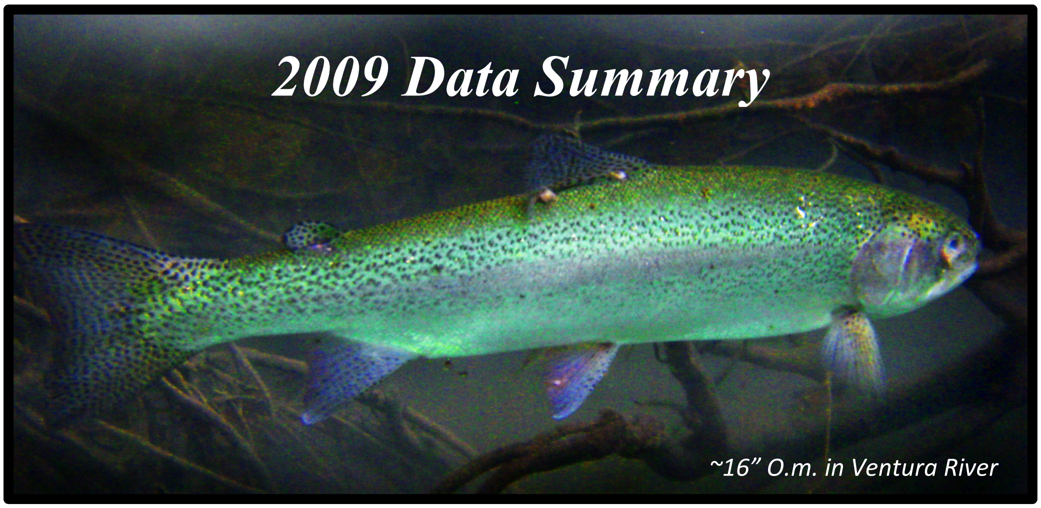
Steelhead Population Assessment in the

Ventura River / Matilija Creek Basin



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Steelhead Population Assessment in the Ventura River / Matilija Creek Basin – *2009 Data Summary*

Introduction

Field sampling to assess the distribution and abundance of *O. mykiss* in the Ventura/Matilija Basin by Thomas R. Payne & Associates (TRPA) was limited in 2009 due to the unavailability of County, State, and Federal funds. The 2009 survey was wholly funded by private contribution from Patagonia, Inc., through the Surfrider Foundation, with volunteer field assistance by Matilija Coalition and NMFS. The August 2009 sampling encompassed four study sites (of 11 original sites) that have been found in recent surveys to contain significant numbers of *O. mykiss* that are potentially derived from anadromous adults, e.g., only sites below Matilija Dam (Figure 1). The one-mile long Ven 3 study site occurs in the "living reach" of Casitas Springs, where groundwater emerges from the long dry channel below Robles Diversion Dam, and includes the habitats surrounding the San Antonio Creek confluence. The Ven 5 study site extends ½ -mile below the confluence of the Lower North Fork Matilija Creek (LNF). The two LNF sites are ½ -mile in length, with the LNFnew site located immediately above the Ojai Quarry, and the LNFmid study site just downstream of Wheeler Gorge. Additional sampling was also conducted in September 2009 just downstream of the Ven 3 study site at Foster Park as part of an independent study, consequently the 2009 abundance estimates for Ven 3 area presented both with and without the Foster Park data.

Methods

Abundance estimates were derived using snorkel counts according to the Method of Bounded Counts (MBC) within randomly selected sampling units stratified by reach and habitat type. Pool and flatwater habitats were sampled in the mainstem Ventura River study sites (Ven 3 and Ven 5), whereas only pool habitats were sampled in the tributary study sites (LNF new and LNF mid). Riffles were not sampled in any study sites due to insufficient depth for snorkeling (Table 1). See TRPA 2007, 2008, and 2009 for detailed descriptions of the study sites, sampling design, abundance estimators, and field methodologies.

The 2009 sampling occurred approximately 2-3 weeks later than sampling in 2006 and 2007, but 2-3 weeks earlier than the 2008 survey. Streamflows during August 2009 were generally similar to flows encountered in 2007, but were only 30% of the flows in 2008 and 15% of the flows in 2006. Maximum water temperatures recorded during sampling in 2009 were generally similar to 2008, but 2-3°C cooler than in 2006 and 2007.

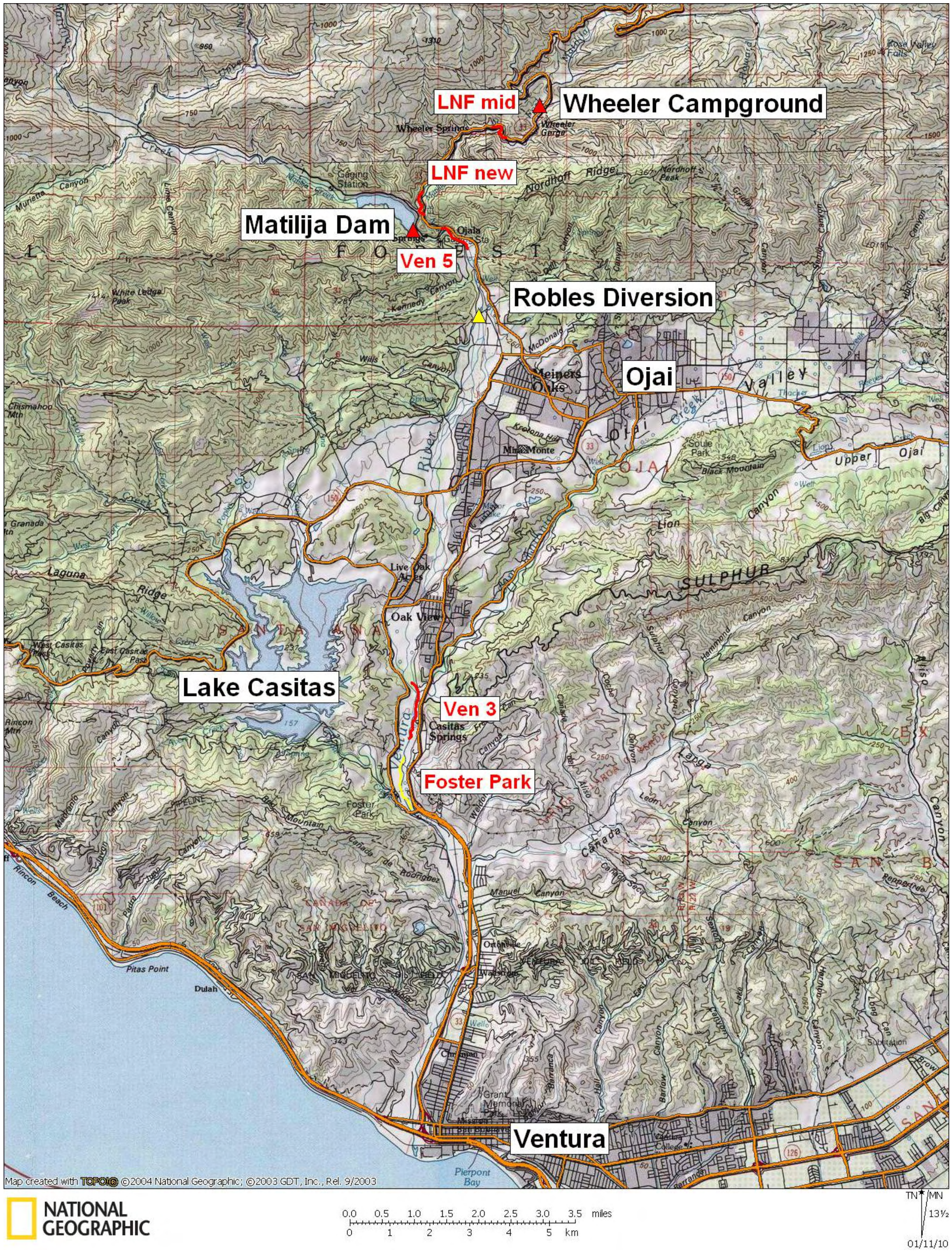

Figure 1. Map showing location of the four study sites sampled in 2009 (the Foster Park reach, sampled independently, is also shown).

Table 1. General sampling statistics for 2009 survey.

Basin Segment	Fish Zone *	HSI Reach	Sampling Dates	# Sampling Units Pools	Flatwaters	Riffles	Est Flow cfs	Water Temps °C Min	Max	# O. mykiss (cm) ** <10	10+
Lower	Anadromous	Ven 1	not sampled	0	0	0	n/a	n/a	n/a	n/a	n/a
below		Ven 2	not sampled	0	0	0	n/a	n/a	n/a	n/a	n/a
Robles		Foster Park***	16-Sep	8	0	0	2.2	17.9	23.3	0	61
Dam		Ven 3	11,12-Aug	6	8	0	4.3	18.3	21.9	0	100
		Ven 4	dry	0	0	0	0	-	-	0	0
		San Antonio	not sampled	0	0	0	n/a	n/a	n/a	n/a	n/a
Middle	Anadromous	Ven 5	12,13-Aug	8	8	0	3.0	18.3	27.4	0	0
between		LNF new	14-Aug	7	0	0	n/a	16.7	18.9	15	14
dams		LNF mid	14-Aug	8	0	0	0.4	15.9	18.3	49	17
Upper	Resident	Mat 3	not sampled	0	0	0	n/a	n/a	n/a	n/a	n/a
above		Mat 5	not sampled	0	0	0	n/a	n/a	n/a	n/a	n/a
Matilija		Mat 7	not sampled	0	0	0	n/a	n/a	n/a	n/a	n/a
Dam		UNF new	not sampled	0	0	0	n/a	n/a	n/a	n/a	n/a

* Anadromous zones also contain resident life-forms ** numbers from first-pass dive counts only *** Foster Park sampled independently

Limited sampling was also conducted in mid-September below the Ven 3 study site in pool habitats adjacent to Foster Park, where a bank protection project is expected to commence in 2010. Ten of the 12 pools found in the 0.7 mi Foster Park reach were sampled by single pass dive counts. Because the Foster Park reach is within the Casitas Springs "live reach", the estimated abundance of *O. mykiss* in the traditional Ven 3 reach was calculated first by *excluding* the new Foster Park data (which is most comparable with estimates from 2006-2008), and also by including the Foster Park as additional single-pass sampling units. Although the Foster Park pool habitats were not randomly selected, all but two of the available pools were sampled (as were all of the Ven 3 pools), and thus the lack of randomization was ignored for this alternative estimate.

The separation of *O. mykiss* into "fry" (<10 cm FL) and "juvenile+" size classes was intended to approximate the proportions of *O. mykiss* represented by young-of-year (age 0+) vs. older age classes (age 1+ and older). Basin-wide sampling in July-August of 2006 and 2007 suggested that the 10cm size criterion was reasonably successful in separating 0+ from older age classes for fish inhabiting tributary streams, but that some 0+ in warmer, mainstem study sites likely exceeded 10cm by mid-summer. The later sampling in 2009 (early to mid-Aug) and especially in 2008 (early to mid-Sept) undoubtedly resulted in a much higher proportion of 0+ *O. mykiss* that exceeded the 10cm length criterion, and were thus classified by divers as "juvenile+" fish. Consequently, these differences in sampling periodicity and spatial/temporal growth rates are expected to somewhat confound the size-specific comparisons of annual abundance. The annual abundance estimates for the "All *O. mykiss*" (e.g., combined size classes) are therefore also included in order to control for this effect (Table 2, bottom).

Results

The abundance estimates from 2009 show the highest numbers of "fry" in LNFmid pool habitats, intermediate abundance in LNFnew pools, and zero abundance in pool and flatwater habitats in the mainstem Ventura River study sites (Table 2 and Figure 2). In contrast, juvenile+ abundance

Table 2. *O. mykiss* abundance estimates in 2009 (Foster Park data not included)

Size Class	Habitat Type	Statistic	Ven 1	Ven 2	Ven 3	Ven 4	Ven 5	LNF new	LNF mid	Mat 3	Mat 5	Mat 7	UNF new
Fry <10cm	Pools	# Units Sampled	0	0	6	0	8	7	8	0	0	0	0
		Abundance	-	-	0	-	0	79	206	-	-	-	-
		Variance	-	-	0	-	0	682	1244	-	-	-	-
		95% C.I.	-	-	0	-	0	64	83	-	-	-	-
		Density (#/mi)	-	-	0.0	-	0.0	270.0	976.0	-	-	-	-
		Variance (#/mi)	-	-	0	-	0	8073	27902	-	-	-	-
		95% C.I. (#/mi)	-	-	0.0	-	0.0	220.0	395.0	-	-	-	-
		Density (#/100ft^2)	-	-	0.00	-	0.00	0.37	1.95	-	-	-	-
		Variance (#/100ft^2)	-	-	0.0000	-	0.0000	0.0148	0.1109	-	-	-	-
		95% C.I. (#/100ft^2)	-	-	0.00	-	0.00	0.30	0.79	-	-	-	-
	Flatwaters	# Units Sampled	0	0	8	0	8	0	0	0	0	0	0
		Abundance	-	-	0	-	0	-	-	-	-	-	-
		Variance	-	-	0	-	0	-	-	-	-	-	-
		95% C.I.	-	-	0	-	0	-	-	-	-	-	-
		Density (#/mi)	-	-	0.0	-	0.0	-	-	-	-	-	-
		Variance (#/mi)	-	-	0	-	0	-	-	-	-	-	-
		95% C.I. (#/mi)	-	-	0.0	-	0.0	-	-	-	-	-	-
		Density (#/100ft^2)	-	-	0.00	-	0.00	-	-	-	-	-	-
		Variance (#/100ft^2)	-	-	0.0000	-	0.0000	-	-	-	-	-	-
		95% C.I. (#/100ft^2)	-	-	0.00	-	0.00	-	-	-	-	-	-
Juv+ ≥10cm	Pools	# Units Sampled	0	0	6	0	8	7	8	0	0	0	0
		Abundance	-	-	134	-	0	60	88	-	-	-	-
		Variance	-	-	8	-	0	25	200	-	-	-	-
		95% C.I.	-	-	7	-	0	12	33	-	-	-	-
		Density (#/mi)	-	-	533.0	-	0.0	206	419	-	-	-	-
		Variance (#/mi)	-	-	130	-	0	292	4,483	-	-	-	-
		95% C.I. (#/mi)	-	-	29.0	-	0.0	42	158	-	-	-	-
		Density (#/100ft^2)	-	-	0.21	-	0.00	0.28	0.84	-	-	-	-
		Variance (#/100ft^2)	-	-	0.00002	-	0.0000	0.0005	0.0178	-	-	-	-
		95% C.I. (#/100ft^2)	-	-	0.01	-	0.00	0.06	0.32	-	-	-	-
Juv+ ≥10cm	Flatwaters	# Units Sampled	0	0	8	0	8	0	0	0	0	0	0
		Abundance	-	-	17	-	0	-	-	-	-	-	-
		Variance	-	-	197	-	0	-	-	-	-	-	-
		95% C.I.	-	-	33	-	0	-	-	-	-	-	-
		Density (#/mi)	-	-	36.0	-	0	-	-	-	-	-	-
		Variance (#/mi)	-	-	916	-	0	-	-	-	-	-	-
		95% C.I. (#/mi)	-	-	72.0	-	0	-	-	-	-	-	-
		Density (#/100ft^2)	-	-	0.03	-	0.00	-	-	-	-	-	-
		Variance (#/100ft^2)	-	-	0.0060	-	0.0000	-	-	-	-	-	-
		95% C.I. (#/100ft^2)	-	-	0.06	-	0.00	-	-	-	-	-	-
All O. mykiss	Pools	# Units Sampled	0	0	6	0	8	7	8	0	0	0	0
		Abundance	-	-	134	-	0	139	295	-	-	-	-
		Variance	-	-	8	-	0	707	1444	-	-	-	-
		95% C.I.	-	-	7	-	0	65	90	-	-	-	-
		Density (#/mi)	-	-	533.0	-	0	477	1,395	-	-	-	-
		Variance (#/mi)	-	-	130	-	0	8,365	32,384	-	-	-	-
		95% C.I. (#/mi)	-	-	29.0	-	0	224	426	-	-	-	-
		Density (#/100ft^2)	-	-	0.21	-	0.00	0.64	2.78	-	-	-	-
		Variance (#/100ft^2)	-	-	0.00002	-	0.0000	0.0153	0.1287	-	-	-	-
		95% C.I. (#/100ft^2)	-	-	0.01	-	0.00	0.30	0.85	-	-	-	-
All O. mykiss	Flatwaters	# Units Sampled	0	0	8	0	8	0	0	0	0	0	0
		Abundance	-	-	17	-	0	-	-	-	-	-	-
		Variance	-	-	197	-	0	-	-	-	-	-	-
		95% C.I.	-	-	33	-	0	-	-	-	-	-	-
		Density (#/mi)	-	-	36.0	-	0	-	-	-	-	-	-
		Variance (#/mi)	-	-	916	-	0	-	-	-	-	-	-
		95% C.I. (#/mi)	-	-	72.0	-	0	-	-	-	-	-	-
		Density (#/100ft^2)	-	-	0.03	-	0.00	-	-	-	-	-	-
		Variance (#/100ft^2)	-	-	0.0060	-	0.0000	-	-	-	-	-	-
		95% C.I. (#/100ft^2)	-	-	0.06	-	0.00	-	-	-	-	-	-

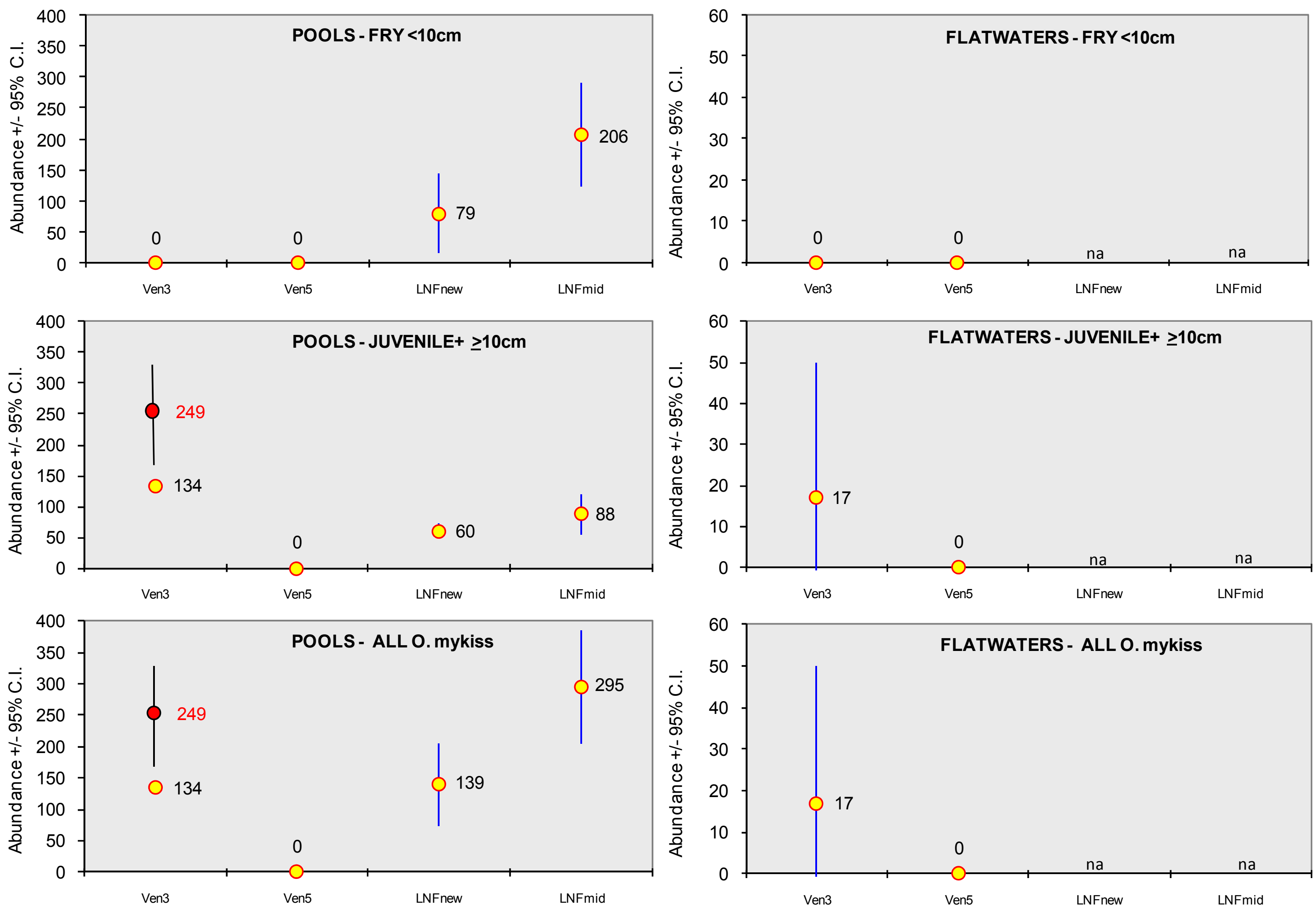

Figure 2. Estimated abundance of fry (<10cm FL) and juvenile+ O. mykiss in August 2009, according to study site and habitat type. Red-filled symbols for Ven 3 juvenile+ and combined estimates include counts from Foster Park (pools only).

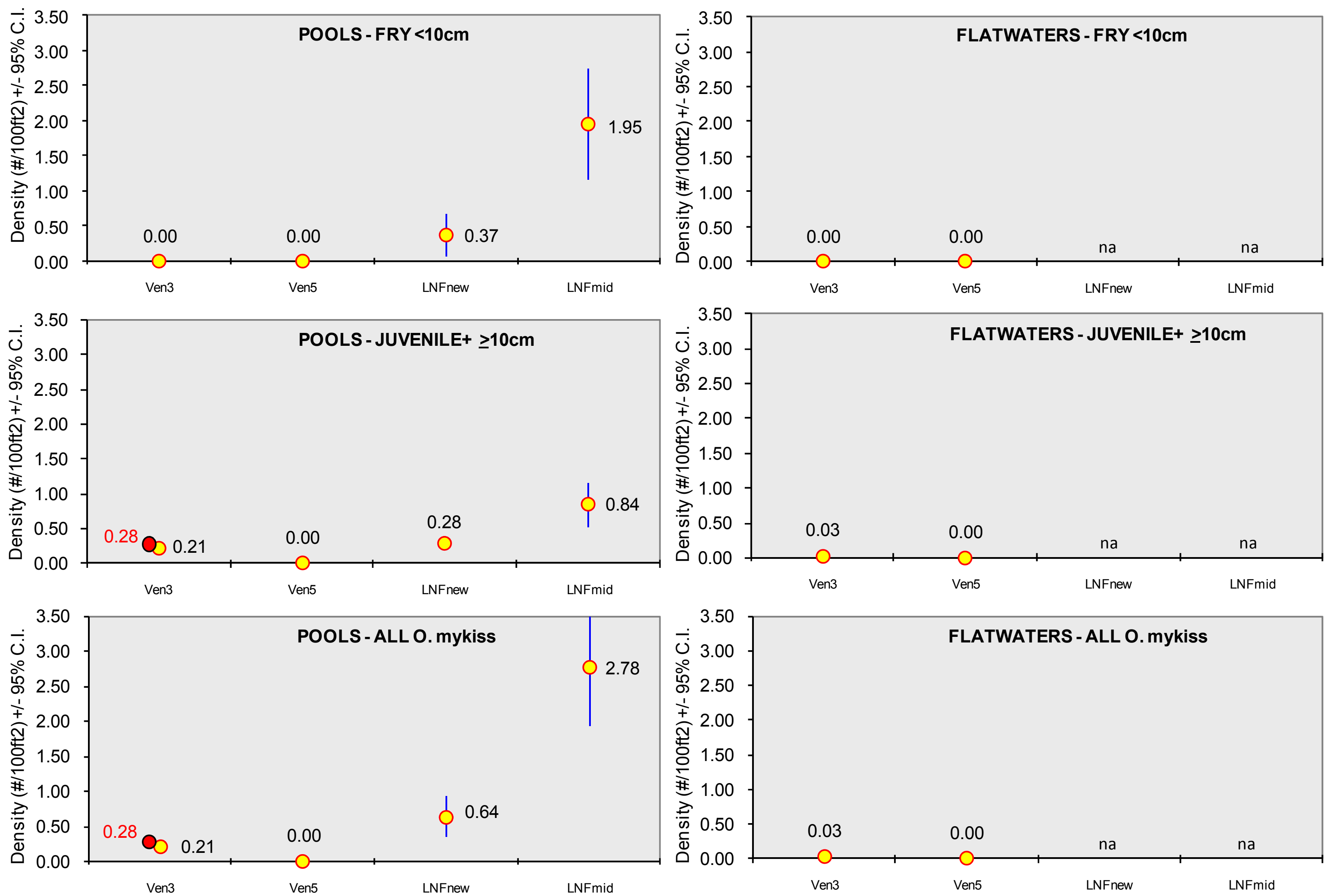

Figure 3. Estimated density (#/100ft^2) of fry (<10cm FL) and juvenile+ O. mykiss in August 2009, according to study site and habitat type. Red-filled symbols for Ven 3 juvenile+ and combined estimates include counts from Foster Park (pools only).

was highest in the mainstem Ven 3 study site (with or without the Foster Park data), with intermediate abundance in the two LNF sites and zero abundance in the Ven 5 study site. When converted to density (in # fish/100ft^2), the density of juveniles becomes highest in the LNFmid study site, with intermediate densities in the LNFnew and Ven 3 sites (Table 2 and Figure 3). The density of both fry and juvenile+ was significantly greater in the LNFmid study site than in the other three study sites, based on non-overlap of 95% confidence intervals. When data were combined to represent basin area, the abundance and density of both fry and juvenile+ *O. mykiss* was far greater in the middle segment (between Robles Diversion Dam and Matilija Dam) than in the lower segment below Robles (Figure 4). [*Note that the estimated abundance and density for the lower segment assumes zero O. mykiss in the Ven 1 and Ven 2 study sites below Casitas Springs, which were not sampled in 2009 but contained zero or near-zero abundance in the preceding three years*].

A comparison of annual abundance over four years from 2006 to 2009 is available for the study sites and habitat types sampled each year (the LNFnew site was not sampled in 2006). For consistency with the 2006-2008 data, the annual comparisons for Ven 3 do not include the 2009 data from Foster Park, but are instead based solely on data from the original Ven 3 study site upstream of Foster Park. The statistical significance of all adjacent annual estimates in pool habitats was assessed using difference equations for 2007-2008 and for 2008-2009, as described in TRPA 2009. For all other annual comparisons, differences were assessed by the more conservative method of verifying overlap in 95% confidence intervals (e.g., non-overlap indicates a significant difference). Significant differences between adjacent years are indicated in the following figures by an asterisk.

For *O. mykiss* fry, abundance declined from relatively low abundance in 2008 to zero abundance in 2009. As previously noted, some of the decline in fry from 2007 to 2008, and from 2008 to 2009, may be attributed to increased growth of fish into the juvenile+ size class. The abundance of fry increased by a minor and insignificant amount in the LNFnew study site, but the increase was three-fold (and statistically significant) in the LNFmid study site (Figure 5). In contrast, the abundance of juvenile+ *O. mykiss* decreased from 2008 to 2009 in all study sites. This decrease was statistically significant for all study sites except for the LNFnew site. Note that in the LNF study sites the 2008-2009 decreases in juvenile+ fish corresponds with the 2007-2008 decreases in fry, which may suggest that a cohort effect is partially responsible for the decrease in juvenile+ fish. This relationship between fry abundance in one year with the juvenile+ abundance the following year was also noted for many study sites in previous surveys, thus suggesting that a strong recruitment of fry can have a significant influence on the abundance of older age classes in following years. When the two size classes are combined, the annual changes from 2008 to 2009 showed significant decreases in the two mainstem study sites, but little change in the two tributary study sites. Annual comparison of abundance in flatwater

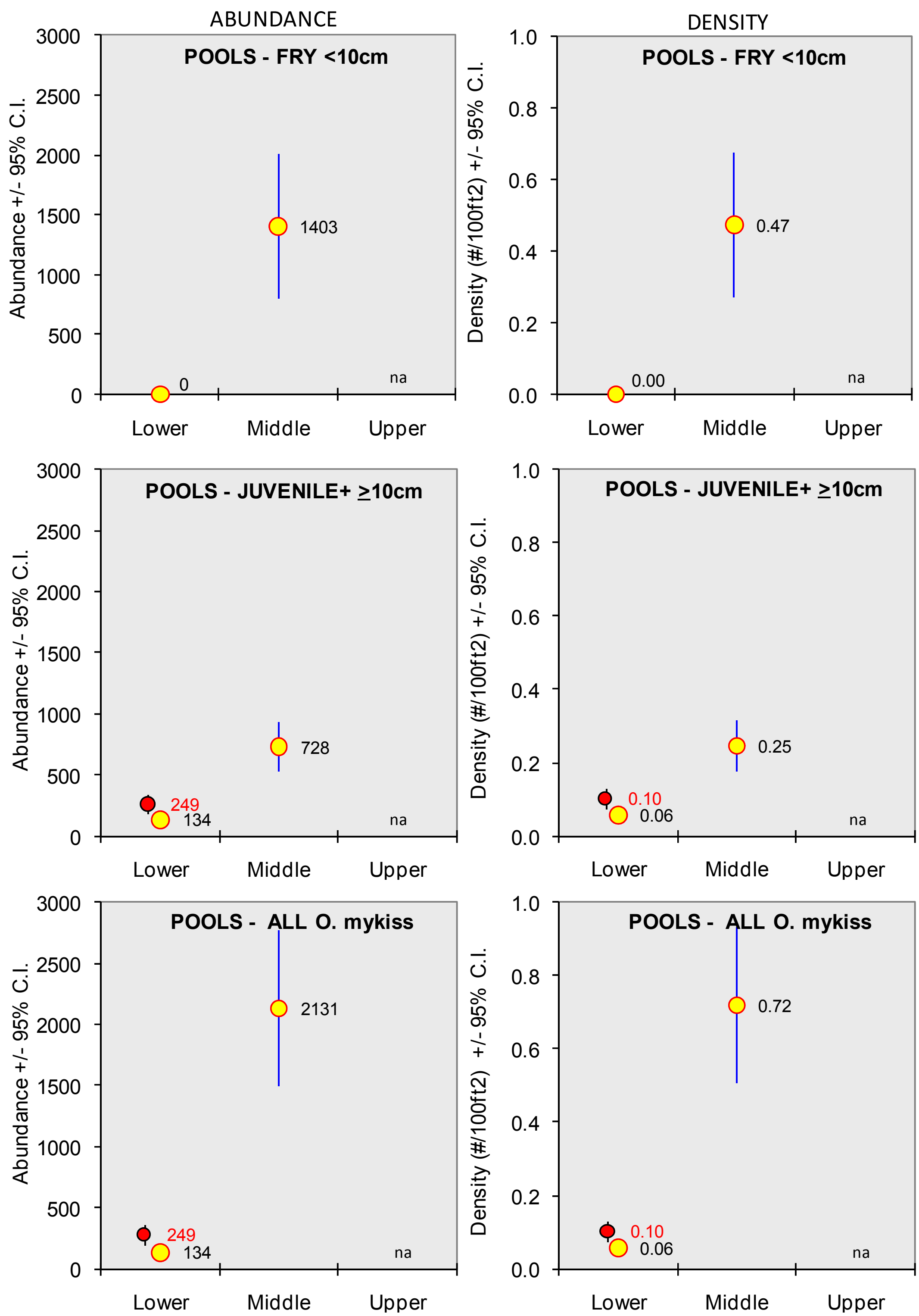

Figure 4. Estimated abundance and density of fry (<10cm FL) and juvenile+ O. mykiss pool habitats in August 2009, according to basin segment. Lower=below Robles Diversion Dam, Middle=between Robles and Matilija Dams, Upper=above Matilija Dam (not sampled in 2009). Red-filled symbols for lower segment juvenile+ and combined estimates include counts from Foster Park.

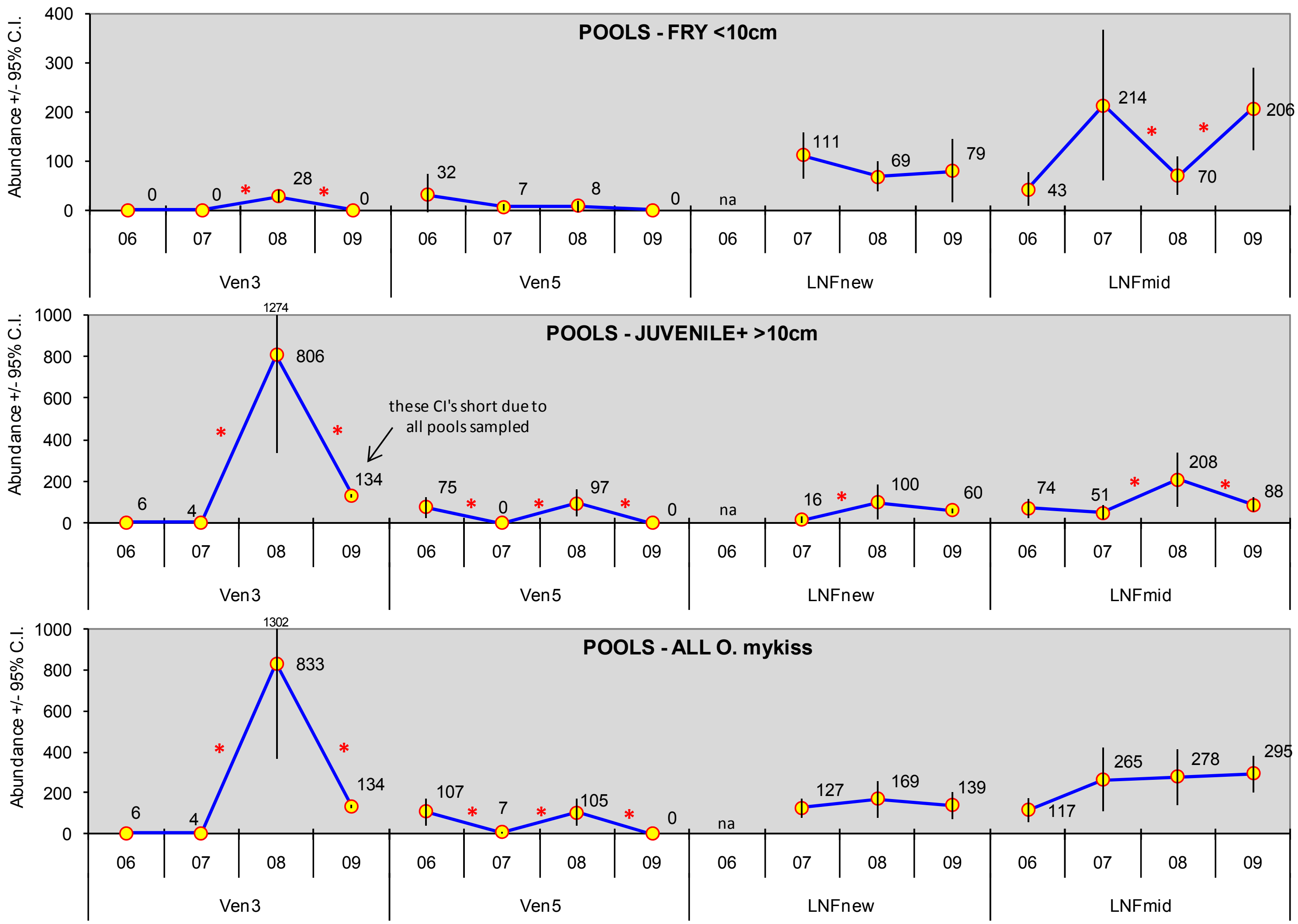

Figure 5. Annual abundance of fry (<10cm FL) and juvenile+ O. mykiss in pool habitats from 2006-2009, according to study site. Asterisks indicate statistically significant differences between adjacent years. (2009 Foster Park data not included)

habitats was only possible for the two mainstem study sites, which showed declines in both fry and juvenile+ abundance from 2008 to 2009 (Figure 6).

Estimates expanded to represent the basin segments (Figure 7) generally reflected the study site trends, with decreased *O. mykiss* fry in the lower segment, increased fry in the middle segment, and decreased juvenile+ and combined size classes in both segments (no upper segment study sites were sampled in 2009).

Conclusions and Additional Observations

The most notable differences in *O. mykiss* abundance in 2009 from prior surveys were the continued presence of juveniles in the Ven 3 study site and the lack of fish in the Ven 5 site. In both 2006 and 2007, a few *O. mykiss* were only observed in one of 22 sampled habitat units (the San Antonio Creek confluence pool or the pool immediately downstream) in the Ven 3 study site, resulting in near zero abundance estimates each year. In contrast, *O. mykiss* were observed in 9 of 13 sampled units in 2008, often in high density, resulting in some of the highest abundance and density estimates in the basin that year (Figures 5 and 6). Although numbers of *O. mykiss* were lower in 2009, fish were observed in six of 14 sampled units (Figure 8), resulting in the highest abundance of juvenile+ fish among the four study sites sampled in 2009 (Figure 2). The addition of pool count data from the Foster Park portion of the Casitas "live reach" in 2009, where juveniles (including one fish estimated at ~16 inches) were observed in four of eight pools), illustrated that *O. mykiss* can successfully inhabit the full length of the Ven 3 study reach at least as far downstream as the Casitas Vista Bridge (approximately 1.2 mi below the bottom of the Ven 3 study site). In previous years, the count data suggested that densities of *O. mykiss* declined to near zero within ¾ mile below the San Antonio Creek mouth, however the Foster Park sampling in 2009 illustrated that significant numbers of juveniles occupy suitable habitat well downstream of that point. The Ven 3 data illustrates the high variability of *O. mykiss* distribution and abundance in this southern California basin; it reveals the potential significance of this mainstem reach in rearing juvenile steelhead (consistent with some historical data, such as Moore 1980); and it also shows the important role of San Antonio Creek for providing spawning and rearing habitat for steelhead.

The Ven 3 study site is also characterized by the occurrence of cold-water inflow in several habitat units, where the seep temperatures were up to 6^{o}F cooler than the main channel. In general, most of these seeps were small (e.g., a couple of ft^2) and did not appear to consistently hold fish. Although the overall magnitude and effect of these seeps on mainstem temperatures is unknown, the San Antonio Creek confluence pool appeared to be cooled in morning hours by about 1^{o}F (from 66.4^{o}F just above the pool to 65.5^{o}F below the pool), due to the combination of cooler (63.4^{o}F) surface inflow from San Antonio Creek (although flowing at only ~0.1 cfs) and additional cold seeps along the pool perimeter. Another notable feature of the Ven 3 study site was the apparent influence of a long (730 ft) and wide (40-102 ft) pool on water visibility. Water visibility (as estimated by divers) below the pool was relatively poor (4-5 ft to see fry), but

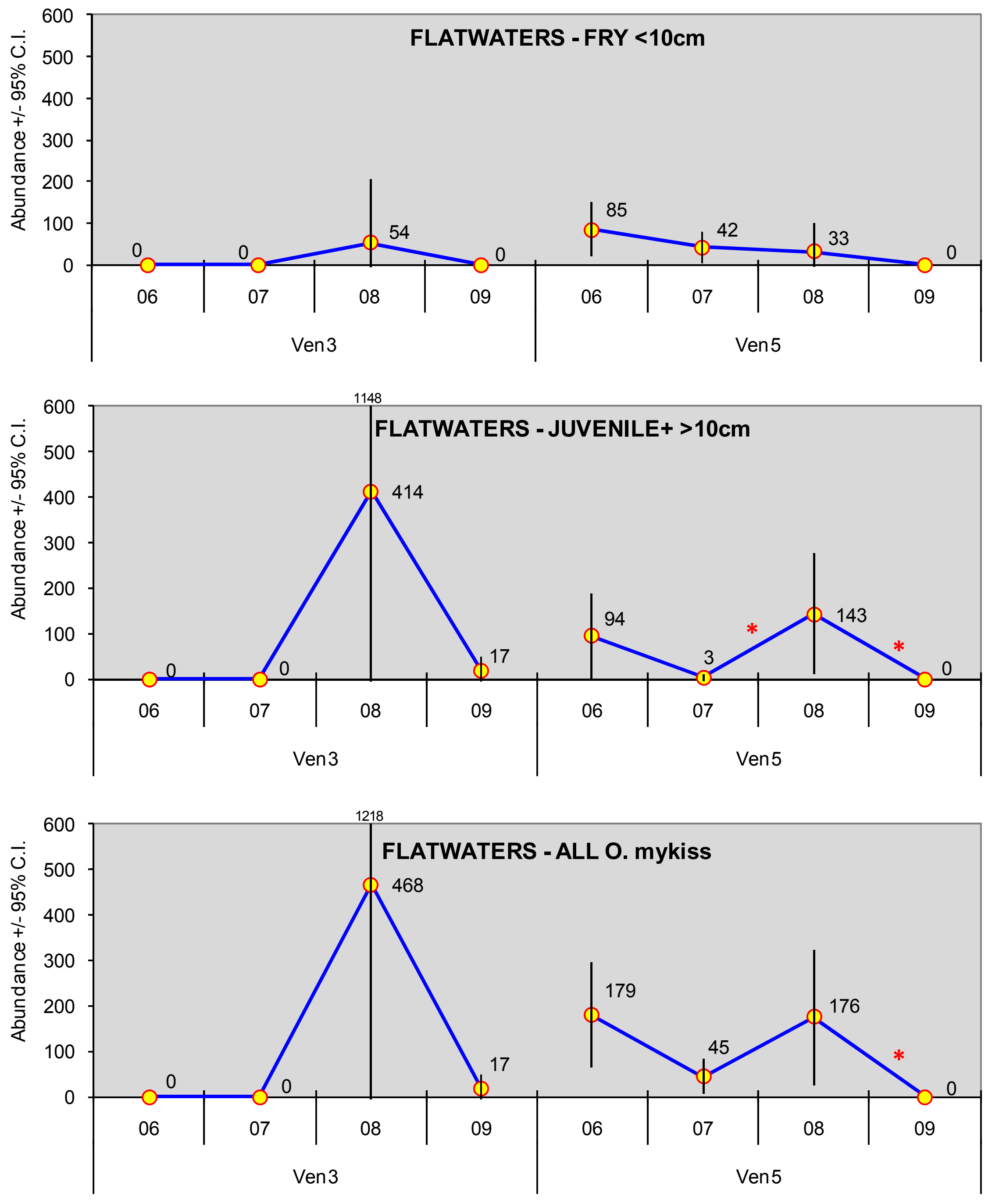

Figure 6. Annual abundance of fry (<10cm FL) and juvenile+ O. mykiss in flatwater habitats from 2006-2009, according to study site. Asterisks indicate statistically significant differences between adjacent years. (2009 Foster Park data not included)

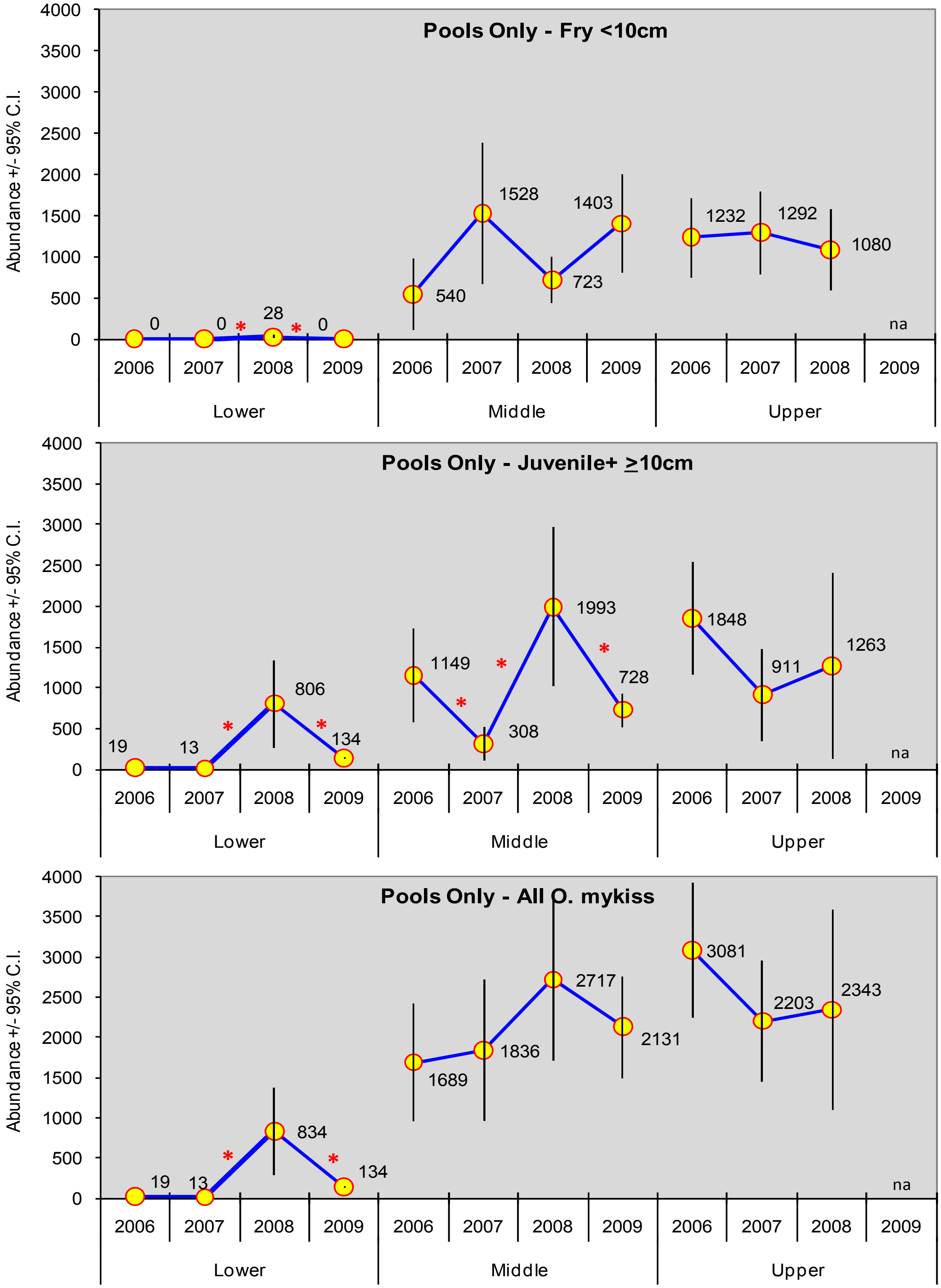

Figure 7. Annual abundance of fry (<10cm FL) and juvenile+ O. mykiss in pool habitats from 2006-2009, according to basin segment. Lower=below Robles Diversion Dam, Middle=between Robles and Matilija Dams, Upper=above Matilija Dam (not sampled in 2009). (2009 Foster Park data not included)

Figure 8. Diver counting fish in the San Antonio Creek confluence pool (left), which contained numerous juvenile+ *O. mykiss* (in center of right photo) amongst schools of arroyo chubs.

upstream of the long pool the visibility was much greater (>7 ft). Divers noted while surveying the pool itself that visibility continually improved as they made their way upstream to the pool head. No surface or subsurface inflow were apparent within this sampling unit (as numerous water temperature reading were made along the rip-rap levee bank), thus it was postulated that the large, slow-flowing pool produced a plankton bloom that was visibly evident.

Cold seeps were not evident in the Foster Park pools sampled one month after the Ven 3 sampling, but several of the pools were thermally stratified, based on temperature and dissolved oxygen profiles. However, there was no obvious relationship between pool stratification and abundance of *O. mykiss* (TRPA, unpublished data).

The lack of any *O. mykiss* observations in the Ven 5 study site immediately below the LNF confluence was unlike prior results, when fish were observed in 23 of 24 sampled units in 2006, in 14 of 25 units in 2007, and in 12 of 16 units in 2008. Divers also noted that even arroyo chub were absent or rare in most Ven 5 units, despite being common in previous years and in the LNFnew study site just upstream. The cause for this lack of fish is unknown; however divers noted what appeared to be an increased amount of fine sediments in this reach, possibly due to the effects of erosion from the Ojai Quarry, the lack of flushing flows over the winter of 2008-2009, or a combination of these two factors. The cooler inflow of the LNF (at 70.4^{o}F) at the top of the Ven 5 study site appeared to have a minor effect on the mainstem water temperature. Above the LNF at noon the mainstem water temperature was measured at 73.9^{o}F, whereas immediately below the confluence the mainstem temperature was 73.5^{o}F. Although cold seeps were not evident in the Ven 5 study site, a large pool at the bottom of the reach was highly stratified in 2009, as also noted in 2007 (but was not stratified in 2008). The highest recorded water temperature of this survey was made immediately upstream of this pool (at 81.3^{o}F in late afternoon), but bottom temperatures throughout the pool were up to 12^{o}F cooler. Despite the cooler bottom temperatures (oxygen levels were not measured in this pool) and abundance of deep water (>5 ft) and instream cover, no *O. mykiss* were observed (only chubs and sunfish). It should also be noted that this pool is heavily used by local residents and fishing equipment is sometimes present.

Also observed was an apparently heavy infestation of black-spot disease on *O. mykiss* fry and juveniles in the LNF study sites in 2009. Black-spot disease (caused by a sub-dermal parasite) is relatively common in southern and central California streams and was previously noted in the Ven 5 study site, the LNF study sites, and in most of the Matilija Creek study sites above Matilija Dam (except in the Upper NF Matilija Creek) in the 2006-2008 surveys. In 2009, however, the black spotting on many *O. mykiss* in the two LNF sites was particularly intense, and suggested a possibly heavier infestation than in previous years.

As also noted in prior reports (see TRPA 2008), riparian vegetation continued to show rapid growth following the scouring effects of the 2005 flood events. Figure 9 shows some comparative photos that illustrate the increased height of riparian trees and density of herbaceous vegetation, which would be expected to increase shading to help cool water temperatures, and also serve to lessen algal growth. The increased density of grasses and shrubs would also enhance allochonous input, including drop of invertebrate prey into the stream.

References

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Figure 9. Comparative photos from 2008 (left photos) and 2009 (right photos) from flatwater unit #13 (top row), flatwater #21 (middle row), and flatwater #48 (bottom row) in the Ven 3 study site. See Figure 9 in TRPA 2008 for comparative photos of unit #21 from 2006 and 2007.