HABITAT CONSERVATION PLAN
BIOLOGICAL MONITORING PROGRAM
San Marcos Springs/River Ecosystem

HIGH FLOW ADDENDUM TO 2015 ANNUAL REPORT

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INTRODUCTION

In 2015, the weather pattern shifted in central Texas due to a strong El Niño pattern that brought much needed precipitation to the San Marcos River watershed. Unfortunately, these rains brought destructive flooding culminating in two high-flow sampling efforts in 2015. The first occurred in June when significant rains fell over the Blanco River causing it to overflow its banks and flow into the San Marcos River near the I-35 highway. These data are presented in the 2015 San Marcos River Comprehensive Monitoring Annual Report (BIO-WEST 2015). A more destructive event occurred on October 30, when a large storm centered over the upper San Marcos River watershed led to significant flooding in the Sink and Purgatory Creek drainages. Unfortunately this event caused the United States Geological Survey (USGS) gage to malfunction, therefore no estimate of the peak flow in the San Marcos River is known. Observations (and photographs) make it clear that a large amount of flow was generated in the Purgatory Creek drainage. This creek flows into the San Marcos River at Bicentennial Park, and resulted in large-scale flooding here and at parks downstream. In addition, a large volume of water came into the San Marcos River from Sink Creek which flows into the river at Spring Lake. This caused flood disturbance in the San Marcos River above the mouth of Purgatory Creek. The data presented below represent sampling completed following the October flood. Please note that by design, high-flow sampling efforts do not include all comprehensive monitoring components (e.g. Macroinvertebrate community sampling, see BIO-WEST 2015, Appendix A). For sampling methodology please refer to the 2015 San Marcos River Comprehensive Monitoring Annual Report (BIO-WEST 2015).

OBSERVATIONS

Water Quality

A summary of water quality data for the November 2015 water quality sampling effort is presented in Tables 1 and 2. Temperatures varied minimally between all sites during the water quality sampling event (Table 1). Dissolved oxygen (DO) concentrations varied from 4.80 mg/l to 8.33 mg/l. The Total Suspended Solids (TSS) values were much higher than normal due to the runoff flows associated with the October flooding event. Values ranged from <1.67 to 18.0 mg/l (Table 2). Alkalinity was consistent between sites (Table 2), with values similar to those measured previously (BIO-WEST 2015). All of the Soluble Reactive Phosphorous (SRP) concentrations and several of the total phosphorous (TP) concentrations were below laboratory detection limits (<0.05 mg/L and <0.02 mg/L, respectively), which are also well below the Texas Commission on Environmental Quality's screening values of 0.1 mg/L and 0.2 mg/L, respectively (Table 2). Nitrate values varied from 0.65 mg/l in Sink Creek to 1.81 mg/l at the Sessom's Creek site, whereas ammonium values were well below 0.5 mg/L (Table 2). The median concentration of nitrate in the Edward's Aquifer ranges from 1.4 to 1.7 mg/L (Bush et al. 1998), which is consistent with the values measured during this event. The total nitrate values for the San Marcos River are influenced by the high nitrate concentrations.

Table 1. Summary of San Marcos Springs/River ecosystem physical water quality measurements from the November high-flow sampling effort.

Location	Time	Depth (ft)	Temp (°C)	DO (mg/L)	pH	Conductivity (µs/cm)
Hotel	9:21	8.3	21.12	5.01	7.11	588
Submarine	9:31	3.9	20.71	5.06	7.11	599
DS of Boat Dock	9:37	2.1	21.27	5.95	7.12	589
Above Chute	10:25	2.0	21.10	5.75	7.12	595
US of Dam	No sample due to flooding					
Landing Dock	9:42	0.9	20.72	5.71	7.18	582
Boardwalk	No sample due to flooding					
DS of Road	10:01	1.5	20.48	5.11	7.42	622
Sink Creek	9:04	2.2	19.51	4.80	7.42	581
Below Chute	10:32	0.8	21.12	7.75	7.28	559
Below Dam	10:16	0.9	21.61	7.89	7.34	582
Sessom's Creek	10:39	0.4	21.54	6.94	7.25	562
City Park	10:55	4.7	21.75	8.15	7.30	583
Rio Vista Park	11:15	7.1	21.63	8.31	7.33	571
I-35 Crossing	11:30	1.1	20.99	7.86	7.40	564
Thompson Isl. Artificial	11:43	4.9	21.10	7.63	7.45	576
Thompson Isl. Natural	11:47	1.6	21.03	8.33	7.51	550
Animal Shelter	12:06	1.4	20.35	8.30	7.52	560

Table 2. Summary of San Marcos Springs/River ecosystem water quality analytical results from the November high-flow sampling effort.

Location	TSS	Alkalinity (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Total N (mg/L)	SRP (mg/L)	Total P (mg/L)
Hotel	<1.67	260	<.01	1.39	1.55	<.05	<.02
Submarine	<1.67	250	<.01	1.34	1.52	<.05	<.02
DS of Boat Dock	<1.67	250	<.01	1.42	1.55	<.05	<.02
Above Chute	<1.67	260	0.02	1.58	1.97	<.05	0.02
US of Dam	No sample due to flooding						
Landing Dock	<1.67	250	<.01	1.37	1.51	<.05	<.02
Boardwalk	No sample due to flooding						
DS of Road	4.0	260	0.01	0.81	1.08	<.05	<.02
Sink Creek	11.0	250	0.01	0.65	1.07	<.05	0.05
Below Chute	15.0	230	0.02	1.60	1.85	<.05	0.05
Below Dam	<1.67	270	0.02	1.47	1.61	<.05	<.02
Sessom's Creek	6.2	240	<.01	1.81	2.03	<.05	0.04
City Park	2.2	250	0.01	1.51	1.65	<.05	0.03
Rio Vista Park	3.3	250	0.01	1.46	1.54	<.05	0.02
I-35 Crossing	9.8	240	0.02	1.43	1.59	<.05	0.03
Thompson Isl. Artificial	5.3	250	0.02	1.43	1.69	<.05	0.04
Thompson Isl. Natural	9.8	260	0.02	1.43	1.64	<.05	0.74
Animal Shelter	18.0	230	0.02	1.36	1.55	<.05	0.04

Aquatic Vegetation Mapping

Maps of aquatic vegetation observed during the November high-flow critical period sampling effort are presented in Appendix A with a summary of observations per study reach presented below.

Spring Lake Dam Reach

The Spring Lake Dam Reach is the most upstream reach of the San Marcos River in this study. Just upstream in Spring Lake, Sink Creek enters, while Sessom's Creek enters within the reach itself. Total surface area of aquatic vegetation decreased with each successive sampling period in 2015 (Figure 1). This culminated in the lowest total (659.5 m^2) following the October flooding event; the lowest amount of vegetation in this reach since study inception in 2001. Texas wild-rice (*Zizania texana*) (598.4 m^2) made up 91% of the total vegetation left. *Vallisneria*, *Ludwigia*, and *Potamogeton* were no longer present while *Hydrilla* (8.5 m^2), *Hygrophila* (38.3 m^2), and *Sagittaria* (7.0 m^2) were much reduced from previous sampling efforts. The onset of the growing season in 2016 will determine how well these plants recover, and whether the ones lost will re-establish within the Spring Lake Dam Reach.

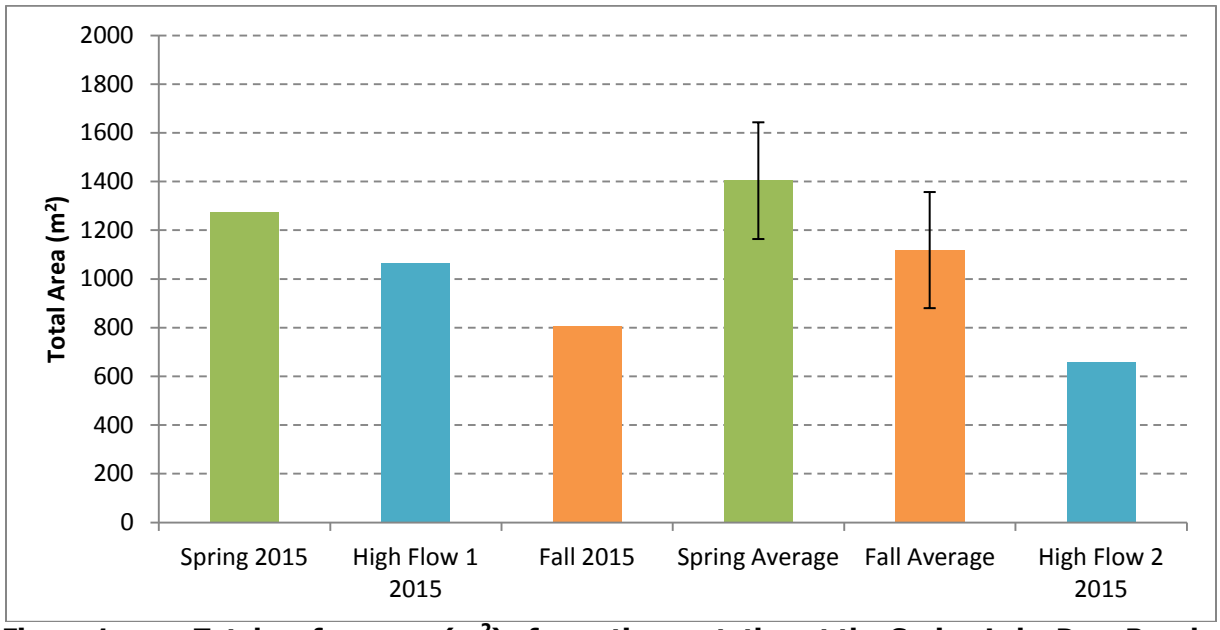


Figure 1. Total surface area (m^2) of aquatic vegetation at the Spring Lake Dam Reach. Long-term study averages are provided with error bars representing one standard deviation from the mean.

City Park Reach

Aquatic vegetation in the City Park Reach followed a similar pattern observed upstream with total surface area decreasing throughout 2015 (Figure 2). Total surface area decreased by 28% from fall (2,702.6 m^2) to the second high-flow sampling effort (1,938.2 m^2). Like the Spring Lake Dam Reach this was the lowest recorded total since the study began. *Hydrilla* was affected the most in the City Park Reach following the October flood decreasing by 70% with much of the scouring occurring in the downstream section of the reach where depths are greater (Appendix A). Like upstream, Texas wild-rice was relatively unaffected only decreasing by 13% from fall (1,448.9 m^2) to the second high-flow effort (1,260.7 m^2). This reach is situated upstream of the mouth of Purgatory Creek where significant flooding occurred, and partially explains why aquatic vegetation in the City Park Reach was less affected than the other study reaches.

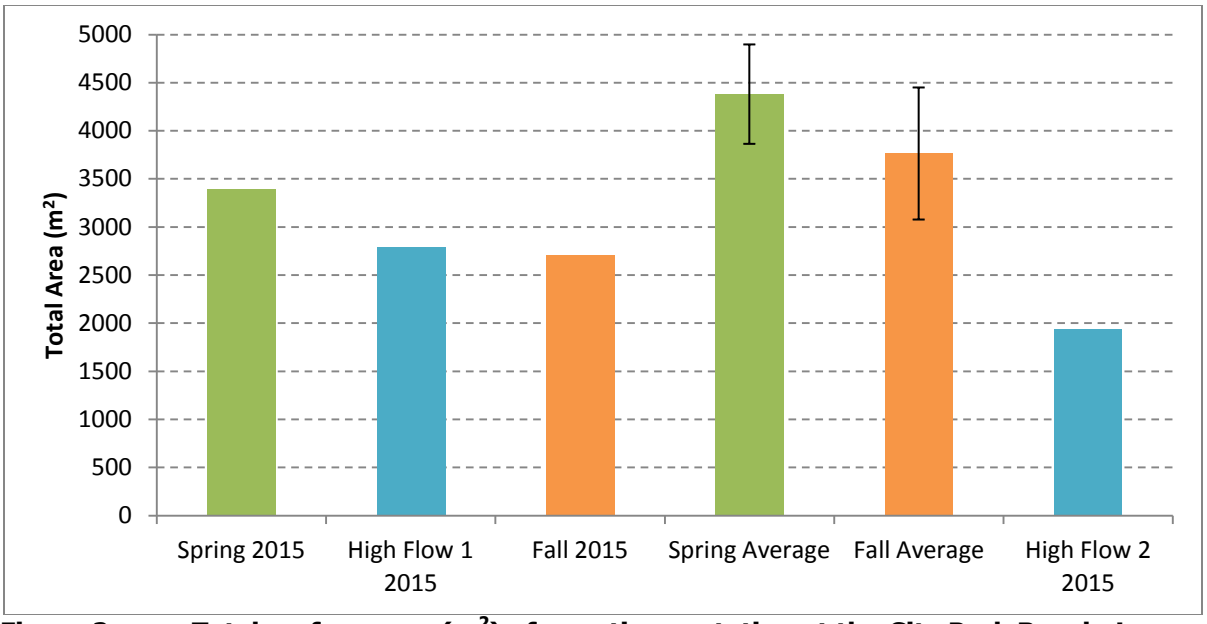


Figure 2. **Total surface area (m^2) of aquatic vegetation at the City Park Reach. Long-term study averages are provided with error bars representing one standard deviation from the mean.**

I-35 Reach

Unlike the other two study reaches, aquatic vegetation at the I-35 Reach increased from the June high-flow event (1,584.4 m^2) to fall (1,767.7 m^2), but fell by 56% following the October flooding event (Figure 3). Total surface area of *Hydrilla* only decreased by 32%, while *Hygrophila* and *Cabomba* decreased by 74% and 87%, respectively. Unlike the upper study reaches, Texas wild-rice was severely reduced following the October flooding decreasing from 374.2 m^2 (Fall) to 81.7 m^2 (High-flow 2), representing a 78% decrease. For Texas wild-rice, much of the scouring occurred in the upper/middle portions of the reach where depths are lower and velocities higher (Appendix A). As stated earlier, Purgatory Creek enters the San Marcos River upstream of the I-35 Reach. Unlike the Spring Lake Dam Reach, most of the species of aquatic vegetation remain in the I-35 Reach, just in reduced coverage. This will likely lead to a resurgence when the growing season begins in 2016 (assuming no more scouring events).

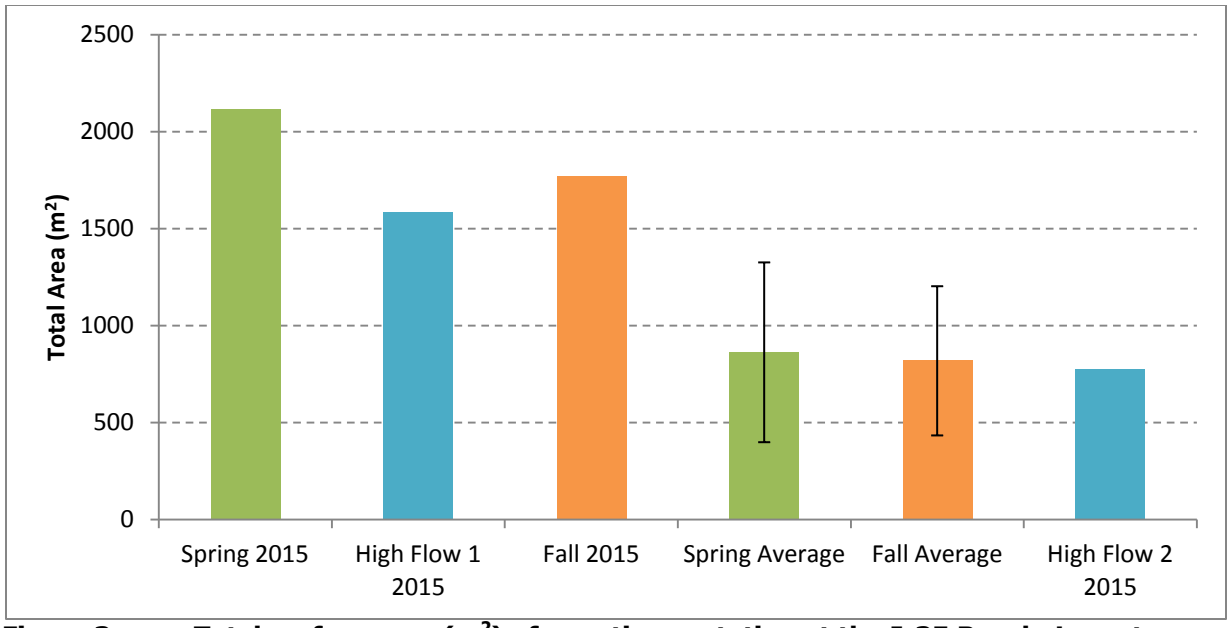


Figure 3. **Total surface area (m^2) of aquatic vegetation at the I-35 Reach. Long-term study averages are provided with error bars representing one standard deviation from the mean. Note that the reach was expanded in 2014 resulting in greater surface area of aquatic vegetation.**

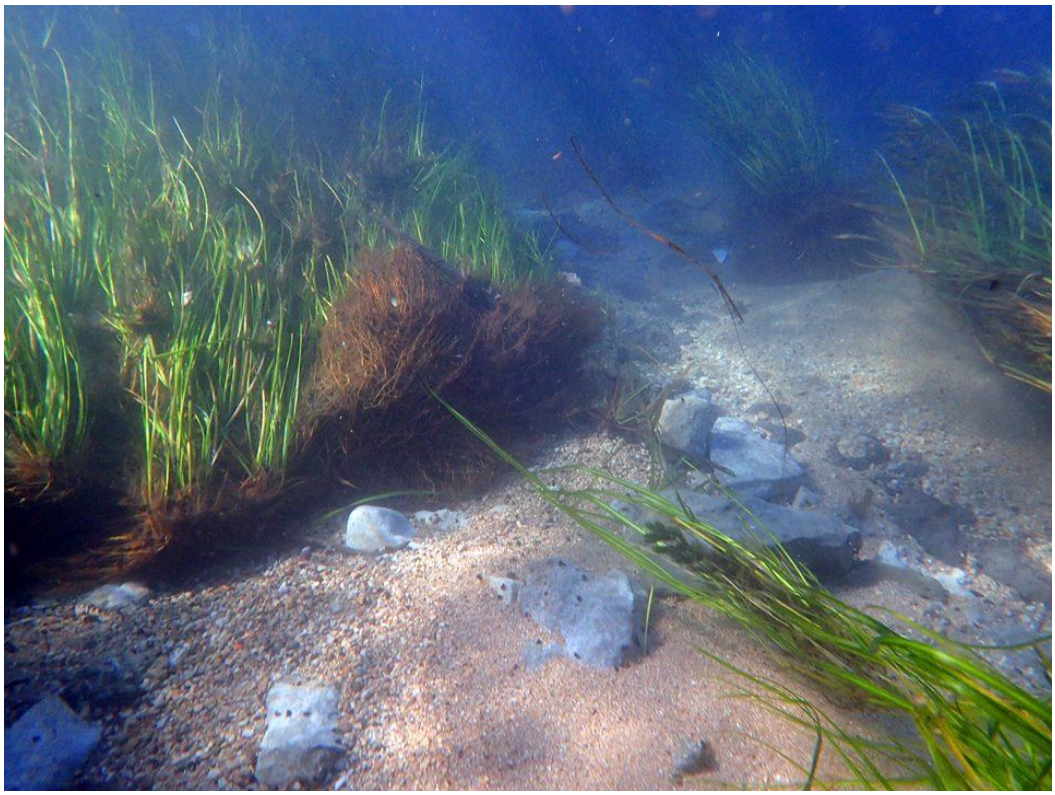
The top of the I-35 Reach, looking downstream from Cheatham Street bridge, October 2015.

Texas Wild-rice Annual Mapping

Texas wild-rice maps for the entire San Marcos River broken out by river segment can be found in Appendix A. In June 2015, total surface area of Texas wild-rice in the San Marcos River was the highest it has been since mapping began for this project in 2001. Texas wild-rice covered 7,489.0 m^2 in late June due to HCP restoration/planting efforts taking place throughout the river. In August 2014, monitoring observed 54 stands of Texas wild-rice occurring below the I-35 highway covering 121 m^2. The June 2015 flood reduced this number to just 4 stands with these stands only occurring between I-35 and Cape's Dam and covering only 19 m^2. These stands were observed during the August 2015 survey but after the October flood event these remaining stands were not found and only two small plants (collected as points) were observed in the nearly one mile stretch from I-35 to the historical limit of Texas wild-rice distribution below the San Marcos Waste Water Treatment Plant. It was not apparent that any Texas wild-rice roots remained intact in this lower reach as much of the river bed below I-35 was subjected to extreme scour evident by deeper pools, exposed bedrock, and the lack of other types of aquatic vegetation.

As stated previously, the October flooding event had a greater impact in the upper San Marcos River. All major tributaries of the San Marcos River, including Sink, Sessom's, and Purgatory creeks, received significant floodwaters and additional urban runoff concentrated into the river channel. During this event the level of Spring Lake rose up to 5 feet and the San Marcos River crested above 6 feet at the University Drive Bridge. This resulted in a 32% reduction in Texas wild-rice coverage to 5,065.5 m^2 (Figure 4). This was the lowest total since summer 2013 (5,019.1 m^2). Currently, Texas wild-rice only extends to just upstream of the I-35 highway bridge, with the few plants just downstream of Cape's Dam no longer present.

In general river bed scour from the October flood was observed to be the main action resulting in severe to extreme damage to Texas wild-rice stands in many locations. River bed scour typically damages Texas wild-rice as sand and gravel is removed from around the roots undermining the root structure leading to the complete uprooting of large clumps of plants. Sediment accretion was also observed in some locations but to a lesser extent. Accretion of large amounts of sediment and sand can smother Texas wild-rice plants although the ability of Texas wild-rice to recover from sediment accretion is possible since the root zone remains intact. In areas where Texas wild-rice remained intact a decrease in top growth biomass was evident, but this type of damage is typically short lived until Texas wild-rice re-grows culms and leaves.



Disturbance of Texas wild-rice roots showing how root undermining can result in complete loss of stands. Photo courtesy of Susan Carper Hanson.

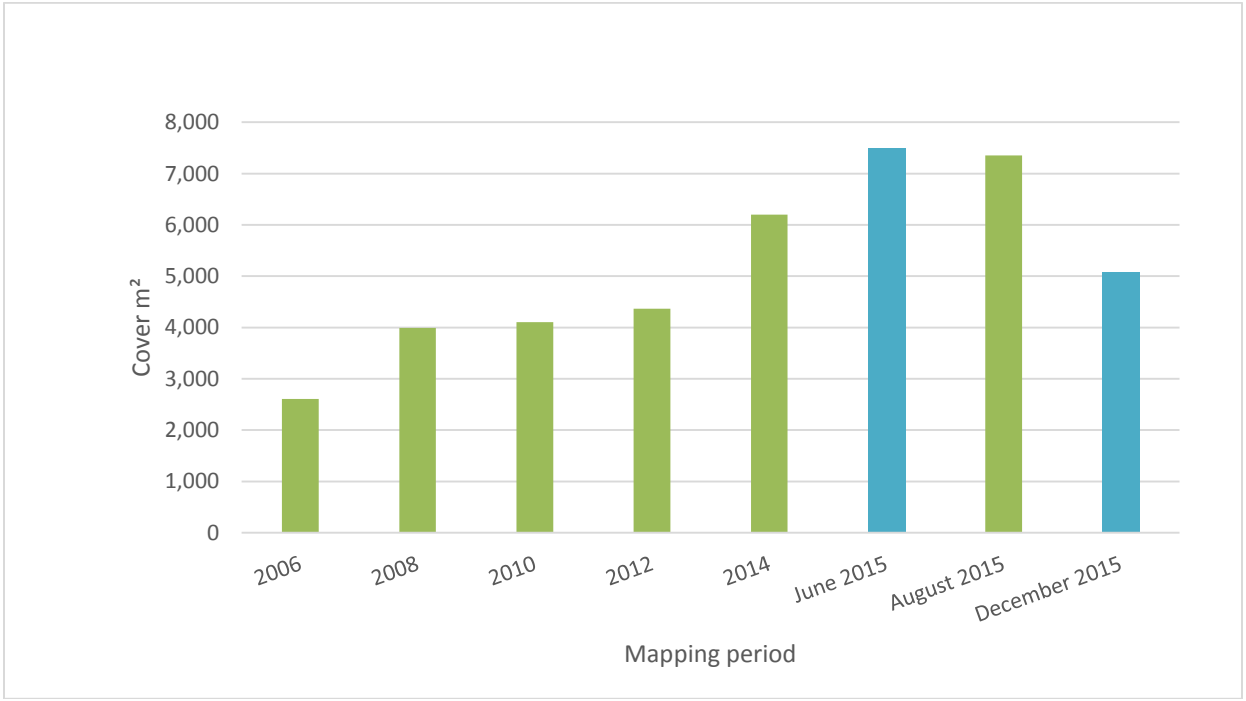


Figure 4. Total surface area of Texas wild-rice stands across selected years in the San Marcos River. Blue represents high-flow Critical Period mapping efforts.

Texas Wild-rice Physical Observations

Observations for vulnerable stands of Texas wild-rice were conducted five times during 2015 with the final effort occurring shortly after the October flooding event (Table 3). Physical observations were made for vulnerable Texas wild-rice stands within two study reaches, the Sewell Park Reach and the I-35 Reach. Methods for physical observations were revised in 2015. To help better assess the coverage of designated vulnerable Texas wild-rice stands, rectangular plots encompassing each stand were mapped in GIS to provide a reference area (BIO-WEST 2015). Stand cover measured within the plot was then used to better document the expansion and retraction of Texas wild-rice. Whereas previously when a vulnerable stand fragmented it was difficult to tell which smaller clumps were once part of the original larger stand and typically only one of the smaller clumps was measured for areal cover while the areal cover of the surrounding clumps was not taken into consideration. With a designated plot all rice within the plot is now mapped providing a more accurate areal cover estimate. Two additional stands were added in the Sewell Park Reach, and three new stands were added to the I-35 Reach. All other stands were relocated from previous years. The coverage of each vulnerable stand in the San Marcos River is presented below (Table 3). Qualitative data and observations were made on each vulnerable stand for a variety of factors such as root exposure, water velocity, minimum depth, percent cover, percent of stand flowering and seeding, percent covered by floating vegetation mats, stand depth, herbivory, and emergence.

Sewell Park

The vulnerable Texas wild-rice stands in Sewell Park are located immediately below University Drive bridge and consequently just downstream of the mouth of Sessom's Creek. However, two additional stands that were added prior to the October flood are actually within the Spring Lake Dam study reach (see Figure 16 of the 2015 San Marcos Biomonitoring Annual Report). Like the initial high-flow sampling effort in June, total surface area of vulnerable plants in this reach actually increased following the October flooding event. Much of these increases in surface area were observed at plants 1 and 4/5. Plant 1 is directly across from the mouth of Sessom's Creek, and likely experienced less disturbance because it was not downstream. Similarly, Plant 4/5 while downstream of the mouth is located on river left on the other side of the San Marcos River. In addition, these are large, well-established plants with firm roots that have weathered other flooding events in the past. Plant 8 was the only Texas-wild rice plant completely lost following the October flood. This plant was located just downstream of the mouth of Sessom's Creek adjacent to a gravel bank that has shifted in previous years because of the lack of vegetation and its proximity to the mouth of Sessom's Creek.

Stand flows decreased from fall (1.07 ft/s) to the second high-flow sampling effort (0.69 ft/s), while no plants were considered emergent (a trend that has continued since spring). In addition, there were no vegetation mats, no Texas wild-rice flowering or seeding, and no obvious signs of herbivory. Root exposure decreased slightly from fall (1.6) to the second high-flow sampling effort (1.0). Interestingly, root exposure was lower in 2015 than previous years despite the higher flows.

Table 3. Total surface area (m^2) of vulnerable Texas wild-rice stands in the San Marcos River in 2015.

STAND NUMBER	SPRING	HIGH-FLOW 1	FALL	HIGH_FLOW 2
Sewell Park 1	41.52	59.21	47.11	61.54
Sewell Park 2	2.47	3.62	1.92	4.78
Sewell Park 3	1.85	2.36	Gone	Gone
Sewell Park 4/5	50.52	53.79	48.51	60.56
Sewell Park 6	1.81	1.88	2.14	1.57
Sewell Park 7	53.63	84.12	61.90	47.63
Sewell Park 8	5.46	3.38	1.2	Gone
Total	**157.26**	**208.36**	**162.78**	**176.08**
I-35-1	4.23	3.08	1.2	Gone
I-35-2	0.7	0.51	Gone	0.86
I-35-3	1.47	1.49	0.89	Gone
I-35-4	59.21	39.04	58.97	20.00
I-35-5	3.04	1.90	0.97	Gone
I-35-6	1.8	2.93	Gone	Gone
I-35-7	11.27	13.05	13.94	9.90
I-35-8	15.95	18.15	12.7	3.64
I-35-9	11.85	10.88	15.81	3.78
I-35-10	19.55	21.42	21.47	Gone
Total	**129.07**	**112.45**	**125.95**	**38.18**

I-35 Reach

Ten vulnerable Texas wild-rice stands were located in the I-35 Reach with three new stands added in 2015 (see Figure 17 of the 2015 San Marcos Biomonitoring Annual Report). Unlike vulnerable stands in the Sewell Park Reach, Texas wild-rice within the I-35 Reach decreased in surface area by 70% from fall (125.95 m^2) to the second high-flow sampling effort (38.18 m^2) (Table 3). As mentioned previously, this reach is downstream of the mouth of Purgatory Creek, which resulted in greater disturbance to aquatic vegetation than areas upstream. Four vulnerable Texas wild-rice plants were no longer present in the I-35 Reach that had been there only a month previous. Plants 1, 3, and 5 were located in very shallow water with typically higher velocities, and were already much reduced in surface area compared to earlier in 2015. Plant 10 was also scoured out (though a few strands of leaves remained), but unlike the other plants, Plant 10 covered nearly 22 m^2 prior to the October flood. This plant was located in shallow water, but near a backwater in a somewhat protected portion of the reach. The loss of this plant underscores

how extensive and damaging the October flooding event was in the San Marcos River. In addition, plants 4, 8, and 9 were all reduced by at least 65% following the flood.

Stand flow was slightly higher following the flood (1.6 ft/s) compared to the fall sampling effort (1.5 ft/s). As in the Sewell Park Reach, no plants were emergent, flowering, or had evidence of herbivory likely due to the greater depths. Root exposure was considered "severe" in only one stand (#4) while root exposure in stands 3, 5 and 9 was considered "moderate". In addition, no vegetation mats were present likely due to the flood pushing any downstream.

Fountain Darter Sampling Results

Drop-net Sampling

A total of 27 drop net samples were conducted on the San Marcos River during the second high-flow sampling effort. Table 4 shows the number of drop-net samples taken from each vegetation type in each reach during the sampling effort. Due to the scouring of vegetation in the Spring Lake Dam Reach, no *Potamogeton* was sampled and a new vegetation type, *Hydrocotyle* was sampled.

Table 4. Drop-net sites and vegetation types sampled in each reach in the San Marcos River during the second high-flow sampling event.

Vegetation Type	Spring Lake Dam	City Park	I-35	Total
Hydrilla		2	3	**5**
Hygrophila	2	2	2	**6**
Potamogeton/ Hygrophila		2		**2**
Sagittaria	2	2	2	**6**
Cabomba			1	**1**
Hydrocotyle	1			**1**
Open	2	2	2	**6**
TOTAL	**7**	**10**	**10**	**27**

From these drop net samples, a total of 162 fountain darters were collected following the October flood. In 2015, 307 darters were collected during the spring effort, and 202 darters were collected during the fall. Submerged aquatic vegetation is a critical component of fountain darter habitat in the San Marcos River, as demonstrated by the density of fountain darters in open habitats ($0.10/m^2$) versus vegetated habitats ($2.3–11.6/m^2$) (Figure 5). Although variation is high between vegetation types, native vegetation types that provide thick cover at or near the substrate such as *Cabomba* ($8.0/m^2$) tend to have the highest fountain darter densities, whereas open substrate with no vegetation has relatively low densities.

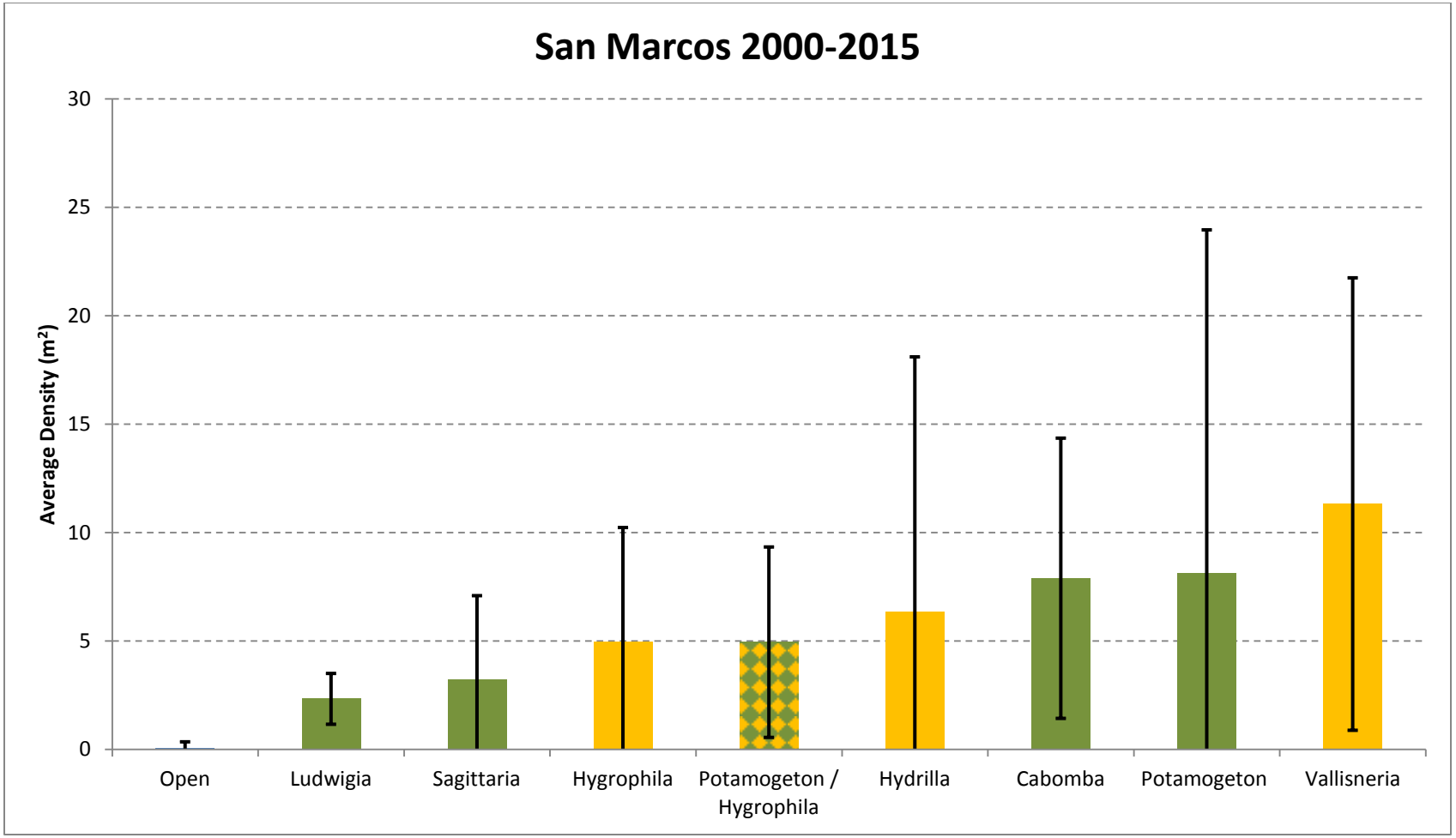


Figure 5. **Average fountain darter density for each sampled vegetation type in the San Marcos River from 2000–2015. Green represents native vegetation, while yellow reflects nonnative types. Long-term study averages are provided with error bars representing one standard deviation from the mean.**

Estimates of fountain darter population abundance (Figure 6) were made according to vegetation coverage within the study reaches and average density of fountain darters found in each vegetation type. The second high-flow population estimate was lower than the fall 2015 estimate and lower than the high-flow average population estimate (Figure 6). High-flow estimates are typically lower because of the scouring of vegetation from the study reaches during flood events. Higher flows following flood events may also influence sampling efficiency. It does stand out that the fall 2015 fountain darter normalized population estimate was lower than all other averages, and outside one standard deviation. This is a result of decreased aquatic vegetation coverage in fall 2015, particularly in the Spring Lake Dam and City Park reaches. This lack of aquatic vegetation was further reduced following the October flood, resulting in the very low normalized population estimate.

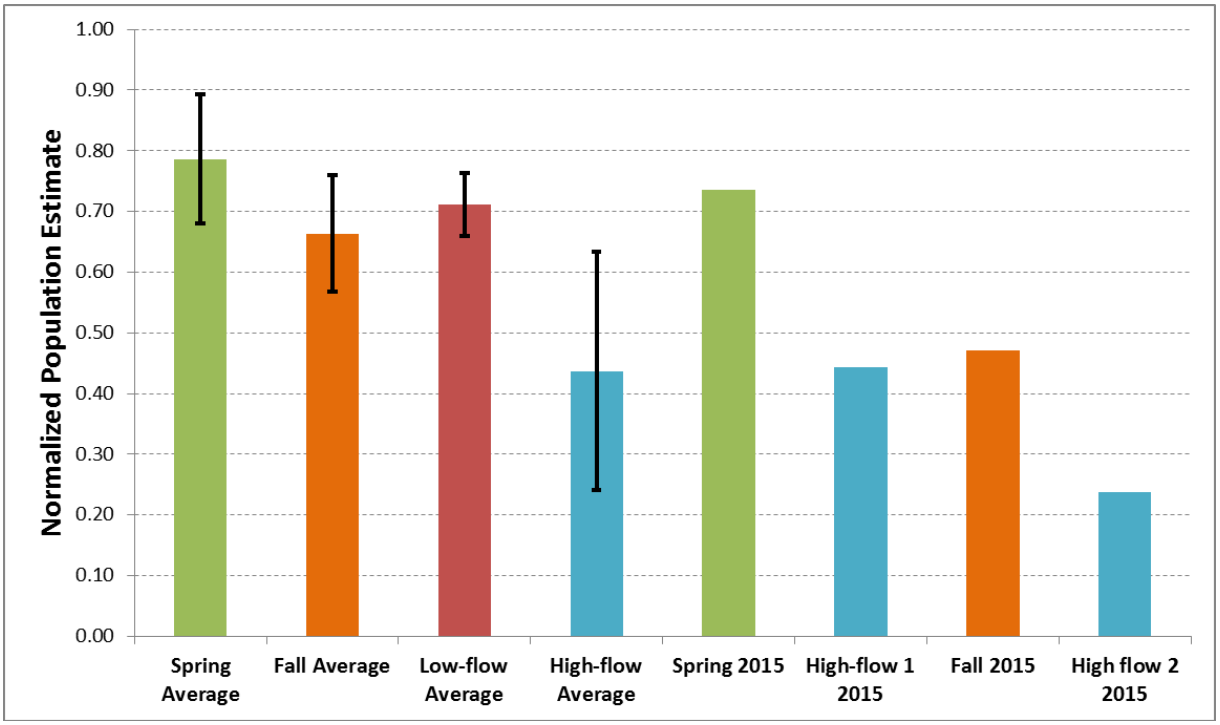


Figure 6. Normalized population estimate for all events 2000–2015. Long-term study averages are provided with error bars representing one standard deviation from the mean.

In addition to fountain darters, 57,515 fishes representing 27 other taxa have been collected by drop netting since 2000 (Table 5). Commonly captured exotic or introduced species include the rock bass (*Ambloplites rupestris*), Texas cichlid (*Herichthys cyanoguttatus*), redbreast sunfish (*Lepomis auritus*), and the sailfin molly (*Poecilia latipinna*).

Table 5. Fish taxa and the number of each collected during drop net sampling. N/I – Native/Introduced.

FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS	High-flow 2 2015	2000–2015
Cyprinidae	*Campostoma anomalum*	Central stoneroller	Native	3	3
	Cyprinella venusta	Blacktail shiner	Native		6
	Dionda nigrotaeniata	Guadalupe roundnose minnow	Native	1	57
	Notropis amabilis	Texas shiner	Native	1	89
	Notropis chalybaeus	Ironcolor shiner	Native		131
	Notropis sp.	Unknown shiner	Native		4
Catostomidae	*Moxostoma congestum*	Gray redhorse	Native		2
Characidae	*Astyanax mexicanus*	Mexican tetra	Introduced	4	59
Ictaluridae	*Ameiurus melas*	Black bullhead	Native		1
	Ameiurus natalis	Yellow bullhead	Native	2	158
Loricariidae	*Noturus gyrinus*	Tadpole madtom	Native		4
Poeciliidae	*Hypostomus plecostomus*	Armadillo del rio	Introduced		58
	Gambusia sp.	Mosquitofish	Native	67	46,697
Centrarchidae	*Poecilia latipinna*	Sailfin molly	Introduced		158
	Ambloplites rupestris	Rock bass	Introduced	23	765
	Lepomis auritus	Redbreast sunfish	Introduced		100
	Lepomis cyanellus	Green sunfish	Native	2	11
	Lepomis gulosus	Warmouth	Native	2	54
	Lepomis macrochirus	Bluegill	Native		78
	Lepomis megalotis	Longear sunfish	Native		19
	Lepomis microlophus	Redear sunfish	Native		2
	Lepomis miniatus	Redspotted sunfish	Native	65	1,523
	Lepomis sp.	Sunfish	N/I	3	298
Percidae	*Micropterus salmoides*	Largemouth bass	Native	1	84
	Etheostoma fonticola	Fountain darter	Native	162	6,943
	Percina apristis	Guadalupe darter	Native	2	27
Cichlidae	*Percina carbonaria*	Texas logperch	Native		1
	Herichthys cyanoguttatus	Texas cichlid	Introduced	7	167
	Oreochromis aureus	Blue tilapia	Introduced		16
Total				**345**	**57,515**

Dip-net Timed Surveys

Timed dip-net collections were conducted five times in the San Marcos River during 2015: April (spring), June (high-flow 1), August (summer), October (fall), and November (high-flow 2). Data gathered from all reaches are graphically represented in Appendix B.

All but one sample (fall) collected from the Hotel Section during the 2015 study period contained individuals in the smallest size class (5–15 mm, Appendix B). The presence of this size class suggests some reproduction is occurring during all seasons. However, fountain darters within this size class are more sporadically observed in the other sections sampled within the San Marcos River and are often found only in spring collections.

Within the City Park Section, abundances observed during timed dip-net surveys were rather dynamic (31–69, Appendix B). The spring 2015 sampling effort had the second highest abundance recorded at this reach (69), but abundances documented in summer and fall were closer to average while during the second high-flow sampling effort, only 33 darters were collected. Due to the decrease in available habitat in the I-35 Section after modification of Rio Vista Dam in spring 2006, the reach was extended to the I-35 highway bridge in 2014. Although more fountain darters were observed in the I-35 Section in 2015 than in 2013 and 2014, the overall total is consistent with past years, and the recent reach expansion makes it premature to use these data for sweeping long-term year-to-year comparisons at this time. Abundance of fountain darters was lower and more variable in the lower portion of the river near Todd Island with no fountain darters captured after the October flood (Appendix B). Habitat (sparse patches of submerged *Hygrophila* and filamentous algae) within this reach fluctuates drastically based on flow conditions and land use in the area, and little vegetation remained here following the October flood.

Presence/Absence Dip-net Surveys

Presence/absence dip netting was conducted on the San Marcos River during the spring (April), high-flow (June), summer (August), fall (October) and the second high-flow (November) sampling efforts in 2015. The percentage of sites with fountain darters was 68% during the second high-flow sampling effort which was lower than fall 74% (Figure 7) but still within the 5th and 95th percentiles for the study.

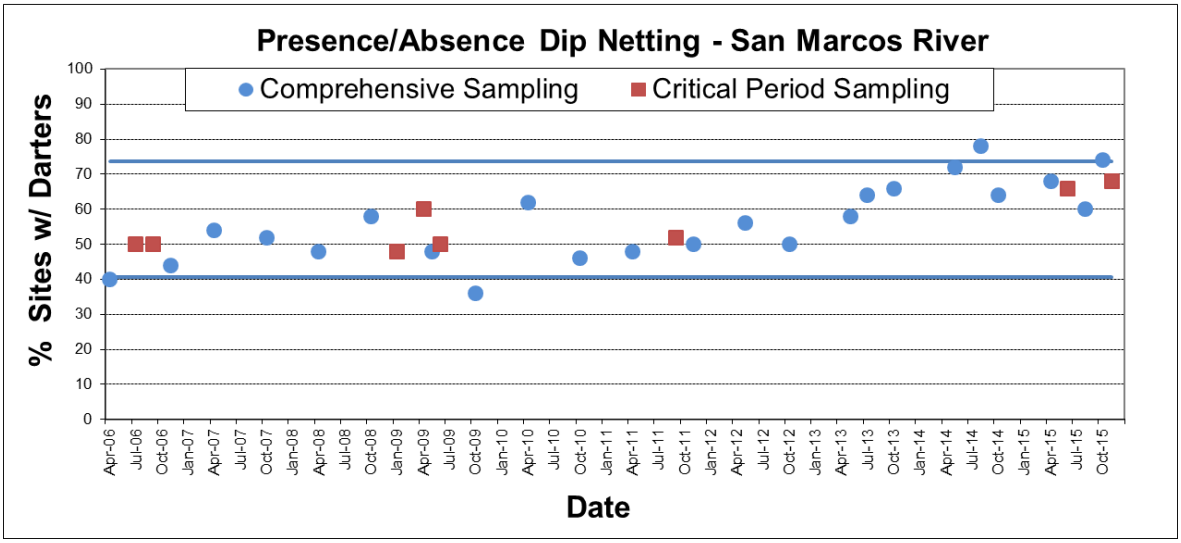


Figure 7. Percentage of sites (n=50) in which fountain darters were present. Solid blue lines mark 5th and 95th percentiles of comprehensive sampling data.

Fixed-Station Survey

For a complete methodology of the fixed-station survey please see BIO-WEST 2015. For this analysis, all high-flow data following the October flood were included. Of the candidate models of the San Marcos data, the model in which detection was modeled as varying among surveys and vegetation types received the most support, with an AIC wieght of 1. Under this model, initial $\psi = 0.84$ and p varied from 0.05 (open sites in the City Park Reach, October 2014) to 0.92 (*Vallisneria* sites in the Spring Lake Dam Reach in May 2014). This model estimates that between primary periods (spring, fall) the probability of colonization of a site is 0.52 (95 % CI: 0.35-0.68), and the probability of local extinction is 0.24 (95% CI: 0.15-0.34) resulting in a probability of persistence (an occupied site remaining so) of 0.76. The naïve (#sites occupied / # sites) and informed (modeled) estimates of occupancy for these data are presented in Table 6. Clearly, both naive and model estimates of occupancy were higher in the first sample collected in spring 2014, dropped significantly the next season, and have remained relatively stable since. It is likely that this was due to changes in vegetative cover at samples sites that has occurred over time due to numerous factors, including recreation, high and low flow periods, and sampling impacts. After the first sampling period, there was an increase in the number of sites consisting of open habitat (no vegetative cover), from no open sites to 25% of sites (Table 7). Simultaneously, there was a reduction in sites covered by *Hydrilla* and an increase in sites

covered by *Hygrophila* (Table 7). These changes in habitat characteristics of sites among sampling periods not only are likely to cause some changes in estimates, they prevent the modeling of occupancy by habitat type, which is of more interest. Future sampling needs revision to ensure that some of these issues are overcome to the greatest possible degree, and that inferences made from this data are appropriate. In the current case, the appropriate and most confident inference is that fountain darter occupancy does not appear to be changing in the San Marcos system at the present time. Continued monitoring will allow more confident inferences to be made from these data in the future.

Table 6. Estimates of site occupancy in 2014 and 2015 by fountain darters in the San Marcos River from multiple season occupancy modelling, as well as naïve occupancy (proportion of sites observed occupied) for comparison.

SAMPLE	MODEL Ψ	NAÏVE Ψ
May-14	0.83	0.74
August-14	0.56	0.64
October-14	0.48	0.44
April-15	0.45	0.50
June-15	0.45	0.38
August-15	0.45	0.40
October-15	0.45	0.38
November-15	0.45	0.30

Table 7. Change in percent of sample sites representing certain habitat types. Habitat types not included showed little or no change.

	2014			2015			
VEGETATION	**May**	**August**	**October**	**April**	**June**	**August**	**October**
Hydrilla	86%	23%	26%	41%	19%	26%	17%
Hygrophila	8%	41%	42%	34%	49%	33%	39%
Open	0%	25%	18%	10%	27%	41%	44%
Potamogeton	5%	11%	13%	15%	5%	0%	0%

Fish Community Sampling

In the San Marcos River, fish community sampling occurred following the October flood, and data are denoted as "fall" in Table 8. At least 25 species of fishes representing 2,870 individuals were captured during the fish community sampling effort following the October flood. Fountain darter densities decreased at all sites except for the I-35 Reach, where density increased (0.05 to 0.1 fish per m^2). This is surprising as much of the flood related disturbance took place downstream of the mouth of Purgatory Creek. Fountain darter densities decreased most in the City Park Reach from summer (0.3 fish per m^2) to fall (0.06 fish per m^2), which may be explained by the loss of vegetation in the middle of the reach where seine sampling is completed.

Table 8. Total number (TotalN) of individuals and species, gear type of efficient catch per unit effort (CPUE), number of individuals for gear type specified, and CPUE (number of individuals per square meter) quantified during all sampling efforts in 2015 from four locations on the San Marcos River.

				Spring Lake			City Park			I-35			Lower River		
	Total N	Gear Type	N for gear type	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Lepisosteus oculatus	9	Meso	6	<0.001	0.001	0.002	0	0	0	0	0	0	0	0	0.002
Cyprinella venusta	286	Seine	163				0	0	0	0	0	0.060	0.081	0.055	0.333
Dionda nigrotaeniata	2,394	Meso	1,737	0.073	0.273	0.589	0	0	0	0	0	0	0	0	0
Macrhybopsis marconis	1	Seine	1				0	0	0	0	0	0	0.002	0	0
Notropis amabilis	23	Seine	17				0.005	0	0	0	0	0	0.024	0	0.0127
Notropis chalybaeus	10	Seine	9				0.003	0	0	0.020	0	0.003	0	0	0
Pimephales vigilax	5	Seine	5				0	0	0	0	0	0	0	0	0.016
Moxostoma congestum	40	Meso	11	<0.001	0	0	0.001	0	0.006	0	0	0	0	0	0
Astyanax mexicanus	2,757	Meso	1,733	0.057	0.114	1.037	0	0	0	0	0	0	0	0	0
Ameiurus natalis	13	Seine	1				0.002	0	0	0	0	0	0	0	0
Ictalurus punctatus	6	Seine	2				0	0	0	0	0	0	0	0	0.006
Hypostomus plecostomus	179	Meso	88	0.007	0	0	0.001	0	0.001	0	0	0.022	0.025	0.012	0.027
Gambusia affinis	13	Seine	9				0.008	0	0.002	0	0	0.010	0	0	0
Gambusia geiseri	640	Seine	394				0.218	0.050	0.275	0	0.010	0.257	0.002	0	0
Gambusia	349	Meso	218	0	0.033	0.065	0	0.014	0.035	0	0	0	0	0	0
Poecilia latipinna	26	Seine	13				0	0.000	0.020	0	0	0.003	0	0	0
Ambloplites rupestris	4	Meso	2	<0.001	0	0	0.001	0	0	0	0	0	0	0	0
Lepomis auritus	450	Meso	309	0.016	0.026	0.064	0.030	0.015	0.020	0	0	0.013	0	0	0.006
Lepomis gulosus	4	Meso	1	0	0	0	0	0	0.001	0	0	0	0	0	0
Lepomis macrochirus	263	Meso	204	0.015	0.027	0.052	0.001	0.003	0	0	0	0	0	0	0
Lepomis megalotis	56	Meso	34	0.000	0.007	0.024	0	0.001	0	0	0	0	0	0	0
Lepomis microlophus	338	Meso	208	0.004	0.025	0.118	0	0	0.003	0	0	0	0	0	0
Lepomis miniatus	40	Seine	18				0.005	0.003	0.011	0	0	0.023	0	0	0
Lepomis	287	Meso	219	0.016	0.003	0.037	0.011	0.015	0.004	0.005	0	0.026	0.008	0.005	0.006
Micropterus salmoides	290	Meso	193	0.009	0.021	0.044	0.006	0.003	0.011	0	0.002	0	0.004	0.001	0.008
Etheostoma fonticola	481	Micro	292	0.133	0.975	0.758	0.188	0.344	0.058	0.450	0.050	0.125	0	0	0
Etheostoma spectabile	62	Seine	32				0	0	0	0	0	0	0.010	0.038	0.076
Percina apristis	75	Seine	50				0.002	0.020	0.003	0.027	0.01	0.007	0.029	0.007	0.048
Percina carbonaria	50	Seine	24				0	0	0	0	0	0	0.026	0.083	0
Percina	1	Micro	1	0	0	0	0	0	0	0	0	0	0.006	0	0
Herichthys cyanoguttatus	51	Meso	30	0.001	0	0.013	0.002	0.001	0.003	0	0.004	0	0	0	0
Oreochromis aureus	4	Meso	2	<0.001	0	0	0.001	0	0	0	0	0	0	0	0
Total N	9,207														

San Marcos Salamander Visual Observations

Densities of San Marcos salamanders exhibited a sharp decline following the October flood at the Hotel Site (Site 2) (Figure 8). From fall (13.2/m^2) to the second high-flow sampling effort (4.8/ m^2) density decreased by 64%. This is the lowest observed density of salamanders at the Hotel Site since the start of the study, and was below one standard deviation of the long-term high-flow average. While a decrease was observed following the June flooding, the October flood had a greater effect which was not surprising considering the nature of the event.

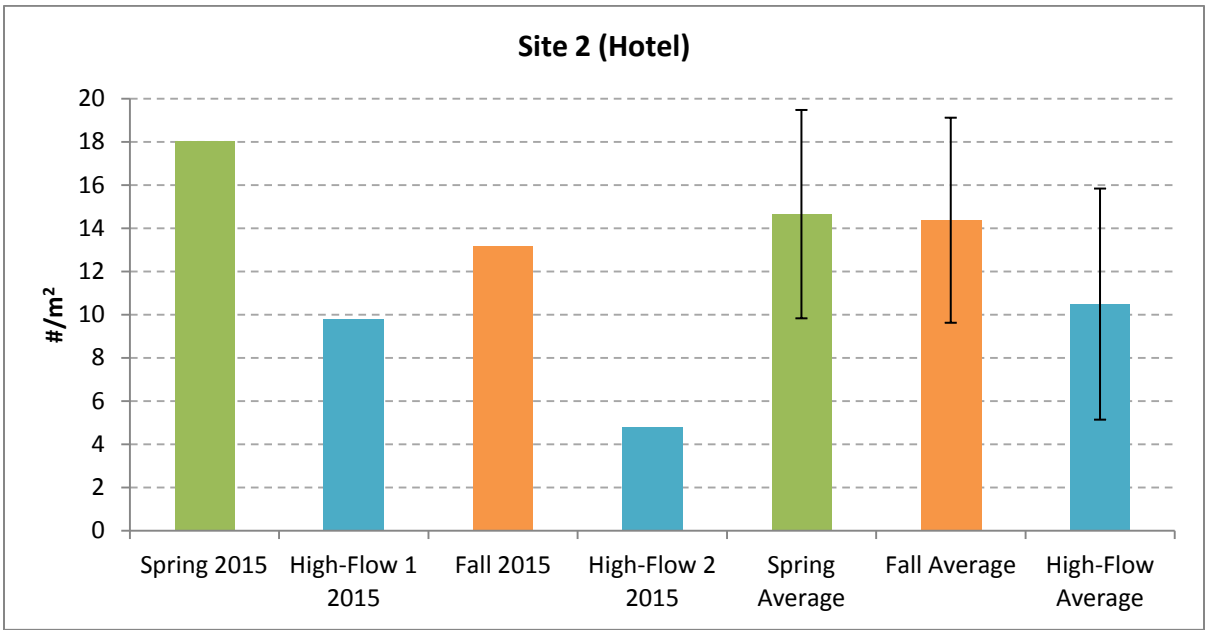


Figure 8. San Marcos salamander densities at Site 2 (Hotel Site) in 2015. Long-term study averages are provided with error bars representing one standard deviation from the mean.

A decrease was also observed at the Riverbed Site (Site 14) following the October flood, but far less dramatic (Figure 9). While salamander density decreased from fall (11.8/ m^2) to the second high-flow sampling effort (9.3/ m^2), this 21% decrease resulted in a density that was still well above the long term high-flow sampling average. It is important to note that both of these sites are located in Spring Lake upstream of the mouth of Sink Creek.

San Marcos salamander densities at the Spring Lake Dam Site (Site 21) decreased by 46% from fall (8.7/ m^2) to the second high-flow sampling effort (4.7/ m^2) (Figure 10). This density was higher than the long-term high flow average, but within one standard deviation. This site did receive significant flows because it is downstream of the mouth of Sink Creek, but habitat (fist-sized rocks) is well established here and able to withstand higher flows.

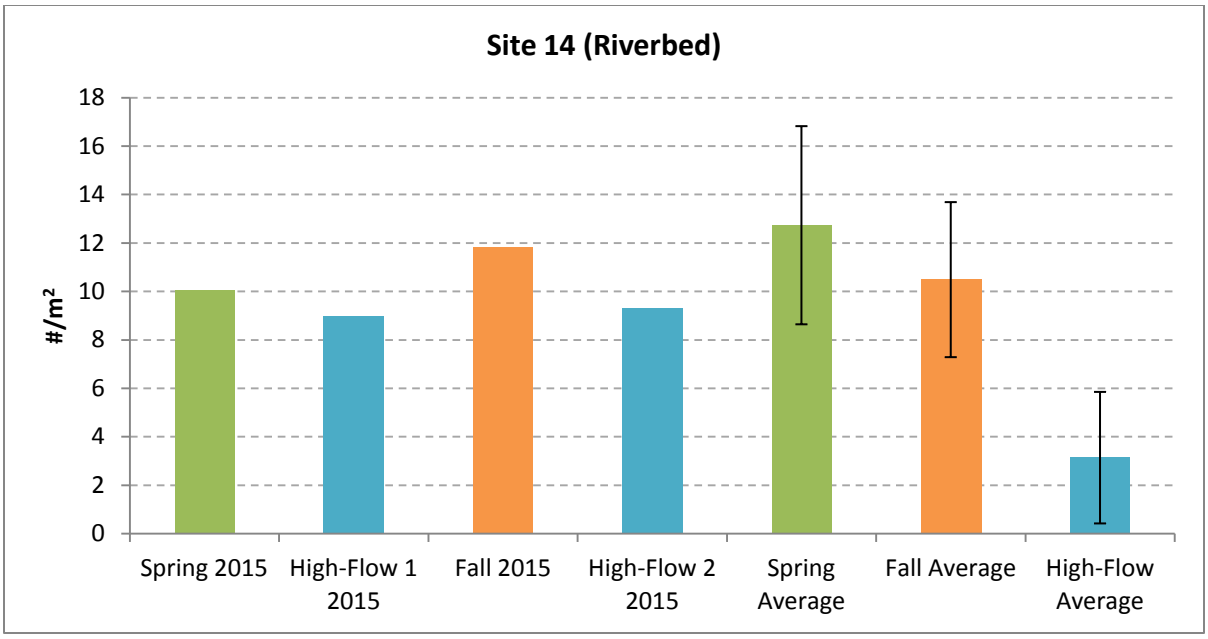


Figure 9. **San Marcos salamander densities at Site 14 (Riverbed Site) in 2015. Long-term study averages are provided with error bars representing one standard deviation from the mean.**

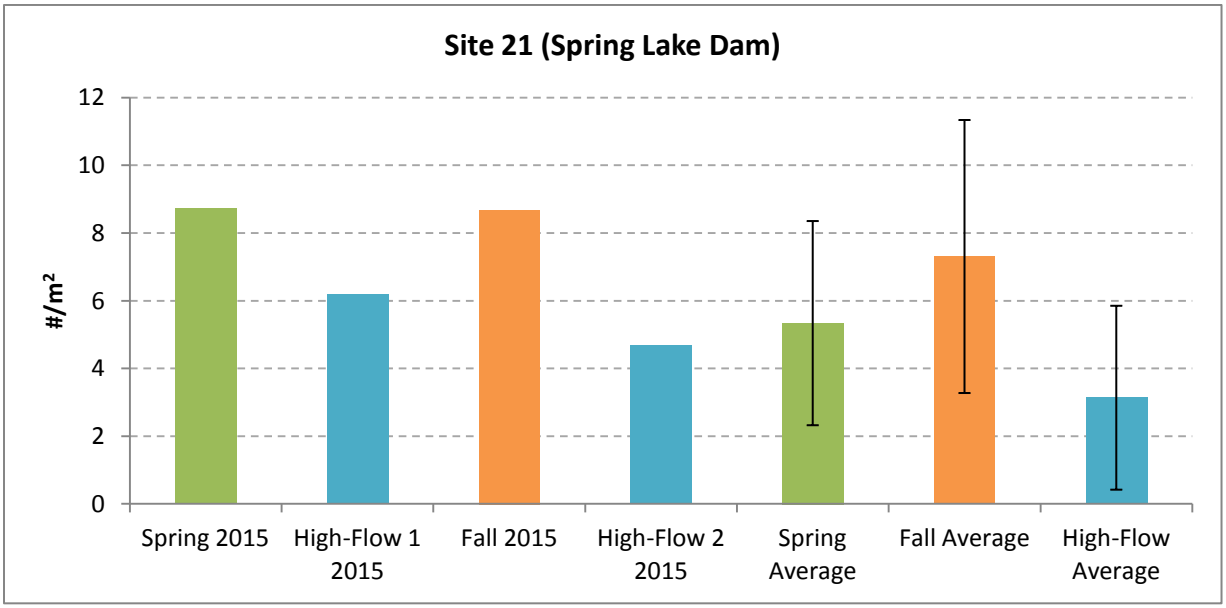
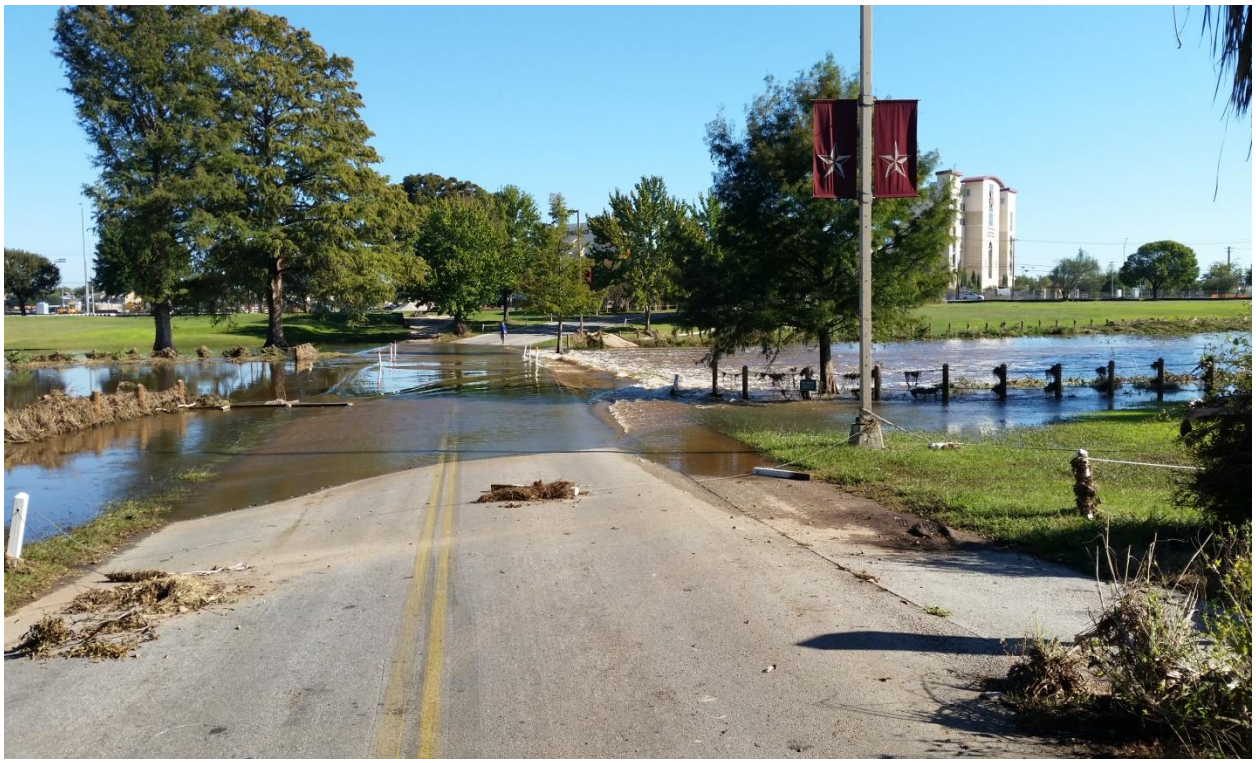


Figure 10. **San Marcos salamander densities at Site 21 (Spring Lake Dam Site) in 2015. Long-term study averages are provided with error bars representing one standard deviation from the mean.**

CONCLUSIONS

Major precipitation events leading to flooding were the main theme for sampling in the San Marcos River in 2015. Although flooding also occurred in June, the October flood had greater effects on the biota and their habitat. Significant losses of aquatic vegetation in the Spring Lake Dam and I-35 reaches resulted in a lower fountain darter population estimate due to loss of habitat. While Texas wild-rice coverage decreased substantially following the flood, HCP measures greatly mitigated these losses. As devastating as the 2015 flooding may have been, the flora and fauna in this central Texas river appear well adapted to events like these and we anticipate them to recover during upcoming periods of more stable flows. It will be interesting to track this anticipated recovery via HCP biological monitoring as flows stabilize in 2016.



Sink Creek flooding at San Marcos Springs Drive.

REFERENCES

BIO-WEST 2015. Habitat Conservation Plan Biological Monitoring Program. San Marcos River Aquatic Ecosystem 2015 Annual Report. Edwards Aquifer Authority. 68 p. plus Appendices.

Bush, P.W., A.F. Ardis, L. Fahlquist, P.B. Ging, C.E. Hornig, and J.L. Lanning-Rush. 1998. Water Quality in South Central Texas, Texas 1996-98. U. S. Geological Survey, Circular 1212.

APPENDIX A: AQUATIC VEGETATION MAPS

Spring Lake Dam Reach

SAN MARCOS RIVER

San Marcos, Texas

Aquatic Vegetation Study Reach
November 2015

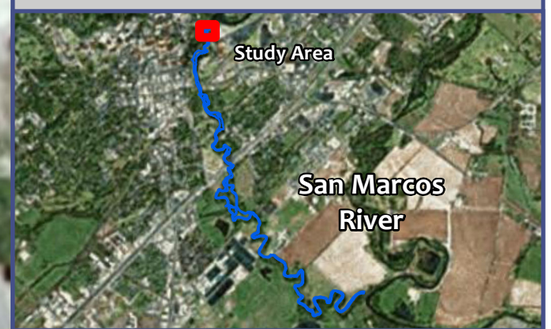
Surveyed: November 15, 2015

SPRING LAKE DAM

Study Reach	4,381.9 m^2

Vegetation Types

Zizania	598.4 m^2
Hydrilla	8.5 m^2
Hydrocotyle	7.2 m^2
Hygrophila	38.3 m^2
Sagittaria	7.0 m^2



0 25 50 100 Feet

0 10 20 Meters

N

BIO-WEST
www.bio-west.com
512.990.3954

Projection: UTM, NAD 83, 14 North
Map Revised: December 15, 2014

City Park Reach

SAN MARCOS RIVER

San Marcos, Texas

Aquatic Vegetation Study Reach
November 2015

Surveyed: November 16-18, 2015

City Park

Study Reach	6,389.0 m^2

Vegetation Types

Zizania	1,260.7 m^2
Heteranthera	6.5 m^2
Hydrilla	227.8 m^2
Hygrophila	297.4 m^2
Ludwigia	0.8 m^2
Potamogeton	53.5 m^2
Sagittaria	91.6 m^2

0 37.5 75 150 Feet

0 20 40 Meters

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BIO-WEST
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512.990.3954

Projection: UTM, NAD 83, 14 North
Map Revised: November 24, 2014

I-35 Reach

SAN MARCOS RIVER

San Marcos, Texas

Aquatic Vegetation Study Reach
November 2015

Surveyed: November 19, 2015

I - 35

Study Reach	10,969.7 m^2

Vegetation Types

Zizania	81.7 m^2
Cabomba	33.4 m^2
Hydrilla	123.5 m^2
Hygrophila	136.8 m^2
Ludwigia	8.1 m^2
Nuphar	11.5 m^2
Sagittaria	376.5 m^2
Zizaniopsis	3.2 m^2

0 50 100 200 Feet

0 20 40 Meters

N

BIO-WEST
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512.990.3954

Projection: UTM, NAD 83, 14 North
Map Revised: November 24, 2014

Texas Wild Rice

SAN MARCOS RIVER

San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, December 2015

FULL SYSTEM MAP

San Marcos River's Edge

Vegetation Types

Zizania

Zizania Cover for Full System = 5,065.5 m^2

0 50 100 200 Feet

0 20 40 Meters

N

BIO-WEST
www.bio-west.com
512.990.3954

Projection: UTM, NAD 83, 14 North
Map Revised: December 15, 2014

SAN MARCOS RIVER
San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, December 2015

FULL SYSTEM MAP

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512.990.3954

Projection: UTM, NAD 83, 14 North
Map Revised: December 15, 2014

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San Marcos, Texas

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Texas Wild Rice, December 2015

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Texas Wild Rice, December 2015

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Texas Wild Rice, December 2015

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0 20 40 Meters

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Texas Wild Rice, December 2015

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Texas Wild Rice, December 2015

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0 50 100 200 Feet

0 20 40 Meters

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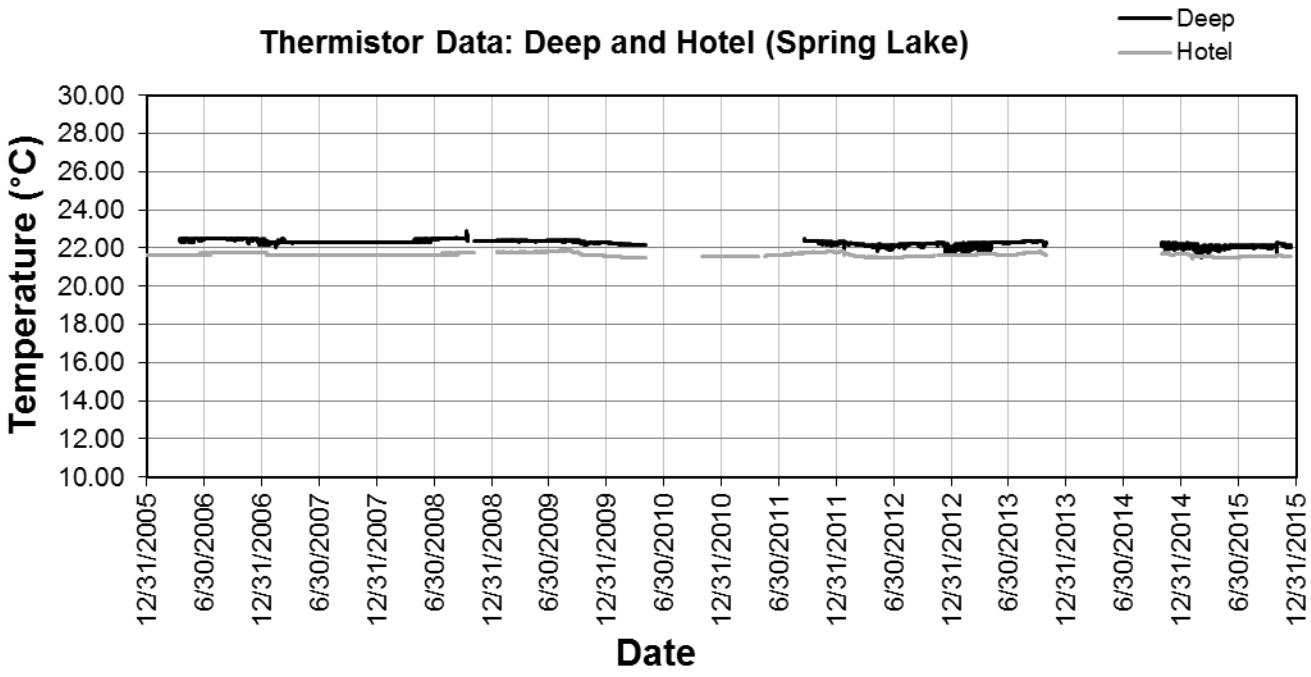
BIO-WEST
www.bio-west.com
512.990.3954

Projection: UTM, NAD 83, 14 North
Map Revised: December 15, 2014

APPENDIX B: DATA AND GRAPHS

Thermistor Graphs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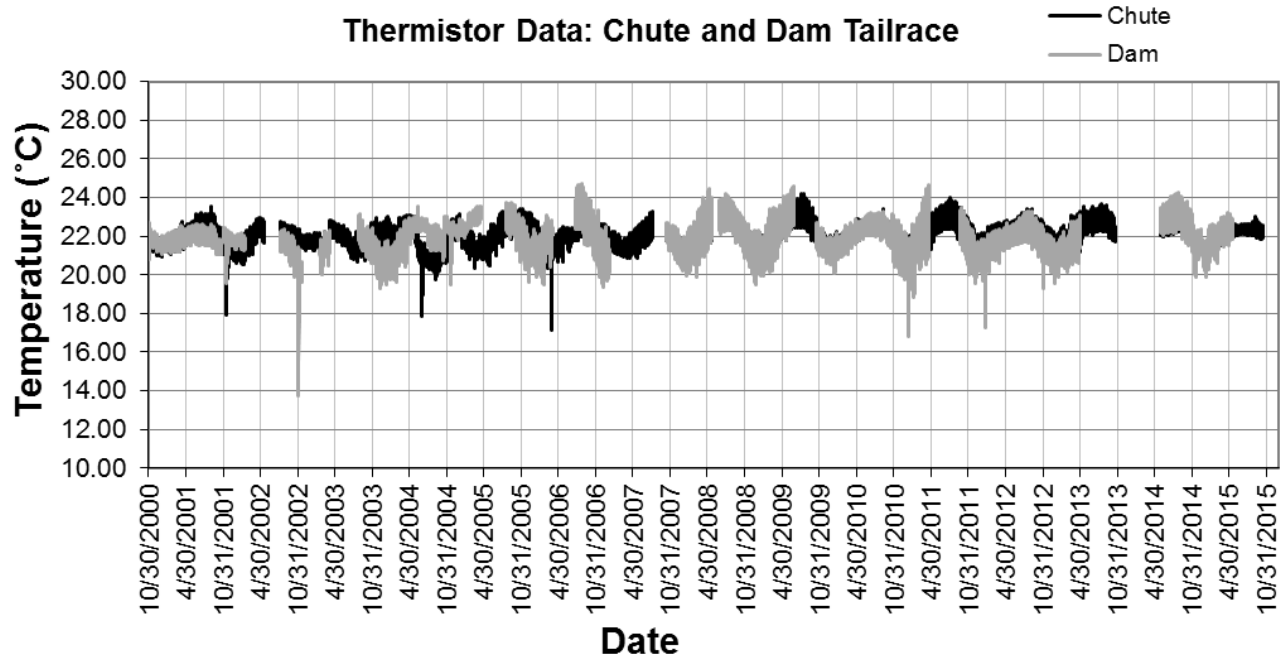
12/31/2015
Date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Dam
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24.00
22.00
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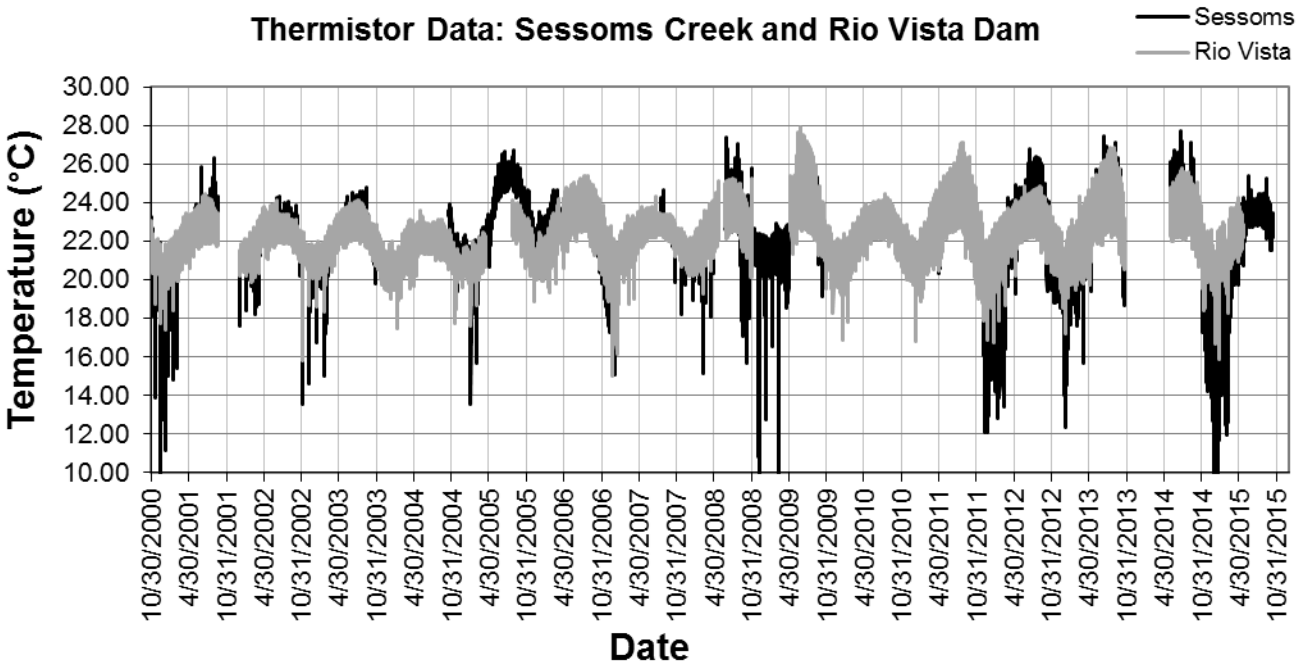
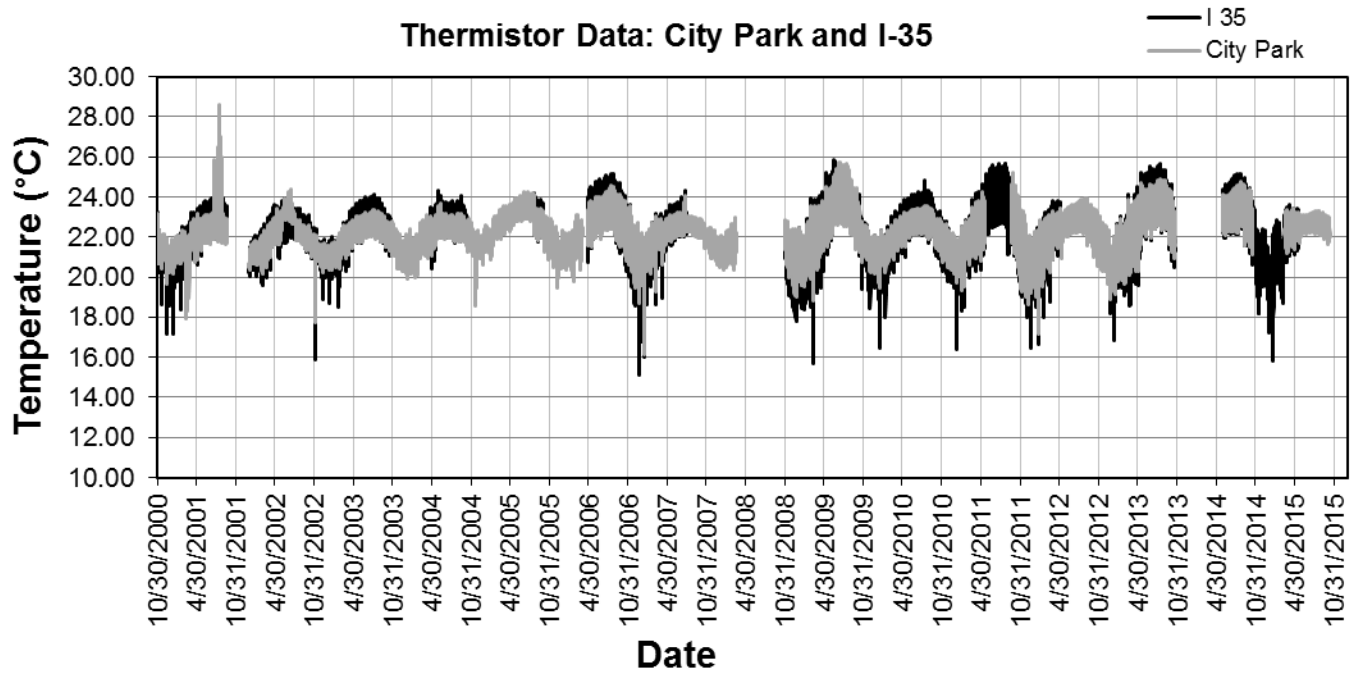
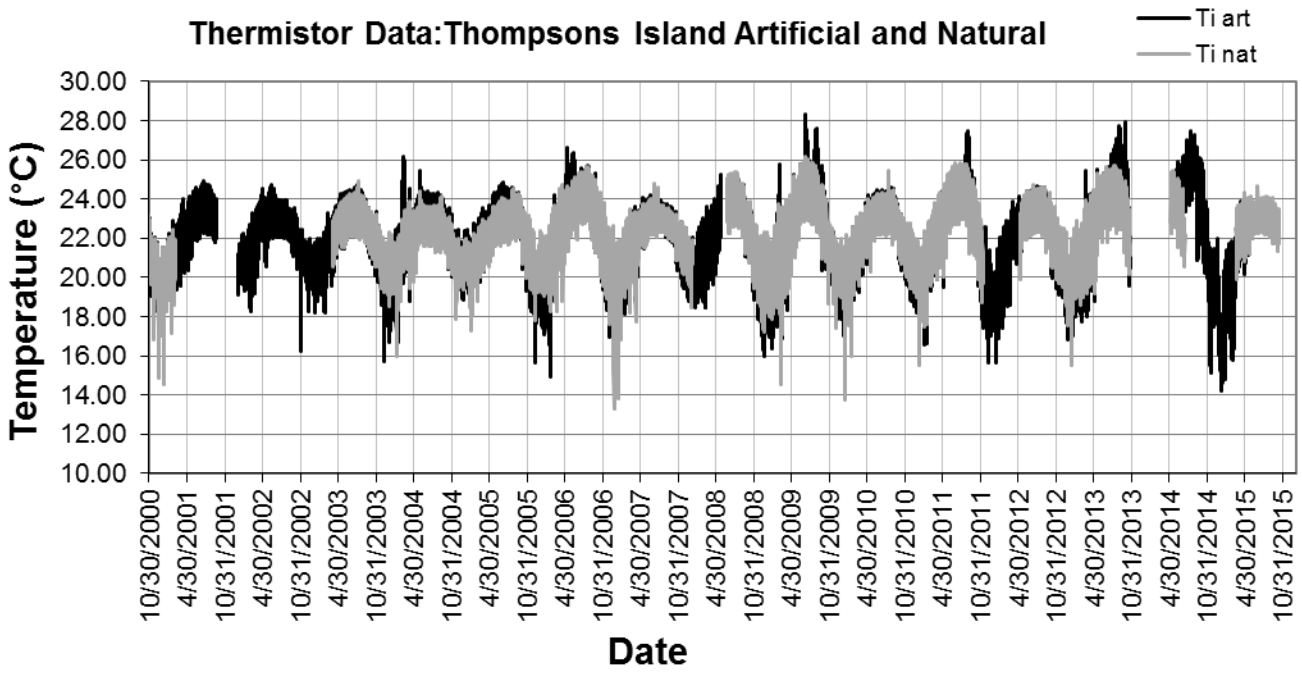
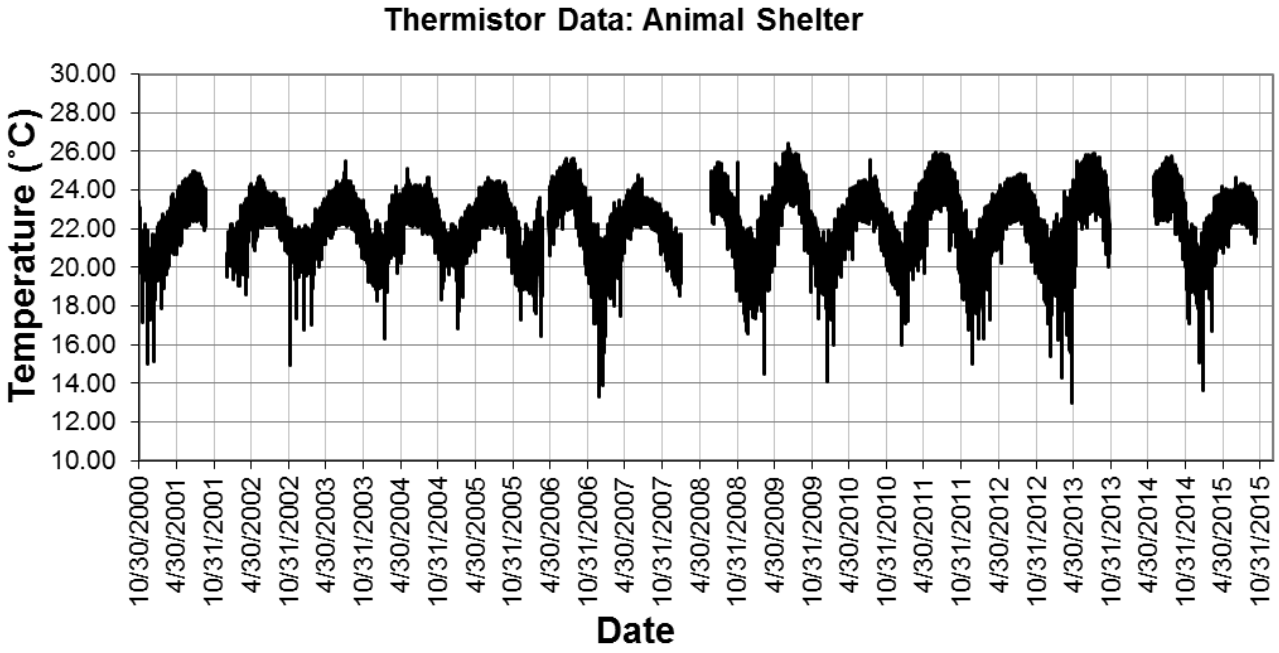
10/31/2015
Date

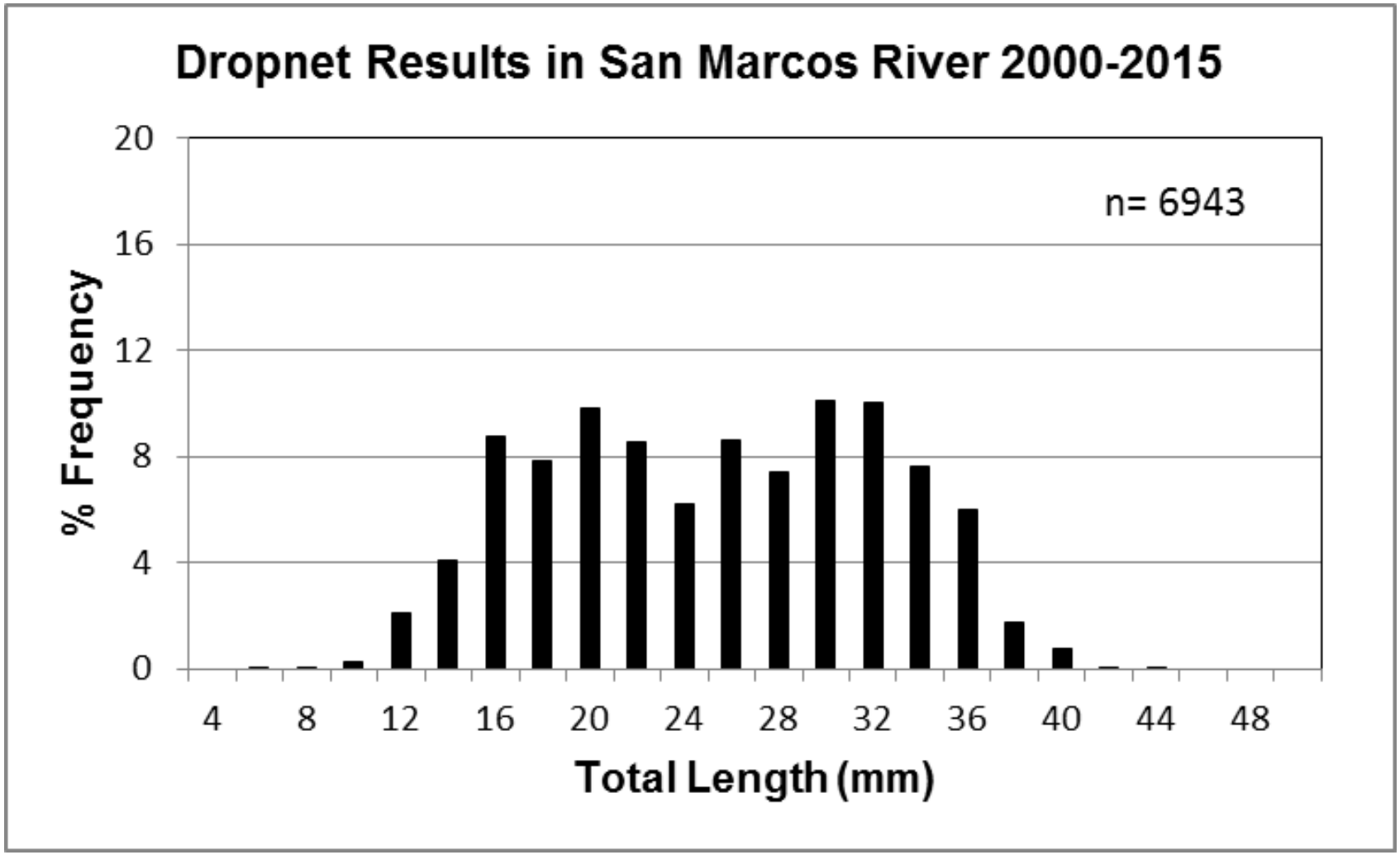

Thermistor Data: Sessoms Creek and Rio Vista Dam
Sessoms
Rio Vista
Temperature (°C)
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
10/30/2000
4/30/2001
10/31/2001
4/30/2002
10/31/2002
4/30/2003
10/31/2003
4/30/2004
10/31/2004
4/30/2005
10/31/2005
4/30/2006
10/31/2006
4/30/2007
10/31/2007
4/30/2008
10/31/2008
4/30/2009
10/31/2009
4/30/2010
10/31/2010
4/30/2011
10/31/2011
4/30/2012
10/31/2012
4/30/2013
10/31/2013
4/30/2014
10/31/2014
4/30/2015
10/31/2015
Date


Thermistor Data: City Park and I-35
I 35
City Park
Temperature (°C)
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
10/30/2000
4/30/2001
10/31/2001
4/30/2002
10/31/2002
4/30/2003
10/31/2003
4/30/2004
10/31/2004
4/30/2005
10/31/2005
4/30/2006
10/31/2006
4/30/2007
10/31/2007
4/30/2008
10/31/2008
4/30/2009
10/31/2009
4/30/2010
10/31/2010
4/30/2011
10/31/2011
4/30/2012
10/31/2012
4/30/2013
10/31/2013
4/30/2014
10/31/2014
4/30/2015
10/31/2015
Date

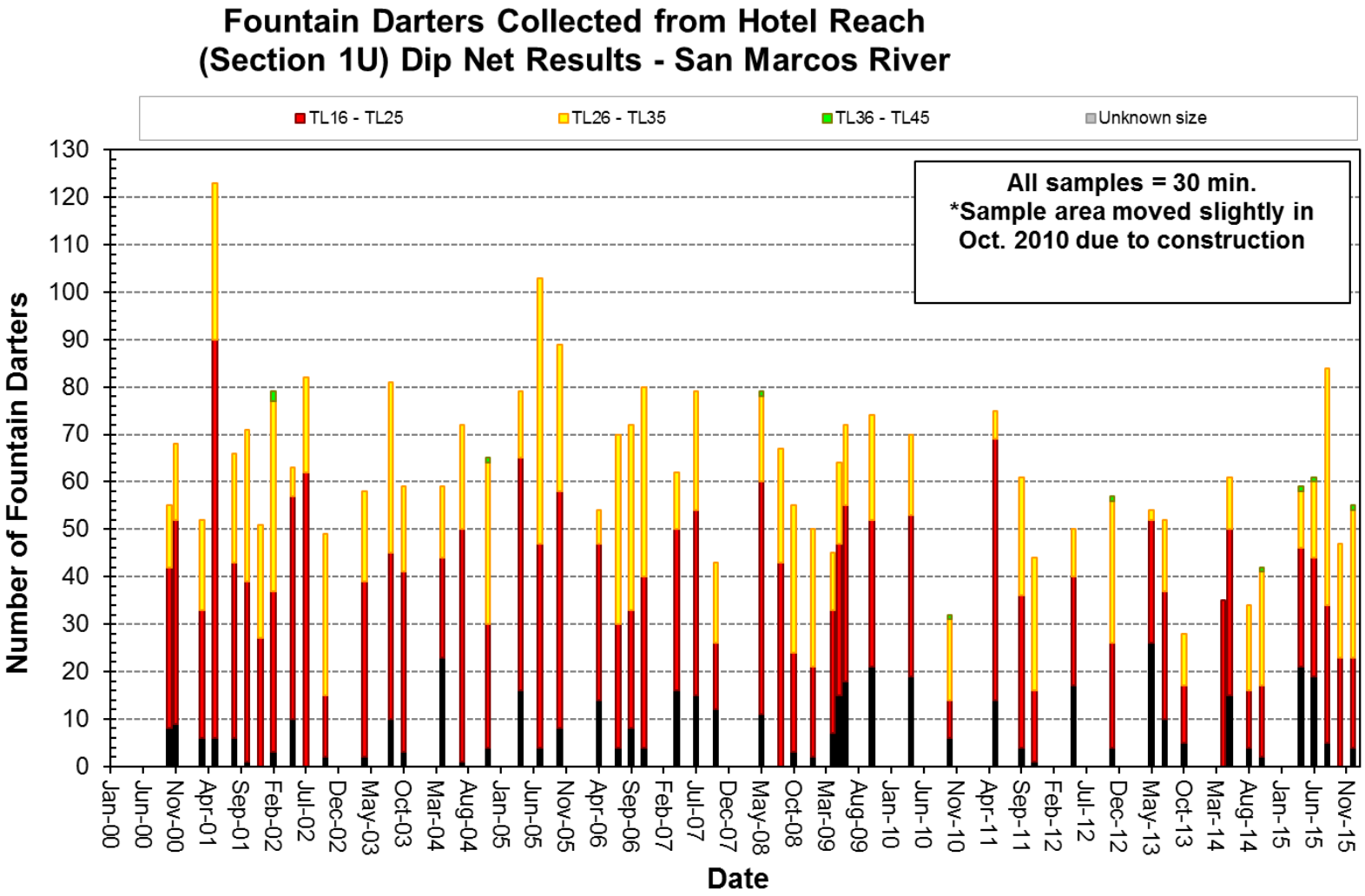

Thermistor Data:Thompsons Island Artificial and Natural
Ti art
Ti nat
Temperature (°C)
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
10/30/2000
4/30/2001
10/31/2001
4/30/2002
10/31/2002
4/30/2003
10/31/2003
4/30/2004
10/31/2004
4/30/2005
10/31/2005
4/30/2006
10/31/2006
4/30/2007
10/31/2007
4/30/2008
10/31/2008
4/30/2009
10/31/2009
4/30/2010
10/31/2010
4/30/2011
10/31/2011
4/30/2012
10/31/2012
4/30/2013
10/31/2013
4/30/2014
10/31/2014
4/30/2015
10/31/2015
Date

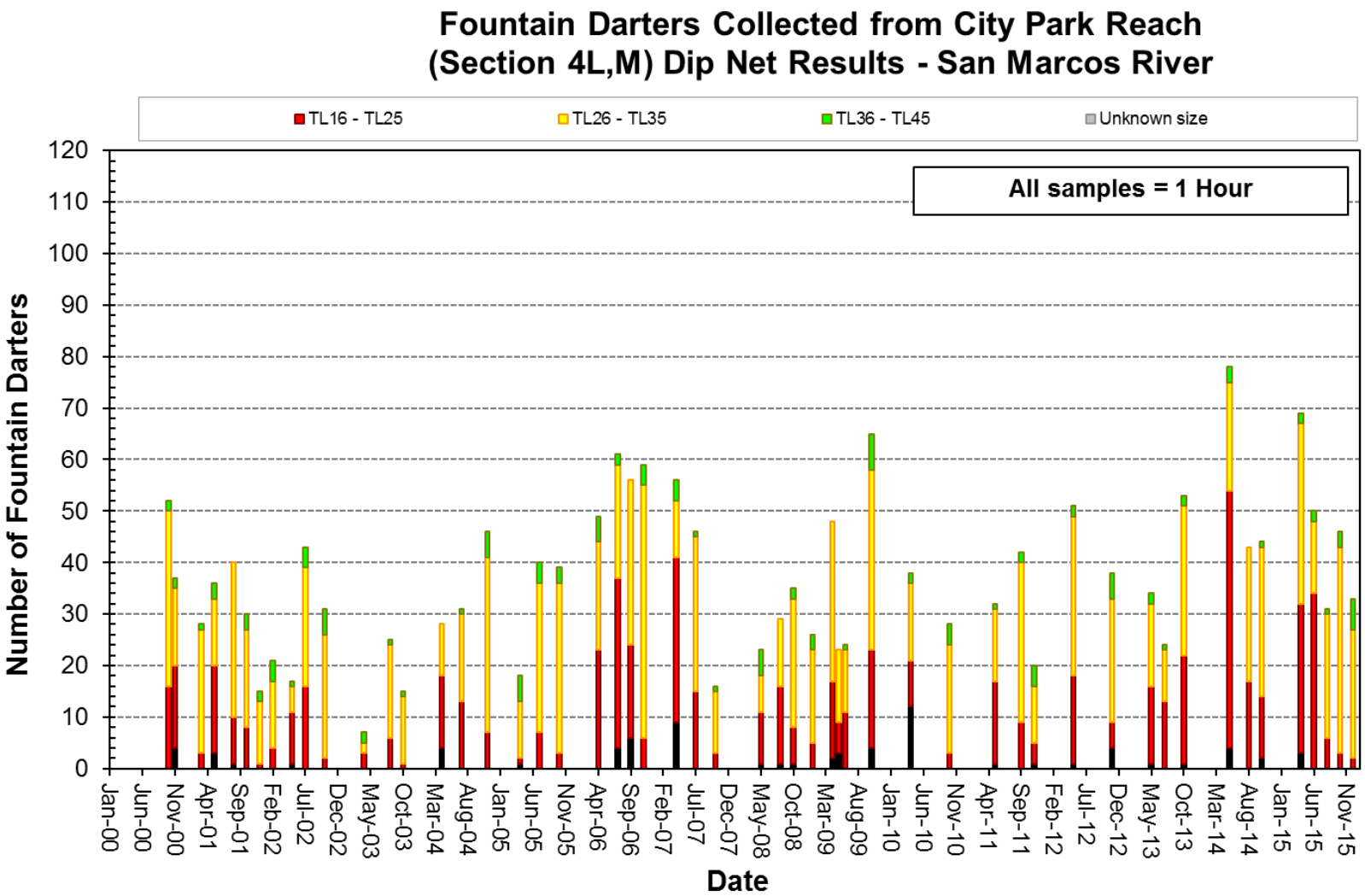

Thermistor Data: Animal Shelter
Temperature (°C)
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
10/30/2000
4/30/2001
10/31/2001
4/30/2002
10/31/2002
4/30/2003
10/31/2003
4/30/2004
10/31/2004
4/30/2005
10/31/2005
4/30/2006
10/31/2006
4/30/2007
10/31/2007
4/30/2008
10/31/2008
4/30/2009
10/31/2009
4/30/2010
10/31/2010
4/30/2011
10/31/2011
4/30/2012
10/31/2012
4/30/2013
10/31/2013
4/30/2014
10/31/2014
4/30/2015
10/31/2015
Date

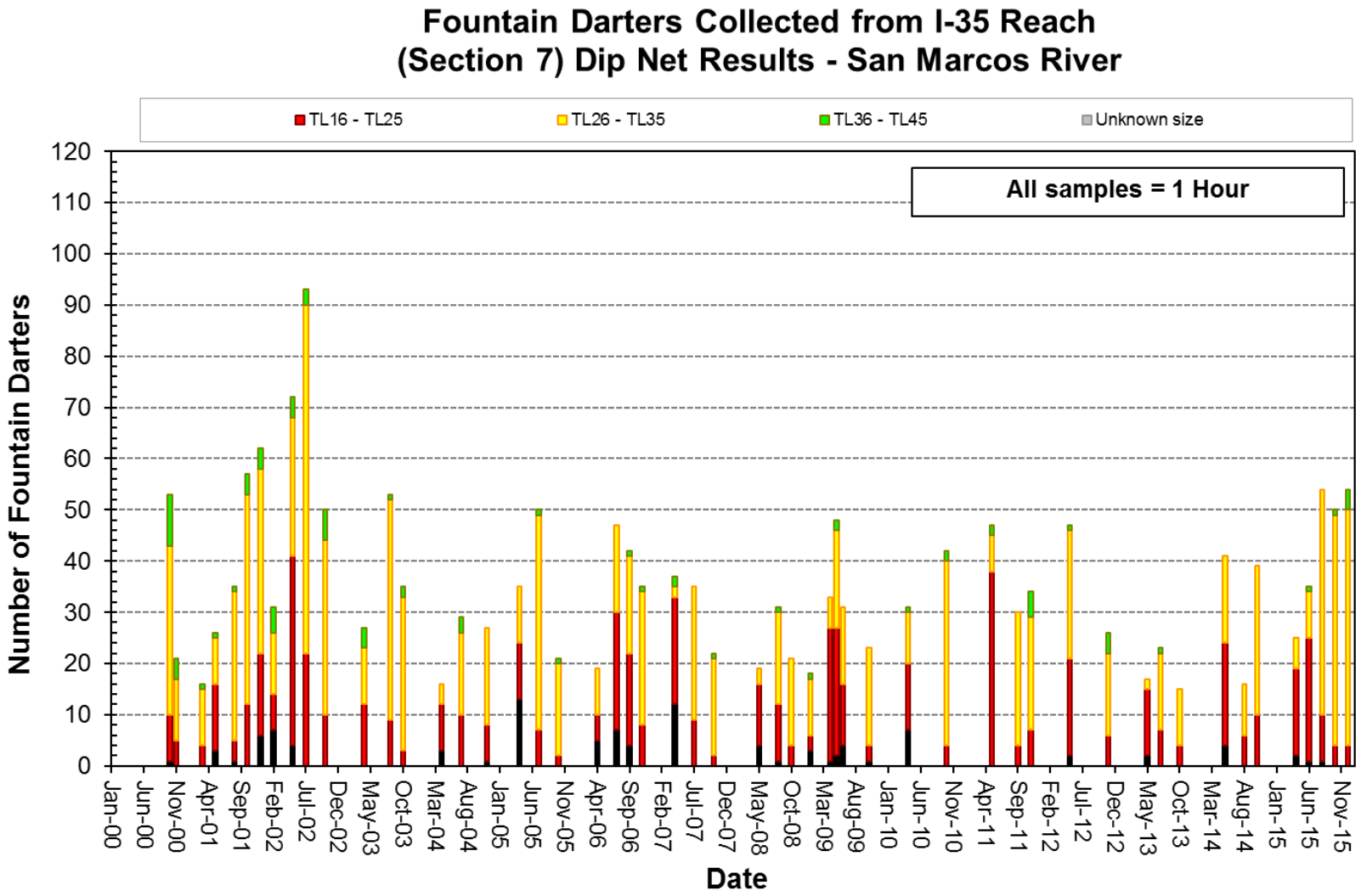
Drop net Graph

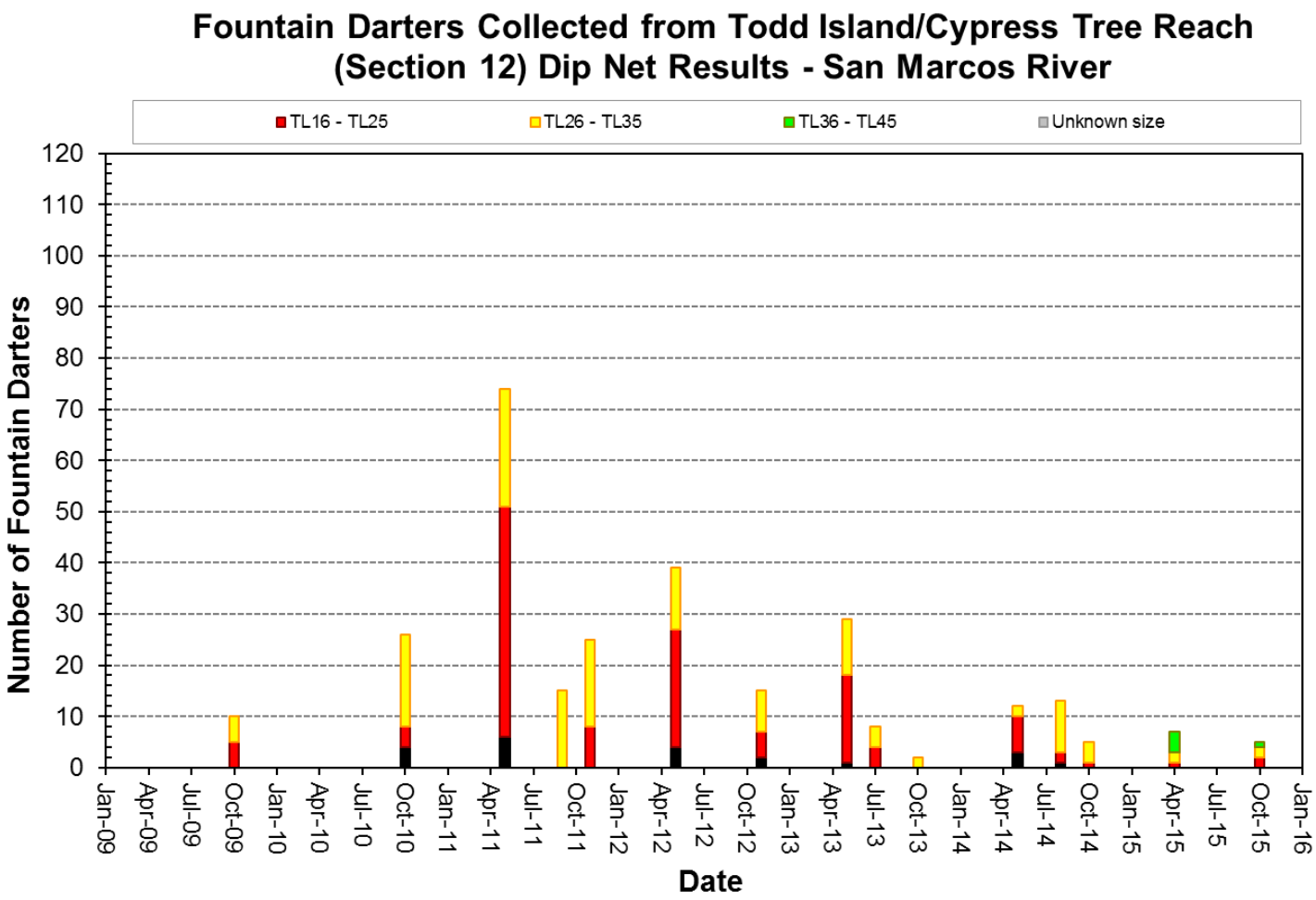

Dropnet Results in San Marcos River 2000-2015
n= 6943
% Frequency
0
4
8
12
16
20
4
8
12
16
20
24
28
32
36
40
44
48
Total Length (mm)

Dip Net Graphs


Fountain Darters Collected from Hotel Reach
(Section 1U) Dip Net Results - San Marcos River
TL16 - TL25
TL26 - TL35
TL36 - TL45
Unknown size
All samples = 30 min.
*Sample area moved slightly in
Oct. 2010 due to construction
Number of Fountain Darters
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Jan-00
Jun-00
Nov-00
Apr-01
Sep-01
Feb-02
Jul-02
Dec-02
May-03
Oct-03
Mar-04
Aug-04
Jan-05
Jun-05
Nov-05
Apr-06
Sep-06
Feb-07
Jul-07
Dec-07
May-08
Oct-08
Mar-09
Aug-09
Jan-10
Jun-10
Nov-10
Apr-11
Sep-11
Feb-12
Jul-12
Dec-12
May-13
Oct-13
Mar-14
Aug-14
Jan-15
Jun-15
Nov-15
Date


Fountain Darters Collected from City Park Reach
(Section 4L,M) Dip Net Results - San Marcos River
TL16 - TL25
TL26 - TL35
TL36 - TL45
Unknown size
All samples = 1 Hour
Number of Fountain Darters
0
10
20
30
40
50
60
70
80
90
100
110
120
Jan-00
Jun-00
Nov-00
Apr-01
Sep-01
Feb-02
Jul-02
Dec-02
May-03
Oct-03
Mar-04
Aug-04
Jan-05
Jun-05
Nov-05
Apr-06
Sep-06
Feb-07
Jul-07
Dec-07
May-08
Oct-08
Mar-09
Aug-09
Jan-10
Jun-10
Nov-10
Apr-11
Sep-11
Feb-12
Jul-12
Dec-12
May-13
Oct-13
Mar-14
Aug-14
Jan-15
Jun-15
Nov-15
Date


Fountain Darters Collected from I-35 Reach
(Section 7) Dip Net Results - San Marcos River
TL16 - TL25
TL26 - TL35
TL36 - TL45
Unknown size
All samples = 1 Hour
Number of Fountain Darters
0
10
20
30
40
50
60
70
80
90
100
110
120
Jan-00
Jun-00
Nov-00
Apr-01
Sep-01
Feb-02
Jul-02
Dec-02
May-03
Oct-03
Mar-04
Aug-04
Jan-05
Jun-05
Nov-05
Apr-06
Sep-06
Feb-07
Jul-07
Dec-07
May-08
Oct-08
Mar-09
Aug-09
Jan-10
Jun-10
Nov-10
Apr-11
Sep-11
Feb-12
Jul-12
Dec-12
May-13
Oct-13
Mar-14
Aug-14
Jan-15
Jun-15
Nov-15
Date


Fountain Darters Collected from Todd Island/Cypress Tree Reach (Section 12) Dip Net Results - San Marcos River
TL16 - TL25
TL26 - TL35
TL36 - TL45
Unknown size
Number of Fountain Darters
0
10
20
30
40
50
60
70
80
90
100
110
120
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Date

APPENDIX C: DROP NET RAW DATA

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Map site:
Spring Lake Dam		S2- Site 1	
Date:	**Time:**	**Observer(s):**	
11/23/2015	853-919	ME,JH,JW,JG	

Overall	Species	Number	Avg. Length (mm)
21	*Etheostoma fonticola*		
4	*Palaemonetes* sp.		
34	*Procambarus* sp.		
5	*Lepomis miniatus*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Etheostoma fonticola*	3	32,29,34
	Procambarus sp.	1	
	Palaemonetes sp.	3	
2	*Etheostoma fonticola*	1	39
	Procambarus sp.	7	
3	*Lepomis miniatus*	1	44
	Etheostoma fonticola	3	33,35,23
	Procambarus sp.	4	
4	*Etheostoma fonticola*	1	33
	Procambarus sp.	4	
5	*Lepomis miniatus*	1	98
	Etheostoma fonticola	3	38,33,26
	Procambarus sp.	5	
6	*Etheostoma fonticola*	1	36
	Lepomis miniatus	1	76
	Procambarus sp.	3	
	Palaemonetes sp.	1	
7	*Etheostoma fonticola*	1	30
	Procambarus sp.	2	
8	*Etheostoma fonticola*	3	24,28,29
9	*Etheostoma fonticola*	1	29
	Procambarus sp.	1	
10	*Procambarus* sp.	1	
11	*Etheostoma fonticola*	2	36,35
	Procambarus sp.	1	
12	*Lepomis miniatus*	2	53,81
	Procambarus sp.	4	
13	*Etheostoma fonticola*	1	35
14	*Procambarus* sp.	1	
	Etheostoma fonticola	1	31
15	No fish or crustaceans collected		
	**Tarebia granifera - slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**	**Map site:**
Spring Lake Dam		S1- Site 2	
Date:	**Time:**	**Observer(s):**	
11/23/2015	920-944	ME,JH,JW,JG	

Overall	**Species**	**Number**	**Avg. Length (mm)**
13	*Etheostoma fonticola*		
2	*Lepomis miniatus*		
35	*Procambarus* sp.		
5	*Palaemonetes* sp.		
1	*Eurycea*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**
1	*Procambarus* sp.	5	
	Palaemonetes sp.	1	
	Etheostoma fonticola	5	34,36,36,30,18
2	*Procambarus* sp.	2	
	Palaemonetes sp.	2	
3	*Etheostoma fonticola*	5	35,38,39,36,34
	Lepomis miniatus	1	76
	Procambarus sp.	6	
	Palaemonetes sp.	2	
4	*Etheostoma fonticola*	1	28
	Lepomis miniatus	1	85
	Procambarus sp.	4	
5	*Etheostoma fonticola*	1	40
	Procambarus sp.	4	
6	*Eurycea*	1	65
	Procambarus sp.	2	
7	*Etheostoma fonticola*	1	32
	Procambarus sp.	6	
8	No fish or crustaceans collected		
9	*Procambarus* sp.	1	
10	No fish or crustaceans collected		
11	*Procambarus* sp.	3	
12	No fish or crustaceans collected		
13	*Procambarus* sp.	1	
14	No fish or crustaceans collected		
15	*Procambarus* sp.	1	
16	No fish or crustaceans collected		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Map site:
Spring Lake Dam		H1 - Site 3	
Date:	**Time:**	**Observer(s):**	
11/23/2015	946-1015	ME,JH,JW,JG	

Overall	Species	Number	Avg. Length (mm)
3	*Herichthys cyanoguttatus*		
9	*Lepomis miniatus*		
29	*Palaemonetes* sp.		
27	*Etheostoma fonticola*		
9	*Procambarus* sp.		
1	*Campostoma anomalum*		
1	*Lepomis gulosus*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Etheostoma fonticola*	1	33
	Lepomis miniatus	1	68
	Palaemonetes sp.	11	
	Procambarus sp.	2	
2	*Etheostoma fonticola*	3	38,33,28
	Palaemonetes sp.	5	
3	*Etheostoma fonticola*	2	35,33
	Lepomis miniatus	2	34,68
	Palaemonetes sp.	2	
4	*Herichthys cyanoguttatus*	2	106,72
	Etheostoma fonticola	6	34,28,28,26,26,20
	Palaemonetes sp.	2	
5	*Etheostoma fonticola*	3	28,26,25
	Procambarus sp.	3	
6	*Lepomis miniatus*	1	75
7	*Procambarus* sp.	1	
	Etheostoma fonticola	1	27
8	*Lepomis miniatus*	1	72
	Etheostoma fonticola	1	28
	Palaemonetes sp.	4	
9	*Procambarus* sp.	3	
	Palaemonetes sp.	3	
10	*Campostoma anomalum*	1	67
	Etheostoma fonticola	2	33,32
	Lepomis miniatus	1	30
11	*Etheostoma fonticola*	3	37,28,32
	Lepomis miniatus	2	88,51
	Palaemonetes sp.	1	
12	*Lepomis gulosus*	1	155
	Lepomis miniatus	1	37
	Etheostoma fonticola	1	38
13	*Etheostoma fonticola*	1	21
14	*Palaemonetes* sp.	1	
15	*Etheostoma fonticola*	1	29
16	*Herichthys cyanoguttatus*	1	62
	Etheostoma fonticola	2	40,32
17	No fish or crustaceans collected		
	**Tarebia granifera - slight*		
	**Melanoides - slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Map site:
Spring Lake Dam		HD1 - Site 4	HD2
Date:	**Time:**	**Observer(s):**	
11/23/2015	1024-1037	ME,JH,JW,JG	

Overall	Species	Number	Avg. Length (mm)
19	*Etheostoma fonticola*		
1	*Procambarus* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Etheostoma fonticola*	4	20,22,25,27
2	*Etheostoma fonticola*	2	20,26
3	*Etheostoma fonticola*	1	31
4	*Etheostoma fonticola*	2	28,24
5	*Etheostoma fonticola*	1	20
6	*Etheostoma fonticola*	2	31,33
7	No fish or crustaceans collected		
8	*Etheostoma fonticola*	1	36
	Procambarus sp.	1	
9	*Etheostoma fonticola*	2	26,20
10	No fish or crustaceans collected		
11	*Etheostoma fonticola*	2	22,28
12	No fish or crustaceans collected		
13	*Etheostoma fonticola*	1	37
14	*Etheostoma fonticola*	1	22
15	No fish or crustaceans collected		
	**Tarebia granifera - slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Map site:
Spring Lake Dam		H2 - Site 5	
Date:	**Time:**	**Observer(s):**	
11/23/2015	1041-1052	ME,JH,JW,JG	

Overall	Species	Number	Avg. Length (mm)
3	*Procambarus* sp.		
6	*Etheostoma fonticola*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	No fish or crustaceans collected		
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	*Procambarus* sp.	1	
5	*Procambarus* sp.	1	
6	*Etheostoma fonticola*	1	34
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	*Etheostoma fonticola*	2	27,32
11	No fish or crustaceans collected		
12	No fish or crustaceans collected		
13	No fish or crustaceans collected		
14	*Procambarus* sp.	1	
15	*Etheostoma fonticola*	3	35,31,36
16	No fish or crustaceans collected		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Map site:
Spring Lake Dam		O2 - Site 6	
Date:	**Time:**	**Observer(s):**	
11/23/2015	1054-1057	ME,JH,JW,JG	

Overall	Species	Number	Avg. Length (mm)

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	No fish or crustaceans collected		
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	No fish or crustaceans collected		
6	No fish or crustaceans collected		
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Map site:
Spring Lake Dam		O1 - Site 7	
Date:	**Time:**	**Observer(s):**	
11/23/2015	1058-1107	ME,JH,JW,JG	

Overall	Species	Number	Avg. Length (mm)

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	No fish or crustaceans collected		
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	No fish or crustaceans collected		
6	No fish or crustaceans collected		
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**	**Map site:**
Spring Lake Dam		HD2 - Site 8	
Date:	**Time:**	**Observer(s):**	
11/23/2015			

Overall	**Species**	**Number**	**Avg. Length (mm)**
	No vegetation		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:
City Park		HD1 - Site 1
Date:	**Time:**	**Observer(s):**
11/23/2015	1156-1215	JG,JW,JH,ME

Overall	Species	Number	Avg. Length (mm)
7	*Etheostoma fonticola*		
8	*Lepomis miniatus*		
2	*Ambloplites rupestris*		
1	*Palaemonetes* sp.		
2	*Gambusia* sp.		
1	*Micropterus salmoides*		
8	*Procambarus* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Lepomis miniatus*	2	64,56
	Gambusia sp.	1	21
	Etheostoma fonticola	1	36
2	*Etheostoma fonticola*	4	31,33,31,32
	Lepomis miniatus	3	95,85,62
	Gambusia sp.	1	15
	Micropterus salmoides	1	75
	Procambarus sp.	4	
3	*Etheostoma fonticola*	1	30
	Lepomis miniatus	1	62
4	No fish or crustaceans collected		
5	*Ambloplites rupestris*	1	107
	Procambarus sp.	2	
6	*Palaemonetes* sp.	1	
7	No fish or crustaceans collected		
8	*Etheostoma fonticola*	1	27
9	*Lepomis miniatus*	1	92
10	No fish or crustaceans collected		
11	*Procambarus* sp.	1	
12	No fish or crustaceans collected		
13	*Ambloplites rupestris*	1	66
14	*Lepomis miniatus*	1	87
	Procambarus sp.	1	
15	No fish or crustaceans collected		

***Tarebia granifera-slight*
**Melanoides - slight*

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**
City Park		O1 - Site 2
Date:	**Time:**	**Observer(s):**
11/23/2015	1218-1221	JG,JW,JH,ME

Overall	**Species**	**Number**	**Avg. Length (mm)**

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**
1	No fish or crustaceans collected		
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	No fish or crustaceans collected		
6	No fish or crustaceans collected		
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**
City Park		O2-Site 3
Date:	**Time:**	**Observer(s):**
11/23/2015	1222-1225	JG,JW,JH,ME

Overall	**Species**	**Number**	**Avg. Length (mm)**

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**
1	No fish or crustaceans collected		
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	No fish or crustaceans collected		
6	No fish or crustaceans collected		
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):	Site:	Site on Map:
City Park	HD2 - Site 4	HD3

Date:	Time:	Observer(s):
11/23/2015	1228-1242	JG,JW,JH,ME

Overall	Species	Number	Avg. Length (mm)
4	*Etheostoma fonticola*		
1	*Herichtyus cyanoguttatus*		
2	*Lepomis miniatus*		
5	*Gambusia* sp.		
1	*Procambarus* sp.		
20	*Palaemonetes* sp.		
5	*Ambloplites rupestris*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Palaemonetes* sp.	1	
2	*Ambloplites rupestris*	2	66,62
	Palaemonetes sp.	2	
3	*Gambusia* sp.	1	20
4	*Palaemonetes* sp.	2	
5	*Lepomis miniatus*	1	76
	Palaemonetes sp.	2	
6	*Ambloplites rupestris*	1	74
	Palaemonetes sp.	2	
7	*Etheostoma fonticola*	1	30
	Palaemonetes sp.	3	
	Ambloplites rupestris	1	148
8	*Palaemonetes* sp.	1	
9	*Etheostoma fonticola*	2	32,31
	Palaemonetes sp.	1	
	Gambusia sp.	3	19,13,16
	Procambarus sp.	1	
10	*Gambusia* sp.	1	32
	Palaemonetes sp.	1	
11	*Ambloplites rupestris*	1	82
	Herichtyus cyanoguttatus	1	40
12	*Palaemonetes* sp.	1	
13	*Etheostoma fonticola*	1	30
	Palaemonetes sp.	1	
14	*Palaemonetes* sp.	2	
15	*Palaemonetes* sp.	1	
	Lepomis miniatus	1	75
	***Tarebia granifera-slight*		

DROP NET - FIELD DATA SHEETS
SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**	
City Park		S1 - Site 5	
Date:	**Time:**	**Observer(s):**	
11/23/2015	1246-1258	JG,JW,JH,ME	
Overall	**Species**	**Number**	**Avg. Length (mm)**
3	*Lepomis miniatus*		
2	*Procambarus* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**
1	*Lepomis miniatus*	1	63
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	*Procambarus* sp.	2	
6	No fish or crustaceans collected		
7	*Lepomis miniatus*	1	96
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		
11	No fish or crustaceans collected		
12	*Lepomis miniatus*	1	122
13	No fish or crustaceans collected		
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
	***Tarebia granifera*-slight		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**
City Park		S2- Site 6
Date:	**Time:**	**Observer(s):**
11/23/2015	1300-1313	JG,JW,JH,ME

Overall	**Species**	**Number**	**Avg. Length (mm)**
4	*Ambloplites rupestris*		
8	*Procambarus* sp.		
4	*Gambusia* sp.		
2	*Lepomis miniatus*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**
1	*Gambusia* sp.	2	35,20
2	*Gambusia* sp.	1	35
3	*Ambloplites rupestris*	1	55
	Procambarus sp.	1	
4	*Procambarus* sp.	2	
5	*Lepomis miniatus*	1	55
6	No fish or crustaceans collected		
7	*Ambloplites rupestris*	2	140,121
8	*Procambarus* sp.	2	
9	*Ambloplites rupestris*	1	83
	Gambusia sp.	1	31
10	No fish or crustaceans collected		
11	No fish or crustaceans collected		
12	*Procambarus* sp.	1	
13	*Procambarus* sp.	1	
14	*Lepomis miniatus*	1	82
15	*Procambarus* sp.	1	

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:
City Park		H2 - Site 7
Date:	**Time:**	**Observer(s):**
11/23/2015	1315-1341	JG,JW,JH,ME

Overall	Species	Number	Avg. Length (mm)
9	*Ambloplites rupestris*		
2	*Etheostoma fonticola*		
2	*Lepomis cyanellus*		
1	*Campostoma anomalum*		
2	*Gambusia* sp.		
23	*Lepomis miniatus*		
1	*Lepomis gulosus*		
34	*Procambarus* sp.		
4	*Palaemonetes* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Lepomis cyanellus*	1	87
	Ambloplites rupestris	3	120,62,63
	Lepomis miniatus	2	70,35
	Procambarus sp.	5	
	Palaemonetes sp.	2	
2	*Lepomis miniatus*	4	63,75,30,60
	Ambloplites rupestris	1	69
	Gambusia sp.	1	32
	Procambarus sp.	1	
	Palaemonetes sp.	2	
3	*Campostoma anomalum*	1	62
	Lepomis miniatus	10	55,68,47,47,42,55,50,38,45,82
	Ambloplites rupestris	4	70,74,70,46
	Lepomis gulosus	1	75
	Procambarus sp.	12	
4	*Ambloplites rupestris*	1	76
	Procambarus sp.	1	
	Etheostoma fonticola	1	32
	Gambusia sp.	1	22
5	No fish or crustaceans collected		
6	*Procambarus* sp.	2	
	Etheostoma fonticola	1	20
7	*Procambarus* sp.	2	
	Lepomis cyanellus	1	100
8	*Lepomis miniatus*	1	30
	Procambarus sp.	5	
9	*Lepomis miniatus*	3	60,60,55
	Procambarus sp.	2	
10	No fish or crustaceans collected		
11	*Procambarus* sp.	1	
12	*Lepomis miniatus*	1	91
	Procambarus sp.	1	
13	No fish or crustaceans collected		
14	*Lepomis miniatus*	1	25
	Procambarus sp.	1	
15	*Lepomis miniatus*	1	36
	Procambarus sp.	1	

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING			
Dip net sweep	Species	Number	Length (mm)

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:
City Park		PH2- Site 8
Date:	**Time:**	**Observer(s):**
11/23/2015	1346-1402	JG,JW,JH,ME

Overall	Species	Number	Avg. Length (mm)
1	*Ambloplites rupestris*		
7	*Procambarus* sp.		
7	*Gambusia* sp.		
5	*Etheostoma fonticola*		
25	*Palaemonetes* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Palaemonetes* sp.	2	
	Gambusia sp.	1	22
2	*Palaemonetes* sp.	10	
	Procambarus sp.	2	
3	*Ambloplites rupestris*	1	95
	Procambarus sp.	1	
	Gambusia sp.	1	13
	Etheostoma fonticola	1	17
	Palaemonetes sp.	5	
4	*Etheostoma fonticola*	1	34
	Procambarus sp.	2	
	Palaemonetes sp.	1	
	Gambusia sp.	1	25
5	*Gambusia* sp.	2	18,25
	Palaemonetes sp.	1	
6	*Palaemonetes* sp.	1	
7	*Procambarus* sp.	1	
8	*Etheostoma fonticola*	1	37
	Palaemonetes sp.	2	
	Gambusia sp.	1	21
9	*Etheostoma fonticola*	2	20,31
	Gambusia sp.	1	24
10	*Palaemonetes* sp.	1	
11	*Procambarus* sp.	1	
12	*Palaemonetes* sp.	2	
13	No fish or crustaceans collected		
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
	***Tarebia granifera-slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:
City Park		PH1- Site 9
Date:	**Time:**	**Observer(s):**
11/23/2015	1406-1422	JG,JW,JH,ME

Overall	Species	Number	Avg. Length (mm)
2	*Gambusia* sp.		
2	*Procambarus* sp.		
7	*Etheostoma fonticola*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	No fish or crustaceans collected		
2	*Etheostoma fonticola*	2	35,30
	Gambusia sp.	2	12,21
3	No fish or crustaceans collected		
4	*Etheostoma fonticola*	2	33,25
5	*Procambarus* sp.	1	
6	No fish or crustaceans collected		
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	*Etheostoma fonticola*	1	34
11	*Procambarus* sp.	1	
12	*Etheostoma fonticola*	1	34
13	*Etheostoma fonticola*	1	30
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
	***Tarebia granifera-slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:
City Park		H1 - Site 10
Date:	**Time:**	**Observer(s):**
11/23/2015	1425-1458	JG,JW,JH,ME

Overall	Species	Number	Avg. Length (mm)
20	*Etheostoma fonticola*		
1	*Ambloplites rupestris*		
2	*Herichthys cyanoguttatus*		
1	*Campostoma anomalum*		
10	*Lepomis miniatus*		
1	*Dionda nigrotaeniata*		
5	*Gambusia* sp.		
10	*Palaemonetes* sp.		
18	*Procambarus* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Etheostoma fonticola*	5	33,36,33,28,37
	Procambarus sp.	3	
	Palaemonetes sp.	6	
	Herichthys cyanoguttatus	1	39
2	*Lepomis miniatus*	2	100,85
	Etheostoma fonticola	6	31,35,30,32,36,30
	Procambarus sp.	3	
3	*Etheostoma fonticola*	3	34,31,30
	Lepomis miniatus	1	55
	Campostoma anomalum	1	49
	Procambarus sp.	1	
4	*Gambusia* sp.	3	33,15,22
	Lepomis miniatus	4	36,44,61,53
	Herichthys cyanoguttatus	1	42
	Etheostoma fonticola	2	30,35
	Palaemonetes sp.	2	
	Procambarus sp.	1	
5	*Lepomis miniatus*	1	58
	Etheostoma fonticola	1	31
	Palaemonetes sp.	2	
	Procambarus sp.	1	
6	*Ambloplites rupestris*	1	100
	Gambusia sp.	1	37
	Etheostoma fonticola	1	33
	Lepomis miniatus	1	77
	Procambarus sp.	3	
7	No fish or crustaceans collected		
8	*Etheostoma fonticola*	2	40,32
	Procambarus sp.	1	
9	No fish or crustaceans collected		
10	*Procambarus* sp.	2	
11	*Lepomis miniatus*	1	32
	Procambarus sp.	1	
12	*Procambarus* sp.	1	
13	No fish or crustaceans collected		
14	*Dionda nigrotaeniata*	1	57
	Gambusia sp.	1	26
15	*Procambarus* sp.	1	

***Tarebia granifera-slight*

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:
IH-35		H1 - Site 3
Date:	**Time:**	**Observer(s):**
11/24/2015	930-1005	ME,JW,JG,JH

Overall	Species	Number	Avg. Length (mm)
32	*Procambarus* sp.		
2	*Herichthys cyanoguttatus*		
14	*Gambusia* sp.		
5	*Palaemonetes* sp.		
9	*Etheostoma fonticola*		
1	*Ameiurus natalis*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Procambarus* sp.	15	
	Herichthys cyanoguttatus	2	32,31
	Gambusia sp.	12	25,30,23,22,26,18,15,16,23,22,18,17,20,15,11
	Palaemonetes sp.	4	
	Etheostoma fonticola	4	40,35,24,36
	Ameiurus natalis	1	21
2	*Gambusia* sp.	2	21,22
	Procambarus sp.	4	
	Palaemonetes sp.	1	
3	*Etheostoma fonticola*	1	33
4	*Procambarus* sp.	1	
5	*Etheostoma fonticola*	3	31,35,35
6	*Procambarus* sp.	7	
	Etheostoma fonticola	1	32
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	*Procambarus* sp.	2	
11	No fish or crustaceans collected		
12	*Procambarus* sp.	2	
13	*Procambarus* sp.	1	
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
	*** Melanoides - moderate*		
	***Tarebia granifera - slight*		
	***Corbicula - slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**
IH-35		S2 - Site 4
Date:	**Time:**	**Observer(s):**
11/24/2015	1006-1026	ME,JW,JG,JH

Overall	**Species**	**Number**	**Avg. Length (mm)**
5	*Etheostoma fonticola*		
1	*Gambusia* sp.		
14	*Procambarus* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**
1	*Etheostoma fonticola*	1	34
	Gambusia sp.	1	20
2	No fish or crustaceans collected		
3	*Procambarus* sp.	1	
4	*Procambarus* sp.	1	
5	*Etheostoma fonticola*	1	36
	Procambarus sp.	3	
6	*Etheostoma fonticola*	1	35
	Procambarus sp.	2	
7	*Procambarus* sp.	2	
8	*Etheostoma fonticola*	1	26
	Procambarus sp.	2	
9	*Etheostoma fonticola*	1	29
	Procambarus sp.	2	
10	No fish or crustaceans collected		
11	*Procambarus* sp.	1	
12	No fish or crustaceans collected		
13	No fish or crustaceans collected		
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
	***Tarebia granifera - slight*		
	*** Melanoides - slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Site on Map:
IH-35		HD1 - Site 5	HD4
Date:	**Time:**	**Observer(s):**	
11/24/2015	1029-1037	ME,JW,JG,JH	

Overall	Species	Number	Avg. Length (mm)
2	*Etheostoma fonticola*		
1	*Gambusia* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	No fish or crustaceans collected		
2	*Etheostoma fonticola*	1	32
	Gambusia sp.	1	21
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	*Etheostoma fonticola*	1	31
6	No fish or crustaceans collected		
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		
11	No fish or crustaceans collected		
12	No fish or crustaceans collected		
13	No fish or crustaceans collected		
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
16	No fish or crustaceans collected		
	***Corbicula - slight*		
	***Tarebia granifera - slight*		
	*** Melanoides - slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:
IH-35		S1 - Site 6
Date:	**Time:**	**Observer(s):**
11/24/2015	1039-1046	ME,JW,JG,JH

Overall	Species	Number	Avg. Length (mm)
2	*Ambloplites rupestris*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Ambloplites rupestris*	1	62
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	No fish or crustaceans collected		
6	*Ambloplites rupestris*	1	65
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		
11	No fish or crustaceans collected		
12	No fish or crustaceans collected		
13	No fish or crustaceans collected		
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
	***Tarebia granifera - slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**
IH-35		HD2 - Site 7
Date:	**Time:**	**Observer(s):**
11/24/2015	1048-1057	ME,JW,JG,JH

Overall	**Species**	**Number**	**Avg. Length (mm)**
6	*Etheostoma fonticola*		
1	*Gambusia* sp.		
29	*Procambarus* sp.		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**
1	*Gambusia* sp.	1	19
	Etheostoma fonticola	1	31
	Procambarus sp.	8	
2	*Procambarus* sp.	1	
3	*Procambarus* sp.	3	
	Etheostoma fonticola	1	29
4	*Procambarus* sp.	3	
	Etheostoma fonticola	1	37
5	*Procambarus* sp.	4	
6	No fish or crustaceans collected		
7	*Procambarus* sp.	4	
	Etheostoma fonticola	1	36
8	No fish or crustaceans collected		
9	*Procambarus* sp.	1	
10	*Procambarus* sp.	1	
11	No fish or crustaceans collected		
12	*Procambarus* sp.	1	
	Etheostoma fonticola	1	34
13	*Procambarus* sp.	1	
14	*Procambarus* sp.	1	
15	*Procambarus* sp.	1	
	Etheostoma fonticola	1	34
16	No fish or crustaceans collected		
	***Tarebia granifera* - slight**		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Site on Map:
IH-35		HD3- Site 8	HD3
Date:	**Time:**	**Observer(s):**	
11/24/2015	1059-1108	ME,JW,JG,JH	

Overall	Species	Number	Avg. Length (mm)
2	*Percina apristis*		
4	*Gambusia* sp.		
2	*Procambarus* sp.		
1	*Etheostoma fonticola*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	*Percina apristis*	1	69
2	*Gambusia* sp.	2	28,46
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	No fish or crustaceans collected		
6	*Procambarus* sp.	2	
7	*Gambusia* sp.	1	34
8	No fish or crustaceans collected		
9	*Etheostoma fonticola*	1	33
10	No fish or crustaceans collected		
11	*Percina apristis*	1	54
12	No fish or crustaceans collected		
13	*Gambusia* sp.	1	32
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
	***Tarebia granifera - slight*		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		**Site:**
IH-35		O1 - Site 9
Date:	**Time:**	**Observer(s):**
11/24/2015	1110-1114	ME,JW,JG,JH

Overall	**Species**	**Number**	**Avg. Length (mm)**
1	*Notropis amabilis*		

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	**Species**	**Number**	**Length (mm)**
1	No fish or crustaceans collected		
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	*Notropis amabilis*	1	68
6	No fish or crustaceans collected		
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		
11	No fish or crustaceans collected		
12	No fish or crustaceans collected		
13	No fish or crustaceans collected		
14	No fish or crustaceans collected		
15	No fish or crustaceans collected		
	***Tarebia granifera* - slight**		

DROP NET - FIELD DATA SHEETS

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Location (Reach):		Site:	Site on Map:
IH-35		O2 - Site 10	
Date:	**Time:**	**Observer(s):**	
11/24/2015	1116-1120	ME,JW,JG,JH	

Overall	Species	Number	Avg. Length (mm)

SAN MARCOS RIVER -HIGH FLOW 2 2015 SAMPLING

Dip net sweep	Species	Number	Length (mm)
1	No fish or crustaceans collected		
2	No fish or crustaceans collected		
3	No fish or crustaceans collected		
4	No fish or crustaceans collected		
5	No fish or crustaceans collected		
6	No fish or crustaceans collected		
7	No fish or crustaceans collected		
8	No fish or crustaceans collected		
9	No fish or crustaceans collected		
10	No fish or crustaceans collected		