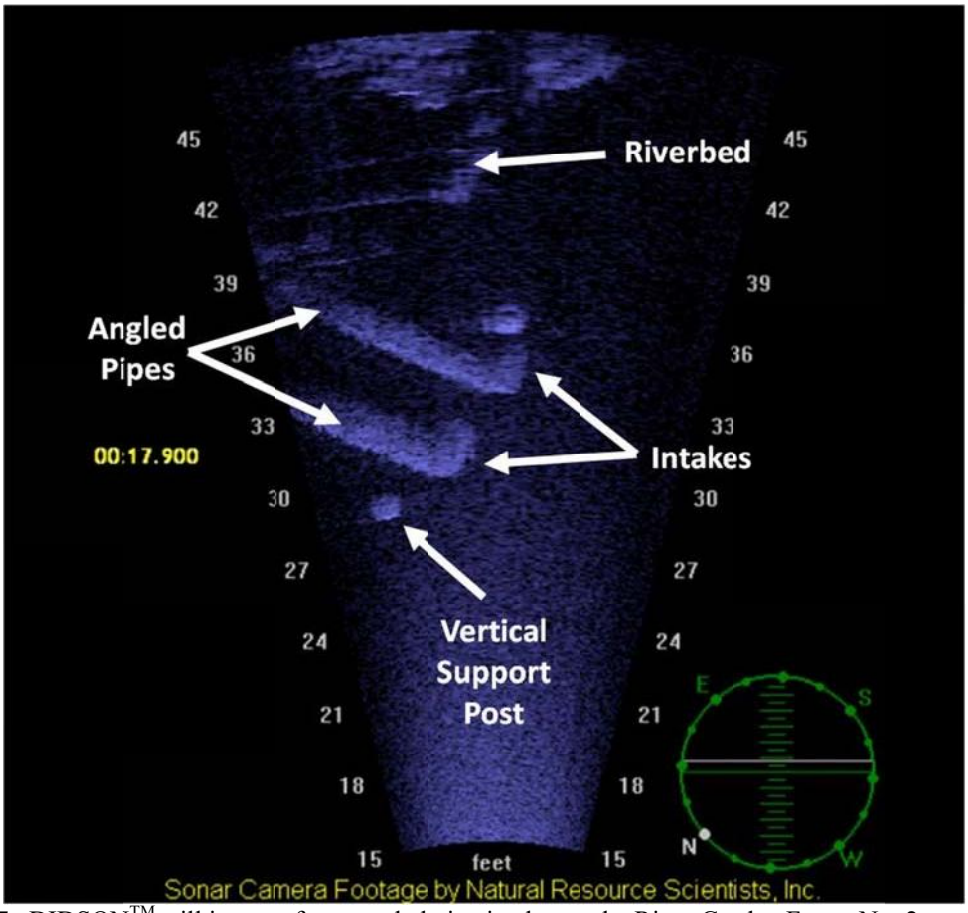

Figure 27. DIDSON™ still image of two angled pipe intakes at the River Garden Farms No. 2 pump station (looking in an upstream direction). Image taken on July 16, 2008.

Figures 28- 31 show ADCP bathymetry profiles and water velocity distributions across the river channel just upstream and downstream of the River Garden Farms No. 2 pump station as measured on July 16, 2008. The thalweg and the highest concentration of flow are located in the middle of the river channel. The pump station intake is positioned in between an unusual area of high water velocity (downstream of the pump station) and slow moving water (upstream of the pump station, a circumstance resulting from the combination of channel geometry and the sharp bend in the river channel.

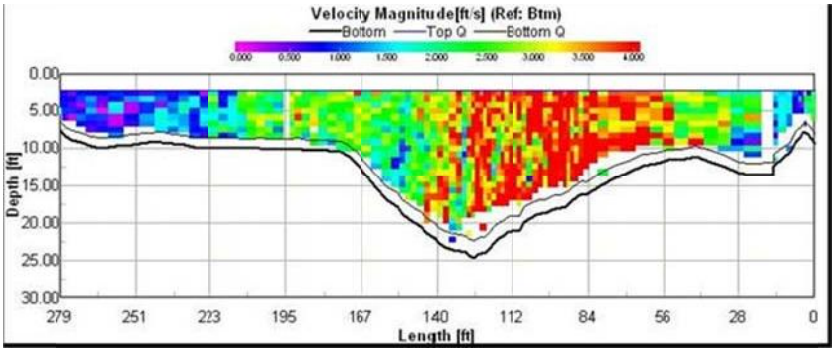

Figure 28. ADCP transect 1 (facing downstream) measured just downstream of River Garden pump station (located on right bank). Right bank is ~5' from start of transect and left bank is ~9' from end of transect.

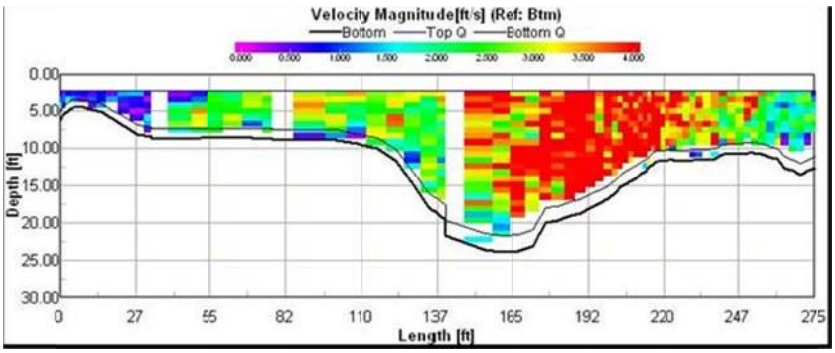

Figure 29. ADCP transect 2 (facing downstream) measured just downstream of River Garden pump station (located on right bank). Left bank is ~9' from start of transect and right bank is ~8' from end of transect.

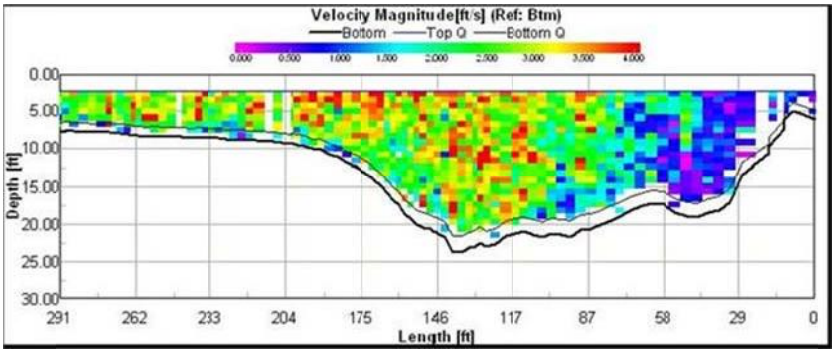

Figure 30. ADCP transect 3 (facing downstream) measured just upstream of River Garden pump station (located on right bank). Right bank is ~5' from start of transect and left bank is ~18' from end of transect.

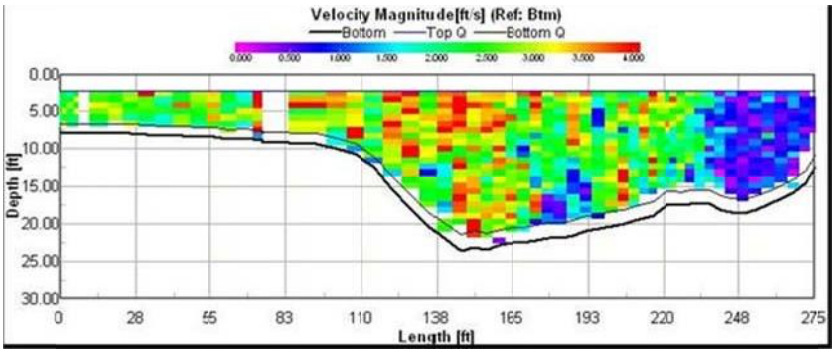

Figure 31. ADCP transect 4 (facing downstream) measured just upstream of River Garden pump station (located on right bank). Left bank is ~18' from start of transect and right bank is ~8' from end of transect.

State Ranch

Fish Entrainment

Fish entrainment monitoring at the outfall for the State Ranch pumping station was initiated on April 1, 2010 (the first authorized day of the Section 10 permit period) (first net pull on April 2nd) and continued until September 30, 2010. Like other sampling sites, the nets were kept in place each day, even if diversions were not occurring that day, to ensure that fish may be captured if water diversions resumed. For example, during April, even though no pumps were operating most of the month, the fyke net was positioned over the culvert each day. Tables 6A, 6B, and 6C provide the total numbers of fish sampled and fish sizes by species. Appendix D at the end of this report provides daily data on fish entrainment.

Twenty-five identifiable fish species were sampled. Sacramento sucker was the dominant species sampled at the State Ranch pump station canal outfall, followed by carp and Tule perch (Figure 32). An estimated seven juvenile Chinook salmon (fall run) were entrained (April 29: three fish, April 30: five fish, May 1: one fish, May 31: one fish). No winter-run fry were observed during late summer or fall when the species is present in the upper portions of the Sacramento River. The daily numbers of all fish species sampled at the outfall were highly variable over the irrigation season (Figure 33).

Table 6A. Grand total of fish by species at State Ranch pump station, April 2 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Sacramento Sucker *(Catostomus occidentalis)*	Carp *(Cyprinus carpio)*	Tule Perch *(Hysterocarpus traski)*	Hardhead *(Mylopharodon conocephalus)*	White Catfish *(Ameiurus catus)*	Sacramento Pikeminnow *(Ptychocheilus grandis)*	Unknown Lamprey *(Lampetra)*	Bluegill *(Lepomis macrochirus)*	California Roach *(Lavinia symmetricus)*
N=589*	N=136*	N=61*	N=39	N=48*	N=34	N=30*	N=29*	N=26
57.1 mm	34.4 mm	66.5 mm	62.1 mm	60.1 mm	59.1 mm	214.3 mm	37 mm	72 mm
15 – 126 mm	16 – 131 mm	21 – 147 mm	38 – 110 mm	30 – 273 mm	24 – 105 mm	95 – 246 mm	22 – 73 mm	30 – 88 mm
(19.9 mm)	(16.2 mm)	(29 mm)	(16.5 mm)	(58.3 mm)	(20.9 mm)	(43.9 mm)	(12.7 mm)	(11.9 mm)

*Totals include these estimates: 1 Sacramento Sucker , 8 Carp, 6 Tule Perch, 11 White Catfish, 10 Unknown Lamprey and 7 Bluegill

Table 6B. Grand total of fish by species at State Ranch pump station, April 2 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Yellow Bullhead *(Ictalurus natalis)*	Brown Bullhead *(Ameiurus nebulosus)*	Pacific Lamprey *(Lampetra tridentate)*	Golden Shiner *(Notemigonus crysoleucas)*	Chinook Salmon *(Oncorhynchus tshawytscha)*	Redear Sunfish *(Lepomis microlophus)*	Bigscale Logperch *(Percina macrolepida)*	Black Bullhead *(Ameiurus melas)*	Black Crappie *(Pomoxis nigromaculatus)*
N=23*	N=21*	N=18*	N=17*	N=11*	N=10*	N=8*	N=8*	N=8
140.4 mm	87.8 mm	191.8 mm	75.4 mm	87.1 mm	37.1 mm	62.5 mm	69.5 mm	76 mm
84 – 204 mm	39 – 220 mm	122 – 660 mm	47 – 205 mm	73 – 125 mm	30 – 52 mm	44 – 85 mm	29 – 159 mm	33 – 154 mm
(45 mm)	(63.6 mm)	(142.1 mm)	(36.4 mm)	(17.6 mm)	(7.1 mm)	(16.5 mm)	(51.6 mm)	(38.5 mm)

*Totals include these estimates: 11 Yellow Bullhead , 3 Brown Bullhead, 3 Pacific Lamprey, 1 Golden Shiner, 4 Chinook Salmon, 3 Redear Sunfish, 2 Bigscale Logperch and 2 Black Bullhead

Table 6C. Grand total of fish by species at State Ranch pump station, April 2 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

River Lamprey *(Lampetra ayresi)*	Green Sunfish *(Lepomis cyanellus)*	Largemouth Bass *(Micropterus salmoides)*	American Shad *(Alosa sapidissima)*	Prickly Sculpin *(Cottus asper)*	Riffle Sculpin *(Cottus gulosus)*	Spotted Bass *Micropterus punctulatus*	Threespine Stickleback *(Gasterostreus aculeatus)*
N=5*	N=3	N=3*	N=2	N=3*	N=2*	N=2*	N=1
120.3 mm	76.3 mm	31.5 mm	61.5 mm	80 mm	108 mm	182 mm	32 mm
91 – 140 mm	47 – 130 mm	30 – 33 mm	43 – 80 mm	(N.A.)	(N.A.)	(N.A.)	(N.A.)
(25.9 mm)	(46.5 mm)	(2.1 mm)	(26.2 mm)				

*Totals include these estimates: 1 River Lamprey, 1 Largemouth Bass, 2 Prickly Sculpin, 1 Riffle Sculpin and 1 Spotted Bass

An additional 14 fish could not be identified (2 included as estimates)

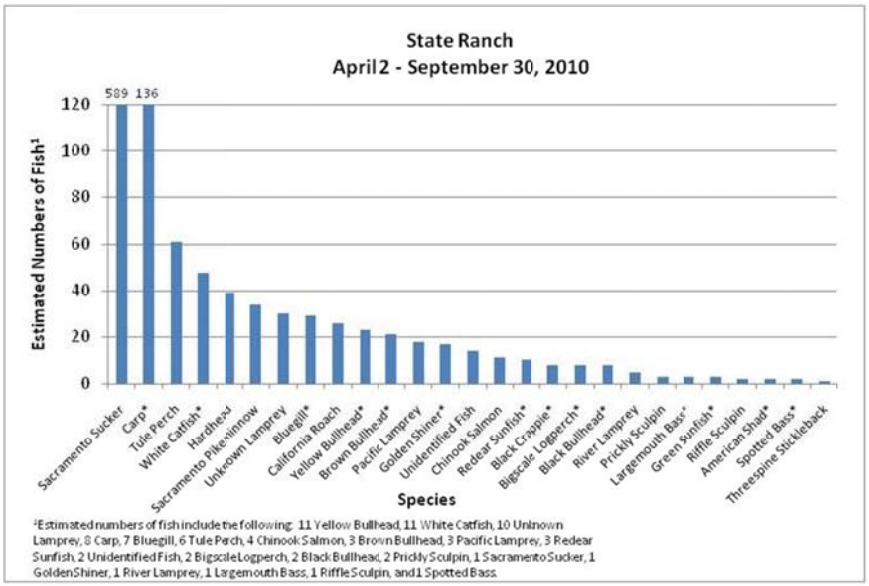

Figure 32. Fish species sampled during entrainment monitoring at State Ranch canal (April 1 – September 30, 2010). Asterisks indicate non-native fish species.

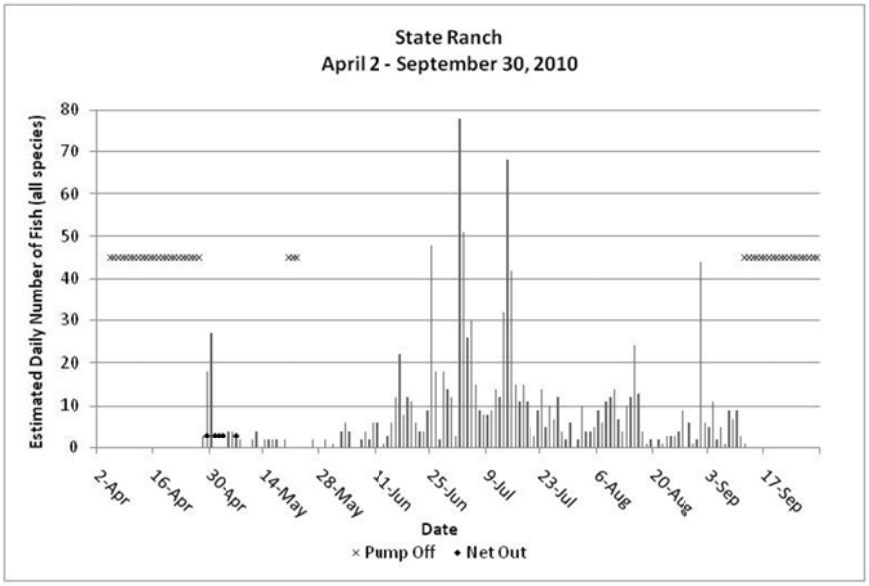

Figure 33. Daily numbers of fish (all species combined) sampled during entrainment monitoring at State Ranch (April 1 – September 30, 2010.

Based on data from a thermograph installed in State Ranch canal, water temperatures were cool early in the season, rose rapidly in the spring, reaching the high 60's to low 70's degrees Fahrenheit from late June to mid-September (Figure 34). All of the non-salmonid species entrained would normally be expected to be present at this river location during the sampling period.

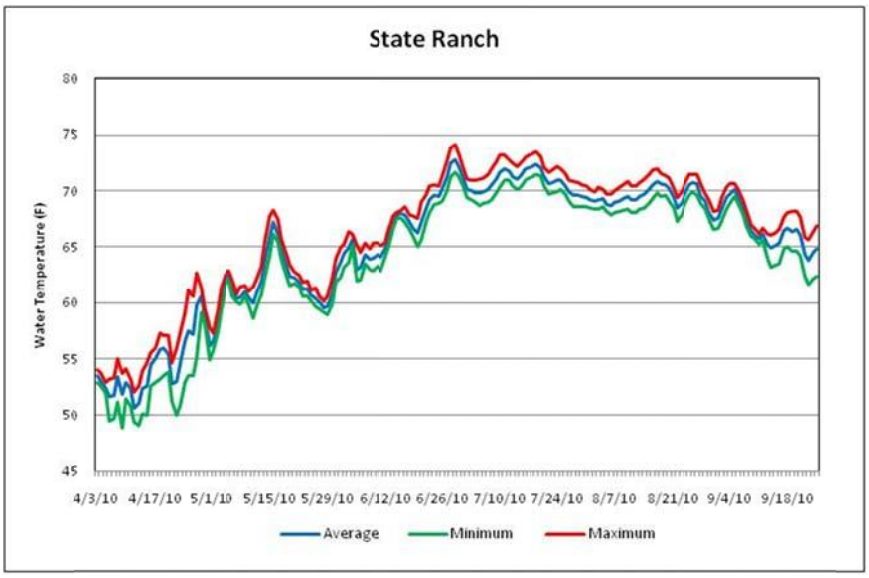

Figure 34. Water temperatures recorded at the State Ranch pump station outfall.

Based on the flow meter installed in the fyke net, daily flow in the canal was highly variable (Figure 35) but provides a relative indication of the timing of water diversions into the canal. No correlations between flow and numbers of fish entrained were evident.

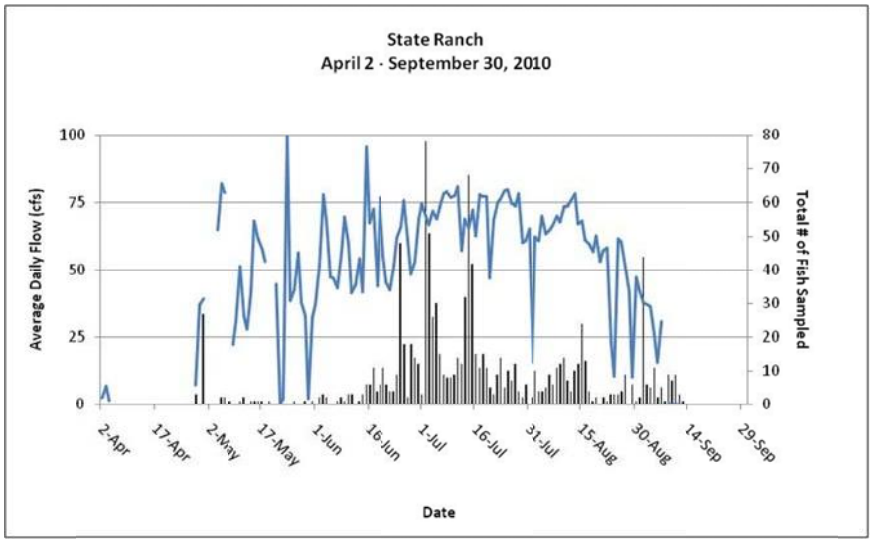

Figure 35. Estimated daily flows (cfs) in the irrigation canal at State Ranch and daily total number of fish (all species) sampled during the 2010 study period.

Physical Features of the Pump Station Intakes

The State Ranch pump station intakes are located on the left side of the river (facing downstream) in a straight portion of the river channel (Figure 36).

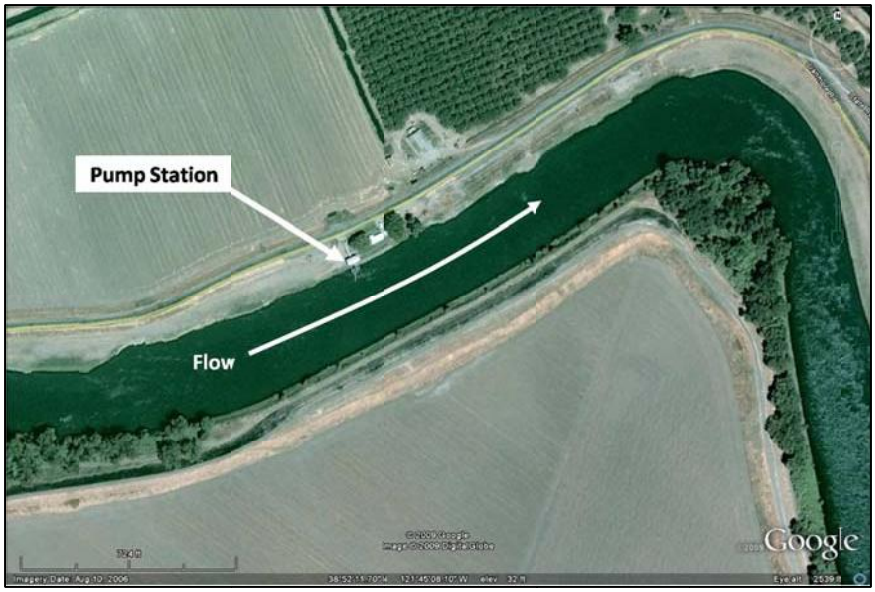

Figure 36. Location of the State Ranch pump station on the Sacramento River.

Based on in-river surveys conducted during the summer of 2008, the four State Ranch intake pipe diameters, in an upstream to downstream direction, are 36 inches, 36 inches, 42 inches, and 29 inches and enter the water at a 33-degree angle (Figure 37) (Table 7). At the time of the survey on June 25, 2008, the water depth at the pipe intakes was 13 feet with the intakes positioned five feet above the sand riverbed, 30 feet from the river's edge, and flow was unidirectional. Rearing habitat for juvenile salmon was characterized as poor and predatory fish habitat was classified as good (Vogel 2008c). Additional features of the site are provided in Table 7.


Figure 37. The State Ranch pump station intakes looking in a downstream direction.

Site Number: 041		TABLE 7. DIVERSION CHARACTERISTICS OF THE STATE RANCH PUMP STATION INTAKE (RIVER MILE 96.25) (DATA FROM VOGEL 2008c) 6/25/08								
Location Facing Downstream	**Channel Configuration at Diversion**	**# of Intake(s) (Upstream to Downstream)**	**Intake Opening Size (Outside Diameter in Inches)**	**Distance Between Intakes (Feet)**	**Intake Angle into Water (Degrees)**	**Estimated Distance from Intake Opening to Bank (Feet)**	**Estimated Riverbed Depth Near Intake (Feet)**	**Estimated Distance of Intake Off River Bottom (Feet)**	**Type of Posts In Water for Support Structure**	**# of Support Posts**
Left	Straight	4	36"	5'	33°		13'	5'	I-Beam	11
			36"	5'	33°	30'	13'	5'		
			42"	5'	33°	30'	13'	5'		
			29"		33°	30'	13'	5'		
Hydraulic Characteristics	**Riverbank Material**	**Riparian Overstory (Type)**	**Riparian Understory (Type)**	**Estimated Time In Shade (Percent)**	**Debris Near Diversion Intake**	**Natural Instream Structure in General Vicinity of Diversion**	**Estimated Riverbed Substrate Near Diversion Intake**	**Juvenile Salmonid Habitat (Overall Quality)**	**Potential Predator Habitat (Overall Quality)**	
Swift Unidirectional	Sa, We, Co	None	None	5%	WD-L	Woody Debris	Sa	1	3	
RIPARIAN IDENTIFICATION			**RIVERBED SUBSTRATE IDENTIFICATION**			**DEBRIS NEAR DIVERSION INTAKE**			**JUVENILE SALMON REARING/PREDATOR HABITAT**	
Code	Type		Code	Type		**Code**	**Type**		Code	Quality
Gr	Grasses		Si	Silt		WD-L	Woody Debris - Low Density		1	Poor
Sh	Shrubs		Sa	Sand		WD-M	Woody Debris - Medium Density		2	Fair
So	Soil		Co	Cobble		WD-H	Woody Debris - High Density		3	Good
Mu	Mulberry		RR	Rip-Rap						
TrA	Ash Tree		HP	Hardpan						
TrC	Cottonwood Tree									
TrO	Oak Tree									
TrUn	Unidentified Tree									
TrW	Walnut Tree		Code	Detail			7/16/08	6/25/08		
TrWi	Willow Tree		Non-Op	Non-Operational		Water Temperature:	70°F	64°F		
Ve	Vegetation		NA	Not Applicable		Secchi Depth:	4'			
We	Weeds		NE	No Estimates		Turbidity (NTUs):	7.89			

DIDSON™ imaging revealed low density of woody debris around the pipe intakes and sand riverbed substrate at the intake location. Figure 38 shows a DIDSON™ still image taken at the State Ranch pumping station. Motion images (.avi files) were recorded on July 16, 2008 and are provided in a separate report on in-river surveys of Sacramento River water diversions (Vogel 2008c).

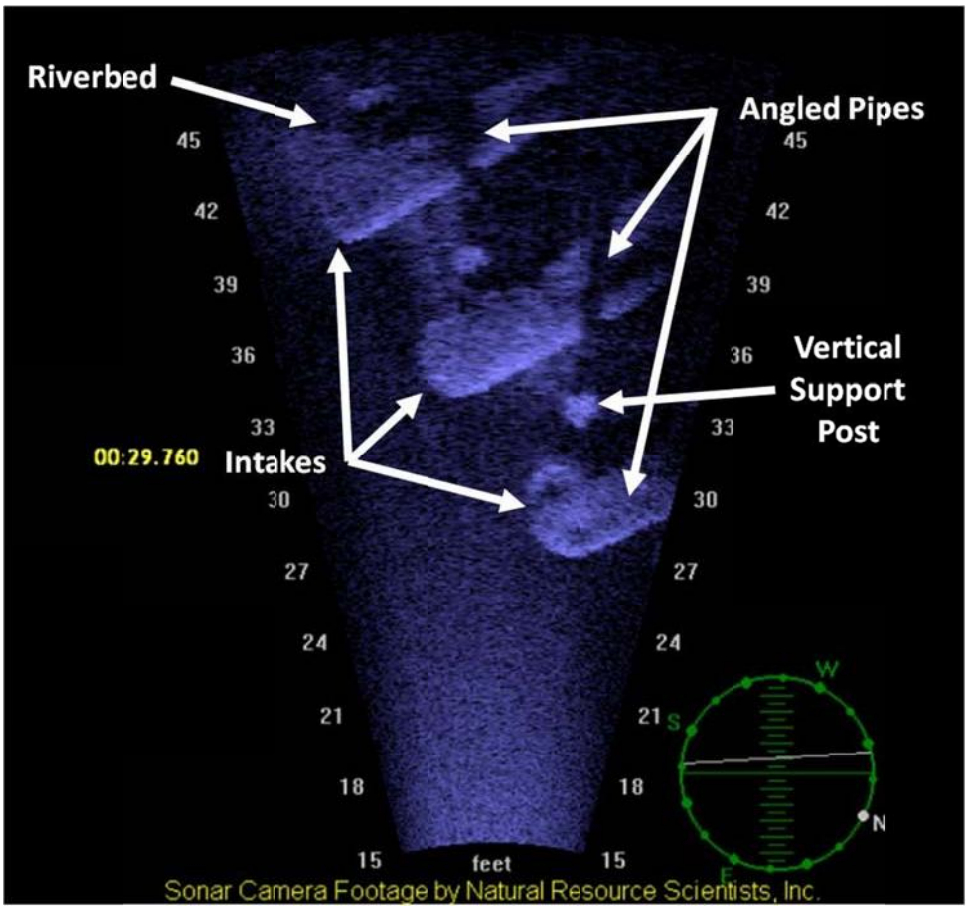

Figure 38. DIDSON™ still image of three of the four angled pipe intakes at the State Ranch pump station (looking in an upstream direction). Image taken on July 16, 2008.

Figures 39- 42 show ADCP bathymetry profiles and water velocity distributions across the river channel just upstream and downstream of the State Ranch pump station as measured on July 16, 2008. The thalweg is located on the right side of the river channel opposite the pump station. The highest concentration of flow is distributed across the middle of the river channel.

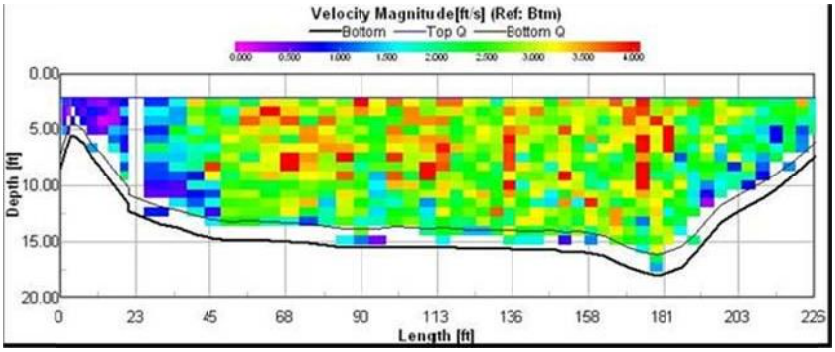

Figure 39. ADCP transect 1 (facing downstream) measured just downstream of State Ranch pump station (located on left bank). Left bank is ~7' from start of transect and right bank is ~8' from end of transect.

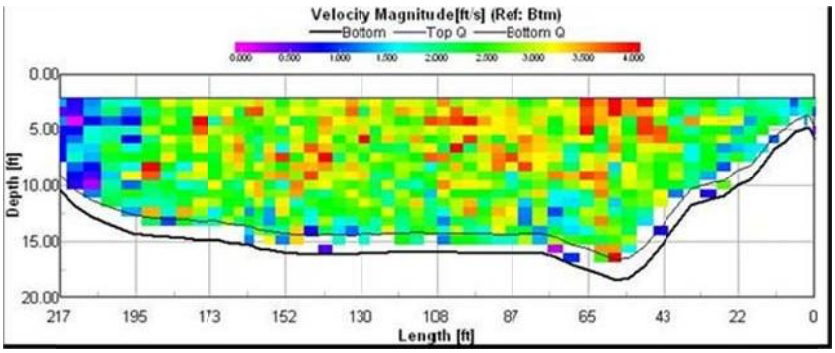

Figure 40. ADCP transect 2 (facing downstream) measured just downstream of State Ranch pump station (located on left bank). Right bank is ~8' from start of transect and left bank is ~4' from end of transect.

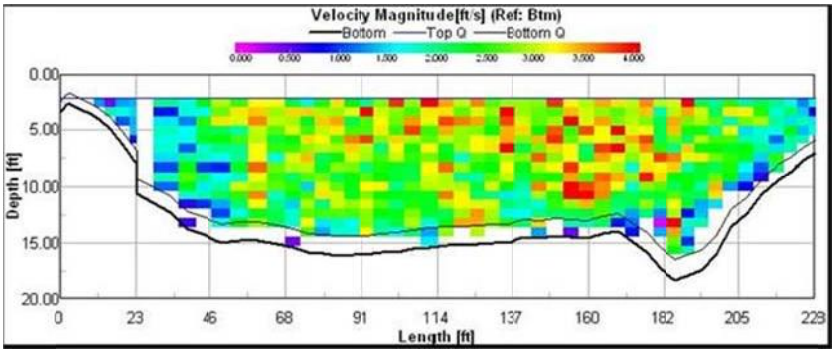

Figure 41. ADCP transect 3 (facing downstream) measured just upstream of State Ranch pump station (located on left bank). Left bank is ~3' from start of transect and right bank is ~6' from end of transect.

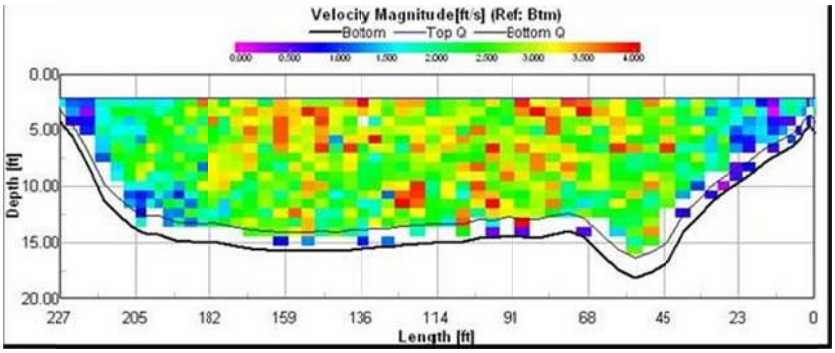

Figure 42. ADCP transect 4 (facing downstream) measured just upstream of State Ranch pump station (located on left bank). Right bank is ~6' from start of transect and left bank is ~5' from end of transect.

South Steiner

Fish Entrainment

Fish entrainment monitoring at South Steiner canals was initiated on May 4, 2010 (the onset of pumping operations at that location) (first net pull on May 5th) and continued until September 30, 2010. Tables 8A, 8B and 8C provide the total numbers of fish sampled and fish sizes by species. Appendix E at the end of this report provides daily data on fish entrainment.

Of the 19 identifiable fish species observed, Sacramento sucker was the most numerous sampled, followed by Tule perch and Sacramento pikeminnow (Figure 43). No juvenile Chinook salmon were observed. The daily numbers of all fish species sampled at the outfall were highly variable over the irrigation season (Figure 44). All of the non-salmonid species entrained would normally be expected to be present at this river location during the sampling period. The total numbers of fish sampled was generally higher than other sites even though the diversion is a relatively small diversion. Expanded sampling during the 2011 season in the bypass channel constructed (but not sampled) after the onset of the 2010 season may help determine if the numbers of fish were an artifact of expansion for lower sampling efficiency in 2010 compared to that anticipated for 2011. However, the higher numbers of fish may be attributable to the entrained species' preference for slower water conditions such as that found near the pipe intakes in the river.

Based on data from a thermograph installed in South Steiner canal, water temperatures were cool early in the season, rose rapidly in the spring, reaching the high 60's to low 70's degrees Fahrenheit from late June to mid-September (Figure 45).

Table 8A. Grand total of fish by species at South Steiner pump station, May 5 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Sacramento Sucker *(Catostomus occidentalis)*	Tule Perch *(Hysterocarpus traski)*	Sacramento Pikeminnow *(Ptychocheilus grandis)*	Hardhead *(Mylopharodon conocephalus)*	Carp *(Cyprinus carpio)*	Pacific Lamprey *(Lampetra tridentate)*	White Catfish *(Ameiurus catus)*
N=493*	N=104*	N=50*	N=29*	N=28*	N=15*	N=10*
57.9 mm	69.5 mm	37.8 mm	60.7 mm	177.7 mm	128.3 mm	34.3 mm
19 – 110	30 – 123	21 – 71	31 – 82	28 – 265	100 – 142	33 – 36
mm	mm	mm	mm	mm	mm	mm
(18.4 mm)	(24 mm)	(11.6 mm)	(15.8 mm)	(88.7 mm)	(13.1 mm)	(1.5 mm)

*Totals include these estimates: 269 Sacramento Sucker , 59 Tule Perch, 32 Sacramento Pikeminnow, 15 Hardhead, 15 Carp, 6 Pacific Lamprey and 5 White Catfish

Table 8B. Grand total of fish by species at South Steiner pump station, May 5 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Black Crappie *(Pomoxis nigromaculatus)*	River Lamprey *(Lampetra ayresi)*	*Bluegill (Lepomis macrochirus)*	Black Bullhead *(Ictalurus melas)*	Brown Bullhead *(Ameiurus nebulosus)*	Prickly Sculpin *(Cottus asper)*	Yellow Bullhead *(Ictalurus natalis)*
N=9*	N=8*	N=8*	N=7*	N=6*	N=5*	N=5*
30 mm	128.5 mm	39 mm	Not Measured	Not Measured	34 mm	140 mm
26 – 36	121 – 136	21 – 73	(N.A.)	(N.A.)	27 – 41	(N.A.)
mm	mm	mm			mm	7 Not Measured
(5.3 mm)	(10.6 mm)	(29.5 mm)			(9.9 mm)	

*Totals include these estimates: 5 Black Crappie, 5 River Lamprey, 5 Bluegill, 4 Black Bullhead, 4 Brown Bullhead, 3 Prickly Sculpin and 3 Yellow Bullhead

Table 8C. Grand total of fish by species at South Steiner pump station, May 5 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Striped Bass *(Morone saxatilis)*	Fathead Minnow *(Pimephales promelas)*	Inland Silverside *(Menidia audens)*	Unknown Sturgeon	Unknown Sculpin	Green Sunfish *(Lepomis cyanellus)*
N=4*	N=3*	N=3*	N=3*	N=3*	N=3*
Not Measured	36 mm	28 mm	86 mm	32 mm	79 mm
(N.A.)	(N.A.)	(N.A.)	(N.A.)	(N.A.)	(N.A.)

*Totals include these estimates: 2 Striped Bass, 2 Fathead Minnow, 2 Inland Silverside, 2 Unknown Sturgeon, 2 Unknown Sculpin and 2 Green Sunfish

An additional 2 fish could not be identified (1 included as an estimate)

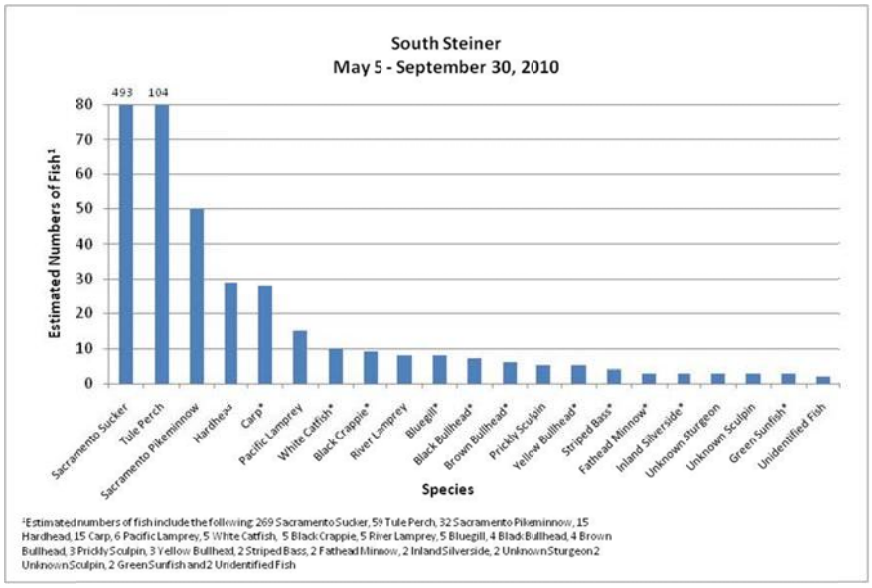

Figure 43. Estimated number of fish species entrained during monitoring at the South Steiner diversion (May 5 – September 30, 2010). Asterisks indicate non-native fish species.

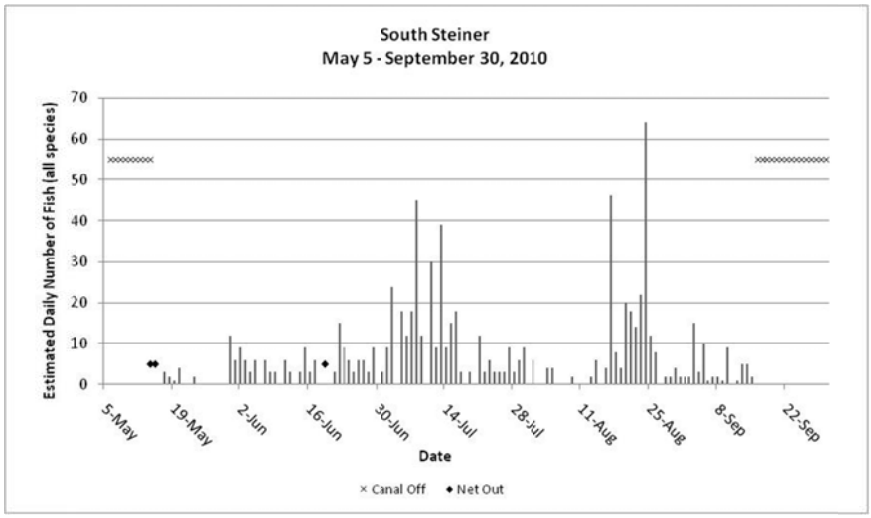

Figure 44. Estimated daily numbers of fish (all species combined) entrained during monitoring at the South Steiner diversion (May 5 – September 30, 2010).

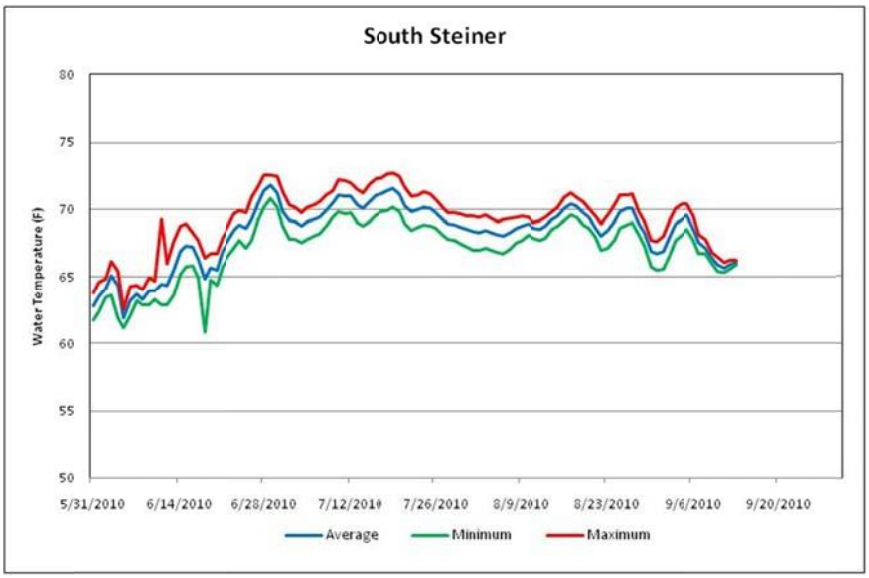

Figure 45. Water temperatures recorded at the South Steiner pump station outfall.

Based on the flow meter installed in the fyke net, daily flow in the canal was highly variable (Figure 46) but provides a relative indication of the timing of water diversions into the canal. No correlations between flow and numbers of fish entrained were evident.

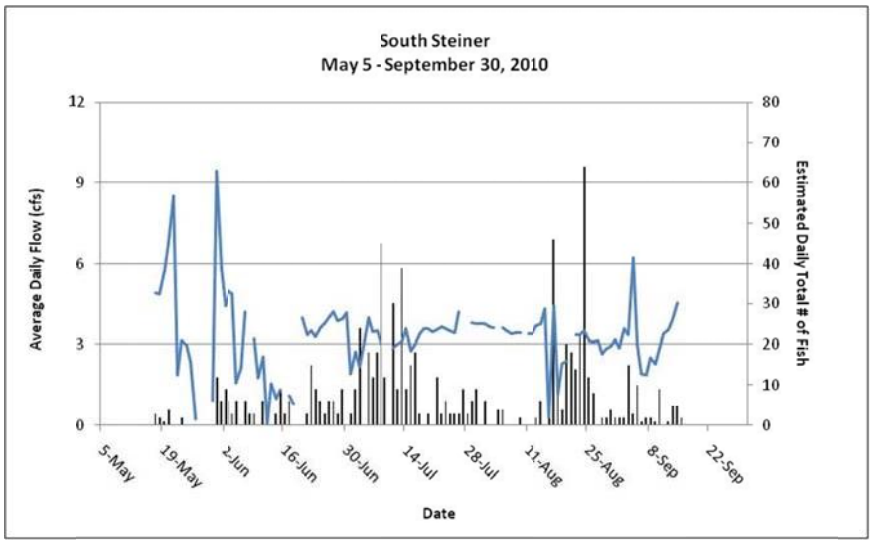

Figure 46. Estimated daily flows (cfs) in the irrigation canal at South Steiner (culvert) and estimated daily total number of fish (all species) entrained during the 2010 study period.

Physical Features of the Pump Station Intake

The South Steiner pump station intake is located on the right side of the river (facing downstream) on the upper end of an outside bend in the river channel (Figure 47).

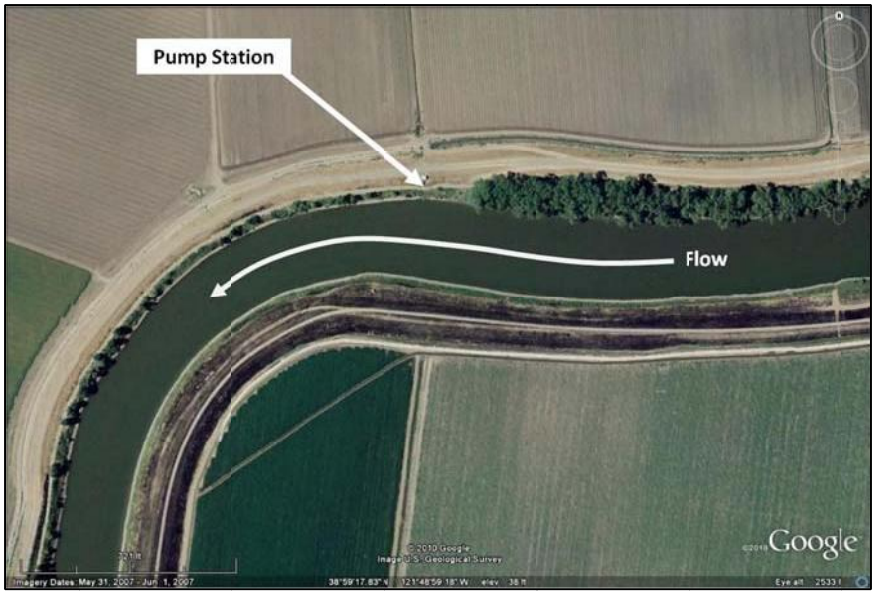

Figure 47. Location of the South Steiner pump station on the Sacramento River.

Based on in-river surveys conducted during the summer of 2008, the 24-inch diameter South Steiner pipe intakes enter the water at 20-degree and 25-degree angles (Figure 48) (Table 9). At the time of the survey on July 8, 2008, the water depth at the pipe intakes was 13-14 feet with the intakes positioned two feet above the cobble and sand riverbed, 25 feet from the river's edge, and flow in the vicinity of the intake was slow and in a back eddy. Rearing habitat for juvenile salmon was characterized as poor and predatory fish habitat was classified as fair (Vogel 2008c). Additional features of the site are provided in Table 9.

Figure 48. The South Steiner pump station intakes looking in a downstream direction.

Site Number: 075		TABLE 9. DIVERSION CHARACTERISTICS OF THE SOUTH STEINER PUMP STATION INTAKE (RIVER MILE 114.3) (DATA FROM VOGEL 2008c) 7/8/08								
Location Facing Downstream	**Channel Configuration at Diversion**	**# of Intake(s) (Upstream to Downstream)**	**Intake Opening Size (Outside Diameter in Inches)**	**Distance Between Intakes (Feet)**	**Intake Angle into Water (Degrees)**	**Estimated Distance from Intake Opening to Bank (Feet)**	**Estimated Riverbed Depth Near Intake (Feet)**	**Estimated Distance of Intake Off River Bottom (Feet)**	**Type of Posts In Water for Support Structure**	**# of Support Posts**
Right	Outside Bend	2	24"	22″	20°	25'	14'	2'	Round Metal Post	4
			24"		25°	25'	13'	2'		
Hydraulic Characteristics	**Riverbank Material**	**Riparian Overstory (Type)**	**Riparian Understory (Type)**	**Estimated Time In Shade (Percent)**	**Debris Near Diversion Intake**	**Natural Instream Structure in General Vicinity of Diversion**	**Estimated Riverbed Substrate Near Diversion Intake**	**Juvenile Salmonid Habitat (Overall Quality)**	**Potential Predator Habitat (Overall Quality)**	
Slow, Back-Eddy	Co, So, Sa, Gr, We	None	Gr, We	5%	WD-L	None	Co, Sa	1	2	
RIPARIAN IDENTIFICATION			**RIVERBED SUBSTRATE IDENTIFICATION**			**DEBRIS NEAR DIVERSION INTAKE**			**JUVENILE SALMON REARING/PREDATOR HABITAT**	
Code	Type		Code	Type		**Code**	**Type**		Code	Quality
Gr	Grasses		Si	Silt		WD-L	Woody Debris - Low Density		1	Poor
Sh	Shrubs		Sa	Sand		WD-M	Woody Debris - Medium Density		2	Fair
So	Soil		Co	Cobble		WD-H	Woody Debris - High Density		3	Good
Mu	Mulberry		RR	Rip-Rap						
TrA	Ash Tree		HP	Hardpan						
TrC	Cottonwood Tree									
TrO	Oak Tree									
TrUn	Unidentified Tree									
TrW	Walnut Tree		Code	Detail			7/23/08	7/8/08		
TrWi	Willow Tree		Non-Op	Non-Operational		Water Temperature:	68°F	69°F		
Ve	Vegetation		NA	Not Applicable		Secchi Depth:	4.6'			
We	Weeds		NE	No Estimates		Turbidity (NTUs):	5.78			

DIDSON™ imaging did not reveal any submerged woody debris around the pipe intakes. Figure 49 shows a DIDSON™ still image taken at the South Steiner pumping station. Motion images (.avi files) were recorded on July 23, 2008 and are provided in a separate report on in-river surveys of Sacramento River water diversions (Vogel 2008c).

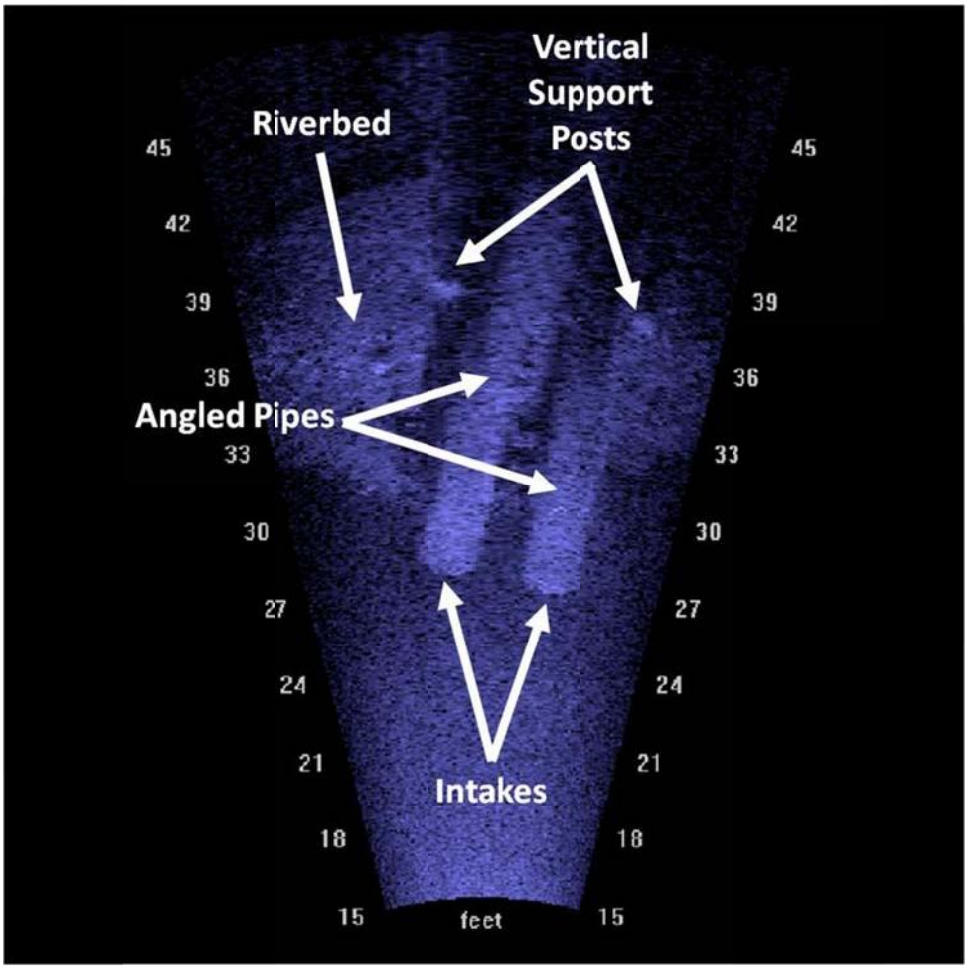

Figure 49. DIDSON™ still image of the two angled pipe intakes at the South Steiner Ranch pump station (looking toward the levee). Image taken on July 23, 2008.

Figures 50- 53 show ADCP bathymetry profiles and water velocity distributions across the river channel just upstream and downstream of the South Steiner pump station as measured on July 23, 2008. The cross-section symmetry is relatively uniform with no well-defined thalweg. The highest concentration of flow is distributed across the middle and left side of the river channel opposite the pump station. The pump station intakes are located in slower water velocities compared to other cross-sectional portions of the channel.

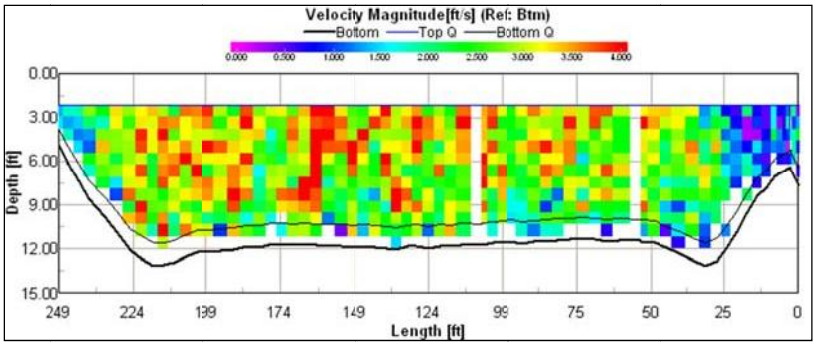

Figure 50. ADCP transect 1 (facing downstream) measured just downstream of South Steiner pump station (located on right bank). Right bank is ~10' from start of transect and left bank is ~8' from end of transect.

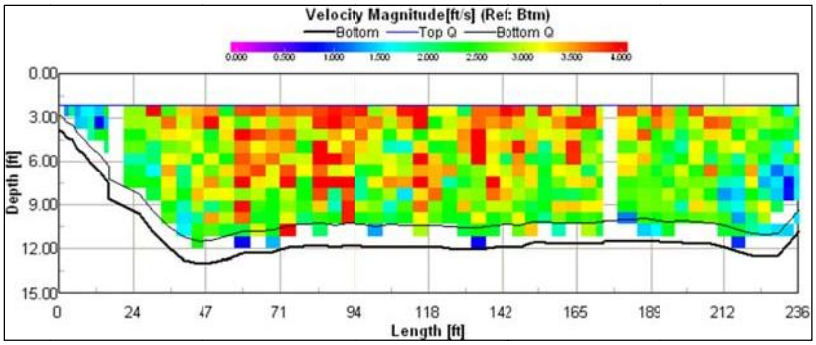

Figure 51. ADCP transect 2 (facing downstream) measured just downstream of South Steiner pump station (located on right bank). Left bank is ~8' from start of transect and right bank is ~12' from end of transect.

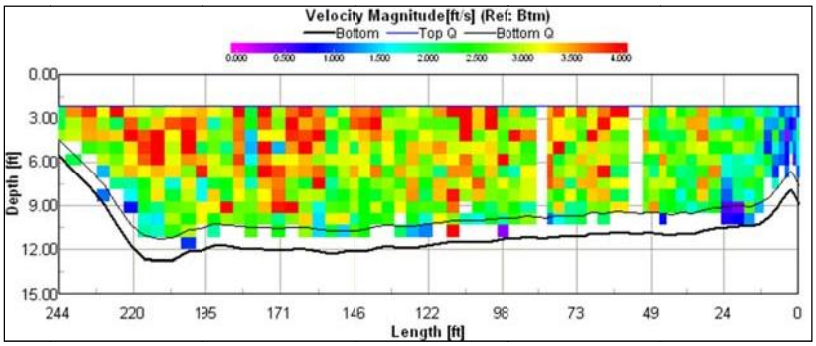

Figure 52. ADCP transect 3 (facing downstream) measured just upstream of South Steiner pump station (located on right bank). Right bank is ~10' from start of transect and left bank is ~4' from end of transect.

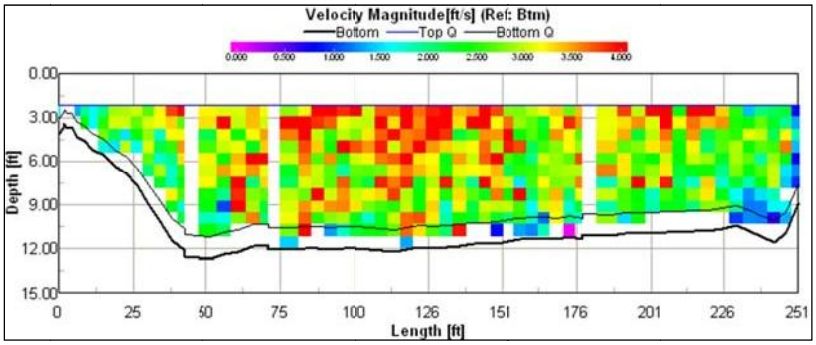

Figure 53. ADCP transect 4 (facing downstream) measured just upstream of South Steiner pump station (located on right bank). Left bank is ~4' from start of transect and right bank is ~7' from end of transect.

Oji

Fish Entrainment

Fish entrainment monitoring at the Oji canal was initiated on May 10, 2010 (the onset of pumping operations at that location) (first net pull on May 11th) and continued until September 30, 2010. Tables 10A and 10B provide the total numbers of fish sampled and fish sizes by species. Appendix F at the end of this report provides daily data on fish entrainment.

Twelve identifiable fish species were observed with Tule perch and Sacramento sucker the most numerous (Figure 54). Only one juvenile Chinook salmon (fall run) was observed (May 11, 2010). The daily numbers of all fish species sampled at the outfall were highly variable over the irrigation season (Figure 55). All of the non-salmonid species entrained would normally be expected to be present at this river location during the sampling period.

Due to lack of pumping during significant portions of the irrigation season, the thermograph placed in the Oji irrigation canal was frequently exposed to ambient air temperatures (Figure 56). Based on partial data from that location when the canal was in operation and a thermograph installed in State Ranch canal located downstream, water temperatures were cool early in the season, rose rapidly in the spring, reaching the high 60's to low 70's degrees Fahrenheit from late June to mid-September (Figure 34).

Table 10A. Grand total of fish by species at Oji pump station, May 11 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)					
Tule Perch ***(Hysterocarpus traski)***	**Sacramento Sucker** ***(Catostomus occidentalis)***	**River Lamprey** ***(Lampetra ayresi)***	**Largemouth Bass** ***(Micropterus salmoides)***	**Pacific Lamprey** ***(Lampetra tridentate)***	**White Catfish** ***(Ameiurus catus)***
N=19* 56.8 mm 34 – 75 mm (12.9 mm)	N=17* 34.9 mm 20 – 61 mm (13.6 mm)	N=3 129.7 mm 108 – 142 mm (18.8 mm)	N=3* 34.5 mm 29 – 40 mm (7.8 mm)	N=2* 132 mm (N.A.)	N=2 41 mm (N.A.) 1 Not Measured
*Totals include these estimates: 4 Tule Perch, 5 Sacramento Sucker, 1 Largemouth Bass and 1 Pacific Lamprey					

Table 10B. Grand total of fish by species at Oji pump station, May 11 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)					
Chinook Salmon ***(Oncorhynchus tshawytscha)***	**Sacramento Pikeminnow** ***(Ptychocheilus grandis)***	**Bluegill** ***(Lepomis macrochirus)***	**Fathead Minnow** ***(Pimephales promelas)***	**Black Bullhead** ***(Ameiurus melas)***	**Redear Sunfish** ***(Lepomis microlophus)***
N=1 90 mm (N.A.)	N=1 51 mm (N.A.)	N=1 41 mm (N.A.)	N=1 51 mm (N.A.)	N=1 36 mm (N.A.)	N=1 42 mm (N.A.)

An additional 10 fish could not be identified (3 included as estimates)

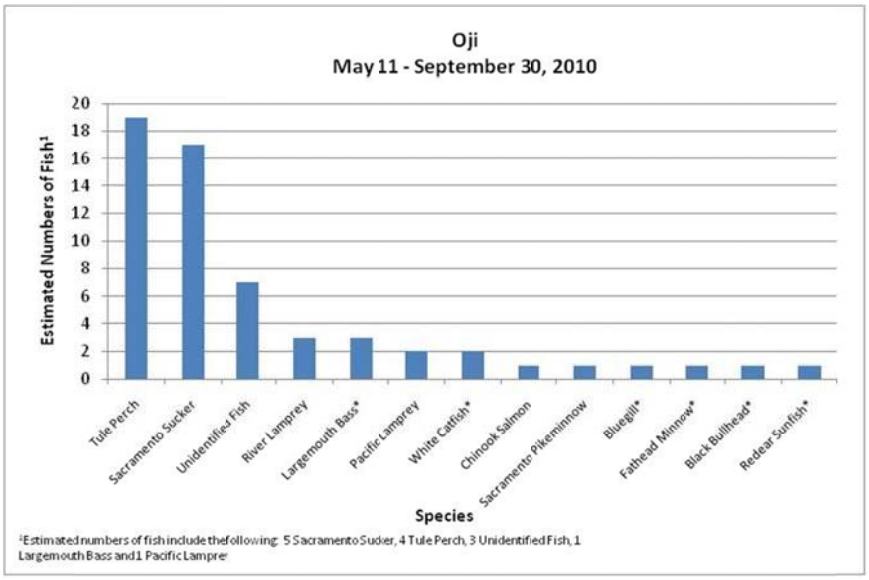

Figure 54. Fish species sampled during entrainment monitoring at the Oji canal (May 11 – September 30, 2010). Asterisks indicate non-native fish species.

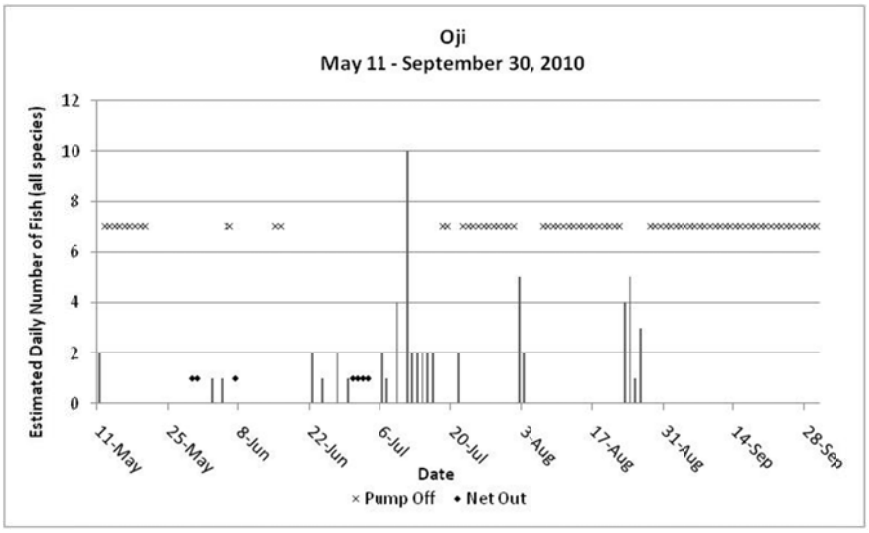

Figure 55. Daily numbers of fish (all species combined) sampled during entrainment monitoring at the Oji canal (May 11 – September 30, 2010).

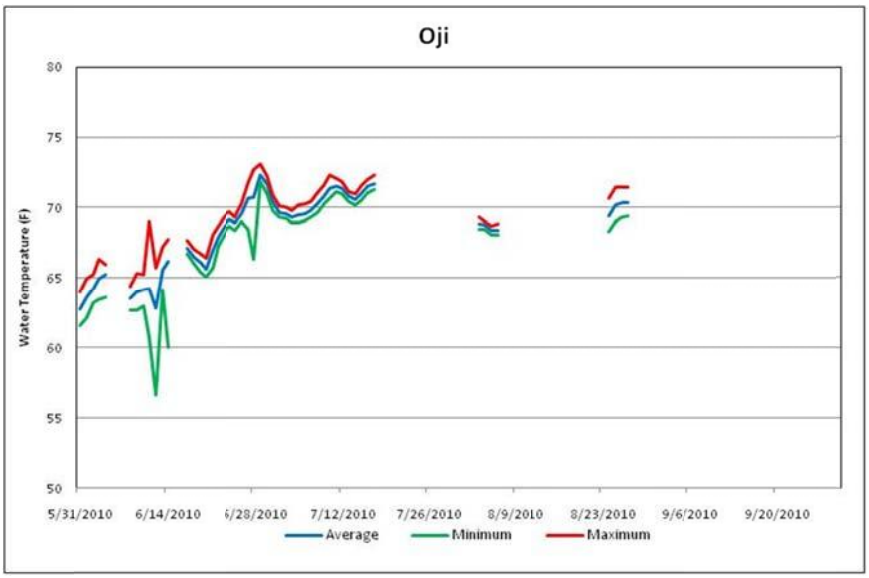

Figure 56. Water temperatures recorded at the Oji canal. Gaps in the data are attributable to periods when no water was diverted and the thermograph was exposed to ambient air temperatures or stagnant water.

Based on the flow meter installed in the fyke net, daily flow in the canal was highly variable (Figure 57) but provides a relative indication of the timing of water diversions into the canal. No correlations between flow and numbers of fish entrained were evident.

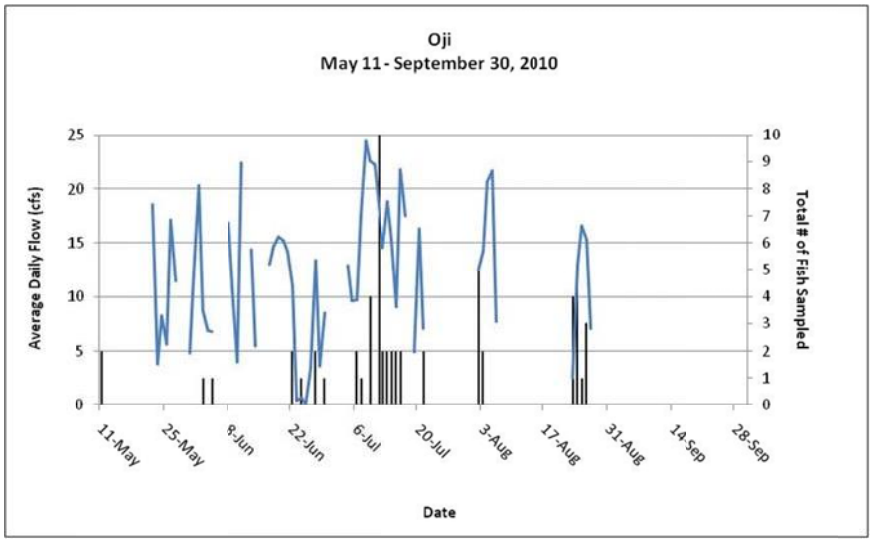

Figure 57. Estimated daily flows (cfs) in the irrigation canal at Oji and daily total number of fish (all species) sampled during the 2010 study period.

Physical Features of the Pump Station Intakes

The Oji pump station intakes are located on the left side of the river (facing downstream) on an outside bend in the river channel (Figure 58).

Figure 58. Location of the Oji pump station on the Sacramento River.

Based on in-river surveys conducted during the summer of 2008, the 30-inch diameter Oji pipe intakes enter the water at 30-degree angle (Figure 59) (Table 11). At the time of the survey on June 30, 2008, the water depth at the pipe intakes was 14 feet with the intakes positioned three feet above the sand and cobble riverbed, 30 feet from the river's edge, and flow in the vicinity of the intake was swift and unidirectional. Rearing habitat for juvenile salmon was characterized as poor and predatory fish habitat was classified as fair (Vogel 2008c). Additional features of the site are provided in Table 11.


Figure 59. The Oji pump station intakes looking in a downstream direction.

Site Number: 054		TABLE 11. DIVERSION CHARACTERISTICS OF THE OJI PUMP STATION INTAKE (RIVER MILE 103.3) (DATA FROM VOGEL 2008c) 6/30/08								
Location Facing Downstream	**Channel Configuration at Diversion**	**# of Intake(s) (Upstream to Downstream)**	**Intake Opening Size (Outside Diameter in Inches)**	**Distance Between Intakes (Feet)**	**Intake Angle into Water (Degrees)**	**Estimated Distance from Intake Opening to Bank (Feet)**	**Estimated Riverbed Depth Near Intake (Feet)**	**Estimated Distance of Intake Off River Bottom (Feet)**	**Type of Posts In Water for Support Structure**	**# of Support Posts**
Left	Straight	2	30"	3’	30°	30'	14'	3'	I-Beam	2
			30"		30°	30'	14'	3'		
Hydraulic Characteristics	**Riverbank Material**	**Riparian Overstory (Type)**	**Riparian Understory (Type)**	**Estimated Time In Shade (Percent)**	**Debris Near Diversion Intake**	**Natural Instream Structure in General Vicinity of Diversion**	**Estimated Riverbed Substrate Near Diversion Intake**	**Juvenile Salmonid Habitat (Overall Quality)**	**Potential Predator Habitat (Overall Quality)**	
Swift, Unidirectional	Co, Gr, We	None	None	5%	None	None	Sa, Co	1	2	
RIPARIAN IDENTIFICATION			**RIVERBED SUBSTRATE IDENTIFICATION**			**DEBRIS NEAR DIVERSION INTAKE**			**JUVENILE SALMON REARING/PREDATOR HABITAT**	
Code	Type		Code	Type		**Code**	**Type**		Code	Quality
Gr	Grasses		Si	Silt		WD-L	Woody Debris - Low Density		1	Poor
Sh	Shrubs		Sa	Sand		WD-M	Woody Debris - Medium Density		2	Fair
So	Soil		Co	Cobble		WD-H	Woody Debris - High Density		3	Good
Mu	Mulberry		RR	Rip-Rap						
TrA	Ash Tree		HP	Hardpan						
TrC	Cottonwood Tree									
TrO	Oak Tree									
TrUn	Unidentified Tree									
TrW	Walnut Tree		Code	Detail			7/17/08	6/30/08		
TrWi	Willow Tree		Non-Op	Non-Operational		Water Temperature:	71°F	68°F		
Ve	Vegetation		NA	Not Applicable		Secchi Depth:	4.1'			
We	Weeds		NE	No Estimates		Turbidity (NTUs):	5.88			

DIDSON™ imaging did not reveal any submerged woody debris around the pipe intakes. Figure 60 shows a DIDSON™ still image taken at the Oji pumping station. Motion images (.avi files) were recorded on July 17, 2008 and are provided in a separate report on in-river surveys of Sacramento River water diversions (Vogel 2008c).

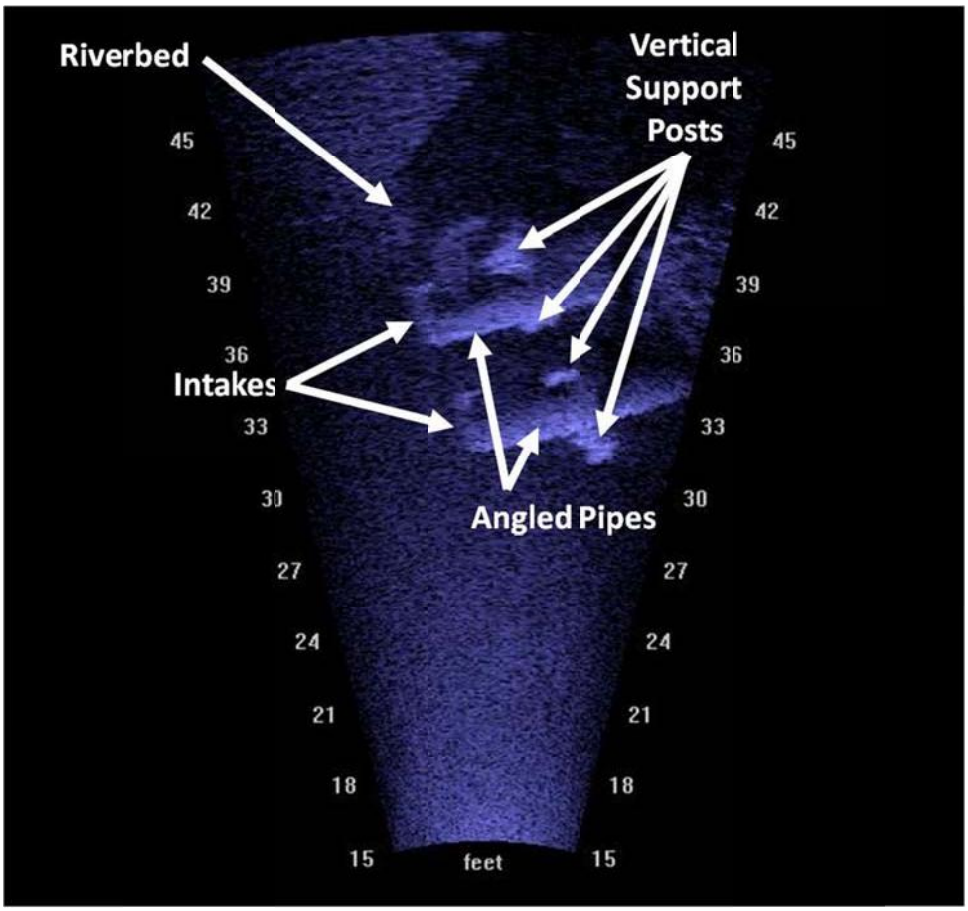

Figure 60. DIDSON™ still image of the two angled pipe intakes at the Oji pump station (looking upstream). Image taken on July 17, 2008.

Figures 61- 64 show ADCP bathymetry profiles and water velocity distributions across the river channel just upstream and downstream of the Oji pump station as measured on July 17, 2008. Although the pump station is positioned on a left outside bend of the river (facing downstream), the highest water velocities and the greatest portion of the flow are distributed toward the right side of the river channel opposite the pump station.

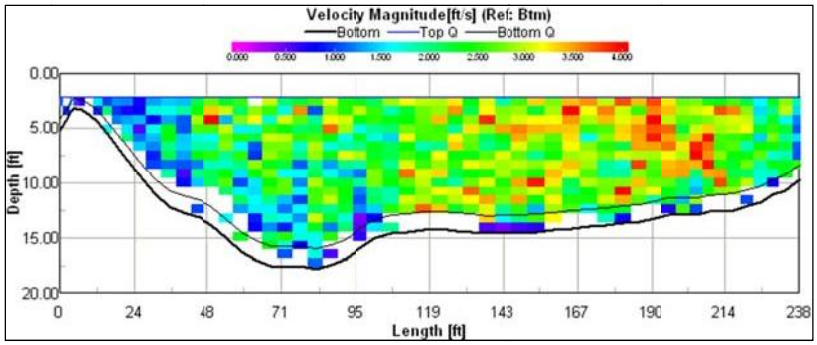

Figure 61. ADCP transect 1 (facing downstream) measured just downstream of Oji pump station (located on left bank). Left bank is ~3' from start of transect and right bank is ~8' from end of transect.

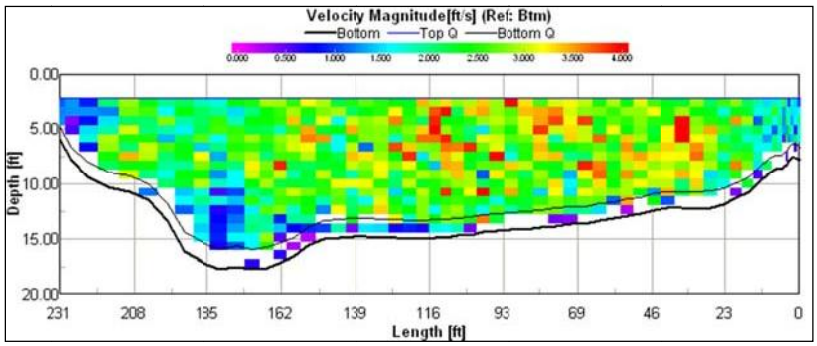

Figure 62. ADCP transect 2 (facing downstream) measured just downstream of Oji pump station (located on left bank). Right bank is ~8' from start of transect and left bank is ~3' from end of transect.

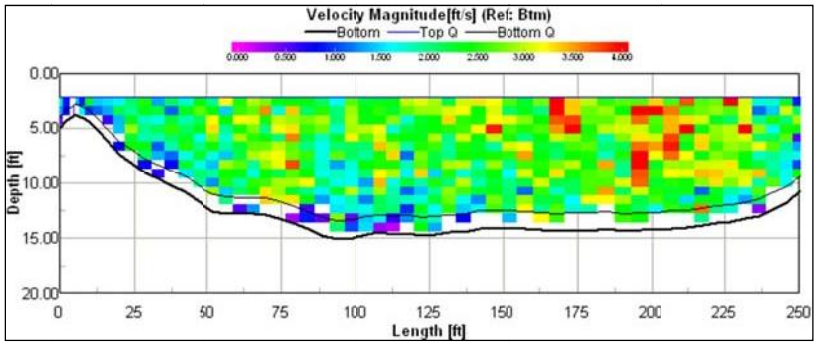

Figure 63. ADCP transect 3 (facing downstream) measured just upstream of Oji pump station (located on left bank). Left bank is ~3' from start of transect and right bank is ~8' from end of transect.

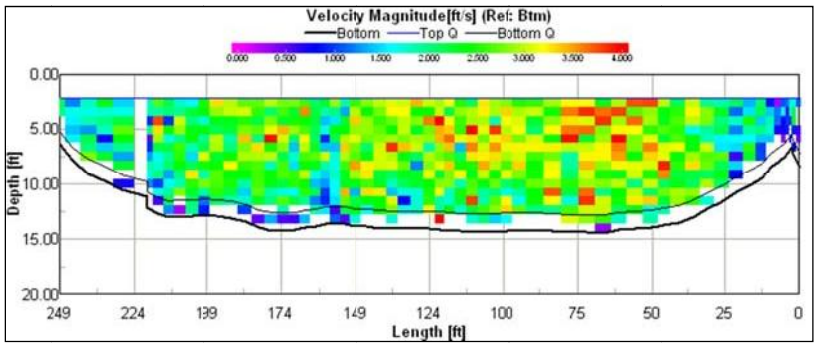

Figure 64. ADCP transect 4 (facing downstream) measured just upstream of Oji pump station (located on left bank). Right bank is ~8' from start of transect and left bank is ~3' from end of transect.

Windswept

Fish Entrainment

Fish entrainment monitoring at the Windswept canal was initiated on May 23, 2010 (the onset of pumping operations at that location) (first net pull on May 24th) and continued until September 30, 2010. Table 12 provides the total numbers of fish sampled and fish sizes by species. Appendix G at the end of this report provides daily data on fish entrainment.

The only fish species observed were Tule perch. It's not known why only this species was sampled because there were no readily apparent physical features or in-river habitat attributes near the intake which would provide an explanation. As compared to other sampling sites, the Windswept canal was frequently not in operation during most of the irrigation season (Figure 65). Although a variety of farming operations changed during 2011, U.S. Bureau of Reclamation pump station records indicated that the total seasonal diversion was not unlike past years' operations (Phil Burroughs, Windswept Ranch, pers. comm., January 18, 2011).

Table 12. Grand total of fish sampled and sizes by species at Windswept pump station, May 24 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Tule Perch *(Hysterocarpus traski)*
N=21 76 mm 61 – 99 mm (12 mm)

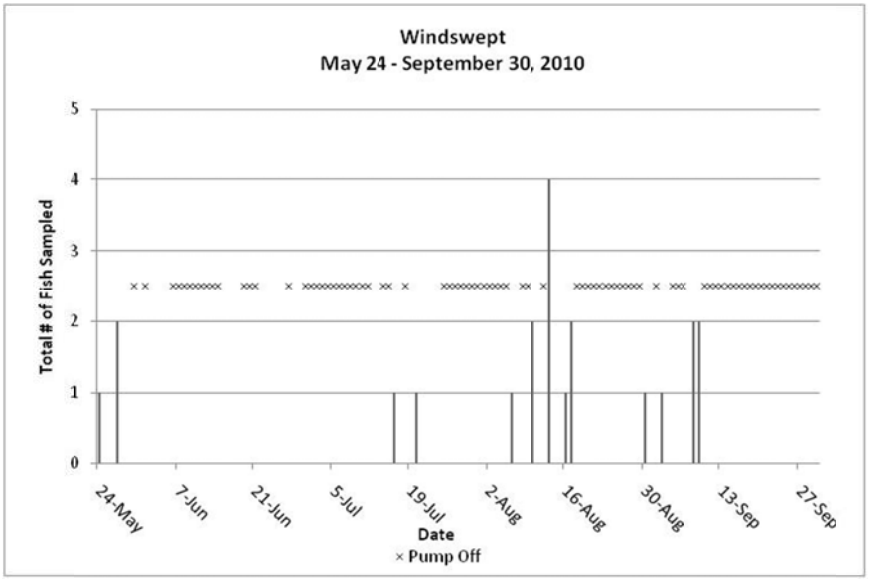

Figure 65. Daily numbers of Tule perch sampled during entrainment monitoring at Windswept canal (May 24 – September 30, 2010).

Pumping infrequently occurred at the Windswept pumping station and, therefore, the thermograph placed in the canal was frequently exposed to ambient air conditions and did not provide much useful data for the site. However, the thermograph placed at the Oji canal was nearby (Figure 56) along with the thermograph at State Ranch (Figure 34) did provide data comparable to temperatures expected at Windswept for at least the early portion of the irrigation season. The infrequent pumping also caused incorrect flow meter readings on the fyke net due to frequent water level drops in the canal exposing the flow meter to air.

Physical Features of the Pump Station Intake

The Windswept pump station intake is located on the left side of the river (facing downstream) on an outside bend in the river channel (Figure 66).

Figure 66. Location of the Windswept pump station on the Sacramento River.

Based on in-river surveys conducted during the summer of 2008, the 24-inch diameter Windswept pipe intake enters the water at 30-degree angle (Figure 67) (Table 13). At the time of the survey on June 30, 2008, the water depth at the pipe intake was 12 feet with the intakes positioned three feet above the cobble riverbed and flow in the vicinity of the intake was swift and unidirectional. Rearing habitat for juvenile salmon was characterized as poor and predatory fish habitat was classified as fair (Vogel 2008c). Additional features of the site are provided in Table 13.

Figure 67. The Windswept pump station intake looking in a downstream direction.

Site Number: 052		TABLE 13. DIVERSION CHARACTERISTICS OF THE WINDSWEPT PUMP STATION INTAKE (RIVER MILE 102.5) (DATA FROM VOGEL 2008c) 6/30/08								
Location Facing Downstream	**Channel Configuration at Diversion**	**# of Intake(s) (Upstream to Downstream)**	**Intake Opening Size (Outside Diameter in Inches)**	**Distance Between Intakes (Feet)**	**Intake Angle into Water (Degrees)**	**Estimated Distance from Intake Opening to Bank (Feet)**	**Estimated Riverbed Depth Near Intake (Feet)**	**Estimated Distance of Intake Off River Bottom (Feet)**	**Type of Posts In Water for Support Structure**	**# of Support Posts**
Left	Outside Bend	1	24"	NA	30°	Not Measured	12'	3'	Round Metal Pole	2
Hydraulic Characteristics	**Riverbank Material**	**Riparian Overstory (Type)**	**Riparian Understory (Type)**	**Estimated Time In Shade (Percent)**	**Debris Near Diversion Intake**	**Natural Instream Structure in General Vicinity of Diversion**	**Estimated Riverbed Substrate Near Diversion Intake**	**Juvenile Salmonid Habitat (Overall Quality)**	**Potential Predator Habitat (Overall Quality)**	
Swift, Unidirectional	Co, We	None	None	5%	None	Woody Debris	Co	1	2	

RIPARIAN IDENTIFICATION		**RIVERBED SUBSTRATE IDENTIFICATION**		**DEBRIS NEAR DIVERSION INTAKE**			**JUVENILE SALMON REARING/PREDATOR HABITAT**	
Code	Type	Code	Type	**Code**	**Type**		Code	Quality
Gr	Grasses	Si	Silt	WD-L	Woody Debris - Low Density		1	Poor
Sh	Shrubs	Sa	Sand	WD-M	Woody Debris - Medium Density		2	Fair
So	Soil	Co	Cobble	WD-H	Woody Debris - High Density		3	Good
Mu	Mulberry	RR	Rip-Rap					
TrA	Ash Tree	HP	Hardpan					
TrC	Cottonwood Tree							
TrO	Oak Tree							
TrUn	Unidentified Tree							
TrW	Walnut Tree	Code	Detail		7/17/08	6/30/08		
TrWi	Willow Tree	Non-Op	Non-Operational	Water Temperature:	71°F	67°F		
Ve	Vegetation	NA	Not Applicable	Secchi Depth:	4.1'			
We	Weeds	NE	No Estimates	Turbidity (NTUs):	7.07			

DIDSON™ imaging did not reveal any submerged woody debris around the pipe intakes although woody debris was present on the pipe at the water's edge. Figure 68 shows a DIDSON™ still image taken at the Windswept pumping station. Motion images (.avi files) were recorded on July 17, 2008 and are provided in a separate report on in-river surveys of Sacramento River water diversions (Vogel 2008c).

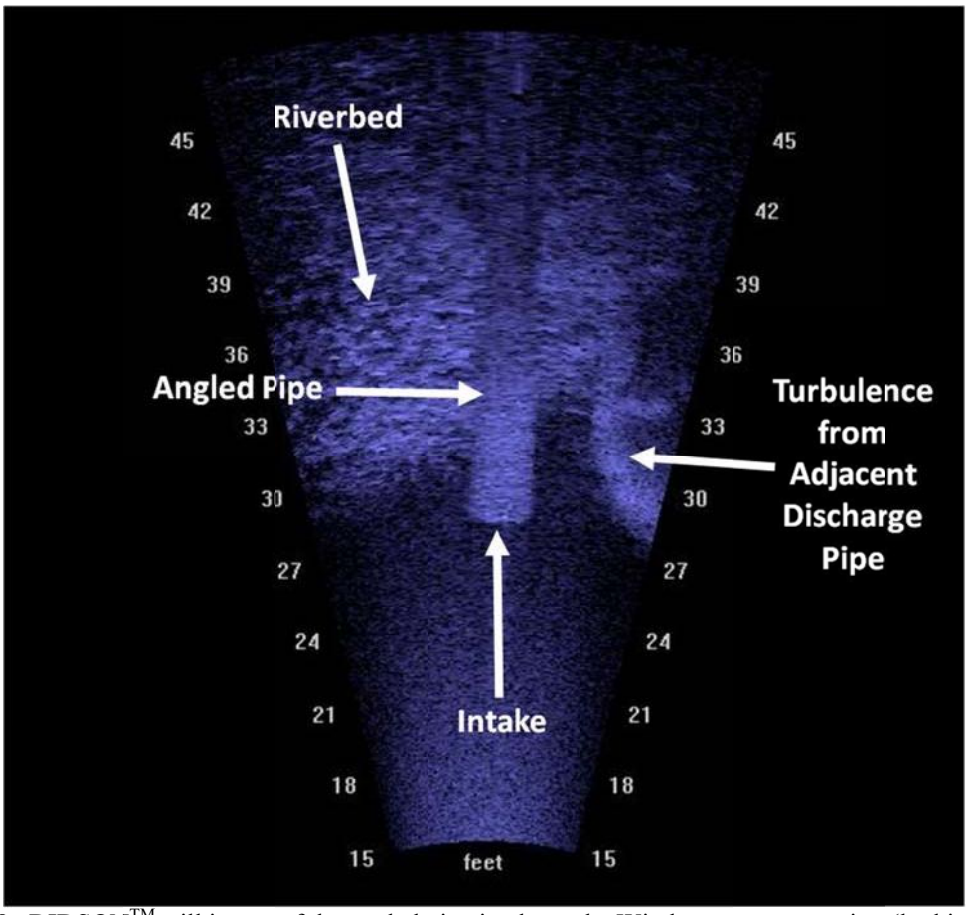

Figure 68. DIDSON™ still image of the angled pipe intake at the Windswept pump station (looking toward the levee). Image taken on July 17, 2008.

Figures 69- 72 show ADCP bathymetry profiles and water velocity distributions across the river channel just upstream and downstream of the Windswept pump station as measured on July 17, 2008. Although the thalweg is located on the left side of the river (facing downstream) on the same side of the channel as the pump intakes, the highest portion of the flow is distributed in the middle of the river channel.

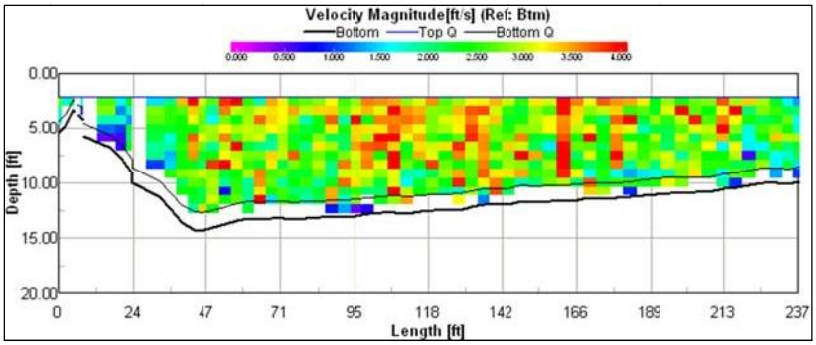

Figure 69. ADCP transect 1 (facing downstream) measured just downstream of Windswept pump station (located on left bank). Left bank is ~3' from start of transect and right bank is ~12' from end of transect.

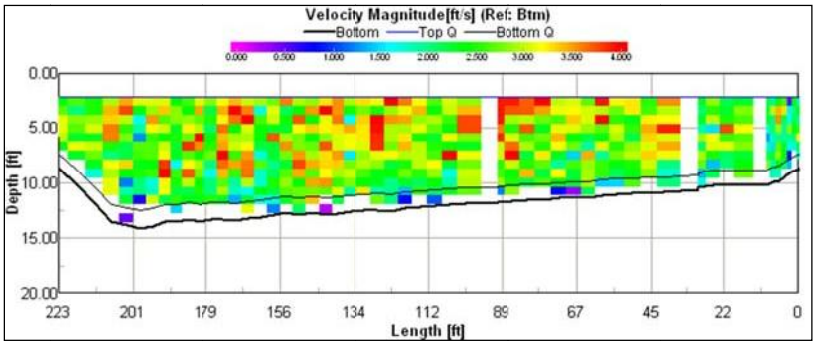

Figure 70. ADCP transect 2 (facing downstream) measured just downstream of Windswept pump station (located on left bank). Right bank is ~12' from start of transect and left bank is ~4' from end of transect.

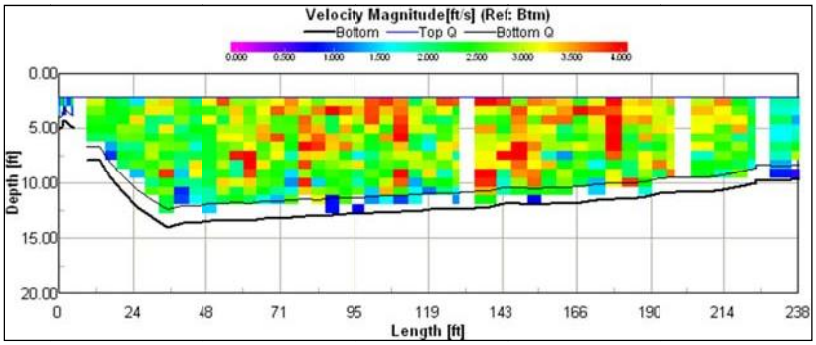

Figure 71. ADCP transect 3 (facing downstream) measured just upstream of Windswept pump station (located on left bank). Left bank is ~6' from start of transect and right bank is ~12' from end of transect.

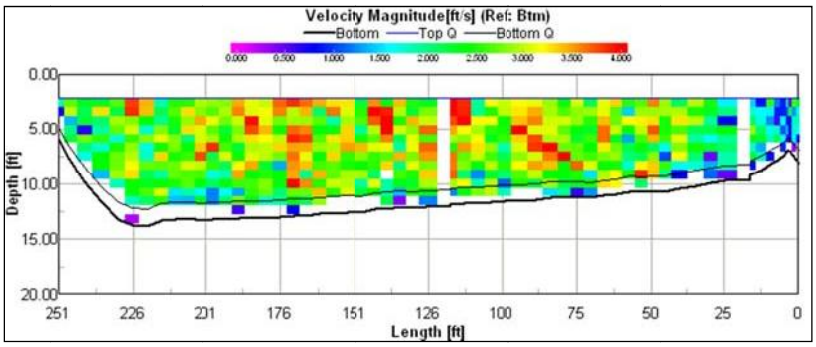

Figure 72. ADCP transect 4 (facing downstream) measured just upstream of Windswept pump station (located on left bank). Right bank is ~12' from start of transect and left bank is ~5' from end of transect.

Portuguese Bend

Fish Entrainment

Fish entrainment monitoring at the Portuguese Bend canal was initiated on April 28, 2010 (the onset of pumping operations at that location) (first net pull on April 29th) and continued until September 30, 2010. Tables 14A, 14B, 14C and 14D provide the total numbers of fish sampled and fish sizes by species. Appendix H at the end of this report provides daily data on fish entrainment.

Thirty identifiable fish species were observed. Sacramento sucker was the most numerous fish species sampled, followed by carp and prickly sculpin (Figure 73). Only one juvenile Chinook salmon (fall run) was observed (May 1, 2010). The daily numbers of all fish species sampled at the outfall were highly variable over the irrigation season (Figure 74). All of the non-salmonid species entrained would normally be expected to be present at this river location during the sampling period.

Based on data from a thermograph installed in the Portuguese Bend canal, water temperatures were cool early in the season, rose rapidly in the spring, reaching the high 60's to low 70's degrees Fahrenheit from late June to early-September (Figure 75).

Table 14A. Grand total of fish by species at Portuguese Bend pump station, April 29 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Sacramento Sucker *(Catostomus occidentalis)*	Carp *(Cyprinus carpio)*	Prickly Sculpin *(Cottus asper)*	Tule Perch *(Hysterocarpus traski)*	White Catfish *(Ameiurus catus)*	Sacramento Pikeminnow *(Ptychocheilus grandis)*	Hardhead *(Mylopharodon conocephalus)*	Bluegill *(Lepomis macrochirus)*	Green Sunfish *(Lepomis cyanellus)*
N=565*	N=383*	N=226*	N=94*	N=56*	N=52*	N=42*	N=28	N=20
78.7 mm	38.6 mm	41.7 mm	64.1 mm	53.1 mm	57 mm	66.1 mm	31 mm	50 mm
20 – 272 mm	15 – 265 mm	20 – 142 mm	20 – 142 mm	21 – 228 mm	15 – 83 mm	42 – 84 mm	21 – 51 mm	35 – 65 mm
(31.2 mm)	(23.7 mm)	(19.8 mm)	(37.8 mm)	(35.6 mm)	(18.9 mm)	(10.8 mm)	(6.4 mm)	(8.4 mm)

*Totals include these estimates: 54 Sacramento Sucker, 108 Carp, 18 Prickly Sculpin, 14 Tule Perch, 2 White Catfish, 11 Sacramento Pikeminnow and 1 Hardhead

Table 14B. Grand total of fish species at Portuguese Bend pump station, April 29 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Black Crappie *(Pomoxis nigromaculatus)*	Brown Bullhead *(Ameiurus nebulosus)*	Yellow Bullhead *(Ictalurus natalis)*	Black Bullhead *(Ameiurus melas)*	Redear Sunfish *(Lepomis microlophus)*	Bigscale Logperch *(Percina macrolepida)*	Pacific Lamprey *(Lampetra tridentate)*	Golden Shiner *(Notemigonus crysoleucas)*
N=18*	N=17*	N=15*	N=14*	N=13*	N=10*	N=8	N=8
75.5 mm	89.1 mm	100.2 mm	54.3 mm	29.2 mm	61.2 mm	165.1 mm	52.3 mm
21 – 139 mm	36 – 258 mm	51 – 183 mm	33 – 137 mm	20 – 42 mm	46 – 77 mm	110 – 204 mm	24 – 95 mm
(45.1 mm)	(73.5 mm)	(51.1 mm)	(37 mm)	(7.3 mm)	(14.8 mm)	(34.3 mm)	(19.9 mm)

*Totals include these estimates: 5 Black Crappie, 2 Brown Bullhead, 1 Yellow Bullhead, 6 Black Bullhead, 3 Redear Sunfish and 3 Bigscale Logperch

Table 14C. Grand total of fish by species at Portuguese Bend pump station, April 29 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Riffle Sculpin *(Cottus gulosus)*	Unknown Sculpin	Wakasagi *(Hypomesus nipponensis)*	River Lamprey *(Lampetra ayresi)*	Largemouth Bass *(Micropterus salmoides)*	Spotted Bass *Micropterus punctulatus*	Unknown Bass	Smallmouth Bass *(Micropterus dolomieui)*
N=8*	N=7	N=6	N=5	N=5	N=5	N=4*	N=3
33.6 mm	45.3 mm	45 mm	136.3 mm	60.8 mm	123.3 mm	47 mm	224 mm
21 – 42 mm	32 – 64 mm	36 – 50 mm	120 – 155 mm	41 – 78 mm	35 – 236 mm	24 – 70 mm	(N.A.)
(8.4 mm)	(11.7 mm)	(5.1 mm)	(17.6 mm)	(13.9 mm)	(91.7 mm)	(32.5 mm)	2 Not Measured (0 mm)

*Totals include these estimates: 3 Riffle Sculpin and 2 Unknown Bass

Table 14D. Grand total of fish by species at Portuguese Bend pump station, April 29 – September 30, 2010. (Number, average fork length, minimum and maximum length, and standard deviation.)

Unknown Lamprey *(Lampetra)*	**White Crappie** *(Pomoxis annularis)*	**Chinook Salmon** *(Oncorhynchus tshawytscha)*	**Threespine Stickleback** *(Gasterostreus aculeatus)*	**Fathead Minnow** *(Pimephales promelas)*	**Threadfin Shad** *(Dorosoma petenense)*	**Striped Bass** *(Morone saxatilis)*	**Sacramento Blackfish** *(Orthodon microlepidotus)*
N=2 105.5 mm 97 – 114 mm (12 mm)	N=2 89 mm 47 – 131 mm (59.4 mm)	N=1 70 mm (N.A.)	N=1 41 mm (N.A.)	N=1 52 mm (N.A.)	N=1 50 mm (N.A.)	N=1 48 mm (N.A.)	N=1 Not Measured (N.A.)

An additional 46 fish could not be identified (seven fish included as expansion estimates)

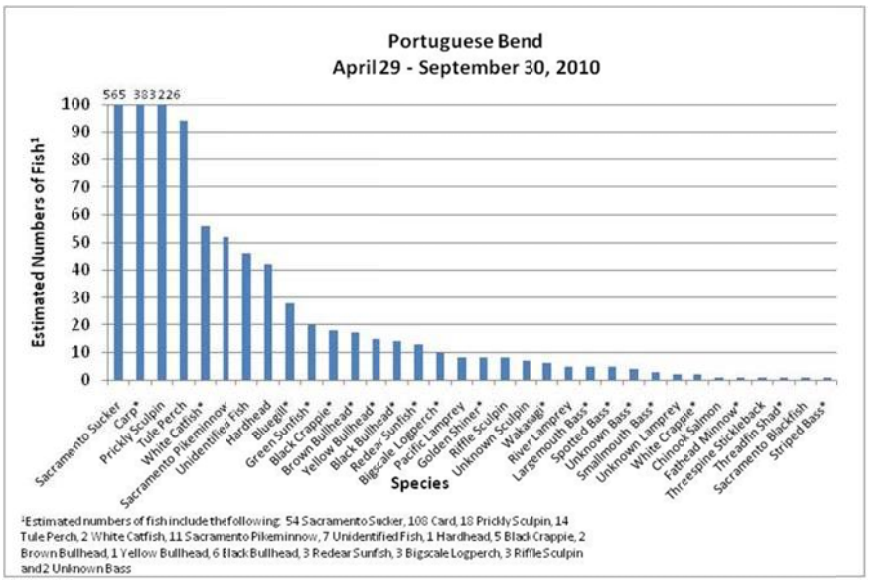

Figure 73. Fish species sampled during entrainment monitoring at Portuguese Bend canal (April 29 – September 30, 2010). Asterisks indicate non-native fish species.

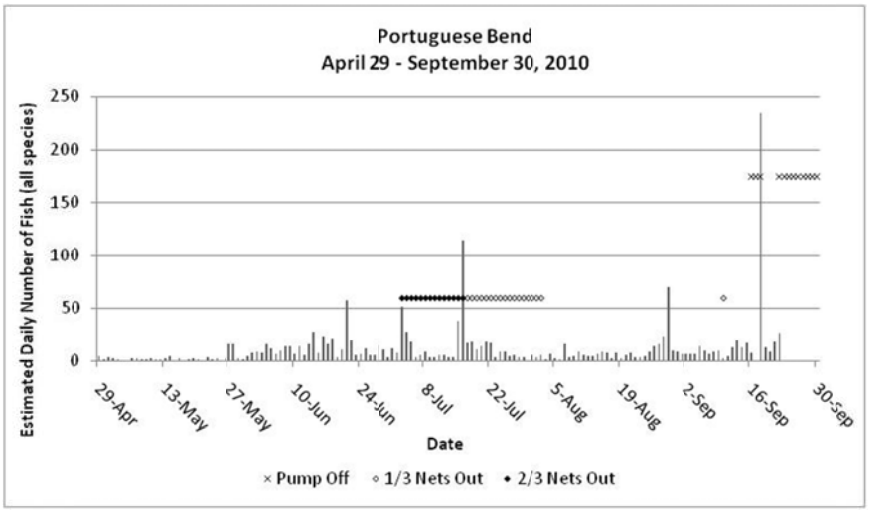

Figure 74. Daily numbers of fish (all species combined) sampled during entrainment monitoring at Portuguese Bend canal (April 29 – September 30, 2010).

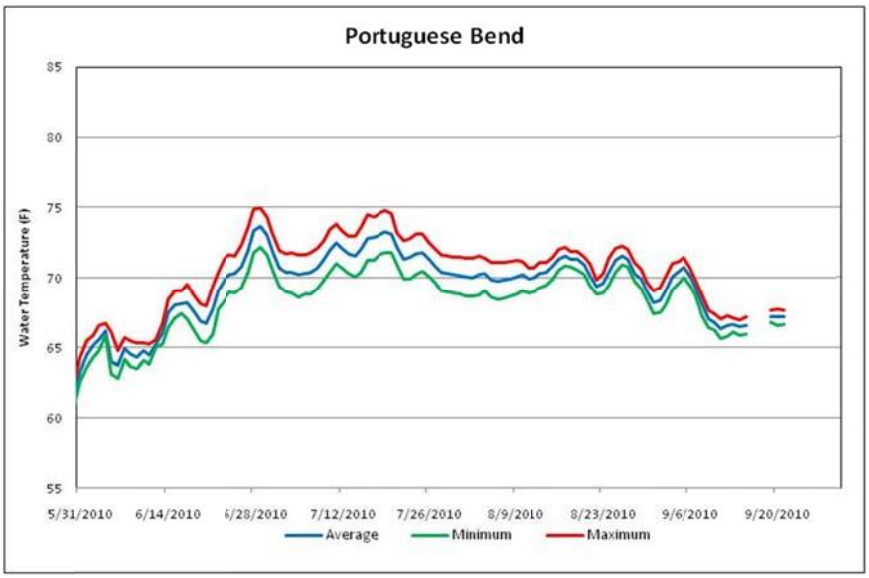

Figure 75. Water temperatures recorded at the Portuguese Bend pump station outfall. Gaps in the data are attributable to periods when no water was diverted and the thermograph was exposed to ambient air temperatures or stagnant water.

Based on daily pumping records, daily flow in the canal increased during the spring, remained at high levels during the summer, then declined in early September (Figure 76) No correlations between flow and numbers of fish entrained were evident.

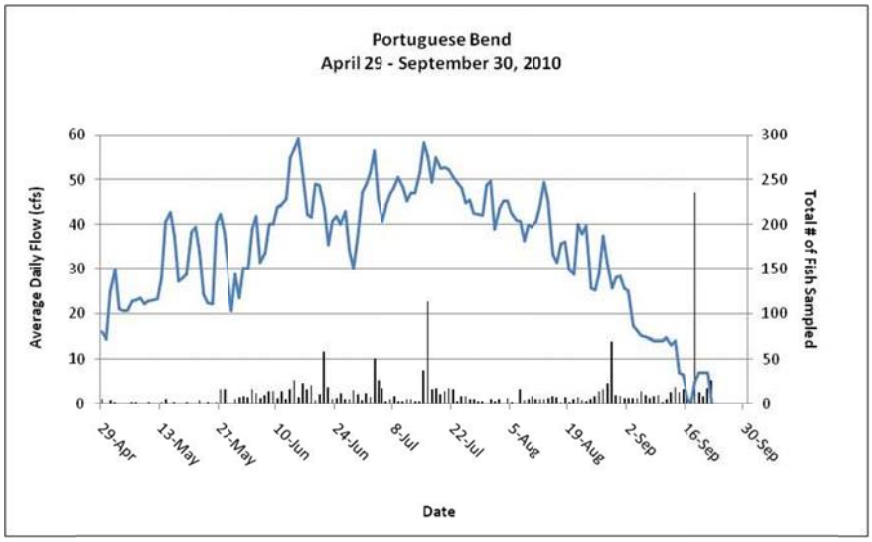

Figure 76. Estimated daily flows (cfs) in the irrigation canal at Portuguese Bend and daily total number of fish (all species) sampled during the 2010 study period.

Physical Features of the Pump Station Intakes

The Portuguese Bend pump station intakes are located on the left side of the river (facing downstream) on an inside bend in the river channel (Figure 77).

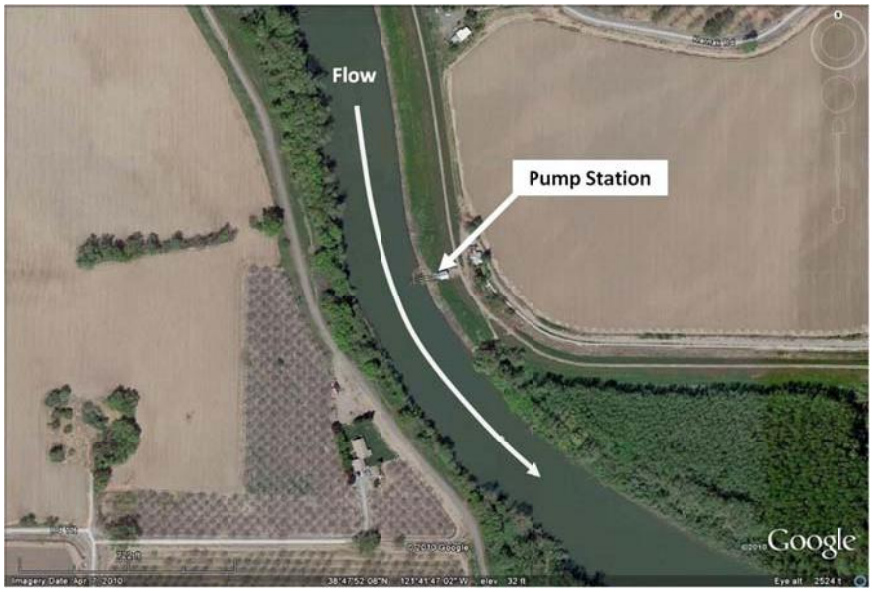

Figure 77. Location of the Portuguese Bend pump station on the Sacramento River.

Based on in-river surveys conducted during the summer of 2008, the four Portuguese Bend intake pipe diameters, in an upstream to downstream direction, are 36 inches, 46 inches, 40 inches, and 22 inches and enter the water at a 20-degree angle (Figure 78) (Table 15). At the time of the survey on June 19, 2008, the water depth at the pipe intakes was 12 feet with the intakes positioned three feet above the riprap substrate riverbed, 33 feet from the river's edge, and flow was swift and unidirectional. Rearing habitat for juvenile salmon was characterized as poor and predatory fish habitat was classified as good (Vogel 2008c). Additional features of the site are provided in Table 15.


Figure 78. The Portuguese Bend pump station intakes looking in a downstream direction.

Site Number: 020		TABLE 15. DIVERSION CHARACTERISTICS OF THE PORTUGUESE BEND PUMP STATION INTAKE (RIVER MILE 88.2) (DATA FROM VOGEL 2008c) 6/19/08								
Location Facing Downstream	**Channel Configuration at Diversion**	**# of Intake(s) (Upstream to Downstream)**	**Intake Opening Size (Outside Diameter in Inches)**	**Distance Between Intakes (Feet)**	**Intake Angle into Water (Degrees)**	**Estimated Distance from Intake Opening to Bank (Feet)**	**Estimated Riverbed Depth Near Intake (Feet)**	**Estimated Distance of Intake Off River Bottom (Feet)**	**Type of Posts In Water for Support Structure**	**# of Support Posts**
Left	Inside Bend	4	36"	5'	20°	33′	12'	3'	I-Beam Round Poles Trash Deflect Poles I-Beam	4 4 1 Group 3
			46"	5'	20°	33'	12'	3'		
			40"	3'	20°	33'	12'	3'		
			22"		20°	33'	12'	3'		
Hydraulic Characteristics	**Riverbank Material**	**Riparian Overstory (Type)**	**Riparian Understory (Type)**	**Estimated Time In Shade (Percent)**	**Debris Near Diversion Intake**	**Natural Instream Structure in General Vicinity of Diversion**	**Estimated Riverbed Substrate Near Diversion Intake**	**Juvenile Salmonid Habitat (Overall Quality)**	**Potential Predator Habitat (Overall Quality)**	
Swift Unidirectional	RR	None	Gr	5%	WD-L	Woody Debris	RR	1	3	

RIPARIAN IDENTIFICATION		**RIVERBED SUBSTRATE IDENTIFICATION**		**DEBRIS NEAR DIVERSION INTAKE**			**JUVENILE SALMON REARING/PREDATOR HABITAT**	
Code	Type	Code	Type	**Code**	**Type**		Code	Quality
Gr	Grasses	Si	Silt	WD-L	Woody Debris - Low Density		1	Poor
Sh	Shrubs	Sa	Sand	WD-M	Woody Debris - Medium Density		2	Fair
So	Soil	Co	Cobble	WD-H	Woody Debris - High Density		3	Good
Mu	Mulberry	RR	Rip-Rap					
TrA	Ash Tree	HP	Hardpan					
TrC	Cottonwood Tree							
TrO	Oak Tree							
TrUn	Unidentified Tree							
TrW	Walnut Tree	Code	Detail		7/3/08	6/19/08		
TrWi	Willow Tree	Non-Op	Non-Operational	Water Temperature:	73°F	72°F		
Ve	Vegetation	NA	Not Applicable	Secchi Depth:	2.3'			
We	Weeds	NE	No Estimates	Turbidity (NTUs):	12.6			

DIDSON™ imaging revealed some submerged woody debris and large fish at the downstream end of the pipe intakes. Figure 79 shows a DIDSON™ still image taken at the Portuguese Bend pumping station. Motion images (.avi files) were recorded on July 3, 2008 and are provided in a separate report on in-river surveys of Sacramento River water diversions (Vogel 2008c).

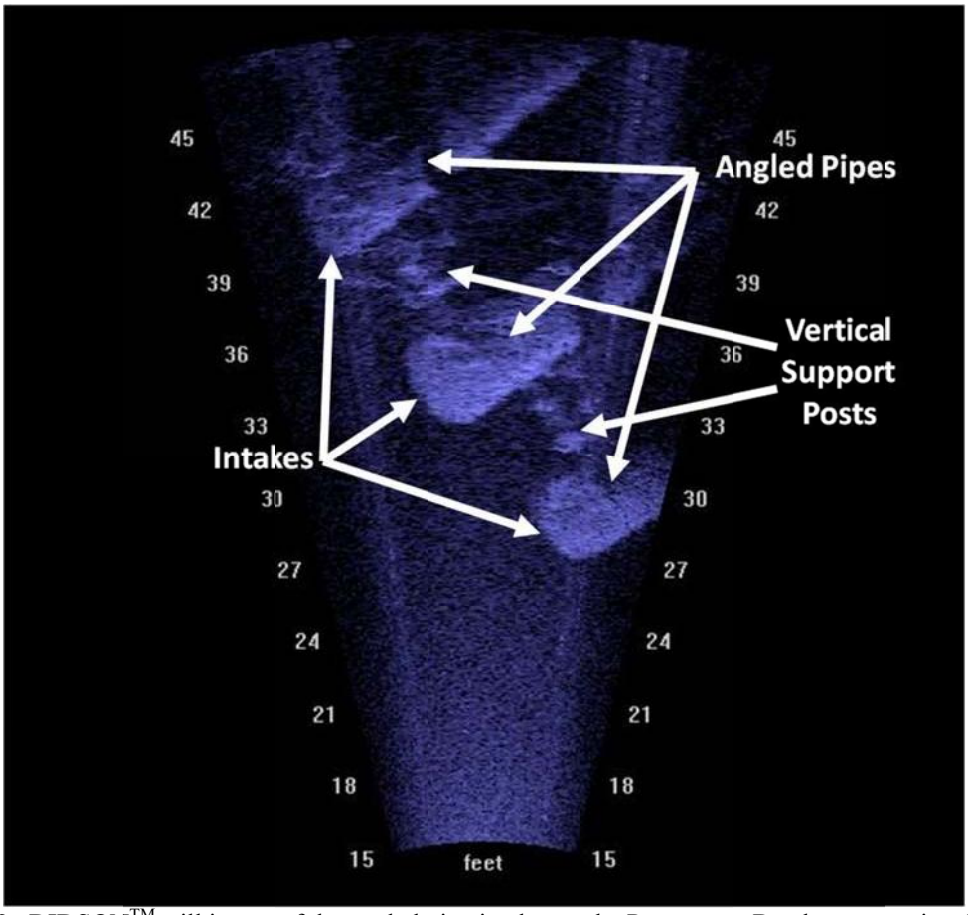

Figure 79. DIDSON™ still image of the angled pipe intakes at the Portuguese Bend pump station (looking upstream). Woody debris at the downstream end of the pipe intakes is not shown. Image taken on July 3, 2008.

Figures 80- 83 show ADCP bathymetry profiles and water velocity distributions across the river channel just upstream and downstream of the Portuguese Bend pump station as measured on July 3, 2008. The thalweg is located on the right side of the river (facing downstream) opposite the pump station intakes. The highest portion of the flow is distributed in the middle of the river channel.

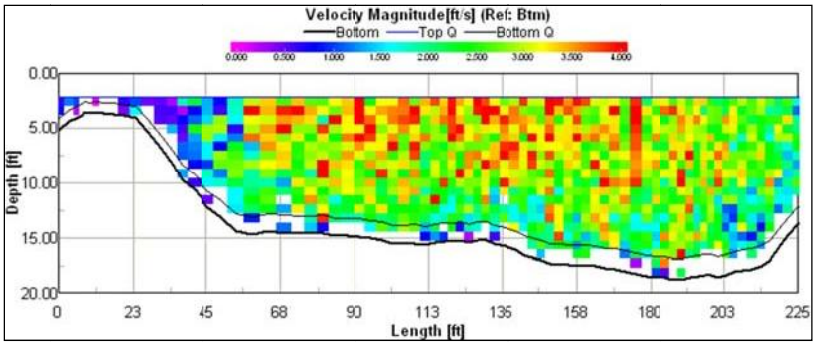

Figure 80. ADCP transect 1 (facing downstream) measured just downstream of Portuguese Bend pump station (located on left bank). Left bank is ~3' from start of transect and right bank is ~10' from end of transect.

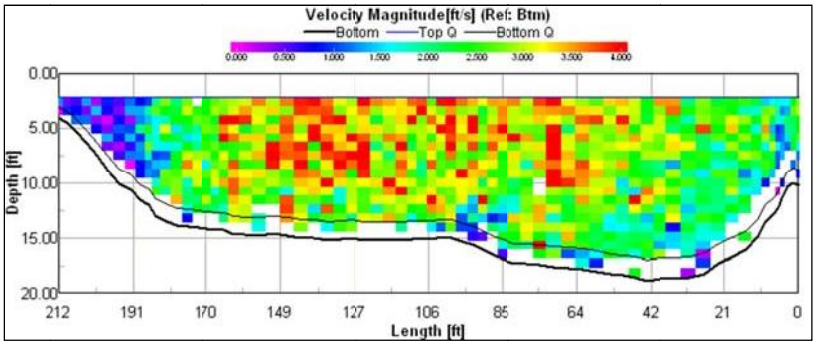

Figure 81. ADCP transect 2 (facing downstream) measured just downstream of Portuguese Bend pump station (located on left bank). Right bank is ~10' from start of transect and left bank is ~3' from end of transect.

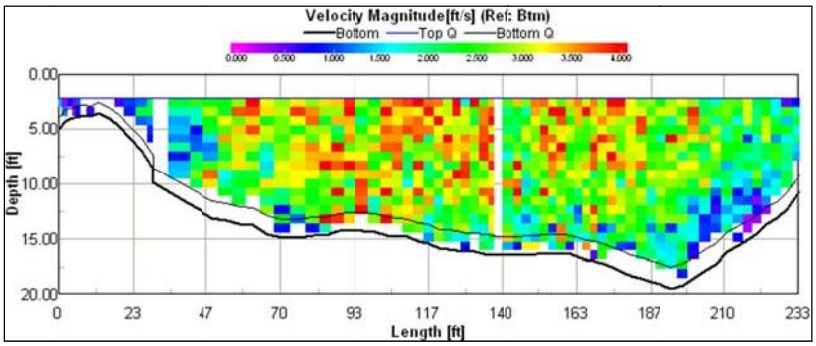

Figure 82. ADCP transect 3 (facing downstream) measured just upstream of Portuguese Bend pump station (located on left bank). Left bank is ~3' from start of transect and right bank is ~8' from end of transect.

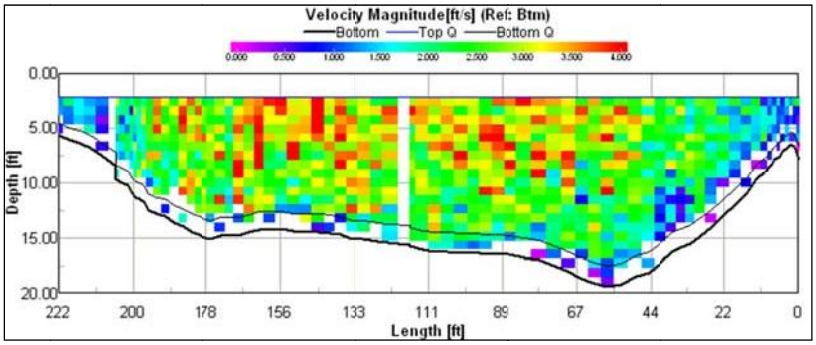

Figure 83. ADCP transect 4 (facing downstream) measured just upstream of Portuguese Bend pump station (located on left bank). Right bank is ~8' from start of transect and left bank is ~6' from end of transect.

Discussion

The loss of young anadromous salmonids at unscreened diversions could be a result of entrainment into the diversion, predation at or near the diversion site, or physical injury associated with the diversion structures. Most investigations of fish losses at diversions have generally focused on the direct losses attributable to entrainment which is the focus of this study. ICF Jones & Stokes (2008), in a literature search and data analysis of fish losses at Central Valley unscreened diversions, concluded that, among those factors examined, salmon smolt entrainment may be primarily a function of proportion of flow diverted from the river and canal flow/pumped discharge. This conclusion was largely based on empirical evidence derived from fish monitoring in the Sacramento River by the U.S. Fish and Wildlife Service using rotary screw traps at RBDD and the U.S. Bureau of Reclamation at a large pumped diversion facility adjacent to RBDD. However, physical characteristics of that facility are dissimilar to other much smaller unscreened diversions on the mainstem Sacramento River as determined through a recent extensive in-river survey conducted during 2008 (Vogel 2008c) which are the focus of this present-day study. For example, the Red Bluff 263-cfs pumping facility has a 210-ft long and 26-ft tall trash rack in front of the pump intakes (ICF Jones & Stokes 2008) which could have a significant deterrent effect on fish entrainment. None of the unscreened diversions between Red Bluff and Verona, California possess any similar type structures (Vogel 2008). Additionally, most of the monitoring data at Red Bluff occurred during different times of year (as early as February) as compared to lower Sacramento River diversions (late spring and summer). Also, the RBDD data were collected in the upper Sacramento River (RM 243) where the spatiotemporal presence of anadromous salmonids is different than the lower Sacramento River.

Vogel (1995) summarized a variety of studies that have been conducted in the past in an attempt to better define inter-relationships between the numbers of juvenile salmonids diverted into unscreened irrigation intakes and potential factors that may affect entrainment. Many of those past studies concluded that the factors affecting fish entrainment into unscreened diversions are complex and poorly understood. The following probably encompass the majority of the most important factors which could affect fry and juvenile anadromous salmonid losses in unscreened diversions (Vogel 1995):

- Salmon run (e.g., fall, late-fall, winter, spring)
- Seasonal timing and magnitude of the water diversion
- Proximity of the diversion to rearing habitat
- Geographic location of the water diversion in the river relative to the proportion of juvenile salmon which would ultimately migrate past the diversion
- Hydrologic conditions preceding the principal downstream migration (e.g., wet or dry water year type)
- Specific life phase of the downstream migrants passing the diversion (e.g., fry versus smolt)

- Physical configuration of the diversion intake and associated facilities
- Location of the diversion intake in the water column
- Concentration of the downstream migrants at various locations in the water column and across the river channel
- Diel changes in fish distribution and behavior
- Diel changes in water diversion rate
- Water velocity near the diversion intake
- Water temperature in the vicinity of the diversion intake
- Location of the diversion intake in the river channel (e.g., oxbow, inside or outside bend, set back or on the river, etc.
- Absence or presence and concentration of predatory fish at the diversion site

Among these factors, the hydrologic conditions and the seasonal timing of salmon emigration played significant roles in the low salmonid entrainment observed during the 2010 sampling program. The spring of 2010 was unusually wet due to frequent late-season storms saturating the agricultural lands served by the irrigation canals sampled during this study. Additionally, the early spring was cooler than normal. These circumstances resulted in a very late onset of irrigation diversions from the Sacramento River.

Additionally, and importantly, the late start of irrigation occurred after the predicted emigration of juvenile salmonids from the upper Sacramento River, as illustrated by the following two figures. DFG operates two eight-foot diameter rotary screw traps a half mile downstream of Knights Landing at Sacramento River mile 89.5. Among other purposes, the DFG fish monitoring program is conducted to determine the timing and relative abundance of juvenile anadromous salmonids emigrating from the upper Sacramento River system (Vincik and Bajjaliya 2008). The majority of the salmon emigration during wet winter conditions occurs during January through March (Vogel and Marine 1991) and is demonstrated by the DFG fish sampling program (Figures 84 and 84). (Additional DFG data from more-recent years will be included in the 2012 final report as data becomes available). Storm events increase river flow and turbidity which causes many salmon to either volitionally or non-volitionally move from the upper river to the Delta. A later emigration of juvenile salmon occurs during April and May as smolts if the fish have not already emigrated from the primary rearing grounds in the upper river. Salmonids entrained during this latter period may represent a significant portion of the salmonids present in the river at that time and would be considered significant (Steve Thomas, NMFS, pers. comm.). Although the DFG monitoring program ceases during the summer months, the sampling is not conducted then due to minimal or no juvenile salmon presence (likely due to warm water temperatures). Because most of the irrigation diversions did not increase substantially until well into May, the fish sampling in the irrigation canals undoubtedly missed the seasonal presence of salmon.

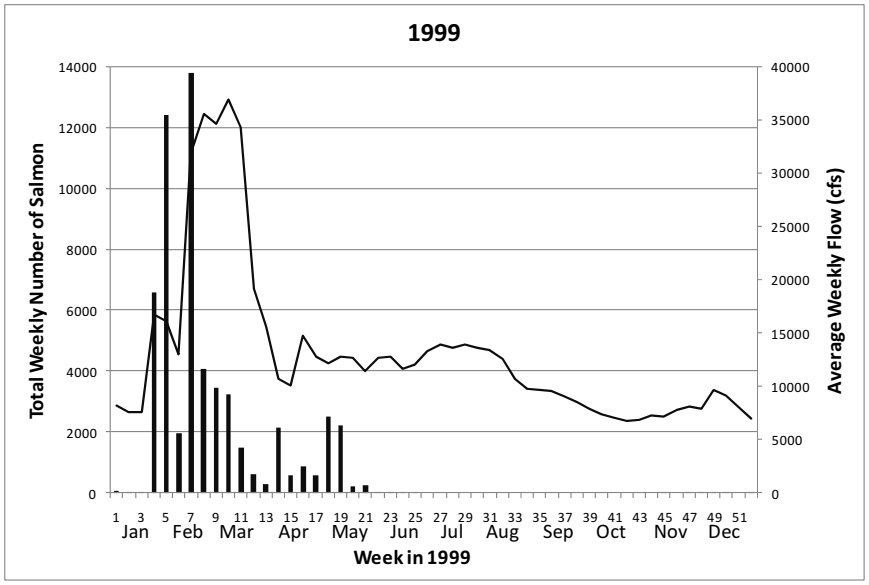

Figure 84. Total weekly numbers of juvenile Chinook salmon (all runs combined) captured with two rotary screw traps near Knights Landing during 1999 compared to average weekly flow (cfs) at Bend Bridge. Monitoring is not conducted during the summer months.

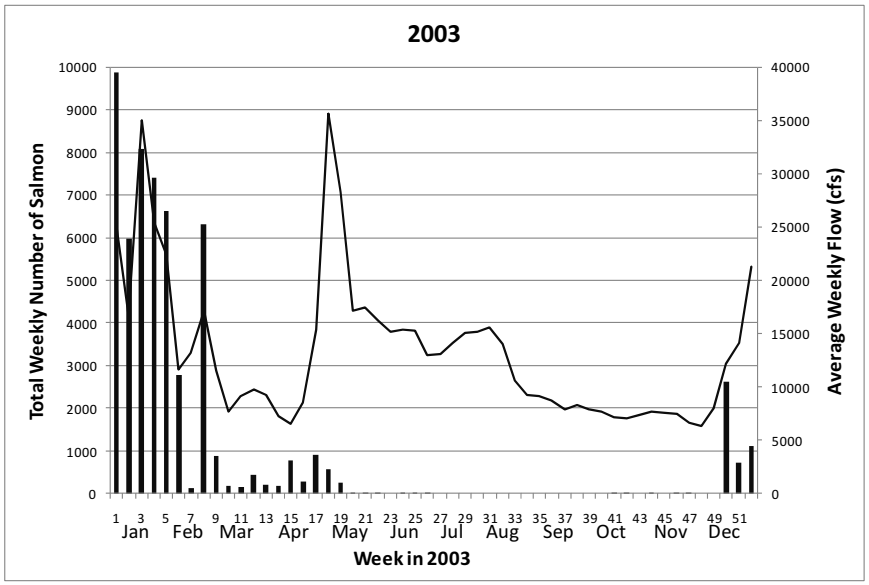

Figure 85. Total weekly numbers of juvenile Chinook salmon (all runs combined) captured with two rotary screw traps near Knights Landing during 2003 compared to average weekly flow (cfs) at Bend Bridge. Monitoring is not conducted during the summer months.

However, direct comparisons of the numbers of fish and species sampled at the seven diversions sites during the 2010 irrigation season with in-river fish monitoring programs in the lower and upper Sacramento River are difficult due to different locations throughout the river, sampling periods, and sampling techniques. For example, fish sampling using rotary screw traps and beach seines at some sites on the Sacramento River provides valuable information on the relative spatiotemporal distribution of fish and the proportional presence of different life stages, but are not directly quantitatively comparable to fish entrainment monitoring at irrigation pumps. Rotary screw traps

sample fish in the upper-most portion of the river water column (e.g., 3-4 feet), beach seines sample fish in near-shore, relatively quiet water habitats, but fish entrainment monitoring in this study samples fish entrained through pipes positioned off the banks of levees near the river bed.

A principal advantage of this sampling program is a comparison of fish entrainment between diversion sites due to relatively close proximity and similar sampling periods and techniques. During the 2010 sampling season, seven sites were monitored but data were limited to compare sites for this second year of the program due to the emigration of most salmonids prior to irrigation and the late onset of the irrigation season. However, some general observations can be made based on the data collected. Each of the seven sampling sites is located in habitats characterized as poor for juvenile salmon (Vogel 2008c). Additionally, each of the sites have diversion pipes positioned relatively deep in the river water column (e.g., 8 to 10 feet deep, depending on river flows) and near the riverbed which are areas presumed to be atypical for the preferences of juvenile salmon. For example, Gaines and Martin (2002) found that the relative abundance of downstream migrating juvenile Chinook salmon was greater in mid-channel areas as compared to river margins and were more abundant in the upper water column than the lower water column.

As observed during the 2009 sampling program, among those salmon captured in 2010, very few were fry-sized (< 60 mm) fish. This circumstance may be attributable to low fry-sized salmon presence in the river during the time periods sampled. Also, the lower river likely serves primarily as a migratory corridor for fish emigrating to salt water and not so much as a rearing area, at least during the period sampled. Because fish sampling could not occur until irrigation diversion operations were initiated, this sampling, by itself, cannot estimate the proportional presence of the various life stages present in the river. However, as data becomes available from other fish sampling programs in the upper and lower river, further examination of this subject will be addressed in the 2012 final report on the four-year program. Some of the sites chosen for sampling during 2011 and 2012 divert water during the river prior and after the principal irrigation season; data acquired during those years will likely provide further insight into the topic.

Additionally, each of the sites is located in the lower Sacramento River, which, during the primary summer-time irrigation season, possesses unfavorable water temperatures for juvenile salmon. These conditions may partially explain the low numbers of juvenile salmon sampled, although other factors such as the naturally low seasonal presence of each of the four runs of salmon and steelhead and the late timing of irrigation diversions likely had an overriding influence. Most of the outmigration of juvenile anadromous salmonids does not coincide with the primary irrigation season in the lower Sacramento River. However, the dominant presence of Sacramento sucker, tule perch, Sacramento pikeminnow, and prickly sculpin (as well as other species sampled) at most of the seven diversion sites is consistent with the types of habitats and seasonable presence expected for those species as described by Moyle (2002). Among those species sampled, the fish sizes were small indicating entrainment of younger life stages which could be explained by lesser swimming capabilities for avoiding entrainment or different habitat preferences

based on life stage. The cumulative effect on the riverine ecosystem resulting from the loss of non-salmonid fish in diversions has never been examined.

Although larger diversions would be generally believed to entrain more fish than smaller diversions, it is useful to compare the rates of entrainment (e.g., fish/acre-feet) between diversions. Because only monthly total diversion data obtained from the U.S. Bureau of Reclamation were available, a comparison of the numbers of all fish species diverted at each site by month was made. September was not included in this comparison due to extremely low pumping during that month at all sites and periodic draining of the canals affecting fish captures. Figure 86 shows that the South Steiner diversion site (30 cfs capacity) showed the highest rate of fish entrainment whereas other larger-capacity diversions (e.g., State Ranch – 128 cfs, Portuguese Bend – 106 cfs) showed a lower rate of entrainment.

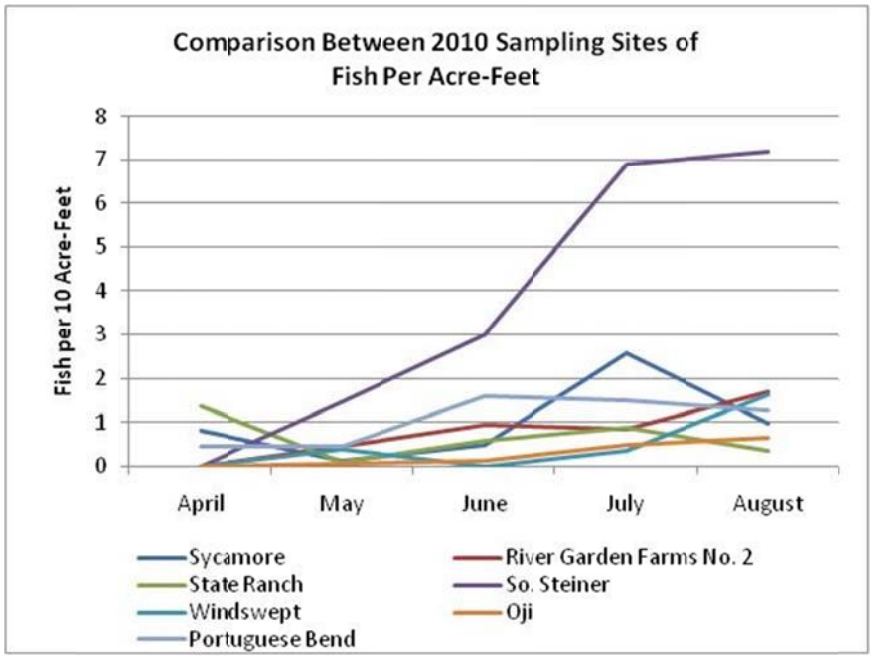

Figure 86. Comparison of the total monthly number of fish (all species combined) per 10 acre-feet for the seven diversions sampled during 2010.

Although data are limited for providing definitive conclusions, the 2010 sampling program suggests that there may be features at the seven sites creating conditions for disproportional fish entrainment rates between sites. It's premature to determine causal circumstances at this time but riverine habitat conditions in the immediate vicinity of the pipe intakes may be a factor. For example, it's hypothesized that the South Steiner site may have entrained a disproportionally higher number of non-salmonid fish compared to other sites due to the back eddy and slow-water characteristics near the river intake. As more data are acquired from additional sites in 2011 and 2012, more detailed comparisons will be possible and will be discussed in detail in the final report on the four-year sampling program. It is anticipated that results of this study, upon completion over the next two years when 12 separate diversions have been sampled and when integrated with the 2008 in-river surveys (including knowledge derived from other past

studies), will lead to a significantly improved understanding of those factors which are most important determinants of fish entrainment.

Recommendations

Unlike diversion canal sampling during 2007 and 2008 at other locations in an earlier program, the fish sampling programs in 2009 and 2010 received timely State and federal permits. This process should continue because it's readily apparent based on delayed permits in the prior study, if fish sampling is not initiated during the spring months (i.e., April and May), opportunities to sample juvenile Chinook salmon would be compromised.

Because physical features on the pump station intakes may affect fish entrainment, underwater examination of each intake (via SCUBA divers or underwater cameras) should be performed prior to removal of the structures for installation of new fish screens. Photographs and measurements of the intakes could be made at the time of intake removal in preparation for replacement by new fish screens. Physical features of each diversion site were partially based on estimates made during above-water surveys in the summer of 2008 (Vogel 2008). Where feasible, some of the submerged features of each diversion where measurements or direct observations may be useful in later determination of why some diversions may (or may not) entrain more fish than other sites include:

- If trashracks are installed over the pipe intake and, if so, bar or grate spacing;
- Observations of any debris covering the pipe intake;
- True diameter of the pipe intake (some pipe intakes are circular where others are oval due to an oblique pipe opening cut; also, some intake pipes are actually a smaller pipe sleeved inside a larger-diameter support pipe;
- Distance of the bottom of the pipe intake above the riverbed (e.g., some fish species are more river bottom oriented such as suckers);
- Artificial support structures (e.g., posts) or woody debris adjacent to the pipe intake which may provide predatory fish habitats;
- Riverbed substrate in the immediate vicinity of the intakes [e.g., some species have different preferences for specific types of riverbed substrate (e.g., mud, sand, gravel, cobble)].

Additionally, it would be useful to obtained additional site-specific information on those diversions sampled for fish entrainment (beyond this study scope) (e.g., maximum and daily average intake velocity, spill back rate, times of day the diversion was/was not operating, and total hours of operation per day) (pers. comm., Steve Thomas, NMFS).

Acknowledgements

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Screen Program and State Proposition Bond funds, respectively. Thanks are due to Dan Meier, U.S. Fish and Wildlife Service, for initiating and managing the project. Thanks are also due to Ashley Indieri and Debbi Lemburg of the Family Water Alliance for managing the project. Shirley Witalis (National Marine Fisheries Service) and Joe Johnson and Robert Vincik (California Department of Fish and Game) are thanked for processing permits for the study. Appreciation is extended to Sutter Mutual – State Ranch, River Garden Farms, Sycamore Mutual Water Corporation, Oji Brothers, Windswept, and RD 108 for permission to sample fish in their irrigation canals. I appreciate thoughtful comments on an earlier draft of this report by Dan Meier (USFWS), Steve Thomas (NMFS), and Treva Porter (CDFG). The field work was capably conducted by the Natural Resource Scientists, Inc. staff including Josh Brown, Matt Toney, Chris Johnston, and Carlos Overstreet.

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Appendix A. Fish species observed during the 2010 entrainment monitoring project.			
Species (Common Name)	**Scientific Name**	**Native**	**Non-Native**
American Shad	*(Alosa sapidissima)*		X
Bigscale Logperch	*(Percina macrolepida)*		X
Black Bullhead	*(Ameiurus melas)*		X
Black Crappie	*(Pomoxis nigromaculatus)*		X
Bluegill	*(Lepomis macrochirus)*		X
Brown Bullhead	*(Ameiurus nebulosus)*		X
California Roach	*(Lavinia symmetricus)*	X	
Carp	*(Cyprinus carpio)*		X
Chinook Salmon	*(Oncorhynchus tshawytscha)*	X	
Fathead Minnow	*(Pimephales promelas)*		X
Golden Shiner	*(Notemigonus crysoleucas)*		X
Green Sunfish	*(Lepomis cyanellus)*		X
Hardhead	*(Mylopharodon conocephalus)*	X	
Inland Silverside	*(Menidia audens)*		X
Largemouth Bass	*(Micropterus salmoides)*		X
Pacific Lamprey	*(Lampetra tridentate)*	X	
Prickly Sculpin	*(Cottus asper)*	X	
Redear Sunfish	*(Lepomis microlophus)*		X
Riffle Sculpin	*(Cottus gulosus)*	X	
River Lamprey	*(Lampetra ayresi)*	X	
Sacramento Blackfish	*(Orthodon microlepidotus)*	X	
Sacramento Pikeminnow	*(Ptychocheilus grandis)*	X	
Sacramento Splittail	*(Pogonichthys macrolepidotu)*	X	
Sacramento Sucker	*(Catostomus occidentalis)*	X	
Smallmouth Bass	*(Micropterus dolomieu)*		X
Spotted Bass	*(Micropterus punctulatus)*		X
Striped Bass	*(Morone saxatilis)*		X
Threadfin Shad	*(Dorosoma petenense)*		X
Threespine Stickleback	*(Gasterostreus aculeatus)*	X	
Tule Perch	*(Hysterocarpus traski)*	X	
Wakasagi	*(Hypomesus nipponensis)*		X
White Catfish	*(Ameiurus catus)*		X
White Crappie	*(Pomoxis annularis)*		X
Yellow Bullhead	*(Ictalurus natalis)*		X

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
4/27/10									
4/28/10									
4/29/10									
4/30/10								N=4 217.8 mm 210 – 232 mm (9.9 mm)	
5/1/10								N=1 122 mm (N.A.)	
5/2/10									
5/3/10									
5/4/10									
5/5/10									
5/6/10								N=3 195 mm 150 – 220 mm (39.1 mm)	
5/7/10									
5/8/10									
5/9/10									
5/10/10	N=1 71 mm (N.A.)								
5/11/10									
5/12/10		N=2 81.5 mm 78 – 85 mm (4.9 mm)							
5/13/10		N=1 Not Measured							
5/14/10		N=1							

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
		Not Measured							
5/15/10		N=4 81 mm 78 – 83 mm (2.2 mm)							
5/16/10		N=3 54 mm 51 – 58 mm (3.6 mm)							
5/17/10		N=4 85.7 mm 80 – 95 mm (8.1 mm)							
5/18/10		N=2 85 mm (N.A.) 1 Not Measured							
5/19/10									
5/20/10									
5/21/10		N=2 89 mm 83 – 95 mm (8.5 mm)							
5/22/10									
5/23/10									
5/24/10									
5/25/10									
5/26/10		N=3 84 mm 76 – 92 mm (11.3 mm)							
5/27/10		N=1							

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
		74 mm (N.A.)							
5/28/10		N=1 91 mm (N.A.)							
5/29/10		N=1 110 mm (N.A.)							
5/30/10		N=2 75 mm (N.A.) 1 Not Measured							
5/31/10								N=4 165.7 mm 143 – 191 mm (24.1 mm)	
6/1/10									
6/2/10		N=1 118 mm (N.A.)						N=1 Not Measured	
6/3/10									
6/4/10									
6/5/10								N=1 178 mm (N.A.)	
6/6/10								N=2 Not Measured	
6/7/10								N=1 180 mm (N.A.)	
6/8/10								N=1 168 mm	

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
								(N.A.)	
6/9/10									
6/10/10			N=1 93 mm (N.A.0						
6/11/10									
6/12/10	N=1 160 mm (N.A.)								
6/13/10									
6/14/10								N=1 109 mm (N.A.)	
6/15/10		N=10 47 mm 38 – 75 mm (15.7 mm)					N=3 40.7 mm 40 – 42 mm (1.2 mm)		
6/16/10									
6/17/10									
6/18/10		N=3 85 mm 80 – 95 mm (8.7 mm)							N=1 62 mm (N.A.)
6/19/10		N=2 82.5 mm 80 – 85 mm (3.5 mm)	N=1 47 mm (N.A.)						
6/20/10		N=1 85 mm (N.A.)							
6/21/10		N=3 87.3 mm 80 – 92 mm	N=1 41 mm (N.A.)						

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
		(6.4 mm)							
6/22/10			N=2 42.5 mm 42 – 43 mm (0.7 mm)						
6/23/10		N=7 73.5 mm 35 – 130 mm (45.2 mm)	N=11 39.6 mm 34 – 45 mm (3.6 mm)						
6/24/10		N=3 82 mm 40 – 107 mm (36.6 mm)	N=1 45 mm (N.A.)						
6/25/10		N=1 72 mm (N.A.)							
6/26/10	N=1 60 mm (N.A.)	N=2 84 mm 81 – 87 mm (4.2 mm)	N=2 42 mm 41 – 43 mm (1.4 mm)						
6/27/10		N=3 31 mm (N.A.) 2 Not Measured					N=7 41.1 mm 30 – 60 mm (5.8 mm)		
6/28/10	N=1 60 mm (N.A.)	N=2 75 mm 42 – 108 mm (46.7 mm)	N=12 46.6 mm 41 – 56 mm (4.3 mm)				N=5 52.4 mm 46 – 60 mm (5.1 mm)		
6/29/10		N=2 70.5 mm 38 – 103 mm (46 mm)	N=3 44.7 mm 42 – 48 mm (3.1 mm)						
6/30/10		N=2	N=5						

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
		44.5 mm 40 – 49 mm (6.4 mm)	43.3 mm 36 – 48 mm (5.3 mm)						
7/1/10	N=1 56 mm (N.A.)	N=3 66.5 mm 35 – 98 mm (44.5 mm)							
7/2/10	N=20 47.1 mm 39 – 57 mm (5.9 mm)		N=5 51.8 mm 39 – 60 mm (8.8 mm)						
7/3/10	N=1 50 mm (N.A.)								
7/4/10	N=5 59 mm 46 – 78 mm (11.9 mm)	N=3 78.7 mm 46 – 98 mm (28.4 mm)							
7/5/10									
7/6/10	N=14 55.7 mm 43 – 69 mm (7.7 mm)	N=3 65.5 mm 40 – 91 mm (36.1 mm)	N=13 42.9 mm 34 – 53 mm (5.8 mm)						
7/7/10	N=27 46 mm 36 – 56 mm (6.7 mm)	N=3 102 mm (N.A.) 2 Not Measured	N=12 43.5 mm 34 – 53 mm (6 mm)						
7/8/10	N=3 46.7 mm 42 – 51 mm (4.5 mm)	N=5 78.5 mm 46 – 111 mm (46 mm)	N=1 59 mm (N.A.)						
7/9/10	N=16 52.5 mm	N=3 79 mm	N=2 45.5 mm						

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
	42 – 72 mm (7.8 mm)	60 – 98 mm (26.9 mm)	41 – 50 mm (6.4 mm)						
7/10/10	N=34 56.3 mm 36 – 84 mm (10.3 mm)	N=3 61 mm 43 – 90 mm (25.4 mm)	N=2 50.5 mm 48 – 53 mm (3.5 mm)						
7/11/10	N=190 51.9 mm 38 – 70 mm (6.5 mm)	N=8 48.7 mm 42 – 54 mm (3.6 mm)	N=10 47.5 mm 40 – 60 mm (5.3 mm)						
7/12/10	N=35 48.1 mm 30 – 73 mm (9.6 mm)	N=7 66 mm 41 – 118 mm (29.9 mm)	N=1 Not Measured						
7/13/10	N=17 52.9 mm 44 – 60 mm (5.7 mm)	N=4 51.7 mm 49 – 54 mm (2.5 mm)							
7/14/10	N=51 49.9 mm 39 – 83 mm (8.8 mm)	N=10 53.6 mm 43 – 89 mm (16.1 mm)	N=3 45.3 mm 36 – 57 mm (10.7 mm)						
7/15/10	N=8 53.3 mm 48 – 59 mm (5.5 mm)	N=10 49.3 mm 43 – 53 mm (3.4 mm)	N=3 42.7 mm 40 – 46 mm (3.1 mm)						
7/16/10	N=13 50.3 mm 41 – 62 mm (7.3 mm)	N=5 52.8 mm 44 – 62 mm (7.5 mm)	N=1 40 mm (N.A.)						
7/17/10	N=37 47.6 mm 32 – 72 mm (10 mm)	N=6 45.3 mm 40 – 54 mm (6.1 mm)	N=1 52 mm (N.A.)						

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
7/18/10	N=8 38.6 mm 29 – 53 mm (9.1 mm)	N=3 44.7 mm 34 – 55 mm (10.5 mm)						N=1 39 mm (N.A.)	
7/19/10	N=9 48.3 mm 42 – 56 mm (4.7 mm)	N=12 51.8 mm 41 – 64 mm (7.2 mm)					N=1 40 mm (N.A.)		
7/20/10	N=24 52.2 mm 44 – 65 mm (5.5 mm)	N=6 66.8 mm 43 – 105 mm (25.4 mm)	N=3 41.3 mm 36 – 49 mm (6.8 mm)						
7/21/10	N=52 57.8 mm 40 – 77 mm (8.2 mm)	N=9 50.4 mm 42 – 60 mm (7.4 mm)	N=5 45 mm 39 – 52 mm (5.5 mm)	N=1 33 mm (N.A.)					
7/22/10	N=10 56.6 mm 45 – 76 mm (10.2 mm)	N=4 54.7 mm 44 – 64 mm (10.1 mm)	N=2 39.5 mm 39 – 40 mm (0.7 mm)						
7/23/10	N=27 54.7 mm 41 – 68 mm (6.5 mm)	N=12 49.2 mm 40 – 60 mm (5.9 mm)					N=3 45.7 mm 42 – 52 mm (5.5 mm)		
7/24/10	N=22 55.8 mm 37 – 70 mm (9.9 mm)	N=13 55.4 mm 50 – 62 mm (4.3 mm)	N=6 47.3 mm 40 – 56 mm (6.4 mm)						
7/25/10	N=40 54.8 mm 38 – 83 mm (7.6 mm)	N=9 42 mm 35 – 50 mm (5.8 mm)							
7/26/10	N=5 51 mm	N=2 56 mm	N=2 51 mm						

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
	49 – 53 mm (2 mm)	44 – 60 mm (5.7 mm)	48 – 54 mm (4.2 mm)						
7/27/10	N=7 61.6 mm 48 – 73 mm (9.9 mm)	N=1 57 mm (N.A.)	N=1 54 mm (N.A.)						
7/28/10	N=9 58.8 mm 41 – 77 mm (12.1 mm)						N=1 55 mm (N.A.)		
7/29/10	N=4 49.7 mm 32 – 75 mm (22.5 mm)	N=16 60.5 mm 49 – 72 mm (7.3 mm)	N=5 42.6 mm 37 – 52 mm (5.9 mm)						
7/30/10		N=2 61.5 mm 60 – 63 mm (2.1 mm)							
7/31/10	N=15 63.2 mm 46 – 91 mm (13.7 mm)	N=9 56.4 mm 48 – 65 mm (5.6 mm)	N=1 Not Measured						
8/1/10	N=31 61.7 mm 40 – 95 mm (13.3 mm)	N=7 63 mm 56 – 70 mm (5.8 mm)							
8/2/10	N=26 57.5 mm 43 – 79 mm (10.3 mm)	N=8 55 mm 49 – 60 mm (3.4 mm)							
8/3/10		N=7 57.6 mm 50 – 63 mm (5.4 mm)							

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
8/4/10	N=2 77.5 mm 69 – 86 mm (12 mm)	N=5 55.7 mm 43 – 74 mm (16.3 mm)							
8/5/10									
8/6/10	N=6 61.3 mm 50 – 69 mm (8.9 mm)	N=2 54 mm (N.A.) 1 Not Measured							
8/7/10	N=6 66 mm 48 – 100 mm (18 mm)	N=6 71.6 mm 48 – 115 mm (25.8 mm)							
8/8/10	N=2 50.5 mm 46 – 55 mm (6.4 mm)	N=2 57 mm (N.A.) 1 Not Measured	N=3 44 mm 36 – 48 mm (6.9 mm)			N=1 78 mm (N.A.)			
8/9/10	N=55 62.7 mm 44 – 92 mm (11.8 mm)	N=4 58.7 mm 56 – 61 mm (2.5 mm)	N=1 42 mm (N.A.)						
8/10/10	N=16 65.8 mm 49 – 84 mm (10.1 mm)	N=9 64.5 mm 54 – 73 mm (7.8 mm)	N=2 44 mm 43 – 45 mm (1.4 mm)	N=1 51 mm (N.A.)		N=1 59 mm (N.A.)			
8/11/10	N=5 74.7 mm 60 – 90 mm (15 mm)	N=4 57 mm 54 – 61 mm (2.9 mm)		N=5 62 mm 40 – 92 mm (20.6 mm)					
8/12/10	N=1 71 mm (N.A.)	N=3 64.7 mm 61 – 67 mm							N=4 93.5 mm 59 – 118 mm

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
		(3.2 mm)							(26 mm)
8/13/10	N=6 79.8 mm 61 – 112 mm (20 mm)	N=3 69 mm 65 – 74 mm (4.6 mm)							N=3 98.3 mm 51 – 124 mm (41 mm)
8/14/10	N=7 72.9 mm 61 – 100 mm (13.9 mm)	N=1 64 mm (N.A.)	N=1 45 mm (N.A.)	N=1 75 mm (N.A.)					N=5 45.2 mm 42 – 48 mm (2.3 mm)
8/15/10	N=6 61 mm 58 – 64 mm (2.6 mm)	N=5 58 mm 50 – 66 mm (11.3 mm)							N=3 50.7 mm 44 – 63 mm (10.7 mm)
8/16/10	N=6 53.5 mm 40 – 66 mm (10.7 mm)	N=2 Not Measured							
8/17/10		N=2 74 mm (N.A.) 1 Not Measured							
8/18/10	N=2 65 mm (N.A.) 1 Not Measured	N=4 53 mm 52 – 54 mm (1.4 mm)							N=1 97 mm (N.A.)
8/19/10		N=1 112 mm (N.A.)							
8/20/10	N=1 73 mm (N.A.)								
8/21/10	N=8 65.3 mm	N=10 60.4 mm	N=2 37 mm						

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
	48 – 112 mm (20.3 mm)	52 – 65 mm (4.1 mm)	32 – 42 mm (7.1 mm)						
8/22/10	N=1 65 mm (N.A.)	N=2 73 mm 60 – 86 mm (18.4 mm)							
8/23/10	N=5 90.8 mm 64 – 121 mm (26.1 mm)	N=2 58 mm (N.A.) 1 Not Measured							
8/24/10		N=2 Not Measured							
8/25/10	N=1 72 mm (N.A.)	N=4 68.3 mm 63 – 74 mm (5.1 mm)							
8/26/10		N=3 82 mm 75 – 86 mm (6.1 mm)							
8/27/10	N=1 115 mm (N.A.)	N=7 70.8 mm 55 – 86 mm (12.2 mm)							
8/28/10		N=7 76.8 mm 62 – 97 mm (13.1 mm)							
8/29/10	N=4 76.3 mm 70 – 88 mm (10.1 mm)	N=9 90.6 mm 77 – 110 mm (13.2 mm)							
8/30/10	N=1	N=1							

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
	71 mm (N.A.)	64 mm (N.A.)							
8/31/10		N=4 63 mm (N.A.) 3 Not Measured							
9/1/10		N=1 71 mm (N.A.)							
9/2/10	N=3 77.5 mm 62 – 93 mm (21.9 mm)	N=4 82 mm 77 – 89 mm (5.6 mm)							
9/3/10	N=2 73 mm (N.A.) 1 Not Measured	N=5 75.6 mm 64 – 91 mm (11.3 mm)							
9/4/10	N=1 88 mm (N.A.)	N=1 Not Measured							
9/5/10	N=3 73 mm 54 – 105 mm (27.9 mm)	N=6 66.8 mm 60 – 72 mm (5 mm)							
9/6/10									
9/7/10		N=1 Not Measured							
9/8/10									
9/9/10	N=2 83.5 mm 77 – 90 mm (9.2 mm)	N=8 70.3 mm 56 – 81 mm (8.9 mm)	N=1 55 mm (N.A.)						
9/10/10	N=5	N=3	N=1						

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
	85.4 mm 73 – 98 mm (10 mm)	69.3 mm 65 – 72 mm (3.8 mm)	51 mm (N.A.)						
9/11/10	N=4 86.3 mm 70 – 102 mm (13.6 mm)	N=6 79 mm 73 – 83 mm (5.3 mm)	N=1 94 mm (N.A.)						
9/12/10	N=12 80 mm 62 – 88 mm (8.2 mm)	N=7 95 mm 80 – 110 mm (21.2 mm)							
9/13/10	N=86 93 mm 66 – 125 mm (14.1 mm)	N=12 88.3 mm 72 – 120 mm (15.2 mm)		N=38 105.5 mm 81 – 131 mm (12.6 mm)	N=26 95.2 mm 81 – 130 mm (12.8 mm)	N=23 84.9 mm 62 – 111 mm (12.6 mm)			
9/14/10	N=40 75.5 mm 51 – 104 mm (14.7 mm)	N=10 86.3 mm 62 – 110 mm (17.6 mm)		N=47 87.7 mm 65 – 117 mm (15.2 mm)	N=2 115.5 mm 97 – 134 mm (26.2 mm)				
9/15/10	N=17 90.6 mm 61 – 114 mm (14.5 mm)	N=1 87 mm (N.A.)		N=4 81.3 mm 69 – 91 mm (11 mm)	N=6 90.5 mm 79 – 108 mm (10.4 mm)		N=1 65 mm (N.A.)		
9/16/10	N=5 96.4 mm 81 – 119 mm (14.7 mm)	N=1 95 mm (N.A.)		N=2 98 mm 92 – 104 mm (8.5 mm)					
9/17/10	N=4 68.8 mm 57 – 98 mm (19.6 mm)								
9/18/10	N=8 75.4 mm 60 – 91 mm								

Appendix B1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Sacramento Sucker	Tule Perch	Prickly Sculpin	Sacramento Pikeminnow	Golden Shiner	Hardhead	Unknown Sculpin	Pacific Lamprey	Sacramento Splittail
	(12.5 mm)								
9/19/10									
9/20/10									
9/21/10									
9/22/10									
9/23/10									
9/24/10									
9/25/10									
9/26/10									
9/27/10									
9/28/10									
9/29/10									
9/30/10									
GRAND TOTALS	N=1,099 61.2 mm 29 – 160 mm (17.1 mm)	N=432 65.5 mm 31 – 130 mm (19.1 mm)	N=130 45.6 mm 32 – 94 mm (8.6 mm)	N=99 91.7 mm 33 – 131 mm (20.2 mm)	N=34 95.6 mm 79 – 134 mm (13.8 mm)	N=25 83.6 mm 59 – 111 mm (13.2 mm)	N=21 46.1 mm 30 – 65 mm (8.1 mm)	N=20 171.8 mm 39 – 232 mm (50.9 mm)	N=17 70.9 mm 42 – 124 mm (30.9 mm)

Appendix B2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Black Bullhead	Bluegill	Black Crappie	California Roach	White Catfish	River Lamprey	Largemouth Bass	Brown Bullhead	Wakasagi
4/27/10									
4/28/10									
4/29/10									
4/30/10									
5/1/10									
5/2/10									
5/3/10									

Appendix B2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Black Bullhead	Bluegill	Black Crappie	California Roach	White Catfish	River Lamprey	Largemouth Bass	Brown Bullhead	Wakasagi
5/4/10									
5/5/10									
5/6/10									
5/7/10									
5/8/10									
5/9/10									
5/10/10									
5/11/10									
5/12/10						N=1 95 mm (N.A.)			
5/13/10						N=2 65 mm (N.A.) 1 Not Measured			
5/14/10									
5/15/10									
5/16/10									
5/17/10									
5/18/10									
5/19/10									
5/20/10									
5/21/10									
5/22/10									
5/23/10									
5/24/10									
5/25/10									
5/26/10									
5/27/10									

Appendix B2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Black Bullhead	Bluegill	Black Crappie	California Roach	White Catfish	River Lamprey	Largemouth Bass	Brown Bullhead	Wakasagi
5/28/10									
5/29/10								N=1 Not Measured	
5/30/10									
5/31/10									
6/1/10	N=3 Not Measured					N=1 Not Measured			
6/2/10	N=5 Not Measured								
6/3/10									
6/4/10									
6/5/10						N=1 Not Measured			
6/6/10					N=3 225 mm (N.A.) 2 Not Measured				
6/7/10	N=2 Not Measured								
6/8/10	N=2 235 mm (N.A.) 1 Not Measured								
6/9/10									
6/10/10					N=1 Not Measured				
6/11/10									
6/12/10								N=2 Not Measured	
6/13/10									
6/14/10		N=1 Not Measured			N=1 Not Measured				

Appendix B2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Black Bullhead	Bluegill	Black Crappie	California Roach	White Catfish	River Lamprey	Largemouth Bass	Brown Bullhead	Wakasagi
6/15/10		N=5 33.3 mm 30 – 38 mm (4.2 mm)			N=1 29 mm (N.A.)				
6/16/10									
6/17/10		N=1 32 mm (N.A.)							
6/18/10									
6/19/10			N=4 78.8 mm 65 – 91 mm (11.6 mm)						
6/20/10			N=4 81.8 mm 80 – 84 mm (1.7 mm)				N=3 45.3 mm 32 – 54 mm (11.7 mm)		
6/21/10			N=2 Not Measured						
6/22/10					N=1 33 mm (N.A.)				
6/23/10									
6/24/10									
6/25/10									
6/26/10								N=1 105 mm (N.A.)	
6/27/10									
6/28/10		N=1 35 mm (N.A.)							

Appendix B2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Black Bullhead	Bluegill	Black Crappie	California Roach	White Catfish	River Lamprey	Largemouth Bass	Brown Bullhead	Wakasagi
6/29/10									
6/30/10									
7/1/10									
7/2/10									
7/3/10									
7/4/10									
7/5/10									
7/6/10									
7/7/10									
7/8/10									
7/9/10									
7/10/10									
7/11/10									
7/12/10									
7/13/10									
7/14/10		N=1 45 mm (N.A.)							
7/15/10									
7/16/10									
7/17/10									
7/18/10									
7/19/10									
7/20/10									
7/21/10									
7/22/10									
7/23/10									
7/24/10									
7/25/10									

Appendix B2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Black Bullhead	Bluegill	Black Crappie	California Roach	White Catfish	River Lamprey	Largemouth Bass	Brown Bullhead	Wakasagi
7/26/10									
7/27/10									
7/28/10									
7/29/10									
7/30/10									
7/31/10									
8/1/10									
8/2/10									
8/3/10					N=1 Not Measured				
8/4/10									
8/5/10									
8/6/10									
8/7/10									
8/8/10		N=1 Not Measured							
8/9/10									N=1 52 mm (N.A.)
8/10/10									
8/11/10									
8/12/10									
8/13/10									N=1 46 mm (N.A.)
8/14/10							N=1 Not Measured		
8/15/10									
8/16/10									
8/17/10									

Appendix B2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Black Bullhead	Bluegill	Black Crappie	California Roach	White Catfish	River Lamprey	Largemouth Bass	Brown Bullhead	Wakasagi
8/18/10									
8/19/10						N=1 Not Measured			
8/20/10		N=2 66 mm 64 – 68 mm (2.8 mm)							
8/21/10									
8/22/10									
8/23/10									
8/24/10									
8/25/10									
8/26/10									
8/27/10									
8/28/10									
8/29/10							N=1 91 mm (N.A.)		
8/30/10									
8/31/10									
9/1/10									
9/2/10									
9/3/10									
9/4/10									
9/5/10									
9/6/10									
9/7/10									
9/8/10									
9/9/10									
9/10/10									

Appendix B2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Black Bullhead	Bluegill	Black Crappie	California Roach	White Catfish	River Lamprey	Largemouth Bass	Brown Bullhead	Wakasagi
9/11/10									
9/12/10									
9/13/10									
9/14/10				N=9 87.7 mm 79 – 97 mm (6.9 mm)			N=1 142 mm (N.A.)		
9/15/10									
9/16/10									
9/17/10									
9/18/10									
9/19/10									
9/20/10									
9/21/10									
9/22/10									
9/23/10									
9/24/10									
9/25/10									
9/26/10									
9/27/10									
9/28/10									
9/29/10									
9/30/10									
GRAND TOTALS	N=12 235 mm 235 – 235 mm 11 Not Measured	N=12 43 mm 30 – 68 mm (15 mm)	N=10 80.3 mm 65 – 91 mm (7.8 mm)	N=9 87.7 mm 79 – 97 mm (6.9 mm)	N=8 95.7 mm 29 – 225 mm (112 mm)	N=6 80 mm 65 – 95 mm (21.2 mm)	N=6 73.8 mm 32 – 142 mm (43.7 mm)	N=4 105 mm 105 – 105 mm 3 Not Measured	N=2 48 mm 46 – 52 mm (3.5 mm)

Appendix B3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Yellow Bullhead	Threespine Stickleback	Riffle Sculpin	American Shad	Green Sunfish	Carp	Unknown Lamprey	Unknown Bass
4/27/10								
4/28/10								
4/29/10								
4/30/10								
5/1/10								
5/2/10								
5/3/10								
5/4/10								
5/5/10								
5/6/10								
5/7/10								
5/8/10								
5/9/10								
5/10/10								
5/11/10			N=1 70 mm (N.A.)					
5/12/10								
5/13/10								
5/14/10								
5/15/10								
5/16/10								
5/17/10								
5/18/10								
5/19/10								
5/20/10								
5/21/10								
5/22/10								
5/23/10								

Appendix B3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Yellow Bullhead	Threespine Stickleback	Riffle Sculpin	American Shad	Green Sunfish	Carp	Unknown Lamprey	Unknown Bass
5/24/10								
5/25/10								
5/26/10								
5/27/10								
5/28/10								
5/29/10								
5/30/10								
5/31/10								
6/1/10							N=1 Not Measured	
6/2/10								
6/3/10								N=1 41 mm (N.A.)
6/4/10								
6/5/10								
6/6/10								
6/7/10								
6/8/10								
6/9/10	N=2 Not Measured							
6/10/10								
6/11/10								
6/12/10								
6/13/10								
6/14/10								
6/15/10	N=1 Not Measured							
6/16/10				N=1 39 mm				

Appendix B3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Yellow Bullhead	Threespine Stickleback	Riffle Sculpin	American Shad	Green Sunfish	Carp	Unknown Lamprey	Unknown Bass
				(N.A.)				
6/17/10								
6/18/10								
6/19/10								
6/20/10								
6/21/10								
6/22/10								
6/23/10								
6/24/10								
6/25/10								
6/26/10								
6/27/10								
6/28/10								
6/29/10								
6/30/10								
7/1/10								
7/2/10								
7/3/10								
7/4/10								
7/5/10								
7/6/10								
7/7/10								
7/8/10								
7/9/10								
7/10/10								
7/11/10								
7/12/10								
7/13/10								
7/14/10								

Appendix B3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Yellow Bullhead	Threespine Stickleback	Riffle Sculpin	American Shad	Green Sunfish	Carp	Unknown Lamprey	Unknown Bass
7/15/10								
7/16/10								
7/17/10								
7/18/10								
7/19/10								
7/20/10								
7/21/10								
7/22/10								
7/23/10								
7/24/10								
7/25/10								
7/26/10								
7/27/10								
7/28/10								
7/29/10								
7/30/10								
7/31/10								
8/1/10								
8/2/10								
8/3/10								
8/4/10								
8/5/10								
8/6/10								
8/7/10								
8/8/10								
8/9/10						N=1 Not Measured		
8/10/10								
8/11/10								

Appendix B3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Yellow Bullhead	Threespine Stickleback	Riffle Sculpin	American Shad	Green Sunfish	Carp	Unknown Lamprey	Unknown Bass
8/12/10								
8/13/10								
8/14/10								
8/15/10								
8/16/10								
8/17/10								
8/18/10								
8/19/10								
8/20/10								
8/21/10								
8/22/10								
8/23/10								
8/24/10								
8/25/10								
8/26/10								
8/27/10								
8/28/10								
8/29/10								
8/30/10								
8/31/10								
9/1/10								
9/2/10								
9/3/10								
9/4/10								
9/5/10								
9/6/10								
9/7/10								
9/8/10								
9/9/10								

Appendix B3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Sycamore diversion.

Date	Yellow Bullhead	Threespine Stickleback	Riffle Sculpin	American Shad	Green Sunfish	Carp	Unknown Lamprey	Unknown Bass
9/10/10								
9/11/10								
9/12/10					N=1 48 mm (N.A.)			
9/13/10		N=1 44 mm (N.A.)						
9/14/10								
9/15/10								
9/16/10								
9/17/10								
9/18/10								
9/19/10								
9/20/10								
9/21/10								
9/22/10								
9/23/10								
9/24/10								
9/25/10								
9/26/10								
9/27/10								
9/28/10								
9/29/10								
9/30/10								
GRAND TOTALS	N=3 Not Measured (N.A.)	N=1 44 mm (N.A.)	N=1 70 mm (N.A.)	N=1 39 mm (N.A.)	N=1 48 mm (N.A.)	N=1 Not Measured (N.A.)	N=1 Not Measured (N.A.)	N=1 41 mm (N.A.)

Appendix C1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Tule Perch	Chinook Salmon	Wakasagi	Sacramento Sucker	Brown Bullhead	White Crappie	White Catfish
5/24/10							
5/25/10	N=2 88 mm 84 – 92 mm (5.7 mm)						
5/26/10							
5/27/10							
5/28/10							
5/29/10		N=2 77.5 mm 75 – 80 mm (3.5 mm)					
5/30/10		N=1 80 mm (N.A.)					
5/31/10		N=6 89.8 mm 74 – 100 mm (8.8 mm)					
6/1/10		N=3 93.5 mm 78 – 109 mm (21.9 mm)					
6/2/10		N=3 64.3 mm 31 – 84 mm (29 mm)					
6/3/10		N=1 73 mm (N.A.)					
6/4/10							
6/5/10							
6/6/10						N=3	

Appendix C1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Tule Perch	Chinook Salmon	Wakasagi	Sacramento Sucker	Brown Bullhead	White Crappie	White Catfish
						39.3 mm 38 – 41 mm (1.5 mm)	
6/7/10							
6/8/10							
6/9/10							
6/10/10							
6/11/10							
6/12/10							
6/13/10							
6/14/10							
6/15/10							
6/16/10							
6/17/10							
6/18/10							N=1 30 mm (N.A.)
6/19/10							
6/20/10							
6/21/10							
6/22/10							
6/23/10							
6/24/10							
6/25/10							
6/26/10							
6/27/10							
6/28/10							
6/29/10							
6/30/10							
7/1/10							

Appendix C1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Tule Perch	Chinook Salmon	Wakasagi	Sacramento Sucker	Brown Bullhead	White Crappie	White Catfish
7/2/10							
7/3/10					N=1 260 mm (N.A.)		
7/4/10					N=1 200 mm (N.A.)		
7/5/10	N=1 48 mm (N.A.)			N=1 150 mm (N.A.)			
7/6/10	N=1 84 mm (N.A.)						
7/7/10	N=4 32.5 mm 31 – 34 mm (2.1 mm)						
7/8/10							
7/9/10							
7/10/10							
7/11/10							
7/12/10							
7/13/10							
7/14/10	N=2 88 mm 86 – 90 mm (2.8 mm)						
7/15/10	N=2 94.5 mm 91 – 98 mm (4.9 mm)				N=1 185 mm (N.A.)		
7/16/10	N=1 84 mm						

Appendix C1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Tule Perch	Chinook Salmon	Wakasagi	Sacramento Sucker	Brown Bullhead	White Crappie	White Catfish
	(N.A.) 1 Not Measured						
7/17/10							N=1 270 mm (N.A.)
7/18/10							
7/19/10	N=1 100 mm (N.A.) 1 Not Measured			N=2 20 mm (N.A.) 1 Not Measured			
7/20/10							
7/21/10							
7/22/10							
7/23/10							
7/24/10							
7/25/10				N=1 Not Measured			
7/26/10							
7/27/10							
7/28/10							
7/29/10							
7/30/10							
7/31/10							
8/1/10							
8/2/10							
8/3/10							
8/4/10	N=1 52 mm (N.A.)						N=1 Not Measured
8/5/10							
8/6/10							

Appendix C1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Tule Perch	Chinook Salmon	Wakasagi	Sacramento Sucker	Brown Bullhead	White Crappie	White Catfish
8/7/10							
8/8/10							
8/9/10							
8/10/10							
8/11/10	N=1 63 mm (N.A.)						
8/12/10							
8/13/10							
8/14/10							
8/15/10							
8/16/10	N=1 60 mm (N.A.)						
8/17/10	N=1 63 mm (N.A.)		N=3 44.3 mm 41 – 50 mm (4.9 mm)				
8/18/10	N=1 63 mm (N.A.)		N=6 45.2 mm 39 – 54 mm (5.5 mm)				
8/19/10	N=1 81 mm (N.A.)		N=2 46 mm 40 – 52 mm (8.5 mm)				
8/20/10							
8/21/10							
8/22/10							
8/23/10							
8/24/10							
8/25/10							

Appendix C1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Tule Perch	Chinook Salmon	Wakasagi	Sacramento Sucker	Brown Bullhead	White Crappie	White Catfish
8/26/10							
8/27/10							
8/28/10							
8/29/10							
8/30/10							
8/31/10	N=1 Not Measured				N=1 Not Measured		
9/1/10							
9/2/10							
9/3/10							
9/4/10							
9/5/10							
9/6/10							
9/7/10							
9/8/10							
9/9/10							
9/10/10							
9/11/10							
9/12/10							
9/13/10							
9/14/10							
9/15/10							
9/16/10							
9/17/10							
9/18/10							
9/19/10							
9/20/10							
9/21/10							
9/22/10							

Appendix C1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Tule Perch	Chinook Salmon	Wakasagi	Sacramento Sucker	Brown Bullhead	White Crappie	White Catfish
9/23/10							
9/24/10							
9/25/10							
9/26/10							
9/27/10							
9/28/10							
9/29/10							
9/30/10							
GRAND TOTALS	N=23 72.4 mm 31 – 100 mm (21.3 mm)	N=16 81.8 mm 31 – 109 mm (17.4 mm)	N=11 45.1 mm 39 – 54 mm (5.2 mm)	N=4 85 mm 20 – 150 mm (91.9 mm)	N=4 215 mm 185 – 260 mm (39.7 mm)	N=3 39.3 mm 38 – 41 mm (1.5 mm)	N=3 150 mm 30 – 270 mm (169.7 mm)

Appendix C2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Fathead Minnow	Golden Shiner	Bluegill	Yellow Bullhead	Sacramento Pikeminnow	Carp	River Lamprey
5/24/10							
5/25/10							
5/26/10							
5/27/10							
5/28/10							
5/29/10							
5/30/10							
5/31/10							
6/1/10					N=1 197 mm (N.A.)		
6/2/10							N=1

Appendix C2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Fathead Minnow	Golden Shiner	Bluegill	Yellow Bullhead	Sacramento Pikeminnow	Carp	River Lamprey
							Not Measured
6/3/10							
6/4/10							
6/5/10				N=1 Not Measured			
6/6/10							
6/7/10							
6/8/10							
6/9/10							
6/10/10							
6/11/10							
6/12/10							
6/13/10							
6/14/10							
6/15/10			N=1 28 mm (N.A.)				
6/16/10							
6/17/10				N=1 179 mm (N.A.)			
6/18/10							
6/19/10							
6/20/10							
6/21/10							
6/22/10							
6/23/10							
6/24/10							
6/25/10							
6/26/10							

Appendix C2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Fathead Minnow	Golden Shiner	Bluegill	Yellow Bullhead	Sacramento Pikeminnow	Carp	River Lamprey
6/27/10							
6/28/10							
6/29/10							
6/30/10							
7/1/10							
7/2/10							
7/3/10							
7/4/10							
7/5/10							
7/6/10							
7/7/10							
7/8/10							
7/9/10							
7/10/10							
7/11/10							
7/12/10							
7/13/10							
7/14/10							
7/15/10							
7/16/10							
7/17/10							
7/18/10							
7/19/10							
7/20/10	N=1 51 mm (N.A.)						
7/21/10							
7/22/10							
7/23/10							

Appendix C2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Fathead Minnow	Golden Shiner	Bluegill	Yellow Bullhead	Sacramento Pikeminnow	Carp	River Lamprey
7/24/10							
7/25/10							
7/26/10							
7/27/10							
7/28/10		N=1 53 mm (N.A.)					
7/29/10	N=1 46 mm (N.A.)						
7/30/10							
7/31/10							
8/1/10							
8/2/10							
8/3/10							
8/4/10							
8/5/10							
8/6/10							
8/7/10							
8/8/10							
8/9/10							
8/10/10							
8/11/10							
8/12/10							
8/13/10							
8/14/10							
8/15/10							
8/16/10							
8/17/10							
8/18/10							

Appendix C2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Fathead Minnow	Golden Shiner	Bluegill	Yellow Bullhead	Sacramento Pikeminnow	Carp	River Lamprey
8/19/10			N=1 50 mm (N.A.)			N=1 54 mm (N.A.)	
8/20/10							
8/21/10							
8/22/10							
8/23/10							
8/24/10							
8/25/10							
8/26/10							
8/27/10							
8/28/10							
8/29/10							
8/30/10							
8/31/10							
9/1/10							
9/2/10							
9/3/10		N=1 41 mm (N.A.)					
9/4/10							
9/5/10							
9/6/10							
9/7/10							
9/8/10							
9/9/10							
9/10/10							
9/11/10							
9/12/10							
9/13/10							

Appendix C2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at River Garden Farms diversion.

Date	Fathead Minnow	Golden Shiner	Bluegill	Yellow Bullhead	Sacramento Pikeminnow	Carp	River Lamprey
9/14/10							
9/15/10							
9/16/10							
9/17/10							
9/18/10							
9/19/10							
9/20/10							
9/21/10							
9/22/10							
9/23/10							
9/24/10							
9/25/10							
9/26/10							
9/27/10							
9/28/10							
9/29/10							
9/30/10							
GRAND TOTALS	N=2 48.5 mm 46 – 51 mm (3.5 mm)	N=2 47 mm 41 – 53 mm (8.5 mm)	N=2 39 mm 28 – 50 mm (15.6 mm)	N=2 179 mm (N.A.) 1 Not Measured	N=1 197 mm (N.A.)	N=1 54 mm (N.A.)	N=1 Not Measured (N.A.)

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
4/2/10									
4/3/10									
4/4/10									
4/5/10									
4/6/10									
4/7/10									
4/8/10									
4/9/10									
4/10/10									
4/11/10									
4/12/10									
4/13/10									
4/14/10									
4/15/10									
4/16/10									
4/17/10									
4/18/10									
4/19/10									
4/20/10									
4/21/10									
4/22/10									
4/23/10									
4/24/10									
4/25/10									
4/26/10									
4/27/10									
4/28/10			N=1 68 mm (N.A.)						N=1 135 mm (N.A.)

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
4/29/10									
4/30/10									N=19 220.4 mm 95 – 246 mm (39.1 mm)
5/1/10									
5/2/10									
5/3/10									
5/4/10									
5/5/10									
5/6/10									
5/7/10									
5/8/10		N=1 45 mm (N.A.)							
5/9/10									
5/10/10									
5/11/10			N=1 105 mm (N.A.)						
5/12/10									
5/13/10									
5/14/10									
5/15/10									
5/16/10									
5/17/10									
5/18/10									
5/19/10			N=1 Not Measured						
5/20/10									

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
5/21/10									
5/22/10									
5/23/10									
5/24/10									
5/25/10									
5/26/10									
5/27/10									
5/28/10									
5/29/10							N=1 41 mm (N.A.)		
5/30/10									
5/31/10									
6/1/10									
6/2/10									
6/3/10									
6/4/10			N=1 27 mm (N.A.)						
6/5/10									
6/6/10									
6/7/10			N=1 84 mm (N.A.)						
6/8/10	N=1 42 mm (N.A.)								
6/9/10									
6/10/10			N=1 21 mm (N.A.)						

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
6/11/10							N=3 26.3 mm 22 – 29 mm (3.8 mm)		
6/12/10									
6/13/10							N=1 32 mm (N.A.)		
6/14/10		N=1 71 mm (N.A.)					N=2 26.5 mm 25 – 28 mm (2.1 mm)		
6/15/10		N=4 65.7 mm 39 – 100 mm (31.2 mm)			N=1 30 mm (N.A.)				
6/16/10		N=2 55 mm 52 – 58 mm (4.2 mm)			N=4 38.3 mm 35 – 41 mm (2.8 mm)				
6/17/10		N=2 40 mm 26 – 54 mm (19.8 mm)			N=6 34 mm 30 – 40 mm (3.7 mm)		N=2 30 mm (N.A.) 1 Not Measured		
6/18/10		N=1 Not Measured			N=1 30 mm (N.A.)		N=1 33 mm (N.A.)		
6/19/10		N=1 45 mm (N.A.)							
6/20/10	N=3 31.3 mm 15 – 59 mm	N=6 29.7 mm 22 – 52 mm	N=1 38 mm (N.A.)						

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
	(24.1 mm)	(11.3 mm)							
6/21/10	N=2 4.5 mm 44 – 49 mm (3.5 mm)	N=1 47 mm (N.A.)					N=1 23 mm (N.A.)		
6/22/10	N=4 44.5 mm 33 – 50 mm (7.8 mm)								
6/23/10		N=2 24 mm (N.A.) 1 Not Measured					N=1 34 mm (N.A.)		
6/24/10	N=3 29.7 mm 20 – 40 mm (10 mm)	N=1 19 mm (N.A.)					N=4 36 mm 27 – 44 mm (8.3 mm)		
6/25/10	N=7 47.3 mm 40 – 61 mm (7.1 mm)	N=33 26.1 mm 16 – 36 mm (4.7 mm)	N=2 59 mm 36 – 82 mm (32.5 mm)						
6/26/10	N=6 28.5 mm 20 – 36 mm (6.2 mm)	N=11 35.3 mm 26 – 56 mm (8.7 mm)							
6/27/10		N=1 43 mm (N.A.)	N=1 36 mm (N.A.)						
6/28/10	N=7 50.7 mm 40 – 56 mm (5.4 mm)	N=5 30.8 mm 22 – 38 mm (6.4 mm)	N=1 45 mm (N.A.)		N=1 230 mm (N.A.)		N=1 45 mm (N.A.)		
6/29/10	N=6	N=7			N=1				

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
	46.8 mm 35 – 59 mm (9.2 mm)	28..3 mm 20 – 49 mm (9.7 mm)			218 mm (N.A.)				
6/30/10	N=9 47 mm 38 – 55 mm (4.9 mm)	N=1 Not Measured					N=1 40 mm (N.A.)		
7/1/10		N=1 42 mm (N.A.)							
7/2/10	N=34 49.6 mm 32 – 65 mm (8.6 mm)	N=41 31.3 mm 20 – 50 mm (6.8 mm)					N=1 40 mm (N.A.)		
7/3/10	N=50 52.1 mm 39 – 65 mm (6.7 mm)								
7/4/10	N=22 47 mm 29 – 65 mm (8.3 mm)		N=2 30.5 mm 25 – 36 mm (7.8 mm)						
7/5/10	N=22 51.8 mm 36 – 72 mm (8.8 mm)		N=3 37.3 mm 36 – 40 mm (2.3 mm)			N=3 36.3 mm 35 – 38 mm (1.5 mm)			
7/6/10	N=12 49.7 mm 33 – 69 mm (9.1 mm)		N=2 45 mm 30 – 60 mm (21.2 mm)						
7/7/10	N=7 61.4 mm 49 – 75 mm (11.1 mm)		N=1 34 mm (N.A.)						

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
7/8/10	N=4 53.3 mm 49 – 56 mm (3.8 mm)	N=1 64 mm (N.A.)	N=2 53.5 mm 48 – 59 mm (7.8 mm)						
7/9/10	N=5 51.8 mm 54 – 62 mm (4 mm)	N=1 85 mm (N.A.)			N=1 53 mm (N.A.)				
7/10/10	N=8 46 mm 25 – 66 mm (16 mm)								
7/11/10	N=10 54.4 mm 32 – 68 mm (12.1 mm)		N=3 90.3 mm 56 – 110 mm (29.8 mm)						
7/12/10	N=8 49.8 mm 39 – 63 mm (9.7 mm)		N=1 82 mm (N.A.)			N=1 58 mm (N.A.)	N=1 59 mm (N.A.)		
7/13/10	N=30 50.3 mm 33 – 67 mm (9.4 mm)		N=1 93 mm (N.A.)						
7/14/10	N=67 70.6 mm 59 – 95 mm (9.1 mm)		N=1 65 mm (N.A.)						
7/15/10	N=39 60.2 mm 47 – 80 mm (7.7 mm)		N=1 61 mm (N.A.)				N=2 62.5 mm 52 – 73 mm (14.8 mm)		
7/16/10	N=12 57.8 mm		N=2 68 mm						

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
	42 – 70 mm (8.3 mm)		66 – 70 mm (2.8 mm)						
7/17/10	N=10 53.3 mm 20 – 70 mm (17.4 mm)					N=1 47 mm (N.A.)			
7/18/10	N=10 69.7 mm 62 – 78 mm (5.4 mm)		N=3 80 mm 68 – 92 mm (17 mm)						
7/19/10	N=9 68.8 mm 52 – 84 mm (9.1 mm)		N=1 41 mm (N.A.)	N=1 50 mm (N.A.)					
7/20/10	N=5 66.4 mm 61 – 75 mm (5.9 mm)								
7/21/10	N=1 61 mm (N.A.)	N=1 49 mm (N.A.)	N=1 88 mm (N.A.)						
7/22/10	N=9 63.9 mm 52 – 75 mm (9.3 mm)								
7/23/10	N=7 63.9 mm 59 – 75 mm (5.8 mm)			N=1 38 mm (N.A.)		N=5 50.6 mm 45 – 61 mm (6.2 mm)			
7/24/10	N=2 69 mm (N.A.) 1 Not Measured			N=3 51.3 mm 50 – 53 mm (1.5 mm)					
7/25/10	N=5		N=1	N=3					

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
	65.6 mm 35 – 78 mm (17.4 mm)		50 mm (N.A.)	44.3 mm 42 – 46 mm (2.1 mm)					
7/26/10	N=3 66 mm 59 – 78 mm (10.4 mm)			N=4 58 mm 45 – 76 mm (13.3 mm)					
7/27/10	N=7 72.7 mm 64 – 84 mm (7.6 mm)		N=3 123 mm 122 – 124 mm (1.4 mm)	N=1 83 mm (N.A.)					
7/28/10	N=1 84 mm (N.A.)					N=2 63 mm 59 – 67 mm (5.7 mm)			
7/29/10	N=1 35 mm (N.A.)								
7/30/10	N=3 55.7 mm 45 – 62 mm (9.3 mm)								
7/31/10									
8/1/10	N=1 77 mm (N.A.)			N=1 47 mm (N.A.)					
8/2/10	N=7 49.3 mm 35 – 75 mm (14.1 mm)			N=2 68.5 mm 50 – 87 mm (26.2 mm)	N=1 273 mm (N.A.)				
8/3/10	N=2 70 mm 52 – 88 mm		N=2 51 mm 47 – 55 mm						

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
	(25.5 mm)		(5.7 mm)						
8/4/10			N=3 100 mm 53 – 147 mm (66.5 mm)						
8/5/10	N=2 73.5 mm 71 – 76 mm (3.5 mm)		N=1 58 mm (N.A.)	N=1 61 mm (N.A.)					
8/6/10	N=5 63.2 mm 50 – 81 mm (12.9 mm)	N=1 131 mm (N.A.)	N=1 59 mm (N.A.)	N=2 70 mm 56 – 84 mm (19.8 mm)					
8/7/10	N=1 31 mm (N.A.)	N=1 44 mm (N.A.)		N=1 58 mm (N.A.)		N=1 43 mm (N.A.)			
8/8/10	N=4 75.8 mm 42 – 91 mm (22.7 mm)			N=3 63.3 mm 50 – 71 mm (11.6 mm)		N=3 60.7 mm 41 – 78 mm (18.6 mm)			
8/9/10	N=9 38.4 mm 30 – 47 mm (6.3 mm)		N=1 52 mm (N.A.)			N=1 24 mm (N.A.)			
8/10/10	N=10 39.5 mm 29 – 53 mm (7.9 mm)	N=1 53 mm (N.A.)	N=1 84 mm (N.A.)			N=1 71 mm (N.A.)			
8/11/10	N=2 44.5 mm 30 – 59 mm (20.5 mm)		N=1 90 mm (N.A.)			N=4 59 mm 38 – 71 mm (14.4 mm)			
8/12/10	N=3 32.7 mm								

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
	30 – 35 mm (2.5 mm)								
8/13/10	N=5 32.6 mm 21 – 50 mm (13 mm)				N=5 49.8 mm 41 – 56 mm (6.5 mm)				
8/14/10	N=4 42.8 mm 32 – 49 mm (7.4 mm)		N=1 115 mm (N.A.)	N=2 67 mm 64 – 70 mm (4.2 mm)					
8/15/10	N=18 37.7 mm 31 – 55 mm (7 mm)			N=3 68.7 mm 53 – 78 mm (13.7 mm)		N=2 54.5 mm 54 – 55 mm (0.7 mm)			
8/16/10	N=11 49.9 mm 39 – 100 mm (18.4 mm)			N=1 75 mm (N.A.)					
8/17/10	N=2 23.5 mm 22 – 25 mm (2.1 mm)		N=1 65 mm (N.A.)		N=1 Not Measured				
8/18/10	N=1 26 mm (N.A.)								
8/19/10	N=1 53 mm (N.A.)				N=1 41 mm (N.A.)				
8/20/10									
8/21/10	N=1 38 mm (N.A.)		N=1 72 mm (N.A.)						
8/22/10								N=1 72 mm	

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
								(N.A.)	
8/23/10	N=1 41 mm (N.A.)			N=2 72 mm (N.A.) 1 Not Measured					
8/24/10			N=1 75 mm (N.A.)	N=2 41 mm 39 – 43 mm (2.8 mm)					
8/25/10	N=1 Not Measured					N=1 40 mm (N.A.)			
8/26/10	N=1 40 mm (N.A.)		N=1 75 mm (N.A.)	N=1 71 mm (N.A.)	N=1 37 mm (N.A.)				
8/27/10	N=1 100 mm (N.A.)			N=2 87.5 mm 65 – 110 mm (31.8 mm)					
8/28/10									
8/29/10	N=1 47 mm (N.A.)				N=3 59.7 mm 55 – 64 mm (4.5 mm)				
8/30/10									
8/31/10									
9/1/10	N=37 107.9 mm 86 – 126 mm (11.2 mm)					N=1 105 mm (N.A.)			
9/2/10	N=1 110 mm (N.A.)		N=1 105 mm (N.A.)			N=1 103 mm (N.A.)			

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
9/3/10						N=5 83.4 mm 53 – 95 mm (17.4 mm)			
9/4/10	N=1 105 mm (N.A.)				N=8 39.1 mm 31 – 44 mm (4.1 mm)			N=2 54.5 mm 30 – 79 mm (34.6 mm)	
9/5/10	N=1 105 mm (N.A.)							N=1 81 mm (N.A.)	
9/6/10				N=1 75 mm (N.A.)	N=1 110 mm (N.A.)			N=1 60 mm (N.A.)	
9/7/10									
9/8/10				N=1 55 mm (N.A.)		N=2 43.5 mm 36 – 51 mm (10.6 mm)		N=6 73 mm 66 – 82 mm (6 mm)	
9/9/10	N=2 98.5 mm 97 – 100 mm (2.1 mm)			N=1 92 mm (N.A.)				N=4 63 mm 54 – 70 mm (8.2 mm)	
9/10/10	N=1 118 mm (N.A.)				N=1 34 mm (N.A.)			N=7 80.1 mm 74 – 88 mm (5.1 mm)	
9/11/10								N=3 74.3 mm 74 – 75 mm (0.6 mm)	
9/12/10								N=1 77 mm (N.A.)	

Appendix D1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Sacramento Sucker	Carp	Tule Perch	Hardhead	White Catfish	Sacramento Pikeminnow	Bluegill	California Roach	Unknown Lamprey
9/13/10									
9/14/10									
9/15/10									
9/16/10									
9/17/10									
9/18/10									
9/19/10									
9/20/10									
9/21/10									
9/22/10									
9/23/10									
9/24/10									
9/25/10									
9/26/10									
9/27/10									
9/28/10									
9/29/10									
9/30/10									
GRAND TOTALS	N=588 57.1 mm 15 – 126 mm (19.9 mm)	N=128 34.4 mm 16 – 131 mm (16.2 mm)	N=55 66.5 mm 21 – 147 mm (29 mm)	N=39 62.1 mm 38 – 110 mm (16.5 mm)	N=37 60.1 mm 30 – 273 mm (58.3 mm)	N=34 59.1 mm 24 – 105 mm (20.9 mm)	N=26 37 mm 22 – 73 mm (12.7 mm)	N=26 72 mm 30 – 88 mm (11.9 mm)	N=20 214.3 mm 95 – 246 mm (43.9 mm)

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
4/2/10									
4/3/10									

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
4/4/10									
4/5/10									
4/6/10									
4/7/10									
4/8/10									
4/9/10									
4/10/10									
4/11/10									
4/12/10									
4/13/10									
4/14/10									
4/15/10									
4/16/10									
4/17/10									
4/18/10									
4/19/10									
4/20/10									
4/21/10									
4/22/10									
4/23/10									
4/24/10									
4/25/10									
4/26/10									
4/27/10									
4/28/10								N=1 79 mm (N.A.)	
4/29/10									
4/30/10			N=1	N=1			N=5		N=1

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
			660 mm (N.A.)	150 mm (N.A.)			82.4 mm 75 – 89 mm (5.2 mm)		105 mm (N.A.)
5/1/10									
5/2/10									
5/3/10									
5/4/10									
5/5/10	N=1 115 mm (N.A.)						N=1 73 mm (N.A.)		
5/6/10				N=1 110 mm (N.A.)					
5/7/10									
5/8/10									
5/9/10									
5/10/10									
5/11/10									
5/12/10									
5/13/10									
5/14/10				N=1 110 mm (N.A.)					
5/15/10								N=1 85 mm (N.A.)	
5/16/10	N=1 110 mm (N.A.)								
5/17/10									N=1 159 mm (N.A.)

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
5/18/10									
5/19/10									
5/20/10									
5/21/10									
5/22/10									
5/23/10									
5/24/10									
5/25/10									
5/26/10				N=1 Not Measured					
5/27/10									
5/28/10									
5/29/10									
5/30/10									
5/31/10							N=1 125 mm (N.A.)		
6/1/10									
6/2/10				N=2 Not Measured					
6/3/10				N=2 182 mm (N.A.) 1 Not Measured					
6/4/10				N=1 84 mm (N.A.)					
6/5/10									
6/6/10									
6/7/10									

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
6/8/10	N=1 118 mm (N.A.)								
6/9/10				N=1 204 mm (N.A.)					
6/10/10			N=2 145 mm (N.A.) 1 Not Measured						
6/11/10									
6/12/10									
6/13/10									
6/14/10									
6/15/10									
6/16/10									
6/17/10									
6/18/10		N=1 205 mm (N.A.)							
6/19/10						N=3 31 mm 30 – 32 mm (0.7 mm)			
6/20/10									
6/21/10					N=2 93.5 mm 33 – 154 mm (85.6 mm)				
6/22/10									
6/23/10									

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
6/24/10			N=1 147 mm (N.A.)						
6/25/10	N=1 220 mm (N.A.)		N=1 160 mm (N.A.)			N=1 36 mm (N.A.)			
6/26/10						N=2 36 mm (N.A.) 1 Not Measured			
6/27/10									
6/28/10					N=2 47 mm 46 – 48 mm (1.4 mm)	N=1 40 mm (N.A.)			
6/29/10									
6/30/10			N=1 122 mm (N.A.)						
7/1/10			N=1 137 mm (N.A.)					N=1 53 mm (N.A.)	
7/2/10			N=2 172.5 mm 159 – 186 mm (19.1 mm)						
7/3/10			N=1 155 mm (N.A.)						
7/4/10			N=2 155 mm 150 – 160						

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
			mm (7.1 mm)						
7/5/10					N=1 64 mm (N.A.)				
7/6/10									
7/7/10									
7/8/10			N=1 Not Measured						
7/9/10								N=1 44 mm (N.A.)	
7/10/10								N=1 50 mm (N.A.)	
7/11/10			N=1 190 mm (N.A.)						
7/12/10				N=1 101 mm (N.A.)					
7/13/10								N=1 64 mm (N.A.)	
7/14/10									
7/15/10									
7/16/10					N=1 80 mm (N.A.)				
7/17/10									
7/18/10	N=1 220 mm					N=1 52 mm			

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
	(N.A.)					(N.A.)			
7/19/10									
7/20/10									
7/21/10									
7/22/10									
7/23/10	N=1 44 mm (N.A.)								
7/24/10									
7/25/10	N=1 185 mm (N.A.)								
7/26/10									
7/27/10									
7/28/10			N=1 122 mm (N.A.)						
7/29/10		N=1 47 mm (N.A.)							
7/30/10		N=3 53.7 mm 49 – 57 mm (4.2 mm)							
7/31/10									
8/1/10									
8/2/10									
8/3/10									
8/4/10				N=1 182 mm (N.A.)					
8/5/10									

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
8/6/10									
8/7/10	N=1 Not Measured								
8/8/10	N=1 42 mm (N.A.)								
8/9/10									N=1 29 mm (N.A.)
8/10/10									
8/11/10									
8/12/10									N=1 39 mm (N.A.)
8/13/10									
8/14/10		N=1 60 mm (N.A.)							N=2 42.5 mm 40 – 45 mm (3.5 mm)
8/15/10	N=1 42 mm (N.A.)								
8/16/10									
8/17/10									
8/18/10									
8/19/10									
8/20/10									
8/21/10									
8/22/10									
8/23/10									
8/24/10									

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
8/25/10									
8/26/10									
8/27/10	N=4 50.3 mm 45 – 55 mm (4.1 mm)	N=2 67.5 mm 60 – 75 mm (10.6 mm)							
8/28/10									
8/29/10					N=2 91.5 mm 83 – 100 mm (12 mm)				
8/30/10									
8/31/10		N=2 78 mm 76 – 80 mm (2.8 mm)							
9/1/10	N=2 56 mm 50 – 62 mm (8.5 mm)	N=4 72.3 mm 60 – 80 mm (8.7 mm)							
9/2/10	N=2 42 mm 39 – 45 mm (4.2 mm)	N=1 79 mm (N.A.)							
9/3/10									
9/4/10									
9/5/10									
9/6/10									
9/7/10		N=1 74 mm (N.A.)							
9/8/10									

Appendix D2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	Brown Bullhead	Golden Shiner	Pacific Lamprey	Yellow Bullhead	Black Crappie	Redear Sunfish	Chinook Salmon	Bigscale Logperch	Black Bullhead
9/9/10									
9/10/10									
9/11/10									
9/12/10									
9/13/10									
9/14/10									
9/15/10									
9/16/10									
9/17/10									
9/18/10									
9/19/10									
9/20/10									
9/21/10									
9/22/10									
9/23/10									
9/24/10									
9/25/10									
9/26/10									
9/27/10									
9/28/10									
9/29/10									
9/30/10									
GRAND TOTALS	N=18 87.8 mm 39 – 220 mm (63.6 mm)	N=16 75.4 mm 47 – 205 mm (36.4 mm)	N=15 191.8 mm 122 – 660 mm (142.1 mm)	N=12 140.4 mm 84 – 204 mm (45 mm)	N=8 76 mm 33 – 154 mm (38.5 mm)	N=8 37.1 mm 30 – 52 mm (7.1 mm)	N=7 87.1 mm 73 – 125 mm (17.6 mm)	N=6 62.5 mm 44 – 85 mm (16.5 mm)	N=6 69.5 mm 29 – 159 mm (51.6 mm)

Appendix D3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	River Lamprey	Green Sunfish	Largemouth Bass	American Shad	Prickly Sculpin	Riffle Sculpin	Threespine Stickleback	Spotted Bass
4/2/10								
4/3/10								
4/4/10								
4/5/10								
4/6/10								
4/7/10								
4/8/10								
4/9/10								
4/10/10								
4/11/10								
4/12/10								
4/13/10								
4/14/10								
4/15/10								
4/16/10								
4/17/10								
4/18/10								
4/19/10								
4/20/10								
4/21/10								
4/22/10								
4/23/10								
4/24/10								
4/25/10								
4/26/10								
4/27/10								
4/28/10								
4/29/10								
4/30/10								

Appendix D3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	River Lamprey	Green Sunfish	Largemouth Bass	American Shad	Prickly Sculpin	Riffle Sculpin	Threespine Stickleback	Spotted Bass
5/1/10								
5/2/10								
5/3/10								
5/4/10								
5/5/10								
5/6/10					N=1 80 mm (N.A.)			
5/7/10								
5/8/10								
5/9/10								
5/10/10								
5/11/10								
5/12/10						N=1 108 mm (N.A.)		
5/13/10								
5/14/10								
5/15/10								
5/16/10								
5/17/10								
5/18/10								
5/19/10								
5/20/10								
5/21/10								
5/22/10								
5/23/10								
5/24/10								
5/25/10								
5/26/10								

Appendix D3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	River Lamprey	Green Sunfish	Largemouth Bass	American Shad	Prickly Sculpin	Riffle Sculpin	Threespine Stickleback	Spotted Bass
5/27/10								
5/28/10								
5/29/10								
5/30/10								
5/31/10								
6/1/10								
6/2/10								
6/3/10	N=1 91 mm (N.A.)							
6/4/10								
6/5/10								
6/6/10								
6/7/10								
6/8/10								
6/9/10								
6/10/10								
6/11/10								
6/12/10								
6/13/10								
6/14/10								
6/15/10								
6/16/10								
6/17/10								N=1 182 mm (N.A.)
6/18/10								
6/19/10			N=1 30 mm (N.A.)					

Appendix D3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	River Lamprey	Green Sunfish	Largemouth Bass	American Shad	Prickly Sculpin	Riffle Sculpin	Threespine Stickleback	Spotted Bass
6/20/10			N=1 33 mm (N.A.)					
6/21/10								
6/22/10								
6/23/10		N=1 130 mm (N.A.)						
6/24/10								
6/25/10								
6/26/10								
6/27/10								
6/28/10								
6/29/10								
6/30/10								
7/1/10								
7/2/10								
7/3/10								
7/4/10								
7/5/10	N=1 130 mm (N.A.)							
7/6/10	N=1 Not Measured							
7/7/10								
7/8/10								
7/9/10								
7/10/10								
7/11/10								
7/12/10								

Appendix D3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	River Lamprey	Green Sunfish	Largemouth Bass	American Shad	Prickly Sculpin	Riffle Sculpin	Threespine Stickleback	Spotted Bass
7/13/10								
7/14/10								
7/15/10								
7/16/10								
7/17/10								
7/18/10								
7/19/10								
7/20/10								
7/21/10								
7/22/10								
7/23/10								
7/24/10								
7/25/10								
7/26/10								
7/27/10				N=1 43 mm (N.A.)				
7/28/10								
7/29/10								
7/30/10								
7/31/10								
8/1/10								
8/2/10								
8/3/10								
8/4/10								
8/5/10								
8/6/10								
8/7/10							N=1 32 mm (N.A.)	

Appendix D3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	River Lamprey	Green Sunfish	Largemouth Bass	American Shad	Prickly Sculpin	Riffle Sculpin	Threespine Stickleback	Spotted Bass
8/8/10								
8/9/10								
8/10/10								
8/11/10								
8/12/10								
8/13/10								
8/14/10								
8/15/10								
8/16/10	N=1 140 mm (N.A.)							
8/17/10								
8/18/10								
8/19/10								
8/20/10								
8/21/10								
8/22/10								
8/23/10								
8/24/10								
8/25/10		N=1 47 mm (N.A.)						
8/26/10								
8/27/10								
8/28/10								
8/29/10								
8/30/10								
8/31/10								
9/1/10								
9/2/10								

Appendix D3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	River Lamprey	Green Sunfish	Largemouth Bass	American Shad	Prickly Sculpin	Riffle Sculpin	Threespine Stickleback	Spotted Bass
9/3/10								
9/4/10								
9/5/10								
9/6/10		N=1 52 mm (N.A.)		N=1 80 mm (N.A.)				
9/7/10								
9/8/10								
9/9/10								
9/10/10								
9/11/10								
9/12/10								
9/13/10								
9/14/10								
9/15/10								
9/16/10								
9/17/10								
9/18/10								
9/19/10								
9/20/10								
9/21/10								
9/22/10								
9/23/10								
9/24/10								
9/25/10								
9/26/10								
9/27/10								
9/28/10								
9/29/10								

Appendix D3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at State Ranch diversion.

Date	River Lamprey	Green Sunfish	Largemouth Bass	American Shad	Prickly Sculpin	Riffle Sculpin	Threespine Stickleback	Spotted Bass
9/30/10								
GRAND TOTALS	N=4 120.3 mm 91 – 140 mm (25.9 mm)	N=3 76.3 mm 47 – 130 mm (46.5 mm)	N=2 31.5 mm 30 – 33 mm (2.1 mm)	N=2 61.5 mm 43 – 80 mm (26.2 mm)	N=1 80 mm (N.A.)	N=1 108 mm (N.A.)	N=1 32 mm (N.A.)	N=1 182 mm (N.A.)

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
5/5/10							
5/6/10							
5/7/10							
5/8/10							
5/9/10							
5/10/10							
5/11/10							
5/12/10							
5/13/10							
5/14/10							
5/15/10							
5/16/10							
5/17/10		N=1 84 mm (N.A.)					
5/18/10		N=1 77 mm (N.A.)					
5/19/10		N=1 Not Measured					
5/20/10	N=1 Not Measured						
5/21/10							
5/22/10							
5/23/10							
5/24/10							
5/25/10							
5/26/10							
5/27/10							
5/28/10							

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
5/29/10							
5/30/10							
5/31/10						N=8 126 mm 100 – 133 mm (12.8 mm)	
6/1/10			N=1 36 mm (N.A.)				
6/2/10							
6/3/10		N=1 78 mm (N.A.)					
6/4/10							
6/5/10		N=1 30 mm (N.A.)	N=1 35 mm (N.A.)				
6/6/10							N=1 Not Measured
6/7/10					N=1 31 mm (N.A.)		
6/8/10	N=1 Not Measured						
6/9/10							
6/10/10							
6/11/10							
6/12/10	N=1 30 mm (N.A.)						
6/13/10							
6/14/10				N=1			

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
				47 mm (N.A.)			
6/15/10				N=1 28 mm (N.A.)			
6/16/10							
6/17/10		N=2 55.5 mm 31 – 80 mm (34.6 mm)					
6/18/10							
6/19/10							
6/20/10							
6/21/10							
6/22/10			N=5 29.4 mm 21 – 34 mm (5.1 mm)				
6/23/10		N=3 62.3 mm 30 – 115 mm (46 mm)					
6/24/10	N=2 23.5 mm 19 – 28 mm (6.4 mm)						
6/25/10	N=1 27 mm (N.A.)						
6/26/10	N=2 33.5 mm 30 – 37 mm (4.9 mm)						

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
6/27/10	N=2 36.5 mm 35 – 38 mm (2.1 mm)						
6/28/10		N=1 Not Measured					
6/29/10		N=3 117 mm 113 – 123 mm (5.3 mm)					
6/30/10							
7/1/10			N=1 32 mm (N.A.)				
7/2/10	N=1 49 mm (N.A.)	N=1 98 mm (N.A.)				N=1 142 mm (N.A.)	
7/3/10	N=8 31.1 mm 20 – 41 mm (5.9 mm)						
7/4/10							
7/5/10	N=6 35.8 mm 30 – 40 mm (4.2 mm)						
7/6/10	N=2 38.5 mm 30 – 47 mm (12 mm)		N=2 35 mm (N.A.) 1 Not Measured				
7/7/10	N=2 31.5 mm 30 – 33 mm (2.1 mm)	N=3 59.3 mm 53 – 71 mm (10.1 mm)					

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
7/8/10	N=14 35.9 mm 29 – 49 mm (5.7 mm)		N=1 38 mm (N.A.)				
7/9/10	N=3 41.7 mm 40 – 44 mm (2.1 mm)						
7/10/10							
7/11/10	N=7 42 mm 34 – 48 mm (5.1 mm)	N=3 54.3 mm 48 – 61 mm (6.5 mm)					
7/12/10	N=2 34.5 mm 32 – 37 mm (3.5 mm)						
7/13/10	N=10 63 mm 32 – 53 mm (6.5 mm)	N=3 63 mm 48 – 88 mm (21.8 mm)					
7/14/10	N=2 41.5 mm 39 – 44 mm (3.5 mm)			N=1 47 mm (N.A.)			
7/15/10	N=3 Not Measured		N=2 37.5 mm 32 – 43 mm (7.8 mm)				
7/16/10	N=5 44.2 mm 32 – 60 mm (10.2 mm)	N=1 46 mm (N.A.)					
7/17/10							

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
7/18/10							
7/19/10	N=1 41 mm (N.A.)						
7/20/10							
7/21/10	N=2 51.5 mm 49 – 54 mm (3.5 mm)		N=1 34 mm (N.A.)		N=1 51 mm (N.A.)		
7/22/10			N=1 50 mm (N.A.)				
7/23/10	N=1 42 mm (N.A.)		N=1 51 mm (N.A.)				
7/24/10		N=1 42 mm (N.A.)					
7/25/10					N=1 55 mm (N.A.)		
7/26/10					N=1 67 mm (N.A.)		
7/27/10	N=2 50.5 mm 46 – 55 mm (6.4 mm)	N=1 53 mm (N.A.)					
7/28/10	N=1 53 mm (N.A.)						
7/29/10	N=1 60 mm (N.A.)	N=1 65 mm (N.A.)					

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
7/30/10	N=1 54 mm (N.A.)	N=1 72 mm (N.A.)			N=1 55 mm (N.A.)		
7/31/10							
8/1/10					N=3 46 mm 42 – 52 mm (5.3 mm)		
8/2/10							
8/3/10							
8/4/10	N=1 51 mm (N.A.)						N=1 Not Measured
8/5/10	N=1 62 mm (N.A.)	N=1 60 mm (N.A.)					
8/6/10							
8/7/10							
8/8/10							
8/9/10	N=1 26 mm (N.A.)						
8/10/10							
8/11/10							
8/12/10							
8/13/10		N=1 54 mm (N.A.)					
8/14/10	N=1 Not Measured				N=1 82 mm (N.A.)		
8/15/10							

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
8/16/10	N=2 66 mm 61 – 71 mm (7.1 mm)						
8/17/10	N=21 69.9 mm 51 – 110 mm (16.3 mm)						N=2 34.5 mm 33 – 36 mm (2.1 mm)
8/18/10	N=4 61 mm 40 – 81 mm (16.8 mm)						
8/19/10	N=1 Not Measured						N=1 34 mm (N.A.)
8/20/10	N=7 79.1 mm 73 – 88 mm (5.6 mm)			N=1 230 mm (N.A.)	N=1 78 mm (N.A.)		
8/21/10	N=6 80.2 mm 70 – 92 mm (8.2 mm)			N=3 240.7 mm 222 – 265 mm (22.1 mm)			
8/22/10	N=5 65.4 mm 45 – 77 mm (12.1 mm)	N=2 67.5 mm 60 – 75 mm (10.6 mm)					
8/23/10	N=9 69 mm 54 – 80 mm (9.9 mm)			N=2 240.5 mm 232 – 249 mm (12 mm)			
8/24/10	N=29 70.2 mm 53 – 89 mm			N=3 222.5 mm 213 – 232 mm			

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
	(10.4 mm)			(13.4 mm)			
8/25/10	N=6 70.3 mm 64 – 80 mm (5.5 mm)						
8/26/10	N=4 78.3 mm 74 – 84 mm (4.6 mm)						
8/27/10							
8/28/10							
8/29/10							
8/30/10	N=1 59 mm (N.A.)	N=1 113 mm (N.A.)					
8/31/10	N=1 56 mm (N.A.)						
9/1/10		N=2 78 mm 75 – 81 mm (4.2 mm)					
9/2/10		N=2 70 mm 64 – 76 mm (8.5 mm)					
9/3/10	N=11 64.3 mm 49 – 86 mm (12 mm)	N=2 56.5 mm 54 – 59 mm (3.5 mm)		N=1 132 mm (N.A.)			
9/4/10	N=3 76 mm 67 – 93 mm (14.7 mm)						

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
9/5/10	N=6 65 mm 45 – 80 mm (14.7 mm)	N=1 110 mm (N.A.)			N=3 72 mm 67 – 78 mm (5.6 mm)		
9/6/10		N=1 65 mm (N.A.)					
9/7/10		N=1 65 mm (N.A.)	N=1 71 mm (N.A.)				
9/8/10		N=1 76 mm (N.A.)	N=1 Not Measured				
9/9/10	N=1 55 mm (N.A.)						
9/10/10	N=9 66.8 mm 60 – 76 mm (6.6 mm)						
9/11/10							
9/12/10	N=1 50 mm (N.A.)						
9/13/10	N=3 69 mm 64 – 74 mm (7.1 mm)	N=1 77 mm (N.A.)			N=1 77 mm (N.A.)		
9/14/10	N=5 79.8 mm 69 – 88 mm (7 mm)						
9/15/10	N=2 53 mm						

Appendix E1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Sacramento Sucker	Tule Perch	Sacramento Pikeminnow	Carp	Hardhead	Pacific Lamprey	White Catfish
	(N.A.) 1 Not Measured						
9/16/10							
9/17/10							
9/18/10							
9/19/10							
9/20/10							
9/21/10							
9/22/10							
9/23/10							
9/24/10							
9/25/10							
9/26/10							
9/27/10							
9/28/10							
9/29/10							
9/30/10							
GRAND TOTALS	N=225 57.9 mm 19 – 110 mm (18.4 mm)	N=45 69.5 mm 30 – 123 mm (24 mm)	N=18 37.8 mm 21 – 71 mm (11.6 mm)	N=14 60.7 mm 31 – 82 mm (15.8 mm)	N=13 177.7 mm 28 – 265 mm (88.7 mm)	N=9 128.3 mm 100 – 142 mm (13.1 mm)	N=6 34.3 mm 33 – 36 mm (1.5 mm)

Appendix E2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	River Lamprey	Bluegill	Black Crappie	Black Bullhead	Prickly Sculpin	Brown Bullhead	Striped Bass
5/5/10							
5/6/10							
5/7/10							
5/8/10							

Appendix E2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	River Lamprey	Bluegill	Black Crappie	Black Bullhead	Prickly Sculpin	Brown Bullhead	Striped Bass
5/9/10							
5/10/10							
5/11/10							
5/12/10							
5/13/10							
5/14/10							
5/15/10							
5/16/10							
5/17/10	N=1 136 mm (N.A.)						
5/18/10							
5/19/10							
5/20/10	N=1 121 mm (N.A.)			N=1 Not Measured			
5/21/10							
5/22/10							
5/23/10					N=1 27 mm (N.A.)		
5/24/10							
5/25/10							
5/26/10							
5/27/10							
5/28/10							
5/29/10							
5/30/10							
5/31/10							
6/1/10	N=1 Not Measured						

Appendix E2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	River Lamprey	Bluegill	Black Crappie	Black Bullhead	Prickly Sculpin	Brown Bullhead	Striped Bass
6/2/10	N=1 Not Measured					N=2 Not Measured	
6/3/10							N=1 Not Measured
6/4/10							
6/5/10							
6/6/10							
6/7/10							
6/8/10				N=1 Not Measured			
6/9/10							
6/10/10							
6/11/10		N=2 22 mm 21 – 23 mm (1.4 mm)					
6/12/10							
6/13/10							
6/14/10							
6/15/10			N=2 27 mm 26 – 28 mm (1.4 mm)				
6/16/10					N=1 41 mm (N.A.)		
6/17/10							
6/18/10							
6/19/10							
6/20/10							
6/21/10							
6/22/10							

Appendix E2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	River Lamprey	Bluegill	Black Crappie	Black Bullhead	Prickly Sculpin	Brown Bullhead	Striped Bass
6/23/10							
6/24/10							
6/25/10							
6/26/10							
6/27/10							
6/28/10							
6/29/10							
6/30/10							
7/1/10							
7/2/10							
7/3/10							
7/4/10							
7/5/10							
7/6/10							
7/7/10							
7/8/10							
7/9/10			N=1 36 mm (N.A.)				
7/10/10							
7/11/10							
7/12/10				N=1 Not Measured			
7/13/10							
7/14/10							
7/15/10							
7/16/10							
7/17/10							
7/18/10							
7/19/10							

Appendix E2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	River Lamprey	Bluegill	Black Crappie	Black Bullhead	Prickly Sculpin	Brown Bullhead	Striped Bass
7/20/10							
7/21/10							
7/22/10							
7/23/10							
7/24/10							
7/25/10							
7/26/10							
7/27/10							
7/28/10							
7/29/10							
7/30/10							
7/31/10							
8/1/10							
8/2/10							
8/3/10							
8/4/10							
8/5/10							
8/6/10							
8/7/10							
8/8/10							
8/9/10							
8/10/10							
8/11/10							
8/12/10							
8/13/10							
8/14/10							
8/15/10							
8/16/10							
8/17/10							

Appendix E2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	River Lamprey	Bluegill	Black Crappie	Black Bullhead	Prickly Sculpin	Brown Bullhead	Striped Bass
8/18/10							
8/19/10							
8/20/10		N=1 73 mm (N.A.)					
8/21/10							
8/22/10							
8/23/10							
8/24/10							
8/25/10							
8/26/10							
8/27/10							
8/28/10							
8/29/10							
8/30/10							
8/31/10							
9/1/10							
9/2/10							
9/3/10							N=1 Not Measured
9/4/10							
9/5/10							
9/6/10							
9/7/10							
9/8/10							
9/9/10							
9/10/10							
9/11/10							
9/12/10							
9/13/10							

Appendix E2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	River Lamprey	Bluegill	Black Crappie	Black Bullhead	Prickly Sculpin	Brown Bullhead	Striped Bass
9/14/10							
9/15/10							
9/16/10							
9/17/10							
9/18/10							
9/19/10							
9/20/10							
9/21/10							
9/22/10							
9/23/10							
9/24/10							
9/25/10							
9/26/10							
9/27/10							
9/28/10							
9/29/10							
9/30/10							
GRAND TOTALS	N=4 128.5 mm 121 – 136 mm (10.6 mm)	N=3 39 mm 21 – 73 mm (29.5 mm)	N=3 30 mm 26 – 36 mm (5.3 mm)	N=3 Not Measured (N.A.)	N=2 34 mm 27 – 41 mm (9.9 mm)	N=2 Not Measured (N.A.)	N=2 Not Measured (N.A.)

Appendix E3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Yellow Bullhead	Green Sunfish	Unknown Sculpin	Inland Silverside	Unknown Sturgeon	Fathead Minnow
5/5/10						
5/6/10						
5/7/10						
5/8/10						

Appendix E3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Yellow Bullhead	Green Sunfish	Unknown Sculpin	Inland Silverside	Unknown Sturgeon	Fathead Minnow
5/9/10						
5/10/10						
5/11/10						
5/12/10						
5/13/10						
5/14/10						
5/15/10						
5/16/10						
5/17/10						
5/18/10						
5/19/10						
5/20/10						
5/21/10						
5/22/10						
5/23/10						
5/24/10						
5/25/10						
5/26/10						
5/27/10						
5/28/10						
5/29/10						
5/30/10						
5/31/10						
6/1/10						
6/2/10						
6/3/10						
6/4/10						N=1 36 mm (N.A.)
6/5/10						

Appendix E3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Yellow Bullhead	Green Sunfish	Unknown Sculpin	Inland Silverside	Unknown Sturgeon	Fathead Minnow
6/6/10						
6/7/10				N=1 28 mm (N.A.)		
6/8/10						
6/9/10	N=1 Not Measured					
6/10/10						
6/11/10						
6/12/10						
6/13/10						
6/14/10						
6/15/10						
6/16/10						
6/17/10						
6/18/10						
6/19/10						
6/20/10						
6/21/10			N=1 32 mm (N.A.)			
6/22/10						
6/23/10						
6/24/10						
6/25/10						
6/26/10						
6/27/10						
6/28/10						
6/29/10						
6/30/10						
7/1/10						

Appendix E3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.						
Date	**Yellow Bullhead**	**Green Sunfish**	**Unknown Sculpin**	**Inland Silverside**	**Unknown Sturgeon**	**Fathead Minnow**
7/2/10						
7/3/10						
7/4/10						
7/5/10						
7/6/10						
7/7/10					N=1 86 mm (N.A.)	
7/8/10						
7/9/10						
7/10/10						
7/11/10						
7/12/10						
7/13/10						
7/14/10						
7/15/10						
7/16/10						
7/17/10		N=1 79 mm (N.A.)				
7/18/10						
7/19/10						
7/20/10						
7/21/10						
7/22/10						
7/23/10						
7/24/10						
7/25/10						
7/26/10						
7/27/10						

Appendix E3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Yellow Bullhead	Green Sunfish	Unknown Sculpin	Inland Silverside	Unknown Sturgeon	Fathead Minnow
7/28/10						
7/29/10						
7/30/10						
7/31/10						
8/1/10						
8/2/10						
8/3/10						
8/4/10						
8/5/10						
8/6/10						
8/7/10						
8/8/10						
8/9/10						
8/10/10						
8/11/10						
8/12/10						
8/13/10						
8/14/10						
8/15/10						
8/16/10						
8/17/10						
8/18/10						
8/19/10						
8/20/10						
8/21/10						
8/22/10						
8/23/10						
8/24/10						
8/25/10						

Appendix E3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.

Date	Yellow Bullhead	Green Sunfish	Unknown Sculpin	Inland Silverside	Unknown Sturgeon	Fathead Minnow
8/26/10						
8/27/10						
8/28/10	N=1 140 mm (N.A.)					
8/29/10						
8/30/10						
8/31/10						
9/1/10						
9/2/10						
9/3/10						
9/4/10						
9/5/10						
9/6/10						
9/7/10						
9/8/10						
9/9/10						
9/10/10						
9/11/10						
9/12/10						
9/13/10						
9/14/10						
9/15/10						
9/16/10						
9/17/10						
9/18/10						
9/19/10						
9/20/10						
9/21/10						
9/22/10						

Appendix E3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at South Steiner diversion.						
Date	**Yellow Bullhead**	**Green Sunfish**	**Unknown Sculpin**	**Inland Silverside**	**Unknown Sturgeon**	**Fathead Minnow**
9/23/10						
9/24/10						
9/25/10						
9/26/10						
9/27/10						
9/28/10						
9/29/10						
9/30/10						
GRAND TOTALS	N=2 140 mm (N.A.) 1 Not Measured	N=1 79 mm (N.A.)	N=1 32 mm (N.A.)	N=1 28 mm (N.A.)	N=1 86 mm (N.A.)	N=1 36 mm (N.A.)

Appendix F1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Tule Perch	Sacramento Sucker	River Lamprey	Largemouth Bass	White Catfish	Chinook Salmon
5/11/10			N=1 139 mm (N.A.)			N=1 90 mm (N.A.)
5/12/10						
5/13/10						
5/14/10						
5/15/10						
5/16/10						
5/17/10						
5/18/10						
5/19/10						
5/20/10						
5/21/10						
5/22/10						
5/23/10						
5/24/10						
5/25/10						
5/26/10						
5/27/10						
5/28/10						
5/29/10						
5/30/10						
5/31/10						
6/1/10						
6/2/10			N=1 142 mm (N.A.)			
6/3/10						
6/4/10						
6/5/10						

Appendix F1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Tule Perch	Sacramento Sucker	River Lamprey	Largemouth Bass	White Catfish	Chinook Salmon
6/6/10						
6/7/10						
6/8/10						
6/9/10						
6/10/10						
6/11/10						
6/12/10						
6/13/10						
6/14/10						
6/15/10						
6/16/10						
6/17/10						
6/18/10						
6/19/10						
6/20/10						
6/21/10						
6/22/10	N=1 34 mm (N.A.)			N=1 40 mm (N.A.)		
6/23/10						
6/24/10	N=1 39 mm (N.A.)					
6/25/10						
6/26/10						
6/27/10						
6/28/10						
6/29/10	N=1 47 mm (N.A.)					
6/30/10						

Appendix F1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Tule Perch	Sacramento Sucker	River Lamprey	Largemouth Bass	White Catfish	Chinook Salmon
7/1/10						
7/2/10						
7/3/10						
7/4/10						
7/5/10						
7/6/10	N=1 54 mm (N.A.)					
7/7/10			N=1 108 mm (N.A.)			
7/8/10						
7/9/10						
7/10/10						
7/11/10		N=3 20 mm 20 – 20 mm (0 mm)				
7/12/10		N=1 Not Measured				
7/13/10		N=1 34 mm (N.A.)				
7/14/10	N=1 42 mm (N.A.)					
7/15/10	N=1 Not Measured					
7/16/10				N=1 29 mm (N.A.)		
7/17/10						
7/18/10						

Appendix F1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Tule Perch	Sacramento Sucker	River Lamprey	Largemouth Bass	White Catfish	Chinook Salmon
7/19/10						
7/20/10						
7/21/10	N=1 63 mm (N.A.)					
7/22/10						
7/23/10						
7/24/10						
7/25/10						
7/26/10						
7/27/10						
7/28/10						
7/29/10						
7/30/10						
7/31/10						
8/1/10						
8/2/10	N=1 68 mm (N.A.)	N=3 39 mm 28 – 50 mm (15.6 mm)			N=1 Not Measured	
8/3/10	N=1 Not Measured					
8/4/10						
8/5/10						
8/6/10						
8/7/10						
8/8/10						
8/9/10						
8/10/10						
8/11/10						
8/12/10						

Appendix F1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Tule Perch	Sacramento Sucker	River Lamprey	Largemouth Bass	White Catfish	Chinook Salmon
8/13/10						
8/14/10						
8/15/10						
8/16/10						
8/17/10						
8/18/10						
8/19/10						
8/20/10						
8/21/10						
8/22/10						
8/23/10	N=2 63.5 mm 58 – 69 mm (7.8 mm)	N=1 61 mm (N.A.)			N=1 41 mm (N.A.)	
8/24/10	N=2 67 mm 59 – 75 mm (11.3 mm)	N=1 39 mm (N.A.)				
8/25/10		N=1 37 mm (N.A.)				
8/26/10	N=2 65.5 mm 61 – 70 mm (6.4 mm)	N=1 40 mm (N.A.)				
8/27/10						
8/28/10						
8/29/10						
8/30/10						
8/31/10						
9/1/10						
9/2/10						

Appendix F1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Tule Perch	Sacramento Sucker	River Lamprey	Largemouth Bass	White Catfish	Chinook Salmon
9/3/10						
9/4/10						
9/5/10						
9/6/10						
9/7/10						
9/8/10						
9/9/10						
9/10/10						
9/11/10						
9/12/10						
9/13/10						
9/14/10						
9/15/10						
9/16/10						
9/17/10						
9/18/10						
9/19/10						
9/20/10						
9/21/10						
9/22/10						
9/23/10						
9/24/10						
9/25/10						
9/26/10						
9/27/10						
9/28/10						
9/29/10						
9/30/10						
GRAND TOTALS	N=15 56.8 mm	N=12 34.9 mm	N=3 129.7 mm	N=2 34.5 mm	N=2 41 mm	N=1 90 mm

Appendix F1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.						
Date	**Tule Perch**	**Sacramento Sucker**	**River Lamprey**	**Largemouth Bass**	**White Catfish**	**Chinook Salmon**
	34 – 75 mm (12.9 mm)	20 – 61 mm (13.6 mm)	108 – 142 mm (18.8 mm)	29 – 40 mm (7.8 mm)	(N.A.) 1 Not Measured	(N.A.)

Appendix F2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.						
Date	**Sacramento Pikeminnow**	**Pacific Lamprey**	**Bluegill**	**Fathead Minnow**	**Black Bullhead**	**Redear Sunfish**
5/11/10						
5/12/10						
5/13/10						
5/14/10						
5/15/10						
5/16/10						
5/17/10						
5/18/10						
5/19/10						
5/20/10						
5/21/10						
5/22/10						
5/23/10						
5/24/10						
5/25/10						
5/26/10						
5/27/10						
5/28/10						
5/29/10						
5/30/10						
5/31/10						
6/1/10						

Appendix F2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Sacramento Pikeminnow	Pacific Lamprey	Bluegill	Fathead Minnow	Black Bullhead	Redear Sunfish
6/2/10						
6/3/10						
6/4/10					N=1 36 mm (N.A.)	
6/5/10						
6/6/10						
6/7/10						
6/8/10						
6/9/10						
6/10/10						
6/11/10						
6/12/10						
6/13/10						
6/14/10						
6/15/10						
6/16/10						
6/17/10						
6/18/10						
6/19/10						
6/20/10						
6/21/10						
6/22/10						
6/23/10						
6/24/10						
6/25/10						
6/26/10						
6/27/10			N=1 41 mm (N.A.)			N=1 42 mm (N.A.)

Appendix F2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Sacramento Pikeminnow	Pacific Lamprey	Bluegill	Fathead Minnow	Black Bullhead	Redear Sunfish
6/28/10						
6/29/10						
6/30/10						
7/1/10						
7/2/10						
7/3/10						
7/4/10						
7/5/10						
7/6/10						
7/7/10						
7/8/10						
7/9/10						
7/10/10						
7/11/10		N=1 132 mm (N.A.)				
7/12/10						
7/13/10						
7/14/10						
7/15/10						
7/16/10						
7/17/10						
7/18/10						
7/19/10						
7/20/10						
7/21/10						
7/22/10						
7/23/10						
7/24/10						

Appendix F2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Sacramento Pikeminnow	Pacific Lamprey	Bluegill	Fathead Minnow	Black Bullhead	Redear Sunfish
7/25/10						
7/26/10						
7/27/10						
7/28/10						
7/29/10						
7/30/10						
7/31/10						
8/1/10						
8/2/10						
8/3/10						
8/4/10						
8/5/10						
8/6/10						
8/7/10						
8/8/10						
8/9/10						
8/10/10						
8/11/10						
8/12/10						
8/13/10						
8/14/10						
8/15/10						
8/16/10						
8/17/10						
8/18/10						
8/19/10						
8/20/10						
8/21/10						
8/22/10						

Appendix F2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Sacramento Pikeminnow	Pacific Lamprey	Bluegill	Fathead Minnow	Black Bullhead	Redear Sunfish
8/23/10						
8/24/10	N=1 51 mm (N.A.)			N=1 51 mm (N.A.)		
8/25/10						
8/26/10						
8/27/10						
8/28/10						
8/29/10						
8/30/10						
8/31/10						
9/1/10						
9/2/10						
9/3/10						
9/4/10						
9/5/10						
9/6/10						
9/7/10						
9/8/10						
9/9/10						
9/10/10						
9/11/10						
9/12/10						
9/13/10						
9/14/10						
9/15/10						
9/16/10						
9/17/10						
9/18/10						

Appendix F2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Oji diversion.

Date	Sacramento Pikeminnow	Pacific Lamprey	Bluegill	Fathead Minnow	Black Bullhead	Redear Sunfish
9/19/10						
9/20/10						
9/21/10						
9/22/10						
9/23/10						
9/24/10						
9/25/10						
9/26/10						
9/27/10						
9/28/10						
9/29/10						
9/30/10						
GRAND TOTALS	N=1 51 mm (N.A.)	N=1 132 mm (N.A.)	N=1 41 mm (N.A.)	N=1 51 mm (N.A.)	N=1 36 mm (N.A.)	N=1 42 mm (N.A.)

Appendix G. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Windswept diversion.	
Date	**Tule Perch**
5/24/10	N=1 96 mm (N.A.)
5/25/10	
5/26/10	
5/27/10	N=2 87 mm 86 – 88 mm (1.4 mm)
5/28/10	
5/29/10	
5/30/10	
5/31/10	
6/1/10	
6/2/10	
6/3/10	
6/4/10	
6/5/10	
6/6/10	
6/7/10	
6/8/10	
6/9/10	
6/10/10	
6/11/10	
6/12/10	
6/13/10	
6/14/10	
6/15/10	
6/16/10	
6/17/10	

Appendix G. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Windswept diversion.	
Date	**Tule Perch**
6/18/10	
6/19/10	
6/20/10	
6/21/10	
6/22/10	
6/23/10	
6/24/10	
6/25/10	
6/26/10	
6/27/10	N=1 42 mm (N.A.)
6/28/10	
6/29/10	
6/30/10	
7/1/10	
7/2/10	
7/3/10	
7/4/10	
7/5/10	
7/6/10	
7/7/10	
7/8/10	
7/9/10	
7/10/10	
7/11/10	
7/12/10	
7/13/10	
7/14/10	

Appendix G. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Windswept diversion.	
Date	**Tule Perch**
7/15/10	
7/16/10	N=1 Not Measured
7/17/10	
7/18/10	
7/19/10	
7/20/10	N=1 Not Measured
7/21/10	
7/22/10	
7/23/10	
7/24/10	
7/25/10	
7/26/10	
7/27/10	
7/28/10	
7/29/10	
7/30/10	
7/31/10	
8/1/10	
8/2/10	
8/3/10	
8/4/10	
8/5/10	
8/6/10	N=1 Not Measured
8/7/10	
8/8/10	
8/9/10	

Appendix G. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Windswept diversion.	
Date	**Tule Perch**
8/10/10	N=2 61 mm (N.A.) 1 Not Measured
8/11/10	
8/12/10	
8/13/10	N=4 63.5 mm 63 – 64 mm (0.7 mm)
8/14/10	
8/15/10	
8/16/10	N=1 71 mm (N.A.)
8/17/10	N=2 66.5 mm 65 – 68 mm (2.1 mm)
8/18/10	
8/19/10	
8/20/10	
8/21/10	
8/22/10	
8/23/10	
8/24/10	
8/25/10	
8/26/10	
8/27/10	
8/28/10	
8/29/10	

Appendix G. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Windswept diversion.	
Date	**Tule Perch**
8/30/10	N=1 80 mm (N.A.)
8/31/10	
9/1/10	
9/2/10	N=1 74 mm (N.A.)
9/3/10	
9/4/10	
9/5/10	
9/6/10	
9/7/10	
9/8/10	N=2 90.5 mm 82 – 99 mm (12 mm)
9/9/10	N=2 71.5 mm 69 – 74 mm (3.5 mm)
9/10/10	
9/11/10	
9/12/10	
9/13/10	
9/14/10	
9/15/10	
9/16/10	
9/17/10	
9/18/10	
9/19/10	

Appendix G. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Windswept diversion.	
Date	**Tule Perch**
9/20/10	
9/21/10	
9/22/10	
9/23/10	
9/24/10	
9/25/10	
9/26/10	
9/27/10	
9/28/10	
9/29/10	
9/30/10	
GRAND TOTALS	N=21 76 mm 61 – 99 mm (12 mm)

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
4/29/10			N=2 66 mm 64 – 68 mm (2.8 mm)						
4/30/10									
5/1/10	N=1 55 mm (N.A.)			N=1 100 mm (N.A.)					
5/2/10									
5/3/10					N=1 Not Measured				
5/4/10									
5/5/10									
5/6/10									
5/7/10				N=1 142 mm (N.A.)					
5/8/10									
5/9/10				N=1 Not Measured					
5/10/10									
5/11/10				N=1 123 mm (N.A.)					
5/12/10				N=1 85 mm (N.A.)					
5/13/10				N=2 112 mm (N.A.) 1 Not Measured					
5/14/10			N=1						

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
			142 mm (N.A.)						
5/15/10									
5/16/10									
5/17/10									
5/18/10									
5/19/10			N=1 83 mm (N.A.)	N=1 Not Measured					
5/20/10				N=1 95 mm (N.A.)					
5/21/10									
5/22/10			N=2 29 mm 28 – 30 mm (1.4 mm)	N=2 29 mm 28 – 30 mm (1.4 mm)					
5/23/10				N=1 Not Measured					
5/24/10			N=2 65.5 mm 35 – 96 mm (43.1 mm)						
5/25/10									
5/26/10			N=1 31 mm (N.A.)	N=1 27 mm (N.A.)					
5/27/10			N=14 32.4 mm 24 – 40 mm (4.4 mm)	N=1 Not Measured			N=1 29 mm (N.A.)		
5/28/10			N=16						

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
			30.4 mm 20 – 43 mm (5.1 mm)						
5/29/10				N=1 29 mm (N.A.)					
5/30/10									
5/31/10			N=1 40 mm (N.A.)					N=1 28 mm (N.A.)	
6/1/10			N=3 47.3 mm 32 – 73 mm (22.4 mm)					N=1 31 mm (N.A.)	
6/2/10			N=8 35.4 mm 29 – 39 mm (3.4 mm)	N=1 31 mm (N.A.)					
6/3/10			N=7 33.1 mm 28 – 38 mm (3.7 mm)						
6/4/10	N=2 25.5 mm 24 – 27 mm (2.1 mm)		N=11 35 mm 29 – 40 mm (3 mm)	N=3 31 mm 29 – 34 mm (2.6 mm)					
6/5/10			N=10 32.1 mm 27 – 40 mm (3.9 mm)	N=1 38 mm (N.A.)					
6/6/10			N=4 31.3 mm 28 – 36 mm (3.4 mm)	N=2 29.5 mm 28 – 31 mm (2.1 mm)					

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
6/7/10	N=1 Not Measured		N=4 36.8 mm 28 – 42 mm (6.2 mm)	N=2 26.5 mm 25 – 28 mm (2.1 mm)					
6/8/10			N=10 37.9 mm 31 – 45 mm (5 mm)	N=1 29 mm (N.A.)			N=2 22.5 mm 15 – 30 mm (10.6 mm)		
6/9/10			N=7 37 mm 28 – 47 mm (6.2 mm)	N=1 118 mm (N.A.)	N=6 32 mm 27 – 39 mm (4.2 mm)				
6/10/10		N=1 31 mm (N.A.)	N=4 35.5 mm 31 – 41 mm (4.4 mm)	N=1 22 mm (N.A.)					
6/11/10			N=3 37.7 mm 35 – 40 mm (2.5 mm)	N=4 28.8 mm 26 – 31 mm (2.2 mm)	N=1 Not Measured			N=3 24.7 mm 23 – 26 mm (1.5 mm)	
6/12/10			N=3 26.7 mm 22 – 35 mm (7.2 mm)					N=1 25 mm (N.A.)	
6/13/10		N=5 75.6 mm 20 – 265 mm (106 mm)	N=8 31.5 mm 20 – 40 mm (7.2 mm)						
6/14/10			N=17 36.2 mm 29 – 44 mm (4.2 mm)					N=3 27.3 mm 24 – 30 mm (3.1 mm)	
6/15/10		N=1 48 mm	N=4 35.3 mm		N=1 37 mm			N=1 37 mm	

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
		(N.A.)	32 – 39 mm (3 mm)		(N.A.)			(N.A.)	
6/16/10	N=1 272 mm (N.A.)	N=4 61.5 mm 41 – 112 mm (33.8 mm)	N=7 39.1 mm 29 – 47 mm (7.8 mm)	N=2 94 mm 73 – 115 mm (29.7 mm)	N=4 47.8 mm 31 – 95 mm (31.5 mm)			N=3 30.3 mm 28 – 32 mm (2.1 mm)	
6/17/10		N=4 47.3 mm 28 – 73 mm (19.6 mm)		N=1 98 mm (N.A.)	N=2 32 mm 30 – 34 mm (2.8 mm)			N=6 33.5 mm 28 – 39 mm (4.5 mm)	
6/18/10		N=18 24.4 mm 18 – 41 mm (6.2 mm)	N=3 39 mm 38 – 40 mm (1 mm)						
6/19/10	N=1 44 mm (N.A.)			N=2 30 mm 30 – 30 mm (0 mm)					
6/20/10		N=8 19.8 mm 15 – 30 mm (4.4 mm)	N=1 34 mm (N.A.)	N=2 29.5 mm 26 – 33 mm (4.9 mm)					
6/21/10	N=3 51 mm 47 – 56 mm (4.6 mm)	N=39 22.8 mm 18 – 34 mm (3.6 mm)	N=3 32.3 mm 30 – 36 mm (3.2 mm)	N=1 35 mm (N.A.)					
6/22/10		N=18 23.7 mm 15 – 38 mm (6 mm)			N=1 228 mm (N.A.)				
6/23/10		N=6 29.4 mm 18 – 48 mm (11.7 mm)							

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
6/24/10	N=3 35.3 mm 31 – 40 mm (4.5 mm)	N=2 30.5 mm 19 – 42 mm (16.3 mm)		N=1 32 mm (N.A.)					
6/25/10	N=2 39 mm 36 – 42 mm (4.2 mm)	N=4 26.3 mm 24 – 30 mm (2.6 mm)	N=2 38.5 mm 36 – 41 mm (3.5 mm)	N=1 30 mm (N.A.)					
6/26/10	N=1 41 mm (N.A.)	N=3 33.7 mm 20 – 50 mm (15.2 mm)		N=1 130 mm (N.A.)					
6/27/10	N=2 30 mm 20 – 40 mm (14.1 mm)	N=3 25 mm 21 – 32 mm (6.1 mm)							
6/28/10	N=4 40.5 mm 27 – 66 mm (18.2 mm)	N=11 33.7 mm 22 – 71 mm (13.3 mm)							
6/29/10	N=1 48 mm (N.A.)	N=10 29.2 mm 20 – 41 mm (5.8 mm)							
6/30/10		N=2 23.5 mm 19 – 28 mm (6.4 mm)	N=1 41 mm (N.A.)						
7/1/10		N=11 38.2 mm 29 – 49 mm (6.2 mm)		N=1 45 mm (N.A.)					
7/2/10	N=2 42 mm	N=6 39.3 mm							

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
	39 – 45 mm (4.2 mm)	26 – 72 mm (16.7 mm)							
7/3/10	N=9 41 mm 36 – 45 mm (3.5 mm)	N=5 36.2 mm 20 – 44 mm (10 mm)	N=1 110 mm (N.A.)	N=1 44 mm (N.A.)					
7/4/10	N=7 46.7 mm 40 – 59 mm (5.9 mm)			N=1 30 mm (N.A.)					
7/5/10	N=2 25.5 mm 21 – 30 mm (6.4 mm)	N=2 34.5 mm 31 – 38 mm (4.9 mm)							
7/6/10									
7/7/10	N=1 41 mm (N.A.)			N=1 Not Measured					
7/8/10		N=3 30 mm 24 – 35 mm (5.6 mm)							
7/9/10				N=1 58 mm (N.A.)					
7/10/10							N=1 28 mm (N.A.)		
7/11/10	N=1 38 mm (N.A.)	N=1 50 mm (N.A.)							
7/12/10	N=1 23 mm (N.A.)			N=1 54 mm (N.A.)					

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
7/13/10			N=1 43 mm (N.A.)						
7/14/10	N=1 48 mm (N.A.)								
7/15/10		N=11 39.5 mm 29 – 53 mm (7.6 mm)	N=1 28 mm (N.A.)				N=1 35 mm (N.A.)		
7/16/10	N=1 68 mm (N.A.)	N=25 43.1 mm 29 – 70 mm (12.1 mm)	N=4 35 mm 22 – 56 mm (14.7 mm)				N=2 37.5 mm 33 – 42 mm (6.4 mm)		
7/17/10	N=2 57 mm 54 – 60 mm (4.2 mm)	N=4 48.5 mm 47 – 51 mm (1.7 mm)	N=1 99 mm (N.A.)				N=2 41 mm 40 – 42 mm (1.4 mm)		
7/18/10		N=4 48 mm 38 – 68 mm (13.8 mm)							
7/19/10		N=6 37 mm 21 – 64 mm (18.3 mm)	N=1 62 mm (N.A.)						
7/20/10	N=1 76 mm (N.A.)	N=1 71 mm (N.A.)	N=1 51 mm (N.A.)	N=4 31.5 mm 21 – 54 mm (15.4 mm)	N=1 153 mm (N.A.)				
7/21/10		N=10 55.4 mm 42 – 69 mm (9.7 mm)							

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
7/22/10		N=5 56.6 mm 43 – 86 mm (16.8 mm)	N=1 43 mm (N.A.)	N=1 53 mm (N.A.)	N=1 Not Measured		N=2 46.5 mm 45 – 48 mm (2.1 mm)		
7/23/10	N=1 32 mm (N.A.)								
7/24/10	N=2 50 mm (N.A.) 1 Not Measured			N=3 79.3 mm 77 – 81 mm (2.1 mm)					
7/25/10	N=3 39.7 mm 29 – 46 mm (9.3 mm)					N=3 45.7 mm 42 – 50 mm (4 mm)			
7/26/10	N=1 71 mm (N.A.)		N=1 37 mm (N.A.)						
7/27/10	N=1 97 mm (N.A.)								
7/28/10	N=2 38 mm 35 – 41 mm (4.2 mm)								
7/29/10	N=1 Not Measured			N=1 22 mm (N.A.)					
7/30/10									
7/31/10									
8/1/10							N=2 42 mm 41 – 43 mm (1.4 mm)		

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
8/2/10	N=4 44.5 mm 39 – 48 mm (3.9 mm)				N=2 51.5 mm 35 – 68 mm (23.3 mm)				
8/3/10									
8/4/10	N=3 31.3 mm 27 – 35 mm (4 mm)	N=1 26 mm (N.A.)	N=1 Not Measured		N=2 39.5 mm 38 – 41 mm (2.1 mm)				
8/5/10		N=2 45.5 mm 31 – 60 mm (20.5 mm)							
8/6/10		N=1 30 mm (N.A.)							
8/7/10	N=1 71 mm (N.A.)	N=2 43 mm (N.A.) 1 Not Measured	N=3 74 mm 43 – 132 mm (60.3 mm)	N=1 101 mm (N.A.)		N=5 58.6 mm 56 – 61 mm (1.9 mm)	N=1 41 mm (N.A.)	N=1 38 mm (N.A.)	
8/8/10						N=1 45 mm (N.A.)		N=3 28.7 mm 27 – 31 mm (2.1 mm)	
8/9/10	N=1 Not Measured	N=1 46 mm (N.A.)			N=1 32 mm (N.A.)			N=2 34 mm 33 – 35 mm (1.4 mm)	
8/10/10	N=3 42 mm 31 – 57 mm (13.5 mm)	N=3 53.5 mm 44 – 63 mm (13.4 mm)	N=1 49 mm (N.A.)		N=1 87 mm (N.A.)				
8/11/10				N=1					

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
				113 mm (N.A.)					
8/12/10	N=2 32 mm 29 – 35 mm (4.2 mm)			N=1 22 mm (N.A.)			N=1 51 mm (N.A.)		
8/13/10	N=1 40 mm (N.A.)	N=2 56.5 mm 40 – 73 mm (23.3 mm)		N=1 26 mm (N.A.)					
8/14/10	N=2 36.5 mm 34 – 39 mm (4 mm)		N=1 105 mm (N.A.)				N=2 46 mm 40 – 52 mm (8.5 mm)	N=1 40 mm (N.A.)	
8/15/10	N=4 41.3 mm 38 – 45 mm (3 mm)	N=1 51 mm (N.A.)		N=2 130 mm (N.A.) 1 Not Measured	N=1 42 mm (N.A.)		N=1 52 mm (N.A.)		
8/16/10	N=5 45 mm 37 – 53 mm (7.3 mm)			N=1 99 mm (N.A.)		N=1 60 mm (N.A.)			N=1 49 mm (N.A.)
8/17/10		N=1 Not Measured				N=1 65 mm (N.A.)			
8/18/10	N=2 36.5 mm 24 – 49 mm (17.7 mm)	N=1 Not Measured		N=2 Not Measured		N=1 69 mm (N.A.)			
8/19/10	N=1 34 mm (N.A.)			N=1 20 mm (N.A.)					
8/20/10	N=2	N=1	N=1						N=1

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
	58.5 mm 52 – 65 mm (9.2 mm)	35 mm (N.A.)	34 mm (N.A.)						35 mm (N.A.)
8/21/10	N=2 70 mm 62 – 78 mm (11.3 mm)	N=1 Not Measured			N=1 51 mm (N.A.)	N=1 64 mm (N.A.)		N=1 21 mm (N.A.)	N=1 42 mm (N.A.)
8/22/10	N=1 Not Measured			N=1 68 mm (N.A.)		N=1 50 mm (N.A.)			N=1 55 mm (N.A.)
8/23/10	N=2 35.5 mm 33 – 38 mm (3.5 mm)	N=1 36 mm (N.A.)							
8/24/10		N=2 54 mm 49 – 59 mm (7.1 mm)			N=2 52 mm 49 – 55 mm (4.2 mm)				
8/25/10	N=2 76.5 mm 58 – 95 mm (26.2 mm)	N=2 43 mm 39 – 47 mm (5.7 mm)		N=2 112 mm 110 – 114 mm (2.8 mm)	N=1 44 mm (N.A.)	N=1 65 mm (N.A.)			N=1 39 mm (N.A.)
8/26/10	N=9 77.8 mm 47 – 105 mm (16.5 mm)	N=1 78 mm (N.A.)		N=1 132 mm (N.A.)		N=1 76 mm (N.A.)			
8/27/10	N=7 107.2 mm 85 – 125 mm (13.7 mm)	N=1 70 mm (N.A.)	N=1 55 mm (N.A.)						N=1 51 mm (N.A.)
8/28/10	N=17 82.9 mm 42 – 132 mm (20 mm)	N=2 56 mm (N.A.) 1 Not			N=1 41 mm (N.A.)		N=3 50.7 mm 48 – 52 mm (2.3 mm)		

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
		Measured							
8/29/10	N=64 95.3 mm 73 – 125 mm (14.6 mm)	N=3 95.5 mm 91 – 100 mm (6.4 mm)				N=1 67 mm (N.A.)			N=2 57.5 mm 55 – 60 mm (3.5 mm)
8/30/10	N=3 122.5 mm 111 – 134 mm (16.3 mm)	N=6 83.8 mm 64 – 105 mm (14.5 mm)							
8/31/10	N=5 85.2 mm 47 – 114 mm (25 mm)	N=2 101.5 mm 96 – 107 mm (7.8 mm)							N=1 55 mm (N.A.)
9/1/10	N=1 75 mm (N.A.)	N=1 45 mm (N.A.)		N=1 79 mm (N.A.)	N=1 54 mm (N.A.)		N=2 74 mm 72 – 76 mm (2.8 mm)		
9/2/10	N=2 85.5 mm 63 – 108 mm (31.8 mm)		N=1 128 mm (N.A.)						N=2 46.5 mm 39 – 54 mm (10.6 mm)
9/3/10		N=2 56 mm (N.A.) 1 Not Measured					N=3 69.3 mm 58 – 76 mm (9.9 mm)		
9/4/10	N=4 80.8 mm 78 – 83 mm (2.2 mm)					N=2 70.5 mm 67 – 74 mm (4.9 mm)		N=1 51 mm (N.A.)	
9/5/10	N=8 76.5 mm 65 – 93 mm (8.9 mm)	N=1 74 mm (N.A.)			N=2 123 mm 121 – 125 mm (2.8 mm)	N=4 70 mm 68 – 73 mm (2.6 mm)			

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
9/6/10	N=6 82.3 mm 73 – 91 mm (7 mm)					N=2 71 mm 67 – 75 mm (5.7 mm)			N=1 65 mm (N.A.)
9/7/10	N=5 91.8 mm 81 – 113 mm (12.6 mm)		N=1 62 mm (N.A.)				N=1 79 mm (N.A.)		
9/8/10	N=7 98.3 mm 72 – 140 mm (25 mm)								
9/9/10	N=4 102.3 mm 89 – 120 mm (15.9 mm)				N=5 48.4 mm 40 – 56 mm (7.4 mm)		N=1 74 mm (N.A.)		
9/10/10					N=1 41 mm (N.A.)				
9/11/10	N=1 115 mm (N.A.)				N=3 42 mm 39 – 48 mm (5.2 mm)	N=1 53 mm (N.A.)			
9/12/10	N=11 86.8 mm 72 – 113 mm (15 mm)		N=1 77 mm (N.A.)		N=1 63 mm (N.A.)				
9/13/10	N=9 86.1 mm 52 – 155 mm (30.5 mm)				N=4 41.3 mm 21 – 59 mm (15.8 mm)		N=1 66 mm (N.A.)		N=2 60.5 mm 58 – 63 mm (3.5 mm)
9/14/10	N=8 79.4 mm 63 – 98 mm			N=1 125 mm (N.A.)	N=1 52 mm (N.A.)				N=2 43.5 mm 41 – 46 mm

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
	(15 mm)								(3.5 mm)
9/15/10	N=12 106 mm 90 – 124 mm (11.4 mm)			N=1 95 mm (N.A.)	N=1 51 mm (N.A.)		N=1 80 mm (N.A.)		N=1 53 mm (N.A.)
9/16/10	N=6 92.8 mm 71 – 125 mm (19.8 mm)		N=1 40 mm (N.A.)						
9/17/10									
9/18/10	N=193 107.2 mm 77 – 145 mm (16.5 mm)		N=7 76.7 mm 45 – 120 mm (26.5 mm)	N=5 87 mm 44 – 103 mm (24.7 mm)	N=5 43.8 mm 32 – 57 mm (10.5 mm)	N=16 73.3 mm 52 – 84 mm (8.1 mm)	N=3 72 mm 52 – 83 mm (17.3 mm)		
9/19/10	N=11 101.1 mm 51 – 131 mm (22.1 mm)	N=1 98 mm (N.A.)		N=1 103 mm (N.A.)					
9/20/10	N=3 69 mm 51 – 80 mm (15.7 mm)		N=5 67 mm 41 – 86 mm (23.3 mm)						
9/21/10	N=6 77.7 mm 48 – 109 mm (22.9 mm)		N=6 51 mm 36 – 61 mm (10.7 mm)				N=1 75 mm (N.A.)		
9/22/10	N=10 95.8 mm 67 – 128 mm (24.1 mm)		N=6 55.7 mm 42 – 78 mm (12 mm)				N=7 76.1 mm 70 – 81 mm (3.6 mm)		N=3 46.3 mm 44 – 50 mm (3.2 mm)
9/23/10									
9/24/10									
9/25/10									

Appendix H1. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Sacramento Sucker	Carp	Prickly Sculpin	Tule Perch	White Catfish	Hardhead	Sacramento Pikeminnow	Bluegill	Green Sunfish
9/26/10									
9/27/10									
9/28/10									
9/29/10									
9/30/10									
GRAND TOTALS	N=511 78.7 mm 20 – 272 mm (31.2 mm)	N=275 38.6 mm 15 – 265 mm (23.7 mm)	N=208 41.7 mm 20 – 142 mm (19.8 mm)	N=80 64.1 mm 20 – 142 mm (37.8 mm)	N=54 53.1 mm 21 – 228 mm (35.6 mm)	N=41 66.1 mm 42 – 84 mm (10.8 mm)	N=41 57 mm 15 – 83 mm (18.9 mm)	N=28 31 mm 21 – 51 mm (6.4 mm)	N=20 50 mm 35 – 65 mm (8.4 mm)

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
4/29/10						N=1 110 mm (N.A.)		
4/30/10						N=1 204 mm (N.A.)		
5/1/10						N=1 125 mm (N.A.)		
5/2/10	N=2 70 mm (N.A.) 1 Not Measured							
5/3/10								
5/4/10								
5/5/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
5/6/10		N=1 120 mm (N.A.)						
5/7/10						N=1 145 mm (N.A.)		
5/8/10								
5/9/10								
5/10/10	N=1 240 mm (N.A.)							
5/11/10								
5/12/10								
5/13/10								
5/14/10		N=1 57 mm (N.A.)					N=1 51 mm (N.A.)	
5/15/10								
5/16/10	N=1 72 mm (N.A.)							
5/17/10								
5/18/10							N=1 137 mm (N.A.)	
5/19/10								
5/20/10								
5/21/10								
5/22/10								
5/23/10								
5/24/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
5/25/10								
5/26/10								
5/27/10								
5/28/10								
5/29/10								
5/30/10								
5/31/10	N=1 Not Measured							N=2 33 mm 32 – 34 mm (1.4 mm)
6/1/10		N=2 Not Measured						
6/2/10								
6/3/10						N=1 187 mm (N.A.)		
6/4/10								
6/5/10	N=1 89 mm (N.A.)							
6/6/10								
6/7/10	N=1 258 mm (N.A.)					N=1 187 mm (N.A.)		
6/8/10					N=1 24 mm (N.A.)			
6/9/10								
6/10/10								
6/11/10								
6/12/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
6/13/10			N=1 105 mm (N.A.)					
6/14/10		N=1 Not Measured	N=1 Not Measured					N=1 46 mm (N.A.)
6/15/10								
6/16/10		N=1 Not Measured						
6/17/10		N=1 183 mm (N.A.)				N=2 181.5 mm 172 – 191 mm (13.4 mm)		
6/18/10								
6/19/10								
6/20/10								
6/21/10				N=3 29.7 mm 20 – 36 mm (8.5 mm)				
6/22/10								
6/23/10								
6/24/10								
6/25/10								
6/26/10				N=1 42 mm (N.A.)				
6/27/10			N=1 130 mm (N.A.)					
6/28/10								
6/29/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
6/30/10			N=1 Not Measured					
7/1/10								
7/2/10								
7/3/10								
7/4/10								
7/5/10			N=1 30 mm (N.A.)					
7/6/10								
7/7/10								
7/8/10								
7/9/10								
7/10/10								
7/11/10								
7/12/10								
7/13/10								
7/14/10								
7/15/10								
7/16/10			N=1 50 mm (N.A.)	N=1 36 mm (N.A.)			N=3 36.3 mm 33 – 40 mm (3.5 mm)	
7/17/10	N=2 74 mm 46 – 102 mm (39.6 mm)			N=1 27 mm (N.A.)				
7/18/10	N=1 46 mm (N.A.)							
7/19/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
7/20/10								
7/21/10								
7/22/10		N=1 Not Measured						
7/23/10				N=1 22 mm (N.A.)				
7/24/10								
7/25/10								
7/26/10		N=1 113 mm (N.A.)						
7/27/10			N=2 139 mm (N.A.) 1 Not Measured					
7/28/10					N=1 55 mm (N.A.)			
7/29/10								
7/30/10								
7/31/10	N=1 36 mm (N.A.)			N=2 24 mm 22 – 26 mm (2.8 mm)				
8/1/10								
8/2/10								
8/3/10		N=1 174 mm (N.A.)						
8/4/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
8/5/10								
8/6/10								
8/7/10				N=1 28 mm (N.A.)				
8/8/10								
8/9/10								
8/10/10		N=1 51 mm (N.A.)						
8/11/10							N=1 Not Measured	
8/12/10								
8/13/10								
8/14/10								
8/15/10								
8/16/10								
8/17/10								
8/18/10								
8/19/10								
8/20/10	N=1 50 mm (N.A.)							
8/21/10								
8/22/10								
8/23/10								
8/24/10							N=1 45 mm (N.A.)	
8/25/10								
8/26/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
8/27/10					N=5 48.8 mm 42 – 52 mm (4.3 mm)			
8/28/10								
8/29/10								
8/30/10			N=1 71 mm (N.A.)					
8/31/10			N=1 41 mm (N.A.)					
9/1/10					N=1 95 mm (N.A.)			
9/2/10	N=1 52 mm (N.A.)							
9/3/10		N=2 58 mm 52 – 64 mm (8.5 mm)						
9/4/10								
9/5/10								
9/6/10	N=1 49 mm (N.A.)							
9/7/10								
9/8/10			N=1 21 mm (N.A.)					
9/9/10								
9/10/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
9/11/10								
9/12/10								
9/13/10			N=1 43 mm (N.A.)					
9/14/10							N=1 38 mm (N.A.)	
9/15/10								N=1 64 mm (N.A.)
9/16/10								
9/17/10								
9/18/10		N=1 88 mm (N.A.)	N=1 125 mm (N.A.)					
9/19/10								
9/20/10								
9/21/10	N=1 48 mm (N.A.)							N=3 47 mm 40 – 57 mm (8.9 mm)
9/22/10								
9/23/10								
9/24/10								
9/25/10								
9/26/10								
9/27/10								
9/28/10								
9/29/10								
9/30/10								

Appendix H2. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Brown Bullhead	Yellow Bullhead	Black Crappie	Redear Sunfish	Golden Shiner	Pacific Lamprey	Black Bullhead	Unknown Sculpin
GRAND TOTALS	N=15 89.1 mm 36 – 258 mm (73.5 mm)	N=14 100.2 mm 51 – 183 mm (51.1 mm)	N=13 75.5 mm 21 – 139 mm (45.1 mm)	N=10 29.2 mm 20 – 42 mm (7.3 mm)	N=8 52.3 mm 24 – 95 mm (19.9 mm)	N=8 165.1 mm 110 – 204 mm (34.3 mm)	N=8 54.3 mm 33 – 137 mm (37 mm)	N=7 45.3 mm 32 – 64 mm (11.7 mm)

Appendix H3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Bigscale Logperch	Wakasagi	Largemouth Bass	Spotted Bass	Riffle Sculpin	River Lamprey	Smallmouth Bass	Unknown Bass
4/29/10								
4/30/10								
5/1/10								
5/2/10								
5/3/10								
5/4/10								
5/5/10								
5/6/10								
5/7/10								
5/8/10								
5/9/10								
5/10/10								
5/11/10								
5/12/10								
5/13/10								
5/14/10				N=2 Not Measured				
5/15/10								
5/16/10								

Appendix H3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Bigscale Logperch	Wakasagi	Largemouth Bass	Spotted Bass	Riffle Sculpin	River Lamprey	Smallmouth Bass	Unknown Bass
5/17/10								
5/18/10								
5/19/10								
5/20/10								
5/21/10								
5/22/10								
5/23/10								
5/24/10								
5/25/10								
5/26/10								
5/27/10								
5/28/10								
5/29/10					N=1 35 mm (N.A.)			
5/30/10					N=1 30 mm (N.A.)			
5/31/10								
6/1/10								
6/2/10								
6/3/10								
6/4/10								
6/5/10								
6/6/10								
6/7/10							N=1 224 mm (N.A.)	
6/8/10								
6/9/10								

Appendix H3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Bigscale Logperch	Wakasagi	Largemouth Bass	Spotted Bass	Riffle Sculpin	River Lamprey	Smallmouth Bass	Unknown Bass
6/10/10				N=1 158 mm (N.A.)				
6/11/10								
6/12/10								
6/13/10				N=1 35 mm (N.A.)		N=1 120 mm (N.A.)		
6/14/10						N=3 134 mm (N.A.) 2 Not Measured		
6/15/10							N=1 Not Measured	
6/16/10							N=1 Not Measured	
6/17/10								
6/18/10								
6/19/10								
6/20/10								
6/21/10								
6/22/10								
6/23/10								
6/24/10								
6/25/10								
6/26/10								
6/27/10								
6/28/10								
6/29/10								
6/30/10								
7/1/10								

Appendix H3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Bigscale Logperch	Wakasagi	Largemouth Bass	Spotted Bass	Riffle Sculpin	River Lamprey	Smallmouth Bass	Unknown Bass
7/2/10								
7/3/10								
7/4/10					N=1 42 mm (N.A.)			
7/5/10								N=1 24 mm (N.A.)
7/6/10								
7/7/10								
7/8/10								
7/9/10								
7/10/10								
7/11/10								
7/12/10								
7/13/10								
7/14/10								
7/15/10								
7/16/10	N=1 46 mm (N.A.)							
7/17/10								
7/18/10					N=2 30.5 mm 21 – 40 mm (13.4 mm)			
7/19/10								
7/20/10								
7/21/10								
7/22/10								
7/23/10								

Appendix H3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Bigscale Logperch	Wakasagi	Largemouth Bass	Spotted Bass	Riffle Sculpin	River Lamprey	Smallmouth Bass	Unknown Bass
7/24/10	N=1 55 mm (N.A.)							
7/25/10								
7/26/10								
7/27/10								
7/28/10								
7/29/10								
7/30/10								
7/31/10								
8/1/10								
8/2/10								
8/3/10								
8/4/10								
8/5/10								
8/6/10								
8/7/10								
8/8/10								
8/9/10								
8/10/10								
8/11/10		N=3 42.7 mm 36 – 50 mm (7 mm)						
8/12/10								
8/13/10								
8/14/10								
8/15/10								
8/16/10								
8/17/10								

Appendix H3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Bigscale Logperch	Wakasagi	Largemouth Bass	Spotted Bass	Riffle Sculpin	River Lamprey	Smallmouth Bass	Unknown Bass
8/18/10		N=2 47.5 mm 47 – 48 mm (0.7 mm)						
8/19/10								
8/20/10								
8/21/10			N=1 55 mm (N.A.)					
8/22/10								
8/23/10								
8/24/10								
8/25/10								
8/26/10		N=1 47 mm (N.A.)		N=1 64 mm (N.A.)				
8/27/10								N=1 70 mm (N.A.)
8/28/10								
8/29/10								
8/30/10								
8/31/10								
9/1/10								
9/2/10			N=1 41 mm (N.A.)					
9/3/10								
9/4/10								
9/5/10								
9/6/10								

Appendix H3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Bigscale Logperch	Wakasagi	Largemouth Bass	Spotted Bass	Riffle Sculpin	River Lamprey	Smallmouth Bass	Unknown Bass
9/7/10								
9/8/10	N=1 77 mm (N.A.)							
9/9/10								
9/10/10								
9/11/10								
9/12/10								
9/13/10	N=1 77 mm (N.A.)					N=1 155 mm (N.A.)		
9/14/10								
9/15/10								
9/16/10	N=1 Not Measured							
9/17/10								
9/18/10			N=3 69.3 mm 62 – 78 mm (8.1 mm)					
9/19/10								
9/20/10	N=1 Not Measured							
9/21/10	N=1 51 mm (N.A.)							
9/22/10								
9/23/10								
9/24/10								
9/25/10								
9/26/10								

Appendix H3. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Bigscale Logperch	Wakasagi	Largemouth Bass	Spotted Bass	Riffle Sculpin	River Lamprey	Smallmouth Bass	Unknown Bass
9/27/10								
9/28/10								
9/29/10								
9/30/10								
GRAND TOTALS	N=7 61.2 mm 46 – 77 mm (14.8 mm)	N=6 45 mm 36 – 50 mm (5.1 mm)	N=5 60.8 mm 41 – 78 mm (13.9 mm)	N=5 123.3 mm 35 – 236 mm (91.7 mm)	N=5 33.6 mm 21 – 42 mm (8.4 mm)	N=5 136.3 mm 120 – 155 mm (17.6 mm)	N=3 224 mm 224 – 224 mm (0 mm)	N=2 47 mm 24 – 70 mm (32.5 mm)

Appendix H4. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Unknown Lamprey	White Crappie	Chinook Salmon	Threespine Stickleback	Fathead Minnnow	Threadfin Shad	Striped Bass	Sacramento Blackfish
4/29/10	N=2 105.5 mm 97 – 114 mm (12 mm)							
4/30/10								
5/1/10			N=1 70 mm (N.A.)					
5/2/10								
5/3/10								
5/4/10								
5/5/10								
5/6/10								N=1 Not Measured
5/7/10								
5/8/10								

Appendix H4. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Unknown Lamprey	White Crappie	Chinook Salmon	Threespine Stickleback	Fathead Minnnow	Threadfin Shad	Striped Bass	Sacramento Blackfish
5/9/10								
5/10/10								
5/11/10								
5/12/10								
5/13/10								
5/14/10								
5/15/10								
5/16/10						N=1 50 mm (N.A.)		
5/17/10								
5/18/10								
5/19/10								
5/20/10								
5/21/10								
5/22/10								
5/23/10								
5/24/10								
5/25/10								
5/26/10								
5/27/10								
5/28/10								
5/29/10								
5/30/10								
5/31/10								
6/1/10								
6/2/10								
6/3/10								
6/4/10								

Appendix H4. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Unknown Lamprey	White Crappie	Chinook Salmon	Threespine Stickleback	Fathead Minnnow	Threadfin Shad	Striped Bass	Sacramento Blackfish
6/5/10								
6/6/10								
6/7/10								
6/8/10								
6/9/10								
6/10/10								
6/11/10								
6/12/10								
6/13/10								
6/14/10								
6/15/10								
6/16/10								
6/17/10								
6/18/10								
6/19/10								
6/20/10								
6/21/10								
6/22/10								
6/23/10								
6/24/10		N=1 47 mm (N.A.)						
6/25/10								
6/26/10								
6/27/10								
6/28/10								
6/29/10								
6/30/10								
7/1/10								

Appendix H4. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Unknown Lamprey	White Crappie	Chinook Salmon	Threespine Stickleback	Fathead Minnnow	Threadfin Shad	Striped Bass	Sacramento Blackfish
7/2/10								
7/3/10								
7/4/10								
7/5/10								
7/6/10								
7/7/10								
7/8/10								
7/9/10								
7/10/10								
7/11/10								
7/12/10								
7/13/10								
7/14/10								
7/15/10								
7/16/10								
7/17/10								
7/18/10								
7/19/10								
7/20/10								
7/21/10		N=1 131 mm (N.A.)						
7/22/10								
7/23/10								
7/24/10								
7/25/10								
7/26/10								
7/27/10								
7/28/10								

Appendix H4. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Unknown Lamprey	White Crappie	Chinook Salmon	Threespine Stickleback	Fathead Minnnow	Threadfin Shad	Striped Bass	Sacramento Blackfish
7/29/10								
7/30/10								
7/31/10								
8/1/10								
8/2/10								
8/3/10								
8/4/10								
8/5/10								
8/6/10								
8/7/10								
8/8/10								
8/9/10								
8/10/10								
8/11/10				N=1 41 mm (N.A.)				
8/12/10								
8/13/10								
8/14/10							N=1 48 mm (N.A.)	
8/15/10								
8/16/10								
8/17/10								
8/18/10								
8/19/10								
8/20/10								
8/21/10								
8/22/10								
8/23/10								

Appendix H4. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Unknown Lamprey	White Crappie	Chinook Salmon	Threespine Stickleback	Fathead Minnnow	Threadfin Shad	Striped Bass	Sacramento Blackfish
8/24/10								
8/25/10								
8/26/10								
8/27/10								
8/28/10								
8/29/10								
8/30/10								
8/31/10								
9/1/10								
9/2/10								
9/3/10								
9/4/10								
9/5/10								
9/6/10								
9/7/10								
9/8/10								
9/9/10								
9/10/10								
9/11/10								
9/12/10								
9/13/10								
9/14/10								
9/15/10								
9/16/10								
9/17/10								
9/18/10					N=1 52 mm (N.A.)			
9/19/10								

Appendix H4. Daily numbers of fish sampled by species, average fork length (FL), minimum and maximum fork lengths, and standard deviation in fork lengths (in parentheses) for fish entrained at Portuguese Bend diversion.

Date	Unknown Lamprey	White Crappie	Chinook Salmon	Threespine Stickleback	Fathead Minnnow	Threadfin Shad	Striped Bass	Sacramento Blackfish
9/20/10								
9/21/10								
9/22/10								
9/23/10								
9/24/10								
9/25/10								
9/26/10								
9/27/10								
9/28/10								
9/29/10								
9/30/10								
GRAND TOTALS	N=2 105.5 mm 97 – 114 mm (12 mm)	N=2 89 mm 47 – 131 mm (59.4 mm)	N=1 70 mm (N.A.)	N=1 41 mm (N.A.)	N=1 52 mm (N.A.)	N=1 50 mm (N.A.)	N=1 48 mm (N.A.)	N=1 Not Measured (N.A.)