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Lower San Antonio River Watershed Instream Flows Study Biological Collection Summary Report

Prepared by

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December, 2006

Biological Data Collection – San Antonio River Study Area

Final Report

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Executive Summary

Because of greater demands for fresh water by growing communities like San Antonio, the Texas Legislature has directed Texas Parks and Wildlife Department (TPWD), Texas Commission on Environmental Quality (TCEQ), and Texas Water Development Board (TWDB), in cooperation with other appropriate governmental agencies such as the San Antonio River Authority (SARA), to conduct an instream flow data collection effort. This instream flow collection effort will help determine appropriate flow and habitat conditions necessary to support a sound ecological environment for resident fish species and will help to gain a better understanding of the fish assemblage dynamics within the Lower San Antonio River (SAR) watershed. The Lower SAR watershed was selected as a priority study reach based on the potential for significant reuse of water and the uncertainty of future water development strategies. Methodologies for determining appropriate flow conditions necessary to support a sound ecological environment will also be studied.

SARA field personnel have assisted the State of Texas Agency Staff with reconnaissance, sample site selection, biological and habitat sampling as well as data collection efforts throughout the Lower SAR and Lower Cibolo Creek watersheds. Evaluation of the fish community, flow measurements and habitat assessments were conducted at five sites on the Lower SAR (Loop 1604 in Bexar County, Floresville City Park in Wilson County, Conquista Crossing in Karnes County, SH 72 in Karnes County, and Riverdale Rd. in Goliad County) and three sites on the Lower Cibolo Creek (FM 539 in Wilson County, FM 537 in Wilson County and FM 389 in Karnes County). Data collected from these sampling efforts will provide much needed habitat and baseline data of the fish community composition within the lower SAR watershed. Collection methods included boat and backpack electrofishing as well as seining efforts in as many habitat types as possible. Individual biological collection efforts were segregated by habitat types from which the samples were collected. Photographs and global positioning system coordinates were recorded from the mid-point of each habitat type. Measurements were made of the average habitat depth, dominant substrate, and current velocity within each habitat type.

Data collected from this effort will help to characterize current instream flow conditions within the Lower SAR watershed and will help to make future flow management recommendations needed to sustain the resident

biological community and ensure an adequate water supply for the future needs of all communities within the Lower SAR watershed. The instream flow methodologies that result from this effort will influence the approach that SARA will undertake in the future concerning water related endeavors

Introduction

As noted by Annear et al. (2004) and the National Research Council (NRC 2005), a starting point in addressing natural resource questions relative to instream flow evaluations includes attempting to answer many questions about the biological systems being studied. Areas of importance include identifying the overall community composition, determining which assemblages are likely to be affected, establishing any linkages with flow components, and deciding whether certain assemblages or species should be targeted for study. Much of this information may be available through published literature, though often field sampling will be necessary to develop missing data. The results should be a thorough assessment of flora and fauna sufficient to build an understanding of community composition, connectivity, and function (Annear et al. 2004) that will enable construction of a conceptual model relating assemblage dynamics and flow components (subsistence and base flows, high flow pulses and overbank flows; NRC 2005).

A critical aspect in scoping an instream flow study is to identify existing literature and data and its geographical and temporal coverage, allowing researchers to evaluate data gaps as well as to develop a preliminary conceptual model of the system. Towards that end, Texas Water Development Board (TWDB) Research and Planning Funds were expended during FY04-05 to develop a geo-referenced database that identified literature and data in the areas of hydrology, biology, physical processes, water quality, and connectivity for the lower San Antonio River. Evaluation of existing biological data in the San Antonio River study area indicated potential spatial and temporal gaps in historical collections as well as collection sites that would facilitate long-term trends analysis in fish assemblages.

The goal of this study is to conduct new biological collections, which will attempt to fill in information gaps concerning fish assemblages. Further, these collections are aimed at improving baseline data as part of scoping potential instream flow studies, supplementing information needed for understanding trends in fish assemblage dynamics, and allowing preparation of a conceptual model of fish assemblage dynamics in the study area.

This work is supported by a Research and Planning Fund Research Grant, TWDB Contract No. 2005-483-562, to the San Antonio River Authority in support of Texas Instream Flow Program studies. Work was conducted in cooperation with Texas Parks and Wildlife Department, TWDB, and Texas Commission on Environmental Quality. The scope of work is included in Appendix A.

Study Scope

Study Area Description

Lower San Antonio River

The lower SAR basin is characterized by rolling hills in the upper reaches to flat prairies in the Gulf Coastal area. Much of the lower SAR basin has been cleared up to or near the banks of the SAR for agricultural and ranching purposes leaving isolated islands of brushy habitat scattered throughout the basin. Riparian habitats vary in width from a few meters to greater than fifty or sixty meters in undisturbed areas. There are some areas adjacent to the SAR covered by dense hardwood canopies limiting the growth of underlying vegetation. Log jams are common and can vary from a few meters to a hundred meters. Major tributaries of the lower SAR include the Cibolo Creek, Escondido Creek and Ojo de Agua Creek. Many of the rural communities within the lower SAR basin discharge their treated effluent into the lower SAR or one of its tributaries. Macrophytes (aquatic plants) are sparsely scattered throughout the lower reaches of the SAR.

Characteristics of the lower SAR are influenced by geological formations associated with the Gulf Coastal Plains Province. Some of these formations include the Wilcox Group, Claiborne Group, Jackson Group, Catahoula Tuff and the lower portion of the Fleming Formation. These formations consist primarily of sand, sandstone, silt, clay and gravel. Two other formations influencing the SAR are the Grayson Shale and Wills Point formation which consist largely of clay, marl, limestone, and sandstone. A series of falls formed by an outcropping of lignite and limestone are located between FM 791 and FM 81 near Falls City, Texas. The lower SAR is deep, wide and meandering and the stream bed is composed of deep layers of sand and silt throughout the reach. In many places, stream banks along the lower SAR are entrenched by high, steep, muddy banks and are undercut particularly along outer bends of the river. Flow, depth, widths and velocities exhibit less variability throughout the lower SAR. Instream habitat is dominated by runs and glides. Turbidity increases within the lower SAR due to an increase in suspended particles from the surrounding geological formations and an increase in planktonic algae due to increased nutrient concentrations.

Lower Cibolo Creek

The lower Cibolo Creek flows southeastward over the West Gulf Coastal Plains as it makes its way to the confluence with SAR near Panna Maria, Texas in Karnes County. The banks of the lower Cibolo Creek are steep and undercut. Riparian vegetation is confined to the immediate bank in urban areas and the rural areas possess wide dense hardwood riparian corridors. Stream canopy along the lower Cibolo Creek varies from open canopies in urban areas to partially and completely closed canopies. The upper reaches of this segment are characterized by shallow, fairly uniform channels with alternating riffle and pooled areas and the lower reaches are primarily pools and glides. Substrates consist of gravel, silt and sand. Turbidity is influenced by substrate composition and associated geological formations. Macrophytes are abundant and occur in greater numbers in areas of the stream that are open to direct sunlight and reduced flow. Log jams and sand bars are common in the narrower portions of the stream.

A study area map is included in Appendix B.

Site Selection

Five sites on the San Antonio River mainstem and three sites on Cibolo Creek were sampled under this contract. Criteria used to select sites included: historical data, longitudinal distribution, and the presence of habitat types known to be representative of the stream reaches. From a practical standpoint, the sites were also selected for accessibility and ease of launching boats. Sites on the mainstem San Antonio River were distributed longitudinally from Elmendorf (Bexar County) downstream to Riverdale Crossing (Goliad County) upstream of Goliad. Cibolo Creek sites were located between La Vernia (Wilson County) and it's confluence with the San Antonio River (Karnes County). All sites included areas with runs, pools and riffles, and a variety of substrate and instream cover types. Emphasis was also placed on areas with limited recent fish community data. Biological data collected during this study in these five mainstream sites and three major tributary sites will help to fill spatial and temporal gaps with current fish species occurrences and their associated habitats.

Table 1. Site Locations and Descriptions

Site No.	Latitude	Longitude	Location Description	County
19040	28.66667	-97.5333	San Antonio River upstream of Goliad	Goliad
19050	28.84866	-97.7368	San Antonio River near Runge	Karnes
19060	29.01744	-97.9201	Cibolo Creek near Pawelekville	Karnes
19070	29.17033	-97.9950	Cibolo Creek near Stockdale	Wilson
19080	29.27953	-98.0532	Cibolo Creek near Sutherland Springs	Wilson
19090	28.95153	-98.0643	San Antonio River near Falls City	Karnes
19100	29.11006	-98.1740	San Antonio River near Floresville	Wilson
19110	29.22217	-98.3559	San Antonio River near Loop 1604	Bexar

Methodology

In general, sampling methods for fish assemblages follow those outlined in Surface Water Quality Monitoring Procedures, Vol. 2: Methods for Collecting and Analyzing Biological Community Habitat Data (TCEQ 2005). Though sampling protocols follow that outlined in the above reference, fish collections were segregated by identified major habitat types (e.g., riffle, run, pool). Since the goal in baseline fish sampling is to collect a representative sample of the species present in their relative abundances, all available habitats and combinations of habitats were sampled with the most effective sampling gear that could be feasibly deployed. Habitat data were collected for each sampling event.

A reach was located for each study site that measured 40 times the mean wetted width of the stream up to 1000 m. Reaches may have exceeded 1000m, if the scale of the stream dictated, in order to cover at least one full meander wavelength. This ensured that the reach included most of the representative habitats in the area of the study site.

Seines were used at each study site. Deep pools and runs were typically sampled with a 9.1 m x 1.8 m x 6.4 mm mesh seine, whereas riffles, runs, and small pools were usually sampled using a 4.6 m x 1.8 m x 4.8 mm or a 1.8 m x 1.8 m x 4.8 mm mesh seine. A minimum of 10 effective seine hauls were made but sampling continued until no new species were added. The number of effective seine hauls, the length of seine, and a measurement of the distance of each seine haul were recorded.

Backpack electrofishers (Smith-Root Model 12) were used in wadeable areas that could not be sampled as effectively with other methods; most sites did not require the use of backpack electrofishers. Boat-mounted electrofishers (Smith-Root GPP series) were used in non-wadeable habitats, such as deep pools or runs. All species observed but not captured were noted (along with an estimated total length). Sites were sampled (with one or both types of electrofishers) for a minimum of 900 seconds of combined actual shock time.

Fish samples were preserved for each sampling event (each seine haul or habitat type shocked) and processed independently (e.g., fishes from one seine haul were processed separately from another seine haul). Fish that were too large for sample containers were positively identified, measured on a portable measuring board (total length), checked for disease or anomaly, photographed for vouchering, and released.

A global positioning system receiver was used to take a location at the mid-point of each habitat type sampled (datum=WGS84; units=decimal degrees; reception=3D) and was tied to a photograph of habitat sampled. Average habitat depth, dominant substrate type, instream cover type and density, and current velocity was measured and recorded for each sampling event. Typically a Marsh-McBirney electronic flow meter was used to collect current velocity and depth was measured using a top-setting wading rod. In some cases, an Acoustic Doppler Current Profiler was used to collected representative depth and velocity measurements. Habitat type and lateral location (e.g., bank, mid-channel) were recorded for each sampling event. Substrate was classified using the modified Wentworth scale and instream cover was classified using quartiles and codes. A sampling protocol and field guide were developed and used to ensure consistency in reach layout, habitat measurements, and fish sampling.

Sample Variance

Initially, eleven sites were recommended to adequately sample habitats and longitudinal variation in the San Antonio River. The contract, however, stipulates data collection at eight sites. Eight sites were sampled pursuant to the contract, but the three additional sites were not sampled. The three additional sites were selected to represent the lower San Antonio River mainstem between Goliad and its confluence with the Guadalupe River. Heavy rains and ensuing high flows near the end of the sample period made it infeasible to sample these sites during the contract period.

Results

Table 2. Historical occurrences of fish species for the Lower San Antonio River (SAR) and Lower Cibolo Creek.

Species	Common Name	Lower SAR	Lower Cibolo
Lepisosteus spatula	alligator gar	X	
Lepisosteus osseus	longnose gar	X	X
Lepisosteus oculatus	spotted gar	X	X
Dorosoma petenense	threadfin shad	X	X
Dorosoma cepedianum	gizzard shad	X	X
Astyanax mexicanus	Mexican tetra	X	X
Notemigonus crysoleucas	golden shiner	X	X
Cyprinella lutrensis	red shiner	X	X
Notropis amabilis	Texas shiner	X	
Notropis volucellus	mimic shiner	X	X
Notropis stramineus	sand shiner	X	X
Notropis texanus	weed shiner	X	X
Notropis amnis	pallid shiner	X	
Notropis venustus	blacktail shiner	X	X
Notropis buchanani	ghost shiner	X	X
Dionda episcopa	roundnose minnow	X	
Pimephales vigilax	bullhead minnow	X	X
Pimephales promelas	fathead minnow	X	X
Opsopoeodus emiliae	pugnose minnow	X	X
Ictalurus punctatus	channel catfish	X	X
Ictalurus furcatus	blue catfish	X	X
Ameiurus melas	black bullhead	X	X
Ameiurus natalis	yellow bullhead	X	X
Pylodictis olivaris	flathead catfish	X	X
Gambusia affinis	mosquitofish	X	X
Poecilia latipinna	sailfin molly	X	X
Poecilia formosa	Amazon molly	X	X
Micropterus dolomieu	Smallmouth bass		X
Mictropterus salmoides	largemouth bass	X	X

Table 2. continued

Species	Common Name	Lower SAR	Lower Cibolo
Micropterus treculi	Guadalupe bass	X	
Micropterus punctulatus	spotted bass	X	X
Lepomis gulosus	warmouth	X	X
Lepomis cyanellus	green sunfish	X	X
Lepomis microlophus	redear sunfish	X	X
Lepomis punctatus	Spotted sunfish		X
Lepomis macrochirus	bluegill sunfish	X	X
Lepomis humilis	orangespotted sunfish		X
Lepomis auritus	redbreast sunfish	X	X
Lepomis megalotis	longear sunfish	X	X
Cichlasoma cyanoguttatum	Rio Grande cichlid	X	X
Tilapia mossambica	Mozambique tilapia	X	
Tilapia aureus	Blue tilapia		X
Cyprinus carpio	common carp	X	X
Macrhybopsis aestivalis	speckled chub	X	X
Campostoma anomalum	central stoneroller	X	X
Carpiodes carpio	river carpsucker	X	
Moxostoma congestum	gray redhorse	X	X
Noturus gyrinus	tadpole madtom	X	X
Fundulus notatus	blackstripe topminnow	X	X
Pomoxis annularis	white crappie	X	X
Pomoxis nigromaculatus	black crappie	X	
Percina carbonaria	Texas logperch		X
Percina caprodes	logperch	X	X
Percina shumardi	river darter	X	X
Etheostoma chlorosomum	bluntnose darter	X	
Etheostoma gracile	slough darter	X	
Aplodinotus grunniens	freshwater drum	X	
Anguilla rostrata	American eel	X	X
Carassius auratus	goldfish	X	
Morone chrysops	white bass	X	

Table 2. continued

Species	Common Name	Lower SAR	Lower Cibolo
Erimyzon sucetta	lake chubsucker	X	X
Menidia beryllina	inland silverside	X	
Mugil cephalus	striped mullet	X	
Ictiobus bubalus	smallmouth buffalo	X	X

The data results are presented by site location in table format. Photographs and additional information are available on CD in Appendix C.

Table 3. Summary of depth, velocity, and dominant substrate types by site, sample collection method (seine "S", boat electrofishing "BE", backpack electrofishing "BP"), and habitat. See Table 1 for site descriptions.

				Depth (ft)			Velocity (ft/s)			Number of samples					
Site_id	Method	Habitat	Number of samples	Min	Mean	Max	Min	Mean	Max	Silt/ Clay	Sand	Gravel	Rubble/ Cobble	Boulder	Bedrock
19040	BE	backwater	1	2.0	2.0	2.0	0.46	0.46	0.46	1	0	0	0	0	0
19040	BE	run	8	1.5	2.1	3.4	0.21	1.41	2.17	6	2	0	0	0	0
19040	S	backwater	2	1.4	1.6	1.7	0.03	0.05	0.06	0	2	0	0	0	0
19040	S	riffle	1	1.1	1.1	1.1	0.58	0.58	0.58	1	0	0	0	0	0
19040	S	run	7	0.8	1.4	1.9	0.59	1.10	1.37	0	7	0	0	0	0
19050	BE	backwater	1	2.0	2.0	2.0	0.00	0.00	0.00	1	0	0	0	0	0
19050	BE	pool	3	1.7	2.1	2.5	-0.05	0.22	0.59	2	1	0	0	0	0
19050	BE	run	4	2.9	2.9	3.0	0.44	0.78	1.25	2	1	1	0	0	0
19050	S	pool	5	1.4	2.6	3.9	0.27	0.45	0.69	2	3	0	0	0	0
19050	S	run	7	2.0	2.5	3.0	0.01	0.49	0.92	4	2	1	0	0	0
19060	BE	pool	4	1.5	2.6	4.3	0.02	0.08	0.23	1	1	0	0	0	2
19060	BP	chute	1	1.1	1.1	1.1	2.85	2.85	2.85	0	0	0	0	1	0
19060	BP	riffle	1	0.2	0.2	0.2	0.44	0.44	0.44	0	0	1	0	0	0
19060	BP	run	5	0.9	1.0	1.2	0.13	0.80	1.71	0	0	1	0	1	3
19060	S	backwater	1	2.9	2.9	2.9	0.15	0.15	0.15	0	0	0	0	0	1
19060	S	riffle	3	0.3	0.4	0.4	0.74	1.29	1.64	0	0	3	0	0	0
19060	S	run	6	0.4	1.1	1.7	0.08	0.54	1.45	0	0	3	0	0	3
19070	BE	pool	5	2.0	2.6	3.3	1.25	1.63	2.00	4	0	1	0	0	0
19070	BP	pool	2	1.9	3.1	4.2	0.38	0.41	0.43	1	0	0	1	0	0
19070	BP	riffle	1	0.4	0.4	0.4	0.65	0.65	0.65	0	1	0	0	0	0
19070	BP	run	4	0.6	1.3	1.9	1.91	2.18	2.62	0	0	2	2	0	0
19070	S	backwater	2	0.6	1.0	1.4	0.12	0.37	0.62	0	0	0	2	0	0
19070	S	pool	2	0.6	1.3	1.9	0.18	0.32	0.45	0	0	0	2	0	0
19070	S	riffle	4	0.2	0.8	1.4	0.02	1.66	2.58	0	0	0	4	0	0
19070	S	run	2	0.5	0.9	1.2	0.04	0.18	0.31	0	0	0	2	0	0
19080	BE	pool	4	3.8	6.4	8.8	0.05	0.08	0.11	4	0	0	0	0	0
19080	BP	backwater	3	1.4	1.7	2.1	0.05	0.16	0.26	2	0	1	0	0	0
19080	BP	pool	1	2.9	2.9	2.9	0.09	0.09	0.09	1	0	0	0	0	0
19080	BP	riffle	3	0.5	0.7	0.9	0.70	0.72	0.75	0	0	3	0	0	0
19080	S	backwater	2	1.0	1.4	1.8	-0.14	0.15	0.44	1	0	0	1	0	0
19080	S	pool	2	0.6	0.8	1.0	0.01	0.04	0.06	2	0	0	0	0	0

				Depth (ft)			Velocity (ft/s)			Number of samples					
Site_id	Method	Habitat	Number of samples	Min	Mean	Max	Min	Mean	Max	Silt/ Clay	Sand	Gravel	Rubble/ Cobble	Boulder	Bedrock
19080	S	riffle	2	0.2	0.9	1.5	1.40	2.19	2.97	0	0	0	2	0	0
19080	S	run	4	0.9	1.1	1.5	0.77	1.47	2.72	0	0	1	3	0	0
19090	BP	rapid	9	0.4	0.6	1.0	0.29	2.31	5.87	0	0	0	0	0	9
19090	BP	run	5	0.5	0.9	1.4	0.09	1.10	2.19	1	0	0	0	0	4
19090	S	backwater	1	2.5	2.5	2.5	0.56	0.56	0.56	0	0	0	0	0	1
19090	S	run	7	0.7	1.0	1.7	0.32	1.13	2.74	0	0	0	0	0	7
19100	BE	pool	1	3.5	3.5	3.5	0.17	0.17	0.17	1	0	0	0	0	0
19100	BE	run	5	2.7	4.2	6.8	0.49	0.66	1.00	3	2	0	0	0	0
19100	S	pool	3	1.8	2.6	3.3	-0.01	0.22	0.47	2	1	0	0	0	0
19100	S	riffle	1	0.9	0.9	0.9	2.15	2.15	2.15	0	0	1	0	0	0
19100	S	run	7	1.5	2.6	4.0	-0.12	0.51	1.25	5	1	1	0	0	0
19110	BE	pool	2	6.1	6.2	6.2	-0.06	-0.01	0.05	0	2	0	0	0	0
19110	BE	run	3	1.8	2.1	2.4	0.84	1.54	1.90	0	3	0	0	0	0
19110	S	backwater	2	1.3	1.7	2.0	0.37	0.63	0.89	0	1	1	0	0	0
19110	S	pool	3	1.5	1.8	2.4	-0.04	0.25	0.60	0	3	0	0	0	0
19110	S	riffle	2	0.7	1.2	1.6	1.81	2.21	2.61	0	1	1	0	0	0
19110	S	run	3	1.5	1.8	2.1	0.40	0.64	0.85	1	1	1	0	0	0

Table 4. Occurrences of fish species by San Antonio basin sample site collected during summer 2006. (See Table 1 for site descriptions).

		Sample sites							
Species	Common name	19040	19050	19060	19070	19080	19090	19100	19110
Astyanax mexicanus	Mexican tetra			X	X	X	X		
Cichlasoma cyanoguttatum	Rio Grande cichlid	X		X	X	X	X	X	X
Cyprinella lutrensis	red shiner	X	X	X	X	X	X	X	X
Cyprinella venusta	blacktail shiner						X	X	X
Cyprinus carpio	common carp		X		X				
Dorosoma cepedianum	gizzard shad	X		X	X	X		X	X
Dorosoma petenense	threadfin shad						X	X	
Gambusia affinis	western mosquitofish	X	X	X	X	X	X	X	X
Hypostomus plecostomus	suckermouth catfish							X	X
Ictalurus furcatus	blue catfish	X	X						X
Ictalurus punctatus	channel catfish	X	X	X	X	X	X	X	X
Lepisosteus oculatus	spotted gar	X	X	X		X			X
Lepisosteus osseus	longnose gar		X			X		X	X
Lepomis cyanellus	green sunfish				X	X	X		
Lepomis gulosus	warmouth				X				
Lepomis macrochirus	bluegill			X	X	X	X		X
Lepomis megalotis	longear sunfish	X	X	X	X	X	X	X	X
Macrhybopsis marconis	burrhead chub	X					X	X	
Micropterus punctulatus	spotted bass		X	X	X	X		X	X
Micropterus salmoides	largemouth bass			X	X	X	X		
Moxostoma congestum	gray redhorse			X	X	X			X
Notropis buchanani	ghost shiner	X							
Notropis volucellus	mimic shiner			X	X	X			X

Species	Common name	Sample sites 19040	19050	19060	19070	19080	19090	19100	19110
Noturus gyrinus	tadpole madtom			X	X	X			
Oreochromis aureus	blue tilapia								X
Percina carbonaria	Texas logperch			X	X	X		X	
Percina shumardi	river darter			X		X			
Pimephales vigilax	bullhead minnow	X	X	X	X	X	X	X	X
Poecilia formosa	Amazon molly	X	X	X			X		X
Poecilia latipinna	sailfin molly	X		X		X	X	X	X
Pylodictis olivaris	flathead catfish		X	X			X		

Conclusions

Concurrent to this project, Dr. Tim Bonner, Texas State University, has been preparing annotated species lists that outline historical fish species distribution and abundance within the study area (as well as in the Brazos and Sabine rivers), temporal trends in occurrence, life history information, and linkages between life history and physical habitat, and other environmental requirements. The overall intent of that project is to develop an understanding of fish assemblage dynamics in Texas.

This project complements that work by providing current information about fish assemblages in the SAR and fills in obvious spatial and temporal data gaps, since some of these sites have not been collected in many years. Additional work is anticipated in evaluating historical trends in fish species occurrence and assemblage dynamics as well as preliminary efforts to evaluate habitat utilization and guilding. Historical and 2006 species occurrences will be evaluated to identify longitudinal variation and differences between the San Antonio River mainstem and the Cibolo Creek. Historic and 2006 collections will be compared to determine any discernable differences in fish assemblages over time and identify additional sampling strategies for augmenting the collection record. Habitat and fish assemblage data from 2006 will be analyzed to evaluate correlations between physical habitat variables and species occurrence. We will also give preliminary consideration to defining mesohabitat-based guilds for future studies.

Recommendations for Additional Work

The primary focus in the design of this study was to sample sites which would fill in geographic and long term temporal data gaps identified for the lower SAR; as well as sample sites that have a relatively extensive collection history; in order to facilitate analysis of temporal trends in fish assemblages. While the collection methods appeared to be generally adequate, more effort could be made to collect large species utilizing gill nets, hoop nets, etc. Evaluation of seasonal patterns of distribution and diel variation in habitat utilization, which are known to be exhibited by many species, were beyond the scope of this contract. Additional studies should make an effort to address seasonal and diel effects to the extent practical. Targeted sampling during known spawning seasons should also provide useful information for determining habitat associations during critical periods.

As mentioned previously, initial sample recommendations included eleven sites but only eight were completed. The three sites not collected were all located in the reach between Goliad and the confluence of the Guadalupe and San Antonio Rivers. This leaves a critical gap in our knowledge of fish distribution in the lower San Antonio River since the area in question is relatively inaccessible and there are no recent documented collections. It is recommended that the following sites be sampled using protocols consistent with this study as soon as feasible:

1. Site 19030 - San Antonio River mainstem, on private property located between Goliad State Park and FM 2506 (Goliad County). There are no documented fish collections within this reach. (28.61666, -97.3167)
2. Site 19020 - San Antonio River mainstem at US Hwy 77 (Refugio County). Lasted documented fish collections in this reach were made in 1962. (28.53333, -97.0333)
3. Site 19010 - San Antonio River near its confluence with the Guadalupe River and upstream of backwater effects of the GBRA saltwater barrier (Refugio County). Last documented collections of fish were made in 1962. (28.51667, -96.9000)

References

Annear, T., I. Chisholm, H. Beecher, A. Locke and 12 other authors. 2004. Instream flows for riverine resource stewardship, revised edition. Instream Flow Council, Cheyenne, Wyoming.

NRC (National Research Council). 2005. The science of instream flows: a review of the Texas Instream Flow Program. National Academies Press, Washington, D.C. Available online:
http://books.nap.edu/catalog/11197.html

TCEQ (Texas Commission on Environmental Quality). 2005. Surface water quality monitoring procedures. Volume 2: methods for collecting and analyzing biological community and habitat data. RG-416. TCEQ, Austin, TX.
http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/mtr/swqm_procedures.html

APPENDIX A
Scope of Work

Scope of Work

SUPPLEMENT EXISTING BIOLOGICAL DATA
LOWER SAN ANTONIO RIVER SEGMENT 1901

Background: A preliminary evaluation of existing biological data in the lower San Antonio River sub-basin indicates potential gaps in historical collections that should be supplemented to allow a thorough understanding of the systems and their biology. The goal of this proposal would be to conduct new biological collections, which would facilitate a better understanding of the fish assemblage dynamics within those sub-basins. These collections are aimed at improving baseline data as part of scoping potential instream flow studies in the basin and allowing preparation of a conceptual model of fish assemblage dynamics in the study areas.

Task 1: Collect fish assemblage and associated data
Through coordination between the San Antonio River Authority, Texas Parks and Wildlife Department (TPWD), Texas Water Development Board, and Texas Commission on Environmental Quality (TCEQ), five appropriate sampling locations will be developed to fill baseline data needs within the lower San Antonio River sub basin. Among the considerations for selecting sampling sites are:

- Geographic gaps in data identified from river authority databases;
- A lack of recent collections (e.g., post 1990);
- Overall geographic coverage, especially as it relates to areas where focused instream flow study efforts are anticipated.

In general, sampling methods for fish assemblages will follow those outlined in *Surface Water Quality Monitoring Procedures, Vol. 2: Methods for Collecting and Analyzing Biological Community Habitat Data* (TCEQ 2005). Collections will include boat and backpack electrofishing as well as seining where appropriate. Though sampling duration will follow that outlined in the above reference, collections will be segregated by identified major habitat types (e.g., riffle, run, pool). A global positioning system receiver will be used to take a location at the mid-point of each habitat type (datum=WGS84; units=decimal degrees; reception=3D) and will be tied to an upstream, downstream, left bank, and right bank photograph (left and right banks as facing downstream). A measurement will be made of average habitat depth, dominant substrate, and current velocity.

Sampling will be conducted in consultation with TWDB, TPWD, and TCEQ and a representative from each agency will be notified prior to field sampling events to allow their participation if desired. TPWD will provide technical assistance in field sampling, technical consultation as needed, and quality assurance for identification of biological specimens.

Task 2: Identify fishes, prepare species lists, and report data
Fishes collected in the field will be identified following the requirements for identification, retention, and vouchering outlined in the TCEQ manual cited above. TPWD staff will provide assistance and quality assurance as necessary. Fish assemblage, location, and habitat information will be reported in Microsoft Excel format. Photographs will be submitted in a suitable electronic format and georeferenced.

EXHIBIT B

TASK AND EXPENSE BUDGET

TASK	DESCRIPTION	AMOUNT
1.	Field Collections	$16,391.71
2.	Data management & Report Preparation	7,608.29
TOTAL		**$24,000.00**

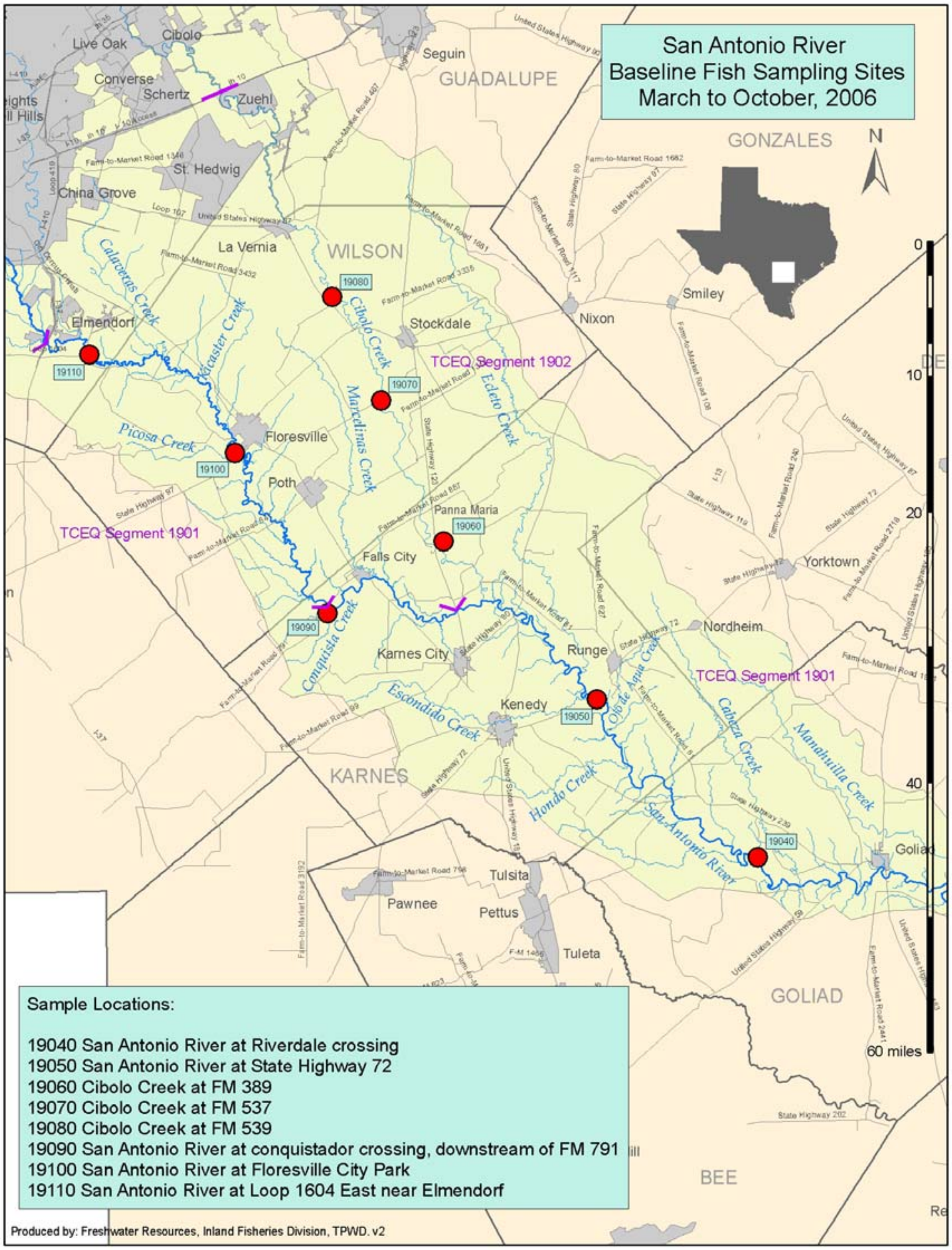
EXPENSE BUDGET

CATEGORY	TOTAL AMOUNT
Salaries & Wages[1]	$12,770.25
Fringe[2]	3,831.08
Travel	500
Expendable Supplies	0
Subcontract Services	0
Equipment Costs	0
Laboratory Services	0
Reproduction	0
Overhead[3]	6,898.67
Profit	0
TOTAL	**$24,000.00**

[1] Salaries and Wages is defined as the cost of labor of scientists, engineers, technicians, stenographers, secretaries, clerks, laborers, etc., for work time directly chargeable to this contract.
[2] Fringe is defined as the cost of social security contributions, unemployment, excise, and payroll taxes, workers' compensation insurance, retirement benefits, medical and insurance benefits, sick leave, vacation, and holiday pay applicable thereto.
[3] Overhead is defined as the costs incurred in maintaining a place of business and performing professional services similar to those specified in this contract. These costs shall include the following:

- Indirect salaries, including that portion of the salary of principals and executives that is allocable to general supervision;
- Indirect salary fringe benefits;
- Accounting and legal services related to normal management and business operations;
- Travel costs incurred in the normal course of overall administration of the business;
- Equipment rental not directly involved in collecting or analyzing contract data;
- Depreciation of furniture, fixtures, equipment, and vehicles;
- Dues, subscriptions, and fees associated with trade, business, technical, and prof. orgs.;
- Other insurance;
- Building rent and utilities; and
- Repairs and maintenance of furniture, fixtures, and equipment

APPENDIX B
Map of study area


San Antonio River
Baseline Fish Sampling Sites
March to October, 2006
Sample Locations:
19040 San Antonio River at Riverdale crossing
19050 San Antonio River at State Highway 72
19060 Cibolo Creek at FM 389
19070 Cibolo Creek at FM 537
19080 Cibolo Creek at FM 539
19090 San Antonio River at conquistador crossing, downstream of FM 791
19100 San Antonio River at Floresville City Park
19110 San Antonio River at Loop 1604 East near Elmendorf
Produced by: Freshwater Resources, Inland Fisheries Division, TPWD. v2
N
0
10
20
40
60 miles
GUADALUPE
GONZALES
WILSON
KARNES
GOLIAD
BEE
TCEQ Segment 1902
TCEQ Segment 1901
TCEQ Segment 1901
Live Oak
Cibolo
Seguin
Converse
Schertz
Zuehl
St. Hedwig
China Grove
La Vernia
Elmendorf
Stockdale
Nixon
Smiley
Floresville
Poth
Panna Maria
Falls City
Karnes City
Kenedy
Runge
Nordheim
Yorktown
Tulsita
Pawnee
Pettus
Tuleta
Calaveras Creek
Cibolo Creek
Marcelinas Creek
Ecleto Creek
Picosa Creek
Conquista Creek
Escondido Creek
Hondo Creek
San Antonio River
Cabeza Creek
Manahuilla Creek
19080
19070
19110
19100
19060
19090
19050
19040

APPENDIX C
Electronic Data CD